# Web – "Greatest Equalizer" for the Developing World

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## ABSTRACT

Web matured from Web to Web 2.0; contents and services matured from static content to dynamic contents; streaming, voice over IP, instant messaging, forums, blogs, commerce, payments, and lifestyle based actionable information. In access methods, we saw maturity from classical Web to Wireless Web to Mobile Web. Web is used in the advanced economies today for "competitive advantage". In this paper we propose different architectures and technologies that will facilitate collaboration between communities through innovative applications in the developing world. This will help Mobile Web to mature to become "greatest equalizer" – to reduce the gap between haves and have-nots.

## Categories and Subject Descriptors

B.4.3 [**Input/Output And Data Communications**]: Interconnections (Subsystems) – *interfaces, topology.*

## General Terms

Economics, Standardization

## Keywords

Digital divide, Actionable Information; SMS-data; SMS-data interoperability; Mobile Web; USRS, USRS-tunneling

## 1. INTRODUCTION

Web had serious impact on societies and economies across the world. It crossed the boundary of geography, race, and politics. In advanced economies Web traditionally played the role of "competitive advantage". E-commerce or storefront in the Web was the trend; it is unfashionable not to have an address on the Web. Contents primarily were static Web pages. Over the years this changed to dynamic contents, forums, blogs, Wikis, instant messages, payments, commerce, voice over IP, or even TV over IP. We have seen different types of streaming contents in the Web starting from songs to moving multi-media contents. Various technologies and growing popularity of Web also prompted the development of social software; Web 2.0 was born. Unlike conventional Web, Web 2.0 is about collaboration and wikis with partnership as the foundation. On access methods, we saw maturity from classical Web to Wireless Web to Mobile Web. We define classical Web as access to Internet and Web through web browsers over high bandwidth wired network. The end-user device for classical Web is a high footprint computer like desktop or laptop computer. Wireless Web is access to Web content through a web browser over high bandwidth wireless networks using portable computers, smartphones, laptop/palmtop, PDA (Personal Digital Assistant) etc. The access network for Wireless Web can be WiFi, WiMax, high bandwidth cellular networks. Whereas, Mobile Web is accessing Web through budget mobile phones that do not support web browsers. Also, in case of Mobile Web the network is a legacy cellular network that does not support high bandwidth data.

In developing world, basic facilities like roads, drinking water or electricity are scarce; in rural part of a country sometime these facilities are even non-existent. There is no school, if there is a school there is no teacher. Health care in rural setup are missing. In some villages there could be health centers without a doctor. In developing countries people migrate from villages to the cities for better quality of life and luxury. Also, in cities there are many intellectuals, experts, and professionals who are willing to volunteer services and time for the community. However, due to bad infrastructure and pain related to traveling, these individuals do not travel to villages and offer services. With the emergence of Mobile Web and Web 2.0, we can change these through innovative technologies and services; we can transform the Web as the platform for collaboration and facilitate it to be the "greatest equalizer" for the under-privileged and the masses in the developing world. This combination of Web 2.0 and Mobile Web will help eradicate digital divide and help overall growth of the under-privileged. In this paper we propose various architectures and technologies that are affordable and have been tested in India to help eradicate the gap between haves and have-nots.

Rest of this paper is structured as follows. We define Mobile Web in Section 2. In Section 3 we cover seamless mobility. In Section 4 we discuss USRS routing algorithm and SMS-data interoperability. In Section 5 we explain Actionable Information and its relevance. Section 6 describes the Web architecture in developing nations that combines classical Web, Wireless Web, and Mobile Web. In Section 7 we mention some mobile Web services. We conclude the paper in Section 8 with some discussion on security.

## 2. MOBILE WEB

We define Mobile Web as the platform to access applications and services in the Web through mobile phones used by the under-privileged and the masses. Under-privileged people use budget mobile phones and legacy cellular networks like GSM

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(Global System for Mobile Communications). It took 12 years for GSM to reach the first billion connections. The second billion has been reached in just two and a half year through growth in developing countries like China, India, Africa and Latin America, which accounted for 82% of the second billion subscribers [1]. It is expected to grow to 4 billions by the end of 2010. A large percentage of these new mobile subscribers use budget phones (90% of phones) that do not support web browsers. These subscribers are mostly prepaid subscribers (75-95% in different countries). Due to lack of realtime prepaid billing for IP content and services, TCP/IP is not always available over prepaid connections (in GPRS, EDGE, or 3G networks). To allow under-privileged users to access information over budget phones, we need to look for alternative transport bearer. As suggested by many experts [2], the transport bearer for Mobile Web should be SMS (Short Message Service). Because SMS is slow and short, Web browsing over SMS is impractical; actionable information through SMS is the way to go. This has been acknowledged by W3C in [2], where Mobile Web is defined as "not at all to connect people to the Web but to provide services (health, banking, government service, education, business,...) which would improve the life of people in developing economies."

SMS meets all criteria for potential data bearer for actionable information for the under-privileged; it does not require any subscription fee, it is "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 (Mobile Number Portability) 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); 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 user connected to an ISP (Internet Service Provider) "A" can access a Web service hosted in 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.

# 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 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 System # 7) signaling network is common to GSM, GPRS (General Packet Radio Service), and 3G carrying signal and SMS. 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; SMS was used for communication between emergency service personnel [3]. 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 (common in rural setup), 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 during roaming. SMS is always On, it cannot be barred or diverted to another mobile device); this makes SMS the perfect bearer for push, reminders, alerts, 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.

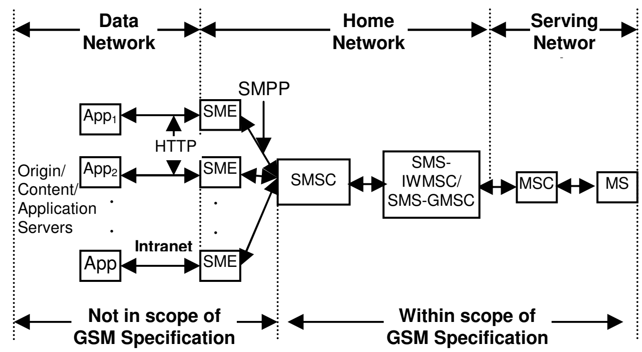


Figure 1: SMS-data architecture (GSM 03.40)

SMS point-to-point where both endpoints are mobile phones – interoperates [4]. However, SMS-data – where SMS is used as a transport bearer with one endpoint always being a computer application, does not interoperate. SMS applications use short operator proprietary codes like 1234, 7557, 333, 676766 etc [5] 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 using which a unique SMS short-code across cellular operators can be reserved [5]. The advantage here is that a uniform code is available across USA, where all operators assign and configure same short-code 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 – makes it user unfriendly and sometime confusing. For Indian Railways for example, there are about 16 sort-codes varying from network to network [6]. Pity is – as there is no SMS-data interoperability, these services are not available in cellular networks outside of India. A foreigner visiting India cannot access any of these services. Such services will even be unavailable within India when a subscriber ports the number in mobile number portability scheme [7, 8].

# 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 Indian cellular networks. We propose that this be used as transport bearer for Mobile Web over SMS. This technology is named Ubiquitous/Universal SMS Routing Service (USRS). Through Ubiquitous SMS Routing Service [9] algorithm – it is possible to route SMS-data to any Web service hosted in the Web. Through Universal SMS Routing Service [10] algorithm SMS-data is routed to a Web service hosted within a private operator centric intranet. Using these routing algorithms, SMS-data can be routed from any home SMSC to any Web service without having to configure the SMSC or the SMS gateway.

For interoperable SMS-data, the SMS-data service identifier will have a global title in E.164 numbering scheme like +919832627538 (+919832MARKET) in addition to usual proprietary short-codes like 627538, or vanity short-code like MARKET (627538), 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 defined as *foster network* (Figure 2). 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 algorithm allows multiple SDSI numbers mapping to a single service that work like aliases. These alias SDSI numbers can be local to an operator. As local SMS is cheaper compared to an international SMS, an international service can be offered at a local price. For critical services this can even be made toll-free.

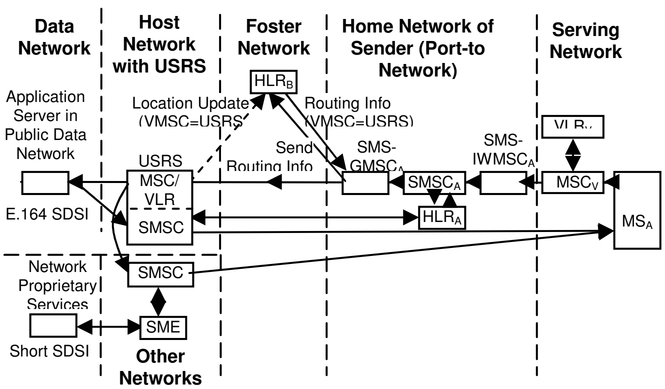


Figure 2: The USRS Routing Algorithm

The USRS routing procedure for online transaction is shown in Figure 2. The USRS server periodically sends MAP_UPDATE_LOCATION message [11] to ensure IMSI (International Mobile Subscriber Identity) remains attached. This location update message from USRS masks the SDSI and modifies the VMSC (Visited MSC) field of the IMSI in the foster HLR corresponding to the SDSI. The VMSC field in the HLR is used by SMSC to determine the routing path for the SMS. As the VMSC field is updated to point to USRS server, to the SMSC – it appears, as if the SDSI is roaming in the host network. Therefore, the SMS-data is routed to the USRS. The USRS server functions like an MSC/VLR (Visitor Location Register) and receives the SMS-data. The SMS received by the USRS is converted into a Web API call through URL. The USRS will also have SDSI to foreign SMSC mapping for these services that are connected to services through proprietary SME (Short Message Entity) with short-code and not accessible through URL.

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 the network managed by the USRS as an MSC/VLR. The SMS-data is routed by the SMS-$GMSC_A$ to the USRS server.

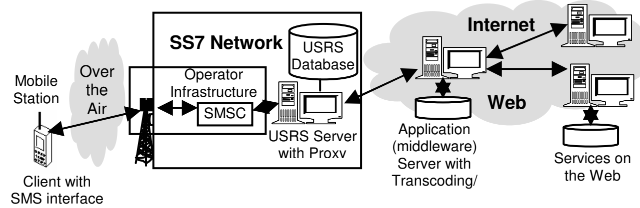


Figure 3: Architecture for Mobile Web access over SMS infrastructure

The USRS server converts the SMS into an HTTP URL request through Web API to fetch the content from the Web. There will also be services through short-codes like 692265 (MYBANK) 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. We call this routing procedure as USRS-tunneling. This is depicted in the lower part of Figure 2.

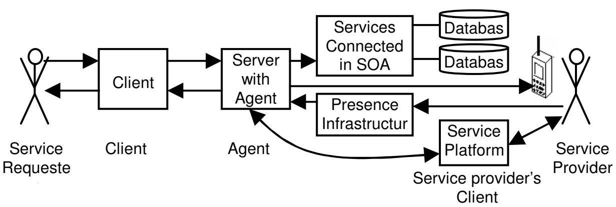


Figure 4: Actionable Information Access Architecture

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 multiple dialogue stateful transaction on the Web needs to be converted into a single dialogue stateless transaction over SMS – where user sends only one SMS as request and will receive one SMS as response (explained in Section 6). Application middleware (Agent in Figure 4) with transcoding capability will translate one request-response into multiple dialogues on the Web side through stateless to stateful translation. To facilitate the under-privileged users, a SSO (Single Sign On) interface can also be added in the Agent.

It is well established fact that mobile number portability (MNP) [7] helps the economy and the consumers. In MNP a subscriber keeps the mobile number while changing the network operator. As SMS-data does not interoperate, when a number is ported to another network, voice and point-to-point SMS will be ported [8] for this ported number; but SMS-data cannot be ported. In other words, all services over the SMS-data will cease to operate. In emerging economies where infrastructure is scarce, mobile phones play the role of storefronts of businesses – like a Web site in advanced economies. Unlike developed countries, developing nations are slow to adopt MNP. Whenever these countries adopt MNP, it will increase churn – resulting Mobile Web inaccessible. Therefore, all Mobile Web services need to be MNP safe. USRS and USRS-tunneling routing algorithms solve these critical problems. Any Mobile Web application that uses USRS routing protocol will be automatically ported when a subscriber ports the mobile number to a new operator.

## 5. ACTIONABLE INFORMATION ARCHITECTURE

Actionable information are these information that facilitate a decision making process with a follow-up action. Unlike normal information that does not necessarily result in an immediate action, actionable information is lifestyle related – that change from environment to environment. Actionable information for business could be sales figures at the end of day. For a traveler, it could be flight reschedule information. For fishermen in the sea, it could be a warning for cyclone. For an unemployed individual job alerts is actionable information. For a farmer, the price of produce in neighboring markets could be actionable information. The information whether the salary has been credited in the bank could be actionable information. Actionable information is generally short and relate to a specific context. Actionable information may involve many parties like 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 actionable notification.

Actionable information for business is likely to involve multiple systems with multiple databases. For Actionable Information in Mobile Web scenarios however, the backend need not always be a distributed system; this will in many scenarios be a server initiated request/response system where the service provider is not a computer but a human expert using another client system with social software. This is depicted in Figure 4. Let us take an example of a healthcare scenario for Virtual OPD (Out Patient Department). This will be a service in Web 2.0 where physicians and expert volunteer their services. A patient wants to consult a cardiac expert in the virtual OPD (VOPD). The agent software checks the VOPD directory and finds out which doctor is available. Based on the result, the agent checks whether the doctor is online. If the doctor is not online or the doctor's presence information is unavailable, the agent sends a notification through SMS-data to the doctor. The doctor may be within the physical boundary of the home network or in a foreign network. The doctor goes online and updates the presence information. Once the presence information is available, a SIP (Session Initiation Protocol) session is setup between the service requester (patient in this case) and the service provider (doctor in this case). Doctor examines the patient over realtime video conference over the Classical Web or Wireless Web. If video conferencing infrastructure is not available, even a text chat over Wireless Web or Mobile Web will be useful. The doctor need not travel to village, the patient need not travel to city; doctor volunteers his time, the patient received the critical healthcare service through telemedicine and eHealth services – a win-win situation.

Actionable information needs to be secured. SMS being a human readable messaging interface, it is in plaintext. SMS as a transport bearer can be secured using cryptographic algorithms on a smartphone. In a budget phone, same can be accomplished through SIM (Subscriber Identity Module) card processor. Any Phase 2+ SIM card conforming to GSM standard 03.48 [12] offers cryptographic support for the SIM card. This includes different ciphering algorithms including hashing algorithms. End-to-end security can therefore be implemented using SIM application toolkit (SAT) or JavaCard applets on the SIM card [13]. SIM cards are tamper resistant processor card. JavaCard implements small-footprint Java on the SIM and supports cryptographic libraries. An SMS can use these libraries and secure itself over-the-air. If security is implemented through JavaCard applet, end-to-end security can be implemented for budget phones.

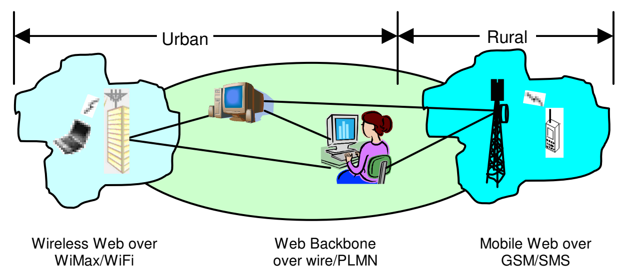


Figure 5: Interoperability between networks in urban and rural

## 6. ARCHITECTURE FOR WEB ACCESS IN DEVELOPING COUNTRIES

The Web in developing countries will be a combination of classical Web, Wireless Web, and Mobile Web. For example, in India some of the resourceful cities are having unwired projects in the pipeline. These are Unwired Bangalore, Unwired Kolkata, Unwired Hyderabad, Unwired Pune, Unwired Mysore, etc. In few years many other cities will follow suite. Governments are offering private parties to install WiMax and WiFi networks across these cities. These are in the BOO (Build Own and Operate) model, where an enterprise is expected to invest in building a city-wide wireless network, own it, and then run it with a business plan for revenue generation and sustainability. These city-wide networks will cover only the urban population. Outside the city, for rural however, it will be Mobile Web where users will be using the Web through mobile phone using SMS. This is depicted in Figure 5.

There will be non-for-profit social software and profit making systems in the Wireless Web. Wireless Web will be used by resourceful people in the cities. Under-privileged people will be using these profit making and not-for-profit systems through Mobile Web over GSM network using SMS. USRS routing will be in place for interoperability of SMS and WiMax/WiFi. Services in these networks will be cross subsidized.

SMS as transport bearer is stateless – each SMS is independent of another SMS in space and time; though, the service on the Web is likely to be statefull. Every SMS carries the unique MSISDN (Mobile Station ISDN) number of the mobile phone in its header; same information is also available to the application. This unique MSISDN number is used to identify a user session (context). The stateless to stateful conversion is done in the application server. Multiple dialogues on the Web is grouped and sent as a batch to the server through an XML file. Following is an example of a farmer wanting to know the price of tomato in the neighboring markets within 10 kilometers radius of Ramnagar (near Bangalore). User enters an SMS "tomato ramnagar" and sends it to 9832MARKET. The SMS is converted into an http URL by the SMS gateway as:

```
http://wweb.u-connect.org.in/message=tomato%20ramnagar&msisdn=9845678321
```

where, msisdn parameter is the telephone number of the mobile phone used by the user. The message parameter contains the message as entered by the user. This server determines the identity of the user from the MSISDN number and sends a XML file to the server as,

```
<MWEB><!-- Begin request data -->
  <SIGNONRQ>
    <SONRQ><!-- Begin signon -->
      <DTCLIENT>20051029101000</DTCLIENT>
        <!-- Oct. 29, 2005, 10:10:00 am -->
      <USERID>MyUserID</USERID><!-- User ID -->
      <USERPASS>MyPassword</USERPASS>
        <!-- Password (SSL encrypts whole) -->
      <APPID>MyMarketApp</APPID>
    </SONRQ><!-- End of signon -->
  </SIGNONRQ>
  <USRMSGRQ>
    <PRODUCE>tomato</PRODUCE>
    <LOCATION>ramnagar</LOCATION>
  </USRMSGRQ><!-- End of statement request -->
</MWEB><!-- End of request data -->
```

The response from the server will be another XML file with the following content.

```
<USRMSGRS>
  <STATUS>
    <CODE>0</CODE>
    <SEVERITY>INFO</SEVERITY>
  </STATUS>
  <INFORS> Market 1 12.30, Market 2 12.00, Market 3 12.50</INFORS>
</USRMSGRS>
```

This will be converted into an http URL and passed to the SMS gateway as.

```
http://sms.gateway.co.in/sendsms?username=foo&password=bar&text=market%201%2012.30,%20Market%202%2012.00,%20Market%203%2012.50&to=9845678321
```

The SMS gateway will send the response to the mobile phone (9845678321) as:

"Market 1 12.30, Market 2 12.00, Market 3 12.50"

User Interface is a challenge that needs to be addressed in Mobile Web. Majority of mobile phones that are in use in the developing nations are with single hand operation. There are some expensive phones though that offer two hands operation; there are also some high-end expensive phones that support GUI (Graphical User Interface) with stylus or pointer device. A normal Web site with graphic intensive content cannot be accessed properly without a stylus or pointer device. WAP was designed specifically keeping these constraints in mind; however, WAP contents are not widely available. Therefore, for the under-privileged people in the developing nations, a new user interface need to be designed that is command and menu based. This user interface will access the service over SMS as transport bearer. JavaCard infrastructure is available on every SIM card independent of the phone capability; therefore, JavaCard framework can be used to develop character based clients. On mid to high-end phones a character based user interface on the client can be developed using J2ME framework that will access the service through SMS-data.

# 7. INNOVATIVE SERVICES FOR THE UNDER-PRIVILEGED

In this section we present some of the innovative services recommended to be part of Unwired-cities in India that will use the philosophy of Web 2.0 for collaboration between the haves and have-nots.

**E-mail, Chat, and Unified Messaging** – This is a messaging service accessible from any device anywhere anytime – including voice, TCP/IP, and SMS access media.

**Virtual OPD –** In this service experts will offer healthcare services to the under-privileged.

**eHealth** – Better access to healthcare for each individual.

**Job Search** – Bangalore and India as a whole is becoming the IT (Information technology) destination of the world. Therefore, all job sites in India primarily service this IT market without any focus to other job markets. This service will cater to the job market for unskilled and semi-skilled people.

**eEducation** – Terminating the social divide by providing equal opportunity for educational.

**ASP Based Services** – These are ASP (Application Service Provider) services for small and medium enterprises. Banking services in ASP model for small co-operative and community banks could be part of such systems.

**Directory Service** – This service will have various directory services starting from telephone, shops, demographic, schools, Government departments, NGO (Non Government Organizations), restaurants, theatre, stores, city maps, etc.

**Search Engine** – This will be a search engine that can do search on text, image, multimedia objects.

**Tutoring** – In this service private tutoring services will be offered where students from different part of the country will interact with tutors.

**Peer-to-Peer Services** – One of the interesting services using this technique will be "Community Digital Library". Many people have their own private digital library. Many of these libraries are very focused and rich. These libraries will be shared with the community using peer-to-peer technologies.

**Virtual Services** – This service will cater to various virtual marketplaces to deal with vegetable vendors that carry vegetables on carts, various home delivery services, self employed individuals, insurance agents etc.

**Law and Order** – Creating a digitally monitored Safe neighborhood for all residence.

**Emergency Services and Disaster management** – Empowers the emergency forces when all odds are against them This includes services in disaster, epidemic, or terrorist attack.

**eGovernance** – Enables the government to role out initiatives instantly with lower budgets and higher level of reach-ability. Through this service under-privileged people will be able to interact with the government.

**Marketplace** – This will be a location specific service to list market information of various perishable goods and produces.

**Mobile Payment and Credit** – This will offer mobile payment, rural credit, and banking services including micropayments. This service will offer microcredit similar to Grameen Bank [www.GrameenFoundation.org].

**Bill Payment** – This service will offer services related to utility and other type of bill payments including property tax, local government tax etc.

**Bus/Train Timing**: In developing countries public buses are the mode of transport for common people. In certain part of the country there could be one or two buses in a day. Though there is some schedule, there is no guarantee that the bus will arrive or depart at the schedule time. This results in productivity loss and loss of opportunity. Accessing bus schedule and booking of tickets could increase the usefulness of a mobile phone.

**Telemetric/CSADA**: Maintenance of machinery and industrial equipment in developing countries is a challenge. Telemetric and SCADA applications will use mobile web.

**Radio Auto-Rickshaw** – There are organized Radio Taxis around the world. However, in developing countries taxis are expensive (because of high petrol price) compared to average income. In these countries cheaper version of taxi is rickshaw or auto-rickshaw. Offering a full fledged radio auto-rickshaw over SMS will help the consumer, rickshaw operator, and environment as a whole.

**Voice over Internet Protocol** – This will be voice services for the under-privileged people at an affordable price.

**Voice based systems** – A significant percentage of the under-privileged population in developing countries cannot read or write; there will be various services that will have voice as user interface.

**Entertainment** – IP TV and Triple Play are potential candidates for this vertical.

**Transport Automation** – Different services starting from simple long distance bus schedule to complex intelligent transportation system (ITS) will be part of this category of services.

**Location Aware Services** – These will primarily be location aware systems and services.

## 8. CONCLUSION AND SECURITY ISSUES

In this paper we presented a model that allows interoperability of Wireless Web and Mobile Web for collaboration of have-nots through SMS-data and haves through WiMax. This will also help eradicate the digital divide in developing countries and help Web to become the "greatest equalizer".

Security has always been a concern in data communication. In wireless environment, the security concern is even higher. However, USRS algorithm can be used to route SMS-data from any point to any service. 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. Between the SMS gateway and the server security is provided through SSL (Secured Socket layer). End-to-end security over SMS can be offered through JavaCard applets on budget phones and client applications on high-end smartphones. On the TCP/IP end security is provided through VPN (Virtual Private Network) and SSL.

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