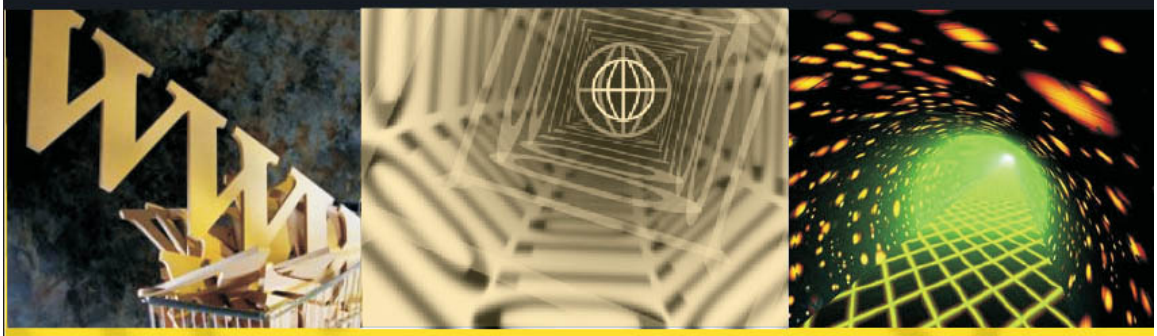
Mobile Applications for Inclusive Growth and Sustainable Development



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Telecom Regulatory Authority of India

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Preface

The Indian telecom sector has seen an exponential growth in the last few years. The number of telephone subscribers in India increased to 600.69 Million at the end of February-2010. With this, the overall Tele-density in India reaches 51.05. Wireless subscription i.e. the mobile telephony has reached 563.73 million of which approximately 30% are rural subscribers. Increasing proliferation of mobile services has created an unique opportunity to deliver information and public services to the masses through innovative applications. The mobile platforms world over are being used to provide financial and banking services, agriculture information, health services, telemedicine and e-education in rural and remote areas. The initiatives to provide various services using mobile applications have already started in India. The potential for m-Applications can be leveraged to boost social and economic activities, governance, and enhance government citizen interaction. For this transformation to be inclusive and beneficial for the under-privileged and rural populations, innovative and new models of public private partnership need to be formulated and deployed.

In order to stimulate and accelerate developments of mobile applications, TRAI has organized the 'National Forum on Mobile Applications for Inclusive Growth and Sustainable Development', with World Bank, as the Knowledge Partner to deliberate on the reforms for leveraging the potential of mobile/wireless technologies and new media for information enabled inclusive growth and sustainable development. The call for papers broadcasted to various communities of practitioners on mobile applications. Research papers and innovative applications from national and international practitioners, researchers and organizations, working on mobile telephony and its applications, were invited. The response received to the call for papers was tremendous and the selected papers are expected to further add to the knowledge of the stakeholders in accelerating the development and deployment of innovative and inclusive public services. TRAI is proud to present this compendium of select papers on Mobile Application for Inclusive Growth and Sustainable Development.

Through this compendium, TRAI aims at sharing of information, best practices and experiences in the domain which could help to accelerate the development and use of mobile applications across key social and economic sectors in India.

Acknowledgement

This document aims to transform the lives of millions of people by inspiring the creation of innovative initiatives and applications for the delivery of inclusive public services for diverse citizen needs like good governance, banking, healthcare, agricultural services and education through mobile/wireless and new media technologies. We hope that new citizen service visions and public private partnership models that evolve from the forum will integrate the poorest of our poor, the remotest of peoples into modern society.

We at TRAI sincerely acknowledge the contributions and extend deep appreciation and gratitude to Authors of the papers for the outstanding work.

Contents

m-Education and Rural specific

m-Applications

Mobile Applications-Case Studies

Other Papers

Mobile Health Card: How to Use Mobile Phones to Increase Rural Immunization Rates

Rahul Abhisek, Sneha Raman, Muzayun Mukhtar, Ekta Ohri, Saswati Saha-Mitra, Aditya Dev Sood

Abstract:

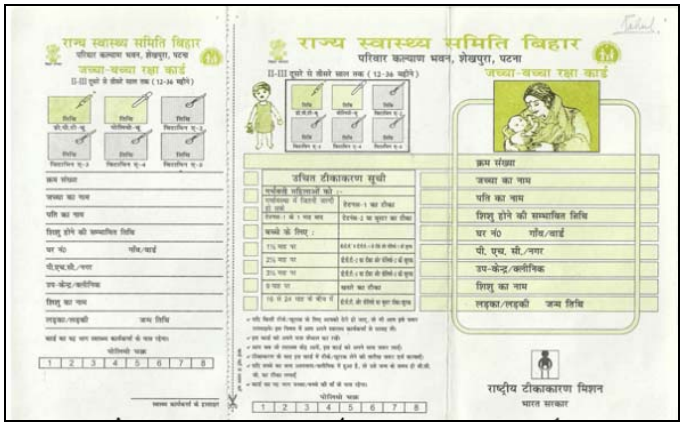
The rural health care system in India, along with many other complex social service institutions operating in India, needs better tracking tools to mark the identity of its beneficiaries. The current approach is paper-and-pen based, requiring extraordinary effort and time on the part of frontline healthcare workers and unnecessary duplication of effort. Two key surfaces are used to track the delivery of services to the beneficiary: the register (system copy) and the health card (user copy). The paper reviews the Routine Immunization (RI) card system and suggests several new directions that could employ mobile technologies to accomplish the existing functions of the RI Cards, while also improving immunization rates. The solutions proposed as well as there likely success are discussed in greater detail in the paper.
Keywords: mobile platform, health, mother child, RI card, routine immunization, rural healthcare, Bihar, vaccination, health worker.

Introduction

India's rural healthcare network, along with many other complex social service institutions, needs better tracking tools to mark the identity of its beneficiaries. The current system employs two key surfaces: the register (system copy) and the health card (user copy). The register is meant to track and maintain a record of the services provided to the beneficiaries, while the health card informs and reminds the beneficiaries to avail these services. The health card demands an interaction initiated by the recipient to avail this information. This approach assumes equal ownership on the service provider as well as the recipient, and could thus function successfully in a scenario where service meets existing demand. But what happens when demand is weak, or in fact absent? The ownership of the service then shifts heavily towards the system and the frontline provider. It not only requires to provide these services when demanded, but to ensure it reaches all recipients targeted, while at the same time rigorously work towards creating an informed user base and generate demand for the future. This paper outlines the key difficulties in maintaining the current system, with a view to proposing possible solutions that employ currently available mobile technologies for the same purpose.

What the Routine Immunization Health Card Does

The Routine Immunization (RI) Health Card records and provides basic data sets for the Frontline Healthcare Worker (FHW) or service provider as well as the recipient, which we will consider to be the child along with its parent or primary caregiver. It contains the name and other demographic details of the recipient, the vaccines to be administered and their progress as well as the due date for their next doses of vaccines. This card also serves as an instruction card for the recipients about the importance of immunization, precautions, preemptive care, vaccine after-care and other general dos and donts. Three grades of FHWs have been observed, each of which has a different relationship with the RI card: Assistant Nurse-Midwife (ANM), Accredited Social Health Activist (ASHA), and Angandwadi Worker (AWW).



Along with the essential information about the recipient, included in the RI health card is also a registration number that is unique to one coverage zone vis-a-vis the recipient. The importance or utility of this serial code remains uncertain among the FHWs and Medical Officers. However, it is clear to us that one of its consequences is to make each card unique, easing searchability in cases of misplaced cards or looking for recipient's name in FHWs data recording tool.

After filling the Mother's name and child's the 'House no' is filled. The concept of house number is found to be not applicable in most recipients case. While Bihar has kuccha and kuccha-pucca houses upto 36.9% and 50.4% (DLHS 3) respectively. In practice, therefore, this entry is often not made.

Though the FHWs maintain their own record of recipients details in a register, they also fill out the card and give it to the recipient. The RI card serves to act as reminder for the recipient family as it states the exact data and time at which the next set of vaccines and secondary doses are due. In an ideal case scenario RI health card should act as a motivator for the recipients to consider getting their child vaccinated.

The use of RI cards, provides a supplementary mechanism for monitoring, tracking or checking district progress and coverage. Apart from enabling the ANM to be aware of her status and directing her efforts accordingly, such massive information feeds into larger national healthcare databases. Considering the complex hierarchy involved in the rural healthcare system, the RI health cards help as a supervision tool for the Monitors, to of the workings of FHWs. The sectioned filled up and their time serve as check points.

The RI card acts as the public face of the healthcare system. This document is the recipient's only form of link to the formal healthcare ecology. It is representative of the Government's efforts but the current approach is ridden with challenges. The card, is the only official document in possession of beneficiaries, granted by the State in the sector of healthcare. Considering that this a public service initiative by the Government, it authorizes them for a free health care service. This is not incentive enough for the recipients and it does not empower them in anyway like other Government issued documents do, in terms of identity, food and produce rations, amongst others.

Current Approach to Record Keeping

The current approach is paper-and-pen based, requiring extraordinary effort and time on the part of frontline healthcare workers. The form is a thin 100 GSM leaf of paper which is folded in half. The card is a simple leaf of paper, medium grey-green with black on a white background. It is trifolated, i.e. folds into three, this also makes reading and comprehension because it does not enable itself to be directionally guided. There are challenges around interactional usage as well. There is difficulty in finding the appropriate

data surface immediately. Though one part of the card is torn away and kept by the ANM, the information on the same is not updated. The individual leaflets also pose a problem in storage, and is very often misplaced. Sometimes, the RI health card is kept by the ASHA or AWW and used for tracking, in place of the due list. The counterfoil, thus, in its current state is a vestigial extension of the card, underused in surface as well as intent.

RI health card for mothers is made during her ante natal check-up but in most cases it is not retained till the child's birth, so a new card is issued with a new serial code as well repeated recipient information.The RI Health card also aims to create awareness about the vaccines delivered. Unfortunately, this attempt at information dispersion restricts itself only to the names of the vaccines and not their purpose or efficacy. There is no mention of the importance of having a certain vaccine administered or the impact of missing one. To a great extent, this is on account of the limitations of space on the card.

While the RI card has high systemic value it can affect the acceptance and eventually the uptake of a complete RI service. Unfortunately, this value is not shared by most recipients, for as we have said, demand for the service Routine Immunization is itself weak and variable. These cards are manually updated on a monthly basis on every occasion of vaccination.

As currently designed, the paper format of the health card is meant to serve as a useful tool for the FHW who administers the vaccine in order to 'track' the due date for the administration of the vaccine. However, we have observed that FHWs follow a specific code for writing dates, which is not easily understood by recipients. To this extent, the work practice of the FHW runs counter to the very rationale for the existence of an RI card.

Different grades of FHWs enjoy varying abilities in respect of bureaucratic functioning as well as literacy skills. Some are unable to make entries into the due-list registers, instead they rely on data on the RI cards, which they collect, aggregate and organize, as reminders to mobilize recipients.

'Reading' the RI Card

The RI health card has illustrations depicting a mother and her phases in due course of pregnancy and after child birth but the rural masses are unable to comprehend the underlying intent in the picture as the purpose of RI is not conveyed in the same.

On the obverse, one notices a set of squares in varying shades of green, grey and white. The title of each page is marked in green and the same hue marks some of the intermediate squares. This poses a visual challenges for the recipients, as it creates a confusion weather the green colored boxes are of higher importance than the grey or cream colored boxes, and therefore if those vaccines more important than others.

Considering that members of most recipient families are semi-literate, but are easily able to understand visuals, there is a need for the design of the card to place more emphasis on the visual design to ensure that most beneficiaries understand the information content in the card. Adding to this, one of the primary reasons the card is not preserved by the recipients is because they do not understand the content and its significance. Increasing the readability of content through visuals would ensure that this information, is actually valued and used by beneficiaries.
While it is challenging to structure such a large amount of data into the health card, it is equally challenging for the recipient families to comprehend it. Precautions and after care information is provided at the end of the document seemingly unimportant. Such information needs to be visibly displayed at the right intervention areas.

The key information on the RI health card, is structured by the use of bullet points which is rendered useless as the recipients is unaware of such information categorization methods.

There is also a certain inconsistency in language -- although most of the content is in Hindi, the numbers are in Arabic as well as Roman Numerals. In addition, the importance of certain information is not conveyed through the use of fonts and varied sizes and colours for text. Certain icons of tablets and syringes are used to convey the nature of the vaccine to be given. These too are poorly understood by the recipients and undermines the utility and efficacy of the card.

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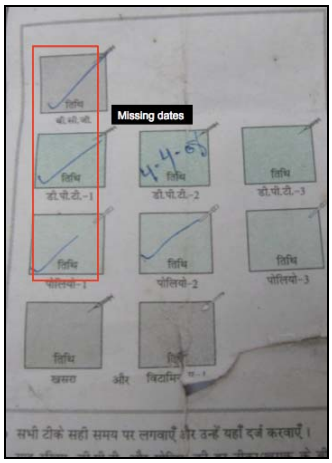
Challenges in using RI card

The physical, paper format of the card poses certain challenges, regardless of the recipients valuing the card and storing it in a safe place for preservation. It not only increases the chances of destruction by unattended children and rodents, but also has a shorter shelf life. Considering that information documented in the health card is vital and can have serious consequences for the beneficiaries, the need for preserving it for a longer time frame is much more significant. Most often, the card meets its end before the immunization of the child is complete. The tangibility of this health card is a serious obstruction for its preservation.



The RI health card makes efforts to educate the people and compel for full immunization, the language of the instructions is quite complex and a substantial group of literate people are unable to understand it. This also reflects a certain mechanical face of the healthcare system which hinders more uptake. There is a need to make such instructions more colloquial.

The RI Health card has the same sets of information repeated twice. This duplication of effort is massive considering the numbers the ANMs are working with during a RI session and full immunization cycle. This indirectly makes provisions for the FHW to take the information for granted. The ANMs become careless about maintaining the RI health card as well as filling in the details diligently. Often, this carelessness displayed by the ANM translates to the recipients as well and the value of the card is not conveyed.

The data manually entered during the RI session is lots which affects the primary vaccination function of an ANM. At the time of tracking of the child especially when the Health Card is lost by the mother, ANM can retrieve the child's RI records from the system or they have devised their own way of enquiring the approximate birth date of the child.

At times, recipients request the ANMs to administer the vaccine at a different bodily location than directed, due to fear of pain or swelling; the ANM obliges and ignores the serious health consequences this could have on the recipient. The RI Health card informs recipients of the names of the vaccines being administered, it does not mention or depict the positions in which a certain vaccine has to be taken which could reduce the frequency of such intimidating situations.

It is essential to educate the beneficiaries about the various types of vaccines and their schedule. There is also a greater need to inform them about the significance of the same, address the concerns around side effects and provide sufficient information about dealing with these side effects, since the rate of drop outs have been observed to be greater than the % of children who were never entered into the RI system. (The 2001-2 Coverage Evaluation Survey indicated that full immunization coverage levels among children in Bihar was only 13%. BCG coverage level was at 39% indicating poor access and utilization of immunization services. Coverage levels for DTP3, OPV3, measles and vitamin A were at 21.1, 21.1, 13.8%, and 11.1%.) The health card, in the present scenario, fails to do this.

While shadowing an ASHA in rural Bihar, we found that the interest of the beneficiaries is so low that FHWs have to go and remind them about the vaccinations many times over. If the FHW is not there to mobilize them then the recipient family do not bother to get their child immunized. The RI health card is not able to promote itself actively in the community.

Sometimes recipient families arrive at the immunization site with no RI health cards and many others with damaged cards. In situations like these, they are sent back to get the RI cards. This causes them to wait longer for immunization which results in lowered patience and trust in the system, escalating drop out rates.

If the recipients do not possess their RI health cards, the FHW tries to look through the registers as a bypass method. As an instance, the FHW in one such case tried to navigate through her set of Mother and Child Register to track the child and on failing to do so, ended up in issuing a new card and therefore a new entry was created in the register with a new serial number provided to the child. In such situations, an ANM would roughly estimate the last vaccination administered to the child by enquiring about the body position where the last vaccine was administered.

Possible Approaches to Technology Solutions

The introduction of mobile technology can greatly employ a focused structuring and delivery of information and help in mobilization by conveying schedules and locations for specific RI sessions through prerecorded calls. Most FHWs possess mobile phones and are comfortable with the basic calling, searching, and adding contact features on the phone. Some entertainment and media features are also used often.

In the proposed system, the RI health card and most of the activities of the FHW will be put onto a mobile platform, eliminating the current approach. Such a system can facilitate data integration thus eliminating the documentation process. Tracking and searchability will be more efficient and will take lesser effort on the part of the FHW in an automated system. This intergrated format of a database would be able to produce and update the immunization figures of a state. While for such a system to function without much glitches data security and required back ups will be mandatory for effective and desired performance.

Recipient families are unaware of schedule and location of RI session and have to completly rely on FHW, most often the RI card is in tattered condition and fails to produce turn ups. Storing this critical information on a mobile platform would ensure its long-term preservation. It would not only be desirable but also extremely valuable. A mobile platform would ensure an integration of information and subsequent accessibility, therefore overcoming geographical barriers. A mobile platform would help track the migrating population allowing them to be able to get and receive vaccination independent of their custody of the health card.

Though there is a locational serial code to help FHWs segregate recipients, there is a requirement for a unique ID for the beneficiary. In the proposed system, the real time information about the children will be available for the FHW on their mobile phones. There will be only one entry for a child in the system. Each child will have a unique identification number which will be is generated by the system. An information card of the beneficiary carrying the identifying data will be made and stored in the server. This information will be developed by the FHWs in real time when the mother visits the RI session site. The ANM will feed in this information to the system about new entries and the information database will be created. Accessing the information about the recipient instantly will provide ANM with the subsequent vaccination date for the child.

This could also be accessed by the FHW through a biometric technology on the their mobile device, which can retrieve a unique ID and henceforth all the details of the recipient. Alternatively if the same unique ID is on the 'mobile health card' of the recipient's mobile phone, it can be directly synchronized. This will result in accurate and easy searchability with effective tracking of the recipient. This unique ID will be location independent which would also enable migratory populations to access the RI service across nation at any public health centres.

The reach of the mobile device can be exploited to identify more beneficiaries. The FHW can utilize the benefits of her social network created on her mobile phone to reach out to newly identified recipients in a remote manner. Information sharing and updates become

easier with the use of a mobile phone. The FHW can here after follow up for obtaining the required information of the recipient. This also enhances mobilization as information of new recipients will be updated on the go and synchronized into larger servers and databases for the future.

Once the information has been fed into the device, effortless mechanisms on a mobile platform like an automated phone call or text message in the local language about the schedule and location of RI can be highly useful. Most often, there is an unawareness among recipients about timings of RI session, timely information about the same on the mobile phone is aimed at solving this issue.

On the system side, the mobile RI application can provide the list of recipients who are due for immunization to the FHW on her mobile phone much in advance. Frequent reminder in terms of messages or alarm can prompt her to reach as many due recipients as possible and therefore complete immunization for a session. Also, at the end of the session, a simple automated call can inform her of how many recipients were missed and are of high priority for the next RI session which will be conducted in her coverage zone.

Benefits & Challenges in Implementing a Mobile Health Solution

We are mindful of the substantial challenges that lay ahead. Just as some FHWs find it difficult to keep up with the pen-and-paper data entry methods they are required to follow today, there may be device and application literacy challenges on a mobile platform in future. The screen of most devices we observed is very small, and not necessarily suitable for detailed form entry. The amount of information held in the current hard RI card is quite large and it would be a substantial visual and interactive design challenge to communicate those elements of data in effective and manipulable ways on a mobile platform. Not all of the technology platforms cited above are robust, and some may have high-latency costs should we attempt to deploy them in an actual field context. To add to this, there will be challenges of data-security, data backup, and in future, data-privacy.

Despite tremendous growth in mobile adoption, not all recipient families have mobile devices today, and that could prove a barrier in future as well. There may be some unanticipated uses for paper-based records that mobile versions cannot serve, including for example submission for identity-proof. Until mobile devices do in fact become ubiquitous, it will be necessary to cycle between formats, pen-and-paper as well as mobile-electronic, just as many offices do now with desktop and printer technology.

Our approach would be to explore in greater detail in future, specific scenarios of use, and the challenges in effecting them, whether cultural, social, technological or otherwise. By iteratively defining what must be done, we expect eventually to arrive at what can be done, and to select the technologies and visual design strategies most conducive to achieving those very goals.

In our view, the benefits of instituting a Mobile Health Card along are great, and substantially outweigh these challenges. These include enhanced efficacy of FHWs, improved abilities to mobilize, contact and coordinate with recipient families, savings of time and mental and physical effort in the creation and maintenance of paper-based records. Moreover, the data generated via mobile devices can more easily be confirmed, cleaned, aggregated and mined, so as to more pointedly target healthcare efforts. Together these gains could result in major increases in rates of immunization in India.

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Dr. SMS – a Mobile-health Information System for Kerala

Sabarish.K, Dr. Rathan Kelkar

Abstract :

The paper presents the Dr. SMS project started by the Government of Kerala to provide comprehensive information on health-related resources via the short message service (SMS). Backed by a database of health infrastructure in 10 out of 14 districts in the State, the facility can provide timely information on medical facilities available in that locality including contact phone number, specialities and super specialities.

Keywords: MDG, IT, ICT, KSITM, Inclusive, Growth, E-Governance, M-Governance, E-health, mHealth, GIS, GPRS, SMS, Dr.SMS, Short Code

Introduction

We live in a global economy; an economy that allows for unrestricted and free movement of goods, services and labour trans-nationally. Projected as an answer to the ills of fragmented economies, the uninhibited freedom of movement that the global economy presents has the potential to bridge gaps between the haves and have-nots. All said, the benefits of the globalised order cannot be achieved all by itself; it needs to have planned and well-thought-after strategic interventions.

It was with the intention of spreading out the benefits of globalisation amongst all that the world leaders committed to forming and implementing the Millennium Development Goals. Agreed to by the world leaders in the United Nations Millennium Summit of 2000, the Millennium Development Goals (MDG) are a set of eight measurable and quantifiable goals to be achieved by 2015. The goals are, (i) eradicate extreme poverty and hunger (ii) achieve universal primary education (iii) promote gender equality and empower women (iv) reduce child mortality (v) improve maternal health (vi) combat HIV/AIDS, malaria and other diseases (vii) ensure environmental sustainability and (viii) develop a global partnership for development.

The Millennium Development Goals have a unique status even considering the proliferation of targets and commitments. They are unique owing to several reasons. First, is the fact that they represent a compact between all the world's major economic players and that the commitment to the goals come from the highest political levels. Even international organisations like the International Monetary Fund and World Bank have explicitly expressed their accountability to achieving these goals. Second, the goals are clearly achievable considering their minimalist nature. Third, there are clear yardsticks for measuring the performance against the goals, facilitating easy monitoring[1].

[1] http://www.endpoverty2015.org/goals

The International Monetary Fund (IMG) has chalked out a Six-Point Agenda for accelerating progress towards the MDGs. The six points are, 'Sustain and broaden the growth of momentum', 'Achieve better results in human development', 'Integrate development and environmental sustainability', 'Scale up aid and increase its effectiveness', 'Harness trade for strong, inclusive, and sustainable growth' and 'Leverage IFI support for inclusive and sustainable development'. A quick look at the Agenda reveals that inclusive growth forms the core strategy towards achieving the MDGs[2].

Inclusive Growth

The term inclusive growth is finding increasing usage in the lexicon of Government leaders, economists, planners and academicians globally. This has emerged from increasing consciousness that growth, which is an increase in some quantity over time, does not by itself indicate that people are better off. Growth, as has been the experience, is often lopsided, leaving out a good majority of the population from its benefits. Inclusive growth arrives as a plausible solution to this, by which all sections of the people can benefit from the growth process.

Ali and Son (2007)[3] clearly spell out the significance of growing interest on inclusive growth. "While some level of growth is obviously a necessary condition for sustained poverty reduction, and strong average growth has been accompanied by a sharp reduction in poverty, the evidence is clear that growth by itself is not a sufficient condition. Growth does not guarantee that all persons will benefit equally. Growth can bypass the poor or marginalized groups, resulting in increasing inequality. High and rising levels of income inequality can lower the impact on poverty reduction of a given rate of growth, and can also reduce the growth rate itself. High inequality also has implications for political stability and social cohesion needed for sustainable growth… reducing inequality has become a major concern of development policy, a concern that has generated interest in inclusive growth".

The International Policy Centre for Inclusive Growth (IPC-IG) of the United Nations Development Programme sees inclusive growth as "both an outcome and a process. On the one hand, it ensures that everyone can participate in the growth process, both in terms of decision-making for organising the growth progression as well as in participating in the growth itself. On the other hand, it makes sure that everyone shares equitably the benefits of growth. Inclusive growth implies participation and benefit-sharing. Participation without benefit sharing will make growth unjust and sharing benefits without participation will make it a welfare outcome"[4].

[2] http://www.imf.org/external/np/exr/facts/mdg.htm

[3] Ali, Ifzal and Son, Hyun Hwa (2007), "Measuring Inclusive Growth", *Asian Development Review,* vol. 24, no. 1, pp.11- 31, retrieved from http://www.adb.org/documents/periodicals/adr/pdf/ADR-Vol24-1-Ali-Hwa-Son.pdf on 10th March 2010

[4] http://www.undp-povertycentre.org/pages/newsite/menu/inclusive/whatisinclusivegrowth.jsp?active=1

The fact that growth by itself does not guarantee equity is supported by data facts and empirical research, as in a study conducted in Andhra Pradesh by Dev (2007)[5]. The study assigns agricultural growth, employment generation and poverty reduction, social sector (health and education) and reduction in regional and other disparities as the four important elements of inclusive growth. The study, after comparing data of last two decades, has concluded that growth alone does not lead to inclusive growth. In spite of recording appreciable growth rates, as indicated from the Gross State Domestic Product (GSDP), inclusive growth could not be achieved due to problems in the four elements of economic growth. "The average annual growth rate was 6.9% during 2002-07 and 7.8% during 2003-07. However, there are problems in the four elements of inclusive growth. Growth of agriculture particularly crop sector is very low. Employment growth in the postreform period (1993-94 to 2004-05) is the lowest in the country. The recent data shows that literacy levels are also low as compared to many other states. The National Family Health survey (NFHS III) indicate that A.P.'s rank for infant mortality is 11 out of 17 states in the year 2005-06". The study further noted Andhra Pradesh cannot achieve Millennium Development Goals.

Thus, it may be summed up that inclusive growth is economic growth which is a necessary and crucial condition for poverty reduction. Inclusive growth has a long term perspective and is concerned with sustained growth or growth that is broad-based across sectors. Inclusiveness refers to equality of opportunity in terms of access to markets, resources and unbiased regulatory environment for businesses and individuals[6]. With regards to inclusive growth in India, the economist Prime Minister Dr. Manmohan Singh has said that it would call for heightened investment in rural infrastructure, spurt in credit for farmers and increase in public spending on education and health care.

Technology and Inclusive Growth

Of all the technology solutions available to us today, Information and Communication Technologies (ICT) are very widely known today. It needs no special reiteration that the 21st century is the age of the Information Technology. Information and Communication Technologies (ICT) have come to have an all-encompassing character with their limitless scope for adaptive applications.

In democracies ICT has an enabling one and one that helps catalyse the process of change by making information more accessible and usable to the masses. The real beauty of ICT lies in the fact that it equips us with information to make informed choices. Technology has the power to take us to a different and necessarily better path. "In the most productive settings, ICTs enmesh individuals and organizations in networks of information and

[5] Dev, Mahendra S (2007), "Inclusive Growth in Andhra Pradesh: Challenges in Agriculture, Poverty, Social Sector and Regional Disparities", Working Paper 71, Centre for Economic and Social Studies, Hyderabad, retrieved from http://www.cess.ac.in/cesshome/wp%5Cwp-71.pdf on 10th March 2010.

[6] http://siteresources.worldbank.org/INTDEBTDEPT/Resources/468980-1218567884549/WhatIsInclusiveGrowth20081230.pdf

collaboration—whether accessed by mobile telephones, dial-up computers or broadband Internet terminals—which heighten awareness and increase performance. ICTs have helped narrow the digital, rural-urban and gender divides, within nations and across geographic boundaries. In this way, ICTs are playing a crucial role in both national wealth creation and global competitiveness. Indeed, the acronym "ICT" might be thought of as standing for the integration of information and the collaboration of individuals and organizations which result in the transformation of political, social and economic activities"[7].

The accent on inclusive growth comes from the fact that inclusiveness is a pre-condition to sustainability. Nations cannot hope to have sustainable development without catering to inclusiveness. While there can be no doubt inclusive growth calls for concentration in infrastructure, especially rural infrastructure, agriculture, education and healthcare, technology can be achieved as a means to achieve the above. Making available updated and state-of-the-art technology solutions to the have-nots of the population at affordable prices can help to foster inclusive growth. In fact ICT can provide solutions at a fraction of the cost of traditional solutions and reduce public spend in areas like healthcare, education, financial services and public services.

The power of ICT to transform notwithstanding, the fact remains that "only a fraction of our global citizens have been touched by technology. There are many across the world, who still stand on the other side of the digital divide. Specifically, technology is reaching only a small fraction of the youth and young adults that need it most, the citizen-consumers that are the heart and soul of techcentered innovation and commerce in the "more developed world"."[8]

E-Governance

The growing realisation that technology can exert itself only if they are properly distributed led to the concept of citizen-centric ICT solutions. Citizen-centric applications came to the fore with the understanding that technology by a good percentage of the population was by default and not by design. Concerted efforts were taken to ensure that ICT remains not as a tool of the 'haves' but equally of the 'have-nots' as well. The period from mid 1990s in India saw the birth of some sector-specific citizen-centric applications. Largely nurtured by the civil society, these applications soon began to find favour with the masses, even though the financial self-sustainability of the application/project remained questionable.

The beginning of this decade saw a spurt in citizen-centric applications. With increasing acceptance of ICT in governance, planners and policy makers came out with solutions to incorporate ICT in governing mechanisms, thus concretizing e-governance in the country. One of the states that led the country is Kerala, which pioneered the Akshaya project in 2002. An initiative of Kerala State Information Technology Mission, the nodal IT implementing agency of the Government, the objective of the Akshaya project was to propel ICT enabled citizen-friendly initiatives by first making at least one member in each

[7] download.microsoft.com/.../MS_Interface_April_June_07.pdf
[8] download.microsoft.com/.../MS_Interface_April_June_07.pdf

of the 6.5 million families of Kerala e-literate. Through this e-literacy programme, the Government wanted to address and redress three issues, viz., low Internet penetration, low e-literacy rate and high costs of availing services. With e-literacy taken care of, the Akshaya project was to emerge as a platform for implementing many e-governance programmes.

E-Health and mHealth

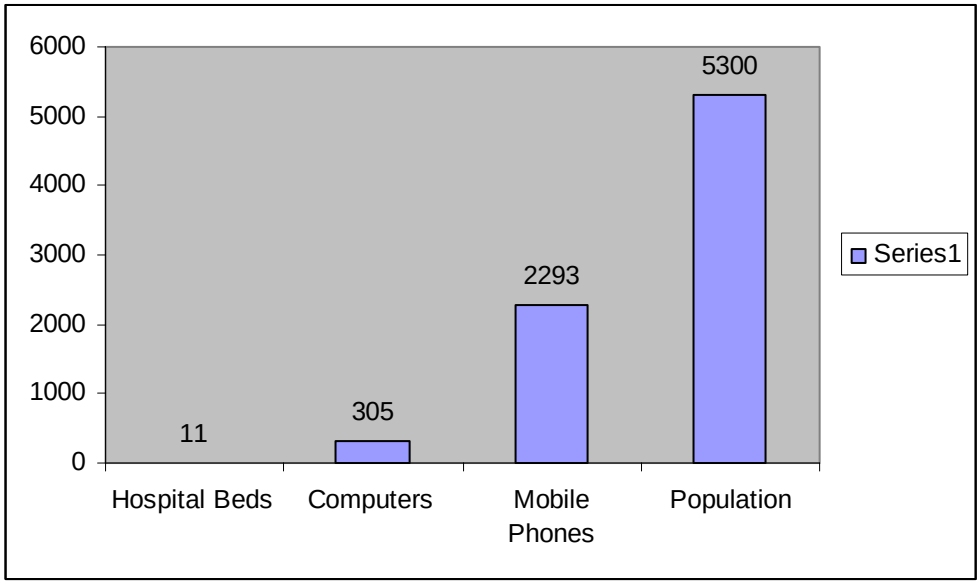
One of the key factors in achieving inclusive growth is ensuring inclusiveness in health care. With the emergence of Internet and associated technologies, various ways were thought to use them productively to improve health care; giving rise to E-health. E-health is essentially the application of Internet and other related technologies to improve the access, efficiency and effectiveness of health care.

In the sequence of technological innovations, it could be said that the mobile phone soon followed the Internet. And very soon mobile phone usurped the Internet in terms of penetration and use. Mobile Health or mHealth could be seen as a significant corollary of e-health and is all about providing health-related services over the mobile communications.

The advantage of mHealth lies in the fact that it creates an effective platform for bringing health care services, especially in developing countries. "With low-cost handsets and the penetration of mobile phone networks globally, tens of millions of citizens that never had regular access to a fixed-line telephone or computer now use mobile devices as daily tools for communication and data transfer. A full 64% of all mobile phone users can now be found in the developing world. Furthermore, estimates show that by 2012, half of all individuals in remote areas of the world will have mobile phones. This growing ubiquity of mobile phones is a central element in the promise of mobile technologies for health". The high penetration of mobile phones is further supported by data facts of technology and health-related services in developing countries, which have that for a population of 5300 million, some 2293 million have mobile phones, 305 million have computers and only 11 millions have access to hospital beds. This can be further understood from the column chart below, which clearly brings out that mobile phones reach further into developing countries than other technology and health infrastructures[9].

Technology and health-related statistics for developing countries (millions)

[9] "mHealth for Development - The Opportunity of Mobile Technology for Healthcare in the Developing World", Vital Wave Consulting. mHealth for Development: The Opportunity of Mobile Technology for Healthcare in the Developing World. Washington, D.C. and Berkshire, UK: UN Foundation-Vodafone Foundation Partnership, 2009, retrieved from http://www.globalproblems-globalsolutions-files.org/unf_website/assets/publications/technology/mhealth/mHealth_for_Development_full.pdf on 12th November 2009



Source: Reproduced from Vital Wave Consulting, Business Monitor International (BMI), International Telecommunications Union, World Bank's World Development Indicators, and the United Nations.

The advent of mHealth has further helped to bridge the technological divide that happened after the widespread growth of e-services. Any unintentional divide caused by the Internet could be rectified through the emergence of mobile phone based services, which use computer and Internet technologies as their backbone.

mHealth in Kerala

mHealth in a State like Kerala acquires high prominence in view of high levels of mobile penetration at 72%, as compared to the all-India average. mHealth also assumes significance in the conducive climate being created for mobile-related initiatives being created in the State in view of its high penetration levels. The Government of Kerala's intention to migrate from e-governance to m-governance was clearly articulated in the State Budget for the year 2010-2011 presented in the first week of March 2010.

It is in this backdrop that the present paper 'Dr. SMS – a Mobile-health Information System for Kerala' is being presented as an application for inclusive growth and sustainable development.

Dr.SMS

The State of Kerala is recognised the world over for its notable achievements in the field of health. With low per capita incomes, Kerala has managed to achieve health indicators that are par with advanced countries of the country. Kerala's mortality indicators including

death rate, infant mortality rate (IMR) and expectation of life at birth has got it a positive berth in the health status ranking across states of India as well as advanced countries. According to the data for the year 2008 presented in the Economic Review 2008, State Planning Board, Trivandrum, the death rate in Kerala is 6.8 as against 7.4 in all India, IMR of 13 vis-à-vis India's 55 and a life expectancy of 71.3 for Kerala males in comparison to 62.3 years for India (female life expectancy stands at 76.3 years in Kerala and 63.9 years in India).

This rosy picture can be quite misleading for outsiders who are not quite aware of the extent of health problems faced by Kerala. The glowing achievements in Kerala's mortality indicators notwithstanding, all does not seem too well with the health sector here. There have been growing concerns about the rising morbidity levels in the State, led chiefly by the increasing incidence of lifestyle related diseases like diabetes, hypertension, heart diseases and cancer. Kerala also has seen a re-emergence of infectious diseases like Leptospirosis, Malaria coupled with increasing reports on diseases like Chikungunya and Dengue. The State also has the highest road accident rate in India.

For lifestyle induced conditions like heart attacks, timely care is very essential to prevent further complications and even mortality. Known widely as the "golden hour", it refers to the first hour of a heart attack. Getting medical help during this period greatly improves chances of recovery. The "golden hour" is equally pertinent in trauma care, which also mandates rapid medical intervention to improve chances of survival.

In this backdrop, the purpose of the Dr.SMS project is to provide comprehensive information on health-related resources via the short message service (SMS). The facility has been integrated with the Short Code (537252 – KERALA in Non Querty mobile keypad), opened exclusively for m-services of the State.

Launched on 29th May 2008, the service was pilot in the district of Kozhikode (Calicut) in Kerala. The choice of Kozhikode was based on the fact that it is the third largest city in Kerala with a population of approximately 20 lakhs. Kozhikode was also chosen for the pilot because it has the highest rates of mobile penetration in the State. Kozhikode also attracts huge migrant population/tourists, who are also one of the main targets of this project. The pilot project met with overwhelming success. The service was especially lapped by the large numbers of tourist population who did not know whom to contact in case of a medical emergency. The pilot phase witnessed around 200 transactions a day, on an average.

Backed by a database of health infrastructure in 10 out of 14 districts in the State, the facility can provide timely information on medical facilities available in that locality including contact phone number, specialities and super specialities (Cardiology, Paediatrics, Opthamology), doctors, ambulance services etc. To avail the facility all that the user has to do is to send a SMS to the designated number 9495949000. The message should contain the word 'health' followed by the 'PIN-code' of the locality for where the information is sought. The service can also provide pointers to blood banks, diagnostic centres, private hospitals, speciality centres, facilities for surgery, ventilators and the like.

The Dr SMS project operates at different levels and can be availed across various media. A message with pin-code and your email ID will generate a detailed email reply to the query. The project also incorporates a health portal, which is available at www.drsms.kerala.gov.in. This portal provides a Web-based information mechanism enabled via the Geographical Information System (GIS). Features like interactive maps, latitudes and longtitudes of the health centres facilitate easy identification. The High end mobiles with GPRS can recieve the details and can function in a Location Based Service mode. The establishment of a centralised Instrumentation facility at State Data Center is the database will be expanded to cover all districts of the State in the near term.

Project Highlights

- The major achievement of the project is its enshrined ability to deliver health related information to the citizens, including location hospitals, medical centres, facilities and doctors in a time-sensitive manner.

- The project is noted for its cost affordability and effectiveness. To send the message, the customer has to pay a nominal amount of 40 paise or less. The cost of the return SMS is borne by the Government of Kerala.

- The service has come to be seen as a first aid kit for any health emergency for the large number of tourists who are on the move in the town and are not aware of the whereabouts of the place.

- The project has helped hospital authorities prepare the emergency room as per the requirements as well as to mobilise the resources like specialist doctors and specialised equipment to take care of the emergency.

Conclusion

The Dr.SMS project, it is hoped, will have a significant role to play in Kerala, which has seen a rise in lifestyle related diseases like diabetes, hypertension, heart disease, cancer etc. By providing timely and authentic information, timely health care can be facilitated, thereby contributing to better disease control and management and ultimately to inclusive health care. Using the ubiquitous mobile phone to provide health-rated information at affordable costs is a great step ahead in achieving inclusive growth and sustainable development through inclusive health care.

SMS based Natural Language Interface for Locating Health Care Service Providers

Rohit Banga, Akhil Langer, Ankush Mittal, Parikshit Sondhi

Abstract :
In this paper we present an implementation strategy for an automated system to address the problem of locating a health care provider. The solution that we propose is designed to strengthen and complement the weak health systems existing at the time of this writing. The motivation for solving this problem comes from the absence of an automated service to obtain the details of a doctor. To locate a doctor for a specific health condition, people currently use ad hoc approaches. While this kind of information can be readily searched for using the Internet, this medium does not reach the masses. Also there are very few websites offering this service in India. In contrast, a common medium of communication that can be leveraged for this problem is the mobile phone which offers SMS as an inexpensive channel of sharing information. The challenge that we foresee in such a situation is the ability of the system to respond to natural language queries. We have developed a collection of techniques for addressing these problems. The design approach is guided by the expected usage of the system by a typical user in India and the use of a mobile phone.

1. Introduction

The Health Care Sector in India is largely unorganized. The people in villages thus have inadequate access to health services. Additionally, the number of physicians per 1000 people is just 0.6 in India as compared to 2.3 in United States (1). Therefore, in order to better equip people with existing health facilities we need to dovetail the use of current technological advancements to the health care sector.

The recent trends in telecommunications sector indicate that cheap mobile phones have reached even remote areas of the country. The total number of wireless subscribers in India stood at 362.3 million at the end of January, 2009 (2) which comprises about 30% of the population. About 8 million mobile phone subscribers are added every month (3). This indicates the presence of a good communication channel which can be leveraged by novel applications to achieve good penetration and usage.

This paper deals with the design of one such application utilizing the Short Messaging Service (SMS) for providing information about health care service providers.

The system that we have designed accepts natural language queries as input from which we extract parameters of interest that help us to rank the doctors.

To summarize, the contributions of our paper are as follows:

1. To the best of our knowledge, the system is the first to map health problem descriptions to health care specializations using natural language queries as input.
2. The system is tolerant to common spelling errors.
3. The system uses existing geo-coding services to map an address to a position on the map and hence uses it to find the closest doctor.
4. We present a simple ranking function for selecting doctors based on the various input terms in the query.

2. Prior Work and Existing Systems

For locating a doctor people currently use ad hoc approaches. For example through the information learnt from the social network of the person or through services like yellow pages. Access to such information is best achieved through the use of systems which inherently involve humans answering questions in the backend (4).

There are a large number of websites on the Internet providing a form based interface for finding doctors. A typical example is Revolution Health (5). This website requires the user to specify the location in one of the fields (example – Austin, TX) and an option to find a doctor by specialty or by health condition. In the first case the user is presented with a drop down list to select the specialization of the doctor required (example – Orthopedics, Otology). When searching by treatment or condition the user is presented with two drop down lists to further narrow down the search conditions. The interface also allows the user to optionally specify the last name of the doctor. A similar functionality is provided by Web MD (6). Moreover, this website caters to US users only. An initiative for doctors in India has been started by Healthcaremagic (7). However, it allows searching for doctors based on specialty only.

Clearly, the drop down menu based interface adopted by these websites is unsuitable for mobile phones and particularly SMS which do not provide UI interfaces like drop-down menus. Logical extensions of the method to a multi-message selection procedure are both inconvenient, time consuming and needlessly expensive for the end user.

A user would usually prefer a doctor near her location. The service provided by (5) expects the user to enter her pin code or specify the city and state. It is currently available for locations in US only. Healthcaremagic (7) allows a user to filter the results based on state and city and is available for India. These services do not allow a user to search at a finer level except when a pin code is provided. However a user may not be too sure of the pin code.

A search system for locating doctors in particular or local businesses in general from Yellow Pages can provide ready access to this information. Such a system based on natural language queries has been discussed in (8). However this system is meant for locating exact matches. Thus a user may use this system for getting the contact details of a doctor, locating any doctor in a locality but may not be able locate a doctor in a nearby locality if there is none in the locality specified in the query. However this system does claim to map natural language words to the kind of business that one is looking for.

Automating this process provides scalability in terms of the number of people the system is able to support.

3. Typical Use Case for our System

Since majority of the people in India still use cheap handsets with limited features and providing information about doctors requires only text, therefore we have chosen SMS as our medium.

We have designed the system keeping the following use case in mind (**Error! Reference source not found.**).

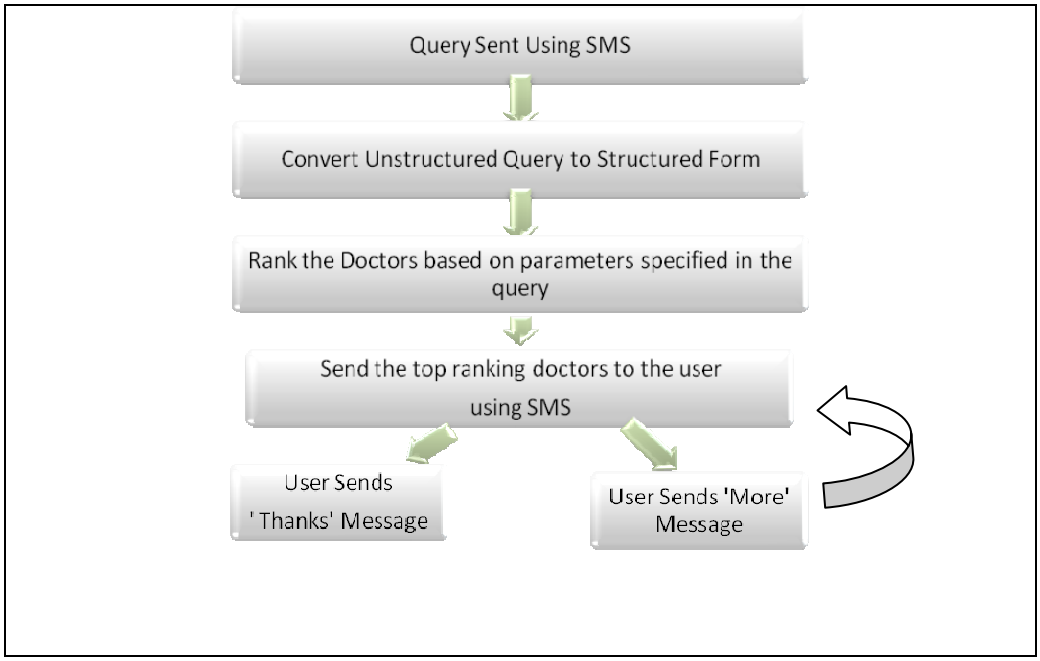


Fig. 1 Flowchart showing usage of System

4. System Architecture

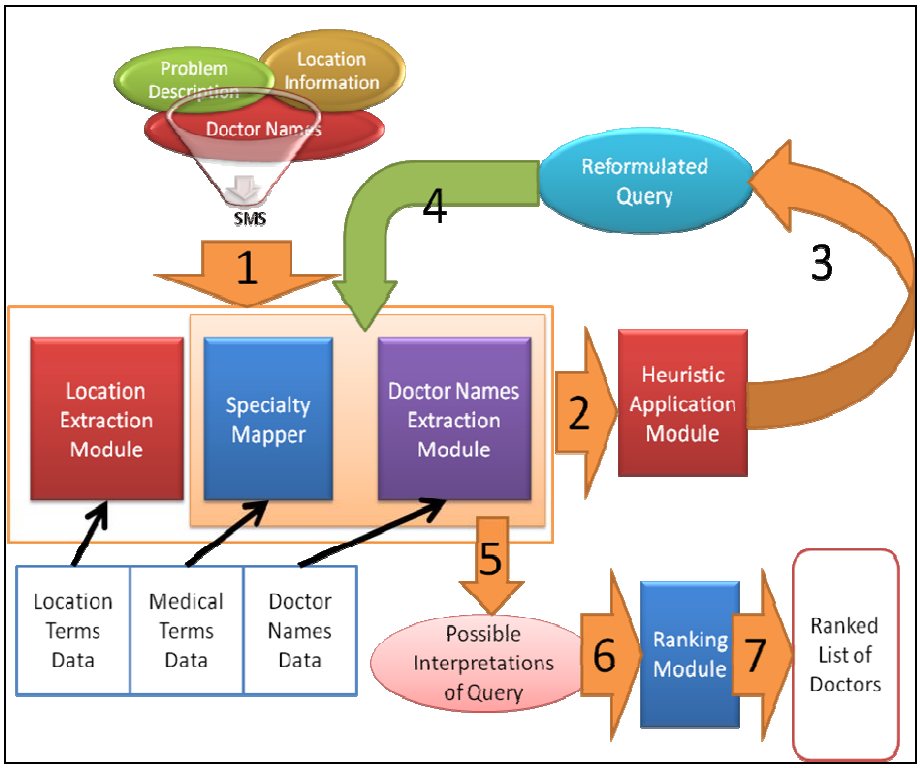


Fig. 2 System Architecture

The SMS query undergoes the following transformation steps as it passes through the system:

1. The query is passed through three Information Extractor modules which determine location related information, medical terms and doctor names occurring in the query. There is no flow of data among these modules. This classification is not deterministic. There may be unclassified terms (not belonging to any category), ambiguous terms (belonging to more than one category).

2. Using the results of Step 1 we apply various heuristics to resolve the ambiguities and classify the remaining terms to the extent possible.
3. In Step 3 the heuristics are used to reformulate the query with the location related terms removed.
4. The query is reevaluated against the medical terms extraction module and doctor names extraction module.
5. The system generates several possible interpretations of the query.
6. An interpretation is chosen and is used to rank the doctors based on the ranking function discussed in Section **Error! Bookmark not defined.**.
7. A ranked list of doctors for this interpretation is sent to the caller which may choose to rerank the doctors for some other interpretation from among the ones in Step 5 above.

5. Implementation

In this section we detail the design of the components outlined in Section **Error! Reference source not found.**. Central to our system is the idea of being able to search for various keywords. For this task we have used Apache Lucene (9). Lucene is an open source software library for keyword based text searching applications. In section **Error! Reference source not found.** we briefly review the basics of Lucene. Sections **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.** discuss the Specialty Mapper, Doctor Names Extraction Module and Location Extraction Module respectively. In Section **Error! Reference source not found.** we describe our algorithm for parsing queries and utilizing these knowledgebases. Section **Error! Reference source not found.** discusses the ranking function for selecting the best doctors for a query.

5.1 Lucene

Lucene is a high-performance java open source text search engine API. Working with Lucene requires us to build an Index. Index is a set of files in a particular format that stores data stored in it. Writing to an Index involves adding Document objects. All data that has to be stored in a document is stored as chunks of Field objects. A field is a name/value pair (10) along with certain properties that indicate how to store and access the fields in the index. For Example, to create an index of all books in a library one can create a document object for each book. Documentation on Lucene can be found at (11).

5.2 Specialty Mapper

We started with the goal of being able to map problem description to a health care specialization. For this we need a knowledgebase and this subsection outlines our strategy for creating one. We used a combination of two sources for collecting terms for our knowledgebase. The first source is the MeSH (Medical Subject Headings) hierarchy and the other is an unstructured collection of sentences for a doctor specialty.

5.2.1 MeSH hierarchy

MeSH is a controlled vocabulary for the purpose of indexing journal articles and books in the life sciences. It has been created by United States National Library of Medicine (NLM) (12). It can also serve as a thesaurus that facilitates searching. The medical terms are organized in the form of a hierarchy (tree). Each node in the tree has a descriptor or subject heading. A given descriptor may occur at several places in the hierarchical tree. The tree locations carry systematic labels known as tree numbers and consequently one descriptor can carry several tree numbers (13). The hierarchy is semantically organized.
Consider the examples of MeSH nodes given in **Error! Reference source not found.**. A part of the MeSH subtree is shown. It is important to note that only one instance of the Node in the MeSH tree is indicated in the table. Each node may occur at multiple places in the hierarchy and corresponding to each occurrence there is a tree number for the node

(descriptor). The immediate ancestor of a node in the hierarchy is listed on the left. The following things may be helpful in understanding the table:

- Blister (A) and eczema (B) have skin diseases as the least common ancestor.
- Conjunctivitis (D) and Myopia (E) have eye diseases as the least common ancestor.
- The tree number has a dotted notation corresponding to the hierarchical structure. Thus (D) and (E) have C11 as a common prefix for the tree number which happens to be the tree number for eye diseases. Similarly (A) and (B) have C17.800 as the common prefix. 'C' denotes the diseases ancestor, 'C17' – skin diseases, 'C17.800' – skin and connective tissue diseases.

Sl. No.	Node	Ancestors of Node	Tree Number
A	Blister	"skin diseases, vesicullobulous" -> "skin diseases" -> "skin and connective tissue diseases" -> "diseases"	C17.800.865.187
B	Eczema	"dermatitis" -> "skin diseases" -> "skin and connective tissue diseases" -> "diseases"	C17.800.174.620
C	Nose	"head" -> "body regions" -> "Anatomy"	A01.456.505.733
D	Conjunctivitis	"Conjunctival diseases" -> "eye diseases" -> "diseases"	C11.187.183
E	Myopia	"refractive errors" -> "eye diseases" -> "diseases"	C11.744.636

Table 1 Examples of MeSH Nodes

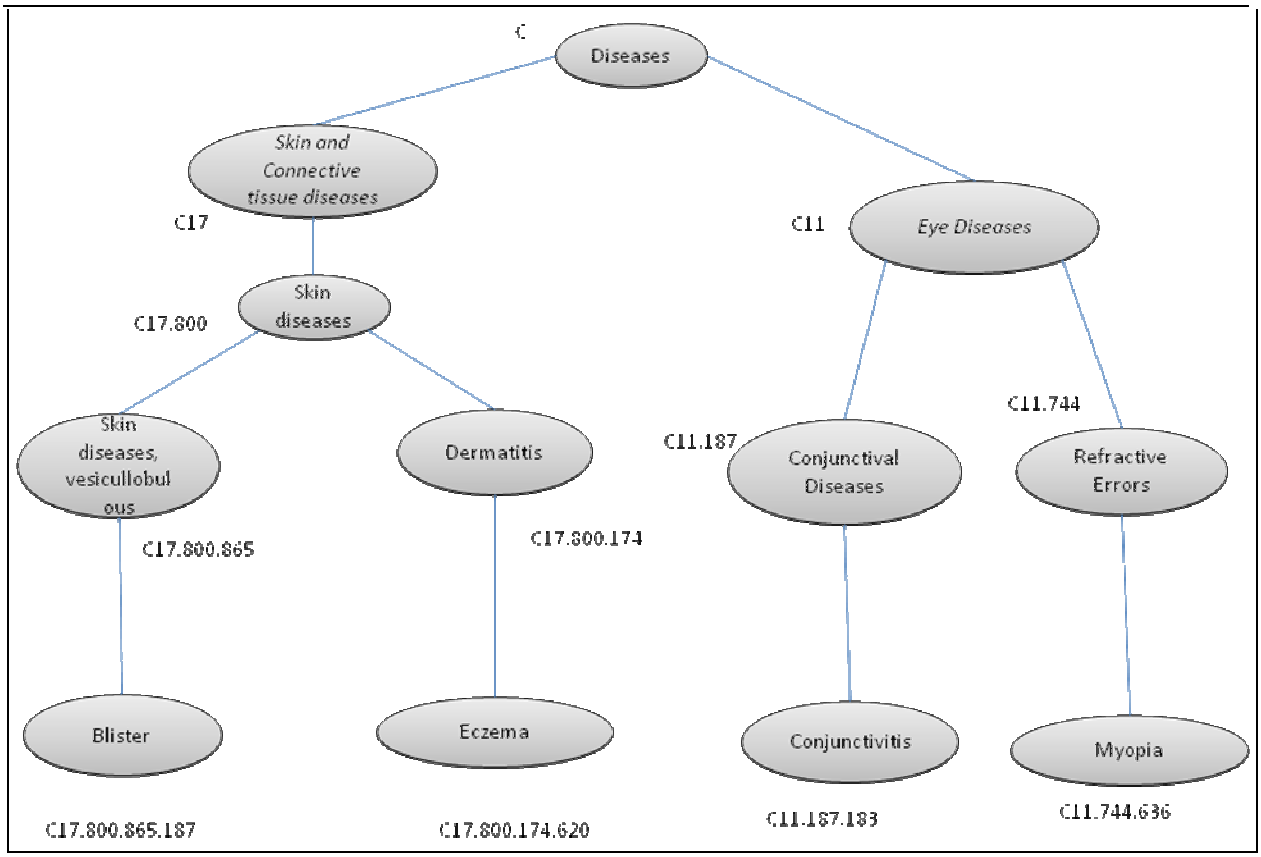


Figure 3 Visualizing the MeSH Heirarchy

We have utilized this structure in the MeSH to build our knowledgebase. We manually created rules to achieve this. Examples of such rules are given in **Error! Reference source not found.**.

Node	Tree Number	Specialist	Example Nodes

			in the subtree
Back	A01.176	Orthopedic	lumbosacral region
calcium metabolism disorders	C18.452.174	Orthopedic	osteomalacia; rickets
orthopedic procedures	E04.555	Orthopedic	amputation; bone transplantation
eye diseases	C11	Ophthalmologist	conjunctivitis; cataract; myopia; vision, low; iritis
Eye	A09.371	Ophthalmologist	cornea; eyelids; eyelashes; pupil; retina
vision disorders	C11.966	Optometrist	blindness; vision, low; color vision defects
respiratory tract diseases	C08	Pulmonologist	asthma; bronchitis; pneumonia; lung diseases, fungal
behavior and behavior mechanisms	F01	Psychiatrist	enurisis; mental fatigue; fingersucking;
psychological phenomena and processes	F02	Psychiatrist	dreams; ego

Table 2 Example Rules to Classify MeSH nodes

By noting the tree numbers as in **Error! Reference source not found.** we can ease the task of categorization of medical terms occurring in the hierarchy. There are some things worth noting about this method of classification:

- All MeSH nodes that have a tree number starting with C11 fall in the category of eye diseases and are hence point to an ophthalmologist. But a more fine classification is required for vision disorders occurring in this subtree which point to an optometrist. Thus "vision, low" occurs in both categories as can be seen in **Error! Reference source not found.**.
  For classification, we store these rules in an appropriate data structure and scan the MeSH descriptors. We look for the longest prefix match to allow this scenario of fine grained classification. This is possible because of the systematic tree numbers assigned by MeSH.
- Many of the MeSH descriptors are complex medical terms that may not be known by all people. For example – "somnambulism" meaning "sleepwalking" is not a common term. While inclusion of these terms might be useful to medical professionals who have the required knowledge, it is better to include the common word "sleepwalking" also so that it is useful for the common man as well. We thus add the definition of these medical terms by looking up Wordnet (14) along with the term.

5.2.2 Unstructured Definitions

MeSH is a controlled vocabulary and thus it does not contain certain commonly used medical terms. As an example "dandruff" does not occur in MeSH. To make the knowledgebase more complete, we also populate it with the description of medical

specialty. This unstructured text allows us to add some common words that are not found in the MeSH hierarchy. The description has been obtained from Wrongdiagnosis.com (15).

5.2.3 Addition to Index

As noted earlier we use Lucene to store the data of the knowledgebase. We create a Lucene Document corresponding to each doctor specialty. This document is populated with the following fields –

a. Title – Doctor specialty
b. Description – the text prepared for the specialty as described in **Error! Reference source not found.**.
c. Node – MeSH nodes that have a corresponding rule defined as illustrated in **Error! Reference source not found.**.

Preprocessing Text – Terms that are added to the index must be preprocessed to make the index case insensitive, independent of different forms of the same word and unaffected by stop words like is, are, a, the etc. Lucene allows us to pass the text through an analyzer (16) to perform these functions. To treat different forms of the same word as equivalent (For e.g. alcoholism and alcohol have the same word root and hence should be treated as similar) we use Porter Stemming Algorithm (17). The Porter Stemmer Filter is provided with Lucene. Similarly a stop word filter is also provided with Lucene to remove words that have no effect on determining the kind of specialist that is required.

5.3 Doctor Names Extraction Module

To test our system we have obtained a database of doctors' details from (7). We store the information of doctors also in a Lucene Index. In this case a document contains the information of a single doctor. The fields that we have included are – name, address, qualification, city, state, latitude, longitude etc. Although not all fields are of interest and indexed. We focus are search on the name field.

We utilize Lucene's fuzzy query feature to achieve approximate matching of names. Thus misspelled names are automatically matched to the nearest match. Another problem with matching names is that the same name may be specified in different forms. For example – Dr. Anuj Kumar Patel may be specified as Dr. AK Patel, Dr. A Patel, Dr. Patel etc. We add all these forms as synonyms to the original term. This feature is also implemented using Lucene.

5.4 Location Extraction Module

It is natural for a user to prefer a doctor that is near to her location. The database of doctors contains the addresses of doctors. To measure nearness of two addresses, we need to encode these addresses in a mathematical form. Thus we encode all addresses in the doctors' database in the form of Latitude and Longitudes. This feature is required by many applications and is called geo coding. We have used Google Maps Geocoding API (18) to achieve this. The Google Maps Geocoding API is accessed using HTTP request. If the service is able to find the address in its database, it returns an HTTP 200 OK message otherwise it returns an error code. In addition if the address is valid the service indicates the accuracy of the result rated on a scale of 0 to 9.

In this manner we can obtain the location of all doctors and the location specified in the query in the form of latitudes and longitudes. To find the closest doctor, we perform a range query on the Lucene index which has the fields latitude and longitude to restrict the search over the doctors which are within some radius of the user's location. For each doctor obtained by this range query search, we find the approximate distance along the earth's surface by using Haversine's Formula (19). However, this approach does not take into account the actual distance along the road and we assume this distance is a reliable estimate of the nearness of a place. The formula is given in **Error! Reference source not found.Error! Reference source not found.**. Using these equations we find the distance, d between the user and each doctor in the list. We later explain how this distance is used by our ranking function.

$$haversin(\theta) = \sin^2\left(\frac{\theta}{2}\right)$$

$$haversin\left(\frac{d}{R}\right) = haversin(\Delta\varphi) + \cos(\varphi_1)\cos(\phi_2)\, haversin(\Delta\lambda)$$

d is the distance between the two points
R is the radius of the earth
φ_1 *is the latitude of point* 1
φ_2 *is the latitude of point*
$\Delta\lambda$ *is the longitude separation*

Fig. 4 Haversine's Formula

However, Google Maps API may not be able to geocode all locations, specially the remote villages in India. Thus, we have built a database of all the villages, sub-districts, districts and towns in India to resolve this issue using the information provided at the website for Census 2001 (20). The latitude and longitude information also needs to be obtained for these locations. An approximate value for a village's geocoded location can be taken to be the same as that for the sub-district in which the village lies. Thus while using an approximate value; our system can identify the locations of a large number of small and remote villages. This data provides us a way to hint at the presence of names of cities, states, district names. This provides a way to hint at the which terms in the query refer to the location, hence providing a starting point for parsing.

5.5 Parsing the Queries

The query is obtained in the form of a single string. We have to separate the various parameters of interest from the query. The parameters as noted before are –

1. Location of user
2. Medical terms
3. Name of the doctor

The queries are naturally structured. This means that the user can list the above three parameters in any order. But it is reasonable to base our parsing heuristics on the "**well formed**" queries. Since the motive of the user is to obtain information about a doctor using SMS, the user may not provide complete sentences and only the keywords may be provided.

Although the parameters may occur in any order, the terms of a particular parameter would be present contiguously. Such assumptions lead to the following:

- We give a high importance to the location parameter. The first stage through which our query is passed is Location Extraction Module. This is used to hint the last word contributing to the location information.
- The last word in the query to hit against this result is considered to be the last occurrence of location information in the query. We call this index (no. of the word) as the 'lastLocIndex'.
- To find the 'firstLocIndex' the index of the first word in the query that provides locational information, start with the first word in the query that provides locational information for the first result from among the hits. Words having index smaller than firstLocIndex may or may not contribute to the location information.
- Thus our aim is to find smallest x between 0 and firstLocIndex such that words having index between x and lastLocIndex contribute to location information only.

We scan the list of words from (firstLocIndex-1) down to 0 and apply the following heuristics:

- If addition of a word increases the accuracy of Geocoding reported by Google Maps then it contributes to location information.
- If the word is unclassified it is assumed to contribute to location information.
- If a word contributes to the highest ranking medical specialty then x = (index of this word +1) as it may not be contributing to location information.
- If a word matches with the name of the highest ranking doctor whose specialty is the same as that indicated by the medical terms occurring in the highest ranking specialty then we again assume that x = (index of this word +1) and break out of the loop.
- For example in the query "skin doctor iit delhi" the word "delhi" is identified as location term in the first pass. The word "iit" increases the accuracy reported by Google Maps while the term doctor is considered as a stop word and the term "skin" contributes to the highest ranking specialty hence is not contributing to the location.

- Remove the terms between x and lastLocIndex from the query and rerank the reformulated query against the specialty mapper and doctor names extraction module. Reranking is required as in our experiments we observed that sometimes words occurring in the address part influenced the ranking of specialty or doctor names. For example in the query "skin doctor subroto park new delhi" the word "park" is ambiguous as it matches with "parkin" a derivative of Parkinson's disease occurring in the medical terms database. Similarly in the query "skin doctor vikas puri new delhi" the term "vikas" matches with "Dr. Vikas" thus requiring reranking after address identification.
- Then rank the doctors on the basis of distance as explained in **Error! Reference source not found.**.

5.6 Ranking Module

We use the following procedure to rank the doctors.

1. Initially the scores of all doctors is zero.
2. When the query contains the name of a doctor, then that doctor's document would be ranked high. Many doctors might have the same or similar names. Thus there would be multiple hits. But Lucene would assign different scores to each hit. The highest ranking document would receive the highest score. Doctors with same names would be assigned the same score. Normalize these score by dividing each score by the highest score. Thus the scores obtained are on a scale of 1. Call the score obtained as a result of this set of doctors, α_1.
3. Now by performing a range query as explained in Section **Error! Reference source not found.**, obtain a list of doctors within a small radius of the user. Find the distance of all these doctors from the user. The score of these doctors is also normalized as follows –

$$score(i) = 1.0 - \frac{dist(i)}{maxdist}$$

The rationale behind this formula is that the doctors which are closer are ranked higher, that is, score of the i^{th} doctor is more if the distance of the i^{th} doctor from the user is less. Moreover the distances are divided by the distance of the farthest doctor from the user, so that score is normalized on a scale of 1. Call the score obtained as a result of this set of doctors, α_2.

4. Give a score to all doctors having some specialty indicated in the query normalized on a scale of 1.0 based on the score returned by Lucene during the second pass through the Specialty Mapper. Call the scores obtained as a result of this set of doctors, α_3. As the number of doctors with a given specialty may be large, an implementation can choose to focus only on those doctors that have been found in steps 2 and 3 as they are likely to be ranked higher than the others.
5. Find the union of the sets of doctors obtained in steps 2, 3 and 4 above. There final scores are computed by adding scores for their occurrence in either of the sets. The final score α is computed by adding α_1, α_2 and α_3, giving weightage β_1, β_2 and β_3 to these scores respectively. These weights are decided by the following set of rules –
    a. Case 1 –
    All three parameters are present
    Assign a higher weight to location if present in the query. If the location is determined with a high accuracy, then a higher value should be given to β_2. The accuracy of location is reported as an integer between 1 and 8 with a higher value indicating more accuracy.
    β_2 = accuracy / 10.0
    β_1 = (1 - accuracy / 10.0) / 2
    β_3 = (1 - accuracy / 10.0) / 2
    b. Case 2 –
    Two parameters are present and one of them is location
    β_2 = accuracy / 10.0
    β_1 = (1 - accuracy / 10.0) **or** β_3 = (1 - accuracy / 10.0) / 2
    c. Case 3 –
    Two parameters are present and is location is absent
    We reject the query in this case.
    d. Case 3 –
    Only location parameter is present
    Let the weight corresponding to location parameter be 1.0 and the others be zero.
    β_2 = 1.0
    β_1 = β_3 = 0.0

6. Final scores are calculated using

$$\alpha = \alpha_1\beta_1 + \alpha_2\beta_2 + \alpha_3\beta_3$$

The above scoring function allows us to find sets of doctors independently for each parameter and the weights allow us to combine these sets to obtain a cumulative ranking.

6. Results

- We obtained a data of over 15000 doctors in India from www.healthcaremagic.com.
- To show the advantage of using Google Maps we cut down the list to 361 doctors from Delhi from 30 different specialties.
- We have conducted alpha testing of the system at our end.
- We generated the example queries were generated by on our own.
- The testing has been done on command line program and not on the actual phones.
- We tried various spelling variations to test the approximate matching ability of Lucene.
- We assume that a single response may span several messages sent from the server side.
- Examples of the queries are indicated in **Error! Reference source not found.**, **Error! Reference source not found.** and **Error! Reference source not found.**.

Fig 5 Example 1 (all three parameters specified)

Fig. 6 Example 2 similar to Example 1 except name not present, notice that result 2 gets ranked higher as no name is specified and the second result in the previous example is closer to the location.

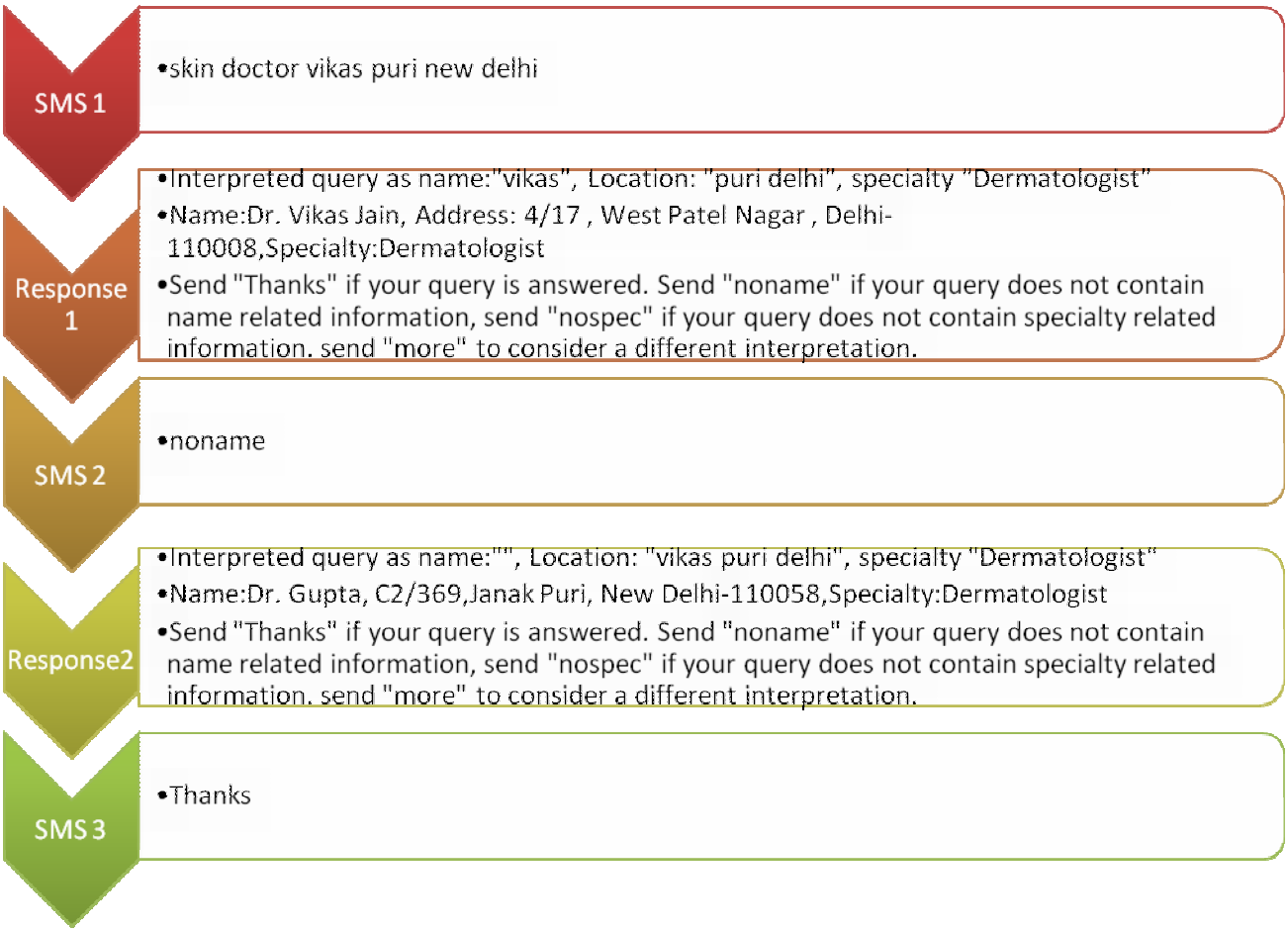


Fig. 7 Example 3 Showing how a misinterpretation is corrected

7. Future Work

This preliminary work has given us a lot of ideas not all of which could be incorporated in this project. In this section, we share these with the aim of giving direction to future work in this field.

- The facility can be extended to automatically fix appointments with a doctor that appears in the search result. In such a case, the availability of a doctor must be taken into account. This would require the server to sync itself with the doctor's public calendar and in case a doctor is unavailable, a substitute doctor can be suggested. The feasibility and usefulness of these features needs to be studied.
- Other parameters can be used for ranking the doctors. For example – rating of doctors, feedback of patients, history of cases handled by a doctor, other preferences specified by a user.
- This paper has focused on the medical domain. In general a system based on the knowledgebase approach as outlined in this work can find businesses by related words. For example the complaint of a "broken pipe" would automatically be referenced to a plumber and so on.
- System must be verified by a medical practitioner before being deployed.
- The system can be extended to other Indian languages as well. The feasibility of this approach and the design changes required would need to be analyzed.

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Ghana's Community Information Centres (CiCs): How effective against Mobile Telephony as a Successful Strategy for e-governance implementation

Johanna Ekua Awotwi

Abstract

The paper analyses the initiatives of Government of Ghana to use ICT for improvement in operational efficiency and service delivery. This analysis is based on data collected from all known public records, reports, and other materials which were researched, and where possible, persons either directly involved with the Community Information Centres' (CiCs)project as administrators or users were interviewed. Common challenges or constraints facing project managers in sustaining the centres are also analyzed. It also determines whether the use of mobile phones gaining in popularity for instance, support the popular rhetoric which has begun to question the need of ICTs or specifically, information centres, beyond the mobile phone; thereby making the centres redundant. Finally, the analysis makes suggestions for possible ways forward in terms of ICT diffusion in rural Ghana.

Keywords: e-Governance, community information centres, telecentres, digital divide, Illiteracy, mobile telephony

1. Introduction

It is a well known fact that solutions to development issues often lie with processes of governance. An example is decentralization which goes to save costs, improve effectiveness and efficiency. The driving force for decentralization can be demand for online services and information that increase democratic participation, accountability and transparency. This includes the design of systems and institutions leading to stronger mechanisms of accountability and the possibility of participation by the citizen and other non-government organizations. (Osborne & Gaebler 1992).

Indeed, the electronic means to support and stimulate good governance is what can well be defined as e-Governance. (Sundresan Perumal et al. 2006) Many developed countries have exploited these technologies successfully for the development of their remote and hard to reach communities. Taking a cue from their experience, developing countries have used these technologies, with varying degrees of success. Many of us are both witness and participants to the exploitation of ICTs to further the goals of development.

It is instructive to note, that Information Technology (IT) and telecom are only means to an end and not an end in them selves. IT is an enabler and if not well utilized effectively for socio-economic benefits, its phenomenal growth is of very little relevance in any country, especially the developing ones.

In an all out effort to address the inequities of development, the global community of governments, scientific and research organizations, donor agencies, civil society organizations and private sector institutions have accepted the UN Millennium Development Goals (MDGs) and the targets that have been set to bring about a qualitative and quantitative difference in the life of the global poor. Richard Heeks, a professor of development informatics at the University of Manchester, has been a consistent champion of the idea that technology must be applied with sensitivity to social, economic, and political contexts. In"ICT4D 2.0: The Next Phase of Applying ICTs for International Development," Heeks explores the evolution of ICTD and its transition to an emerging "ICT4D 2.0," arguing that the first phase was dominated by Internet-enabled PC telecenters catering to development causes that fell short of expectations, whereas the emerging phase is applying ICT much more creatively to development problems. Information is critical to the development process and telecommunications is not just a means of communications, but it provides a link in the entire developmental chain.

Was Heeks talking about the truly stunning, progress made in the global mobile industry over the past 10 years?

Mobile devices have the maximum potential to stimulate the supply and demand of public services because of their pervasiveness, interactivity, multiple functions – voice, radio, internet, payment, their ability to include the most marginalized people in society, their potential to reduce opportunity costs associated with traveling or corrupt practices. Mobile phones are tools for delivering socially – oriented content. (Mishra, A.R. 2008)

Within the field of communication, where do we focus? Is it on policy, processes, the tools, the audiences, or the results? Have we as yet made the synergistic connection between policy and applications and how one is critically dependent on the other? And at what level do we begin our analysis?

This study aims to highlight the potential reforms either needed for, or as a consequence of, the Community Information Centre (CiC) innovation introduced to rural access by Ghana government, to critically evaluate this dominant model and find out whether it is achieving its purpose, and finally to present an alternative approach, if necessary– one appropriate for the conceptualization of information infrastructures that serve the goals of governance and focus on social welfare.

2. Background

The concept of shared access to information was first launched in Europe and Canada in the early 1980s through the movement of "tele-cottage". During the second half of the 1990s the concept was especially boosted by the digital revolution and the emerging interest of development organizations and private sectors. Shared access exists in the context of a broader universal access policy, which is itself embedded in a national development policy framework. It is normally affected, and sometimes directly created, by policy and implementation processes, and involves a variety of actors at the local, national and international levels.

Telecentres no doubt have the development objective of providing the unserved and underserved population with instruments that facilitate social and economic exchanges. These centres therefore have a double aim to serve as a platform of exploitation of local knowledge on one hand and to be the heart of economic and financial transactions of the

community on the other. Unfortunately, the interest in these centres has since subsided because too many projects were ill executed for various reasons. Donors believed the most important failure of ICT4D initiatives was their unsustainability. In terms of ICT for rural development, the term sustainability as used by the international development sector is most often described as the ability to maintain implementation beyond the intervention period.

Interventions, especially short –term ones, when information centres are unviable, are not well suited for ICT-based initiatives that require continued operational support, both in terms of technical advice and funds.

2.1 Ghana

The Republic of Ghana in West Africa has been poised, through its policies, to encourage shared access to its unserved and underserved population. With a population of about 23.382,848 million for 2008 according to the Census Bureau it is divided into ten (10) administrative regions.

GDP per capita at current prices as at 2008 is estimated at around US $1,500.

GDP real growth rate is 6.3% (2008 est.) and GDP composition by sector is; agriculture 37.3%, industry 25.3% and services 37.5% (2006 EST.).

GNI per capita is US$ 590 ('07). (Ghana Internet Market and Telecommunications Report. 16th May 2009)

Ghana has over the years developed her Sectoral Information Communication Infrastructure policy and plan and submitted it to the United Nations Economic Commission for Africa. She is the first country to have completed and presented her Village Information and Communication Infrastructure Policy and Plan. (UNECA)

2.1.1 Community Information Centres in Ghana

A study on rural –access in Ghana commissioned by the IICD in 2008, has revealed that, a rural community in Ghana is a deprived community which lacks telecom infrastructure, electricity and sometimes appropriate buildings. It further revealed that the absence of meaningful economic activity and skilled personnel make these locations unattractive for investors. (Akakpo 2008)

Rural communities therefore, generally have had limited access to technology, and the cost of a PC is typically more than what the average villager can afford. Due to poor connectivity, inadequate infrastructure and human resource limitations, most of the tele centres provide extremely limited services. The Ghana Community Information Centre (CiC) model which began in 2005 has been adopted to provide a hybrid not-for-profit community resource centre and for -profit telecentres. (NCA 2009).As far back as 1992, a great number of tele-centres were established and a 1997 study reports 50-60 such centres in the Greater Accra region (Mansell, 1997).

The CiC project falls within the framework of World Summit on Information Society (WSIS), where all nations are enjoined to attain certain targets, including the provision of ICT access and skills to the underprivileged and rural dwellers globally.

It also operates within the context of the Millennium Development Goals (MDGs) whose set targets address structural concerns that impede economic growth and human development. Ghana's own Poverty Reduction Strategy (GPRS) represents comprehensive policies, strategies, programmes and projects at macro and micro levels to support economic growth and poverty reduction. Within these broad frameworks ICT is being deployed within the CiCs as an integral tool. Government, through its regulators, has placed "Universal Access" requirements on telecommunications providers. These requirements have resulted in infrastructure investment – CiCs - that have made access available to some degree. These centres typically operate at a loss, though.

If e-Governance means access to online services and information that increase democratic participation, accountability, transparency, and the speed of services, could one say confidently that the CiCs in Ghana have been able to achieve these objectives? Have CiCs achieved long-term sustainability? Have the end users benefited from information to and from government, interacted with government online, made transactions online or have had organizational transformation because of the use of ICTs through the CiCs? Has the audience reaction been positive?

2.1.1.1 SOME KEY CiC CHALLENGES

ICTs through the CiCs should play an essential role not only in reaching marginal/under-served communities but also in scaling up the services at affordable costs, creating new markets and new demand for additional products and services. This however is still not happening on any scale, substantive or otherwise.

Even though the government of Ghana has an innovative ICT policy environment, implementation of the CiC idea and sustaining them, has proven to be major hurdles to achieving rural access. A study of the Saltpond, Somanya and Dodowa CiCs in the Central and Eastern Regions respectively, was conducted by the authors for this analysis.

A fully operational and functional level CIC must have the following: the physical building itself with electricity and telephone facilities; a Local Area Network (LAN) with at least five (5) workstations usually supplied by the country office of the UNDP; one server; one switch; one printer; one scanner and five (5) UPSs (Uninterruptible Power Source). (Akakpo, 2008) However, most of the CiCs lack connectivity. The CICs are at various operational and functional levels and only 32 out of 60 operational ones were fully connected by April 2009. (UNDP Accra, June 2009)

Selected communities had to have in place already, access to certain facilities such as electricity and telephones, which put other under served areas out of the loop because they do not have electricity and fixed phone lines. This has definitely been a major limitation to the idea.

Currently, these CiCs operate in isolation because there is neither centralization of standards nor a body to coordinate any such standards on what will make the centres perform better, even though a steering committee is supposed to be in existence.

Interaction in most centres has not been encouraging due to the fact that most sites are located too close to the District Assemblies which is a turn-off for ordinary citizens who do not want officialdom in their daily lives. In other cases, the CiCs are located far away from community residence for example, the Somanya CiC which is more than 2 kilometers away

from the town centre and looks like a white elephant. How then does the population buy into the idea of an Information Centre?

Additionally, the working hours of 8-5 in 5 days a week operation, as witnessed at Dodowa CiC in the Greater Accra Region, makes it even more discouraging to the ordinary folks who normally would prefer to access information during weekends, at a more leisurely pace.

Even though there is an effort at skills' development in all the CiCs, people need time and space in which to learn basic skills and fee-based access is not a viable way to achieve this. If standards were centralized, the fee-free initiative would be replicated in all the centres in order to encourage capacity building as is being done at Saltpond for the youth.

The CiCs are not transactional centres in the sense that even though the awareness to transact may be there, there is no data supporting such usage of ICTs in the rural areas.

There is also very little data supporting how the centres have transformed the lives of people who use these centres. The most important transformation, if one can say so, is that of awareness of what ICTs could do to make lives easier.

If out of 100 CiCs only 32 are fully connected in 2009, then it means Ghana has a long way to go in making the concept work to her benefit.

An area that may need more re-focusing for instance is whether the demand for communication services is sufficient to make a CiC economically viable. The CiC managers have had trainer- training sessions conducted by the UNDP. However, the donor agency cannot go further than the intervention period in order for the CiCs to achieve sustainability.

An evaluation of the project idea shows that there is an attempt to send information to the rural areas, but what kind of information? Is the existence of the centre merely to raise a strong emphasis on ICT awareness to a mainly illiterate community?

Traditionally, in Ghana, the installation of Telecenters has been seen as a technology-based project where a series of computers are placed in order to satisfy a communication need. However, there are no appropriate processes designed to understand the community and its needs and to design products and services that promote social and economic development.

Ghana's CiCs still have very limited access of rural population to social and economic information and transformation. Challenges continue to include lack of enough and consistent revenue to support running expenditures for connectivity, lack of local content and content development for the mainly illiterate rural population, technical problems which linger on for months because of inadequate technical staff – (Dodowa CiC), for example, and insufficient skills and awareness to fully optimize the use of ICTs.

The slow pace of CiC development may also be due to its lack of positive socio-economic impact, lack of centralized standards and also the fact that there may be an alternative to empowering and informing the underserved and unserved more effectively and without a lot of financial pain. The absence of Public –Private –Partnership (PPPs) involvement could also be a factor in the ineffectiveness of CiC operations.

Unless people have other venues for building their awareness of and confidence in using ICTs, the CiCs have not proven a robust method of overcoming the multiple barriers to access that many people face. It may therefore be a mirage after all.

3. Mobile Telephony

Mobile telephony on the other hand, has emerged as one of the most important and widespread forms of ICT in recent decades, with a significant impact on economic growth and poverty reduction. We are suggesting therefore, the use of mobile telephony as an alternative to the CiCs in accessibility to government services.

Mobile communications penetration has boomed in the developing world, compensating for an often underdeveloped and flawed fixed telephony infrastructure and offering a promising tool to lift more and more people out of poverty and improve market efficiency.

Studies have shown that this rapid increase in mobile penetration has contributed significantly to economic growth. Fuss, Meschi and Waverman 2005, looked at 92 countries, both developed and developing, to estimate the impact of mobile phones on economic growth for the period 1980 to 2003. They found that a 10% difference in mobile penetration levels over the entire sample period implies a 0.6% difference in growth rates between otherwise identical developing nations.

By the end of 2009 there were some 448.1 million mobile phone subscribers in Africa, up from just 373.0 million at the end of 2008 - a stunning 20 percent increase representing 75 million new subscribers in just one year. (M2 Press WIRE Via Acquire Media NewsEdge) Dublin - Research and Markets).

Mobile telephony has brought in its wake three kinds of benefits (id21, 2007) viz; incremental – offering faster and cheaper communications; transformational –innovative applications such as bringing m-banking to largely rural unbanked population and enabling people to pay for goods and services and finally, production benefits from the creation of new livelihoods, not only through professional telecommunications jobs but also through activities like re-selling airtime or phone cards.

Mobile technologies provide fertile ground to explore the provision of basic government services including e-governance services.

Awareness of computers and the internet has been generally lower than that of telephone service, thus presenting obvious extra barriers to the use of these technologies. It is noted too, that communication is widely valued and appreciated more than information-related services, an observation further reinforced by the fact that the Internet, where accessed, is used primarily for e-mail.

Mobile technology has therefore, allowed many developing countries like Ghana to leapfrog the lack of fixed infrastructure and thus provide access to telephony services to a much larger portion of their citizens where CiCs have been found wanting.

3.1 The State of Ghana's Mobile Telephony

Since launching the first cellular mobile network in sub-Saharan Africa in 1992, according to M2 Press WIRE Via Acquire Media NewsEdge Dublin - Research and Markets, Ghana has

become one of the continents most vibrant mobile markets with now six competing operators, including regional heavyweights such as MTN, Vodafone, Zain and Millicom (Tigo). At a market penetration of only just over 50%, opportunity continues to exist in the provision of basic voice services as well as 3G mobile broadband access, given the country's poorly developed fixed-line infrastructure.

Ghana's Business and Financial Times February 2010, states the total number of subscribers as 15.1 million in December 2009. Data from the country's telecom regulator, National Communications Authority (NCA), shows more than two thirds of the estimated 25 million Ghanaians have access to telephone access. Mobile network subscriptions increased from 14, 242,476 in the 3rd quarter to 15,108,916 in the 4th quarter, representing 6% growth over the 3rd quarter. Fixed networks saw a reverse growth from 267,432 access lines in the 3rd quarter to 267,389 lines, representing a negative growth of 0.02 percent. Clear indication of preference for the cellular to fixed phones.

Technology Assessment Project (TAP) of the University of Ghana, Legon, took a study tour of Moree in the Central Region with particular focus on its fishermen. It was established that the fishermen use mobile phone to communicate with their agents and customers from various parts of the country to find competitive prices. But one of the most significant mobile phone initiatives in Ghana is Busylab's TradeNet or eSoko platform which leverages on the mobile networks and their extensive coverage. It uses basic mobile phone features and the web. Enterprises and producer associations can use TradeNet's mobile service to send out SMSs to their customers, suppliers and members at a fraction of the cost. Messages sent out could include information disseminated on weather, disease alerts and extension services among others. With a database full of profiles, Busylab is also marketing services to companies that can advertise to previously inaccessible groups, reaching even the most remote smallholder farmer. The CiCs do not offer any of such assistance.

Additional developmental usage of cellular phones have been noted by Jeremiah Sam & Kwami Ahiabenu, II of penplusbytes.org, in their article titled 'Ghana's Competitive Mobile Market Spurs Multiple Apps,' March 2010, that a number of financial institutions are offering mobile financial services, which are expected to attract a huge amount of liquidity held by Ghanaians currently operating outside the banking system. MTN Ghana pioneered mobile money transfer in 2009, and other players are getting into the act. For example, Afric Xpress has introduced txtnpay, a system for remittance, paying bills, buying mobile prepaid airtime, checking bank balances and paying for goods and services. Rhukaya Adams, a sales agent at txtnpay, says that a lot of people use this system to pay their cable television bills. Indeed, most banks are now enabling clients' access to their bank accounts through mobile phones. The Ghana's Ambulances Service Directorate reports that in some parts of rural Ghana, mobile phones have helped to drastically reduce childbirth-related mortality among women by creating a communication channel between patients and health care institutions in other locations, the article added.

Regardless of whether an area is urban or rural, the value that will attract lower-income customers consists of affordable connectivity. From the consumer's point of view, connectivity means a handset and a service.

Stand-alone access centres or CiCs for instance, are difficult to maintain in rural areas and tend to have limited market demand, with the exception of phone services. This also means that, even when externally supported, they tend to have limited use and impact.

4. Conclusion And Suggestions

Research carried out for the World Bank (id21, 2007), in 24 sub-Saharan African nations, found that 57% of people were within range of a mobile signal and that a further 40% of the world's uncovered population could be served with $3 billion of market-led investment by 2015. Only the remaining 3% would require government intervention, through a subsidy of $2.1 billion (World Bank, 2007)

E-governance applications, through ICTs, represent a mechanism for delivering services more directly to poor people and for poor people to provide feedback. However, since poverty dominates most rural parts of Africa and there is the lack of access to information, knowledge, and skills that could improve earnings and lift them out of poverty, more innovative solutions should be found to enable them have interactive communications.

A way out could be leapfrogging fixed infrastructure and leveraging existing wireless infrastructure which Village Phones in Bangladesh and Uganda for instance offer. This is a viable strategy for increasing teledensity in developing countries and helping the poor lift themselves out of poverty. Another project, RASCOM, seeks to cover over 80,000 African villages, providing coverage to 80 million rural Africans. The CTO's Commonwealth African Rural Connectivity Initiative (COMARCI) is expected to assist in improving ICT connectivity in 18 African countries with the use of mobile telephony.

The ability to connect everywhere at anytime by a majority of citizens is what is important. Even the best technology and carefully crafted plans will fail unless there is sufficient education and awareness about the initiatives, capabilities, and expected responsibilities of the evolving landscape.

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m-Governance …Leveraging Mobile Technology to extend the reach of e-Governance

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Abstract:

m-Governance is not a replacement for e-Governance, rather it complements e-Governance. e-Governance is the use of information technology like WAN, Internet and mobile computing by Governance agencies, to transform private businesses and public agencies, as well as to empower the citizens. m-Governance, on the other hand, is the use of mobile or wireless to improve Governance service and information "anytime, anywhere". Mobile applications also rely on good back office ICT infrastructure and work processes. This paper shares the potential of using mobile phones as input devices in certain areas where last mile connectivity becomes issues for simple data inputs of critical importance for decision making in government departments.

Index Terms – Mobile Governance, Last mile connectivity, Simple data input devices.

1. Definition & Introduction

M-Government is part of a broader phenomenon of mobile-enabled development or leveraging the mobile revolution to enable development impact. It takes electronic services and makes them available via mobile technologies using devices such as mobile phones. These services bypass the need for traditional physical networks for communications and collaboration. M-Governance is a sub-domain of e-governance. m-Governance has the possibility to extend the reach of e-governance. e-Governance is the use of information and communication technologies (ICTs) to improve the activities of public sector organizations. m-Governance has the potential to help make public information and governance services available "anytime, anywhere" to citizens and officials. Mobile services are cheaper as well as accessible in most of the rural areas in India and/or Asian countries.

M-Governance is particularly suited for the developing world where Internet access rates are low but mobile phone usage is growing rapidly in both urban and rural areas. Globally, the number of mobile phones has exceeded the number of fixed/wired phones. This is also the case in many individual nations, including 49 middle-income and 36 low-income countries. This list also includes India.

2. M-Governance & e-Governance

m-Governance is not a replacement for e-Governance, rather it complements e-Governance. e-Governance is the use of information technology like WAN, Internet and mobile computing by Governance agencies, to transform private businesses and public agencies, as well as to empower the citizens. m-Governance, on the other hand, is the use of mobile or wireless technologies like cellular phones, laptops, and PDAs with wireless Internet connections to improve Governance service and strengthen people "anytime, anywhere". Mobile applications also rely on good back office ICT infrastructure and work processes: Governance networks and databases, data quality procedures, transaction recording processes, etc. But it is just the tip of an iceberg: just the final delivery channel to the citizen. Underneath is a complex infrastructure that is required in order to make that final delivery device work. Mobile growth statistics are now showing an increase of 60 to 80

lakhs per month in case of new connections and it is estimated that there are around 52 crore mobiles used in India as on December 2009.

3. Models & Examples

m-Governance is not a new concept. The **private sector** has been greatly leveraging the use of mobile phones for delivery of value added services for the following which however are mostly SMS based:

- **Banking**
- **Media**
- **Airlines**
- **Telecom**
- **Entertainment**
- **News**
- **Sports**
- **Astrology**
- **Movie Tickets Etc.**

We have also seen a few initiatives in Government sector using mobile innovatively which again are all SMS based:

- Food & Civil Supplies
  - Tracking Lorry Movements
  - Information on availability of Ration at FP Shops
- Irrigation / Water Resources
  - Reservoir Levels monitoring
- Urban Local Bodies
  - Grievance Redressal
  - Garbage dump removals
- Water Supply
  - SMS a water tanker
- Railways
  - Ticket Booking
- Examination Results and Mark Lists
- Agriculture
- Weather Reports, Market prices, seed availability etc.

International initiatives…a few examples include

- M-Dubai – 4488 – Push & Pull service
  - Civil Aviation – Flight timings
  - Police – Fines
  - Notification of Expiry of Trade Licenses etc.
- Singapore
  - Trade Licenses
  - CPF contributions
  - Road Tax Renewal
  - Passport Renewal
  - Government notifications
  - Consumer Price Index
  - Performance of the Singapore economy
  - Court Hearing
  - Track Traffic Information
  - Live traffic images
  - Public Works monitoring etc.
- Estonia
  - Mobile Parking
  - Mobile Transport Ticketing
  - Mobile Payments in Shops.

- South Africa
  - Cell-Life Update: Using Mobiles to Fight HIV/AIDS

- Disease Surveillance with Mobile Phones in Uganda

- Other initiatives
  - Emergency services
  - Traffic Information
  - Payment of Government fees
  - Child's Absence from School

Courtesy: mobilemonitors.org, www.praxis.ee

Other examples include Police department where wireless technology has always been an important part of law enforcement. In India, the Chennai City Traffic Police introduced a SMS service and a caution system for those violating traffic rules. "Through the SMS service, the public can inform the traffic control room about traffic accidents, vehicle breakdown and traffic jams". Also, the public can get detailed information before buying a particular vehicle that might have violated traffic rules by just sending an SMS with the registration and engine number of the vehicle.

Health and safety inspectors can now file their reports from the field in real time using mobile or handheld terminals, eliminating paper forms and the need to re-enter the data collected when they get back to the office.

m-Governance is not only about efficiency but it also allows for citizen activism. In the Philippines, citizens are able to help enforce anti-pollution laws by reporting smoke-belching public buses and other vehicles via SMS. SMS is also being used to get citizens involved in the fight against crime and illegal drugs.

4. M-Government Adoption: Mobile / Wireless Applications in Government

m-Government can be applied to four main purposes in the public sector, as summarized below:

4.1 m-Communication (G2C2G)

Providing information to the public is not a trivial activity. It is the foundation of citizen empowerment. Without relevant information citizens are unable to form intelligent opinions and, thereby, are unable to act on the issues before them meaningfully. Mobile devices provide an important access channel for governments to reach citizens (G2C). For example, Singaporeans can choose to receive SMS alerts for a variety of e-services such as: renewal of road tax, medical examinations for domestic workers, passport renewal notifications, season parking reminders and parliament notices and alerts. Citizens of Malta can register to receive SMS notifications of court sitting/hearing deferrals, license-renewal, exam results, and direct credit payments from the Department of Social Security. In the UK, the London police have included text messaging in their alerting service options. This service sends alerts to businesses in London about security threats, including bomb alerts. The 24-hour service contacts all users in real time with a message that is sent within 30 seconds of the alert being received by the police. Despite a monthly fee for the pager/text message service and the existence of a free email service there are more businesses that signed up for the pager/text message alerts (1,121 firms in total) than for the email alert system (589 firms). Such figures indicate the popularity of m-government services.

Aside from these opt-in G2C communications via mobile phones, SMS is also being used in emergency broadcasting. At the height of the SARS incident, the Hong Kong government sent a blanket text message to 6m mobile phones in a bid to scotch fears emanating from rumours about intended government action to stem the disease.

SMS is also a channel for citizens to communicate with government (C2G). In the Philippines, half of cabinet agencies have SMS-based services that allow citizens to ask for information or to comment and complain about government officials and services. In China, the 150 million mobile phone owners can now send SMS to the 2,987 deputies of the National People's Congress.

4.2 m-Services (Transactions and Payments)

SMS and other mobile devices not only provide a channel of communication between citizens and government, they also enable government-to-citizen transactions.

The Singapore government has decided to leverage the power of SMS for its goal of increasing population. Its Social Development Unit acts as an official dating agency for educated single people. It gives members 40 free messages over their mobile phones to allow them to contact eligible professionals. Singapore's National Library Board has also introduced an SMS service that allows regular users to query the status of their accounts and books borrowed, and receives reminders before the due date of their book loans. They can also undertake transactions such as making book renewals or paying fines using their mobile phones. The service costs each user $5 per year.

Other examples of the potential for the technology can be taken from industrialised countries:

- Norway's tax collectors have introduced SMS tax returns. Taxpayers who have no changes to make to the form they receive in the post can now simply send a text message with a code word, their identity number and a pin code instead of returning the form by mail. This new service benefits the estimated 1.5 million Norwegian taxpayers who normally return this income tax form by mail.
- In Finland, SMS tickets can be used for Helsinki's public transport system. These tickets can be ordered by sending a text message and the user is billed through his or her regular mobile phone bill. The ticket itself is also delivered to the commuter by SMS.

While the use of m-payment in e-Government is still limited, it is expected that as mobile payments systems evolve from simple payments for digital content and services to complex integrated handset, bank and operator payment. Its use for transacting business with government will also grow.

4.3 m-Democracy

Use of SMS and mobile devices for citizen input to political decision-making is an m-government application with tremendous potential to enhance democratic participation. At present, there are no significant experiments with m-democracy in developing/transitional countries, so evidence here is taken from experiences in the UK. Most of the UK experiments with electronic voting, including voting via mobile phones, are meant to discover more convenient ways to involve citizens in political decision-making.

Several concerns would have to be attended to before voting over mobile phones gains widespread acceptance. Questions of security and secrecy are top of the list. With the traditional voting method it is sufficient to present oneself at the polling (voting) station. An m-voting system has to ensure that the message sender is a registered voter, and that no-one abuses the system to vote more than once or vote in place of another person. Voters in Liverpool and Sheffield in May 2002 local elections were given PIN numbers to use if they want to vote by text message.

Another issue is to make the system as user-friendly as possible. If PINs are used, chances are many would forget their PINs if they are too long. Then there is the problem of using a phone keypad to key in parties or candidate names. Finally, the voting procedure itself must allow voters at any stage to repeat the instructions and choices. In addition, the capacity of the system would need to be sufficient to deal with peak periods because congested telephone lines are as frustrating as long lines in the polling stations.

However, these are 'technical' issues that may not be as difficult to overcome as voters' willingness to use mobile phones and SMS to vote.

4.4 m-Administration

m-Government also provides opportunities to improve the internal operation of public agencies. Again, there are few instances of such applications yet in developing/transitional economies.
Another potential for wireless technology is that it may provide a seamless environment for government employees to stay connected from any device. Up-to-date government-to-employee (G2E) information and services can be provided at any time, whether the data they need is on the Internet, on their network, or on a portable device under their control.
The other potential usage for m-Administration include:

- Health
  - Monitoring Progress – NRHM
  - Telemedicine
- Irrigation / Water Resources
  - Capturing Reservoir Storages
  - Monitoring Releases of water through Sluices
  - Monitoring Minors and sub minors area under a given Canal
- Electricity Board
  - Citizen Grievances
  - Bill Collections
- Public Works Monitoring
- Urban Local Bodies
  - Citizen Grievances
  - Bill Collections
  - Garbage Collection

5. Impact Of M-Government

An examination of a number of mobile government applications within various countries

shows that mobile business applications may not be easily applied to governmental administration, yet there are compelling reasons for doing so. Is it unreasonable for citizens, for example, to expect technology-enabled services from their government similar to the services available to them from private sector organizations such as airlines, banks and utility companies where flight reservations, currency exchanges and bill payments are now possible without human intervention? As such, there is an increasing need to introduce mobile technologies for governmental organizations. Mobile Government is one of the new and important developments in e-government. The high rate of mobile phone penetration opens a new channel for governments to reach their citizens fast and provide timely information to them. The features of mobile technology to be accessible anywhere, anytime make that possible. The promise of e-government to provide greater access to government information is progressing in many developed countries as the infrastructure is not a big issue and the adoption of e-government seems to be at a good pace. In contrast, the e-government adoption rate in developing countries is relatively lower. This may be mainly due to the lack of technical infrastructure in supporting government's efforts, as well as such factors involving cost of getting an Internet enabled PC, and ability of citizen's learning and accessing e-government applications: "readiness for adoption of e-government". Among others, such factors involving the readiness contribute largely to slow rate of Internet penetration in developing /under developed countries which subsequently may lead to e-government adoption problems. However, more and more mobile telecom operators are being active in developing countries and the demand for mobile phones is increasing continuously. The cost of owning a mobile phone is much cheaper than a computer with internet connection and the learning how to use a mobile phone is also simpler. The demand is huge, and so are the opportunities for the governments to reach the ever expanding network of citizens around country. A unified information campaign could be launched by government to advertise all its SMS- based services, will raise people awareness and use of these services. There is need to enhance the electronic linkages among offices within an agency and among government agencies.

5.1 m-Government in emergency situation

The Italian Ministry of Foreign Affairs, during the aftermath of the Asian Quake, sent a SMS to Italians located in the struck area. The message was: "Answer indicating your identity, health status, and place where you are". With approximately 15000 SMS the Ministry tried to trace Italian citizens who faced the disaster. According to official information, several hundreds replied helping the embassy and rescue teams to list affected people in the Tsunami area. The Italian Government obtained the list of people located in struck area from phone companies that provided the information based on the international roaming services. This is a real life example of how m-Government can help in such a situation.

According to the National Oceanic and Atmospheric Administration's center in Hawaii, the earthquake was detected and a warning about the approaching tsunami was sent to the Pacific Tsunami Warning Center. The reason that the warnings were unable to reach the millions in the disaster region is because none of the countries had a working tsunami-warning network.

The crucial part is the coordination among the technology experts, governments, and emergency response agencies not only in the tsunami hit region but all around the globe. Along with tidal gauges and sensors in the ocean, a well organized communication system, a well understood emergency preparedness, and training of resort operators, fisherman and public in general are at hand.

Mobile applications in disaster management will be one of the most useful and critical areas of implementation. It will be useful not only for the prevention activities such as mobile alerts but also an invaluable tool for the recovery efforts of, for example, rescue team working in the fields.

It is true that the system absolutely rely on the wireless communication channel that is not widely spread in several countries. Or some might give the fact that in Aceh right after the earth quake the all communication channel went down. But for prevention and life saving purposes, such system may give significant difference. The system should also be socialized to the public continuously so they can trust the information sent by the government.

In villages people are more comfortable with their local language so mobile application with local language support will add value to the efforts taken for m-Governance and increase the number of citizens to avail the benefits of m-Government. By leveraging the technology and mobile government implementation, there is a hope that in the future the impact of disasters can be lessen and more lives can be saved.

6. M-Government Benefits And Challenges

m-Government can bring potential benefits for the public sector, but it also faces challenges, as discussed below.

6.1 Benefits

The main benefit that m-government brings is its boundary-breaking potential: truly allowing working on an anywhere, anytime basis and helping to create a truly integrated digital nervous system for government. Because of its immediacy and convenience, it also reduces the barriers to public service operations, encouraging citizens or service providers to make use of the technology where previously barriers were discouragingly high.

These core benefits can be seen reflected in a broader set of m-government benefits, including:

Increasing the productivity of public service personnel: m-government allows public servants to enter data into digital systems exactly where they are in the field. Not only does this move data-gathering closer to real-time operations, it also reduces the time public servants spend on data activities, thus releasing more of their time for value-added, service-related activities. For example, where previously reports would be noted on paper in the field and then retyped back at base, they can now be entered direct, not only removing duplication of effort but also reducing the number of data errors. Increasing the effectiveness of public service personnel: public servants in the field currently have to make do with the data they carry around with them – in their heads or in portable files. With m-government, they can take the whole of digitised government with them into the field, allowing them to make much better-informed decisions and actions.

Improving the delivery of government information and services: m-Government can deliver data and services whenever and wherever the citizen is. This has a benefit to citizens – they can get immediate access to whatever they want no matter where they are. It also has a benefit to governments – for example in sending terror alerts or other very time-sensitive information, m-government provides the greatest chance of getting through quickly and directly.
Increasing channels for public interactions: m-government (where not used to substitute for other channels) provides an additional channel for interactions all stakeholders in governance – service deliverers, policy makers, service consumers, civil society representatives. This provides greater choice.
Lower costs leading to higher participation: the hope in relation to the political process is that, by reducing the time and effort of communication, m-government will encourage more communication, from e-voting, to contributions to political debates, to complaints or queries.

6.2 Challenges

mGovernment does face a number of challenges:

6.2.1 Cost: m-government tends to be yet one further channel for e-government, in which case it will create additional costs. This will continue until m-government can truly substitute for other delivery channels. Such substitution will be viable for applications within government. At least some governments have been able to adopt innovative costing strategies, for example, using fee-sharing arrangements that avoid the public sector having to provide many up-front costs.

6.2.2 mDigital divide: as just noted, not everyone has a mobile phone. In particular, older and poorer groups in society tend to be excluded from this technology. If there are benefits to be had from m-government, these groups will be denied them, and a challenge to m-government is to ensure it is not just one more way in which the "haves" benefit at the expense of the "have nots".

6.2.3 Mobile mindsets: mobile devices – cell phones particularly – are seen by many as tools more for fun and entertainment than for serious activities. Yet politics is a serious business involving difficult choices. Aligning these two mismatched worlds may be difficult. One sign already emerging of this underlying tension is the use of m-government systems for playing pranks, such as hoax messaging, encouraged by the anonymity that many mobile devices (which are often unregistered) offer.

6.2.4 Trust/security: if m-government is to encompass m-payment systems or other transactional public services, then it must have good security and must be trusted. As yet, there is still a credibility gap to be crossed for many mobile device users.

6.2.5 Data overload: mobile devices increase the pressures of a world in which users are permanently connected: "always on". These permanent connections increase the number of messages circulating and can create a blizzard of communications – some valuable, some not – in which public service communications can come to be devalued or lost.

7. M-Government Guiding Principles

Some guiding principles as discussed below.
Firstly, recognise that m-government is not a substitute for e-government. Not all applications can run on mobile devices nor should they. Not all wireless connections are cost competitive compared to wired connection.

m-Government should be conceived and developed as part of the overall e-government strategy and programme. The exact mix of m-government and traditional e-government applications depends on the unique conditions of each country. An important determinant would be the state of the nation's information infrastructure. It is easy to build expectations but difficult to regain trust. Citizens who are turned off by their experience with m-government are not only harder to lure back but will also bad mouth it to other.

Thus it is important to:Choose m-government applications wisely. Make sure they are non-trivial but also be careful that they are not the most difficult. Make sure that the application is user-friendly. Balance your need for information with the comfort (or frustration) level of the user with the technology.

In deploying m-government applications ensure that citizens get exactly what the application claims to be able to deliver in the shortest possible time. If it is a channel to receive complaints, be sure to regularly get back to the complainants about the status of their complaint until it is resolved. Boiler plate messages will not satisfy your citizens. Ensure that there are suitable back-office systems in place to deliver on m-government

promises. Partnerships, particularly with telecommunication companies (telcos) offering cellular services, matter. Telcos bring to the table greater knowledge about security, reliability, ease of use and affordability issues related to mobile applications.

Ensuring Entitlements to Poor: MERComs Mobile Social Audit Application

Vijay Pratap Singh Aditya, Rohit Magotra, K Sasikumar, Mansingh Durga Prasad Nayak

Abstract:

Poor governance and lack of monitoring mechanism leads to poor delivery of social welfare programme to poor populations across developing countries. Lack of infrstructure and corruption further compounds the problem, endangering livelihoods security of poorest people depending on welfare programme entitlements for survival. The paper details about Monitoring Entitlements for Rural Communities (MeRComs) mobile phone based monitoring system for social audit which allows tracking of delivery of entitlements to rural poor.

1. Introduction

Poor governance and lack of monitoring mechanism leads to poor delivery of social welfare programme to poor populations across developing countries. Lack of infrastructure and corruption further compounds the problem, endangering livelihoods security of poorest people depending on welfare programme entitlements for survival.

Despite double-digit growth, global takeovers by Indian firms, India continues to be home to one third of the world's poor. It is the world's second most populous country, ranked 128th out of 177 countries on Human Development Index, with an estimated population of 1.15 Billion in 2010. According to UNDP, 25% of these 1.15 billion people live below poverty line and in terms of absolute nos. it is a staggering 325 million people. It boasts the dubious record of having one of the highest infant mortality rates and maternal mortality rates in the world. On top of this 2.2 million infants die every year from preventable causes (one fifth of global child deaths).

Women's Organization for Socio Cultural Awareness (WOSCA) has been working with tribal and marginalized communities of some of the poorest districts of Orissa. WOSCA visualizes a society full of peace, joy and happiness where there will be no poverty, ignorance, diseases, suffering, hunger, exploitation, injustice and which will be saturated with solidarity, integrity, fraternity, non-discrimination, brotherhood and prosperity.

WOSCA is involved in social audit process in four Gram Panchayat's (GPs) where women Self Help Group (SHG) members are exposing corruption in MGNREGA implementation to a greater extent. With an objectives to strengthen the grassroots governance WOSCA is involved in capacity building of Panchayat Raj Institutions (PRI) members on their roles and responsibilities to make more accountable to people. Leadership training to PRI members, MGNREGA facilitation and model GP facilitation are the ongoing capacity building program of WOSCA.

The poor people living in the WOSCA's project area identified for monitoring delivery of entitlements is unorganised, are deprived from legitimate entitlements and that leaves them in a very disadvantageous position in developing themselves and no bargaining power whatsoever. Due to lack of education and outside exposure they had the tendency to accommodate with all sorts of exploitation and are suffering without putting any resistance & efforts to improve the situation. To raise their voice against corruption they were lacking information and knowledge.

To empower the poor and women both socially and economically, WOSCA undertook awareness drives, provided hand holding support to people in getting information through Right to Information (RTI) from block offices, facilitate social audit process, used community media for exposing corruption. Owing to its efforts Public Distribution System (PDS) and MGNREGA work have been streamlined in two GPs and 1478 House Holds (HHs) are getting all benefits regularly. Information sharing is taking place among village institutions in a regular manner. This prevents corrupt people to enter in the development activities. This also prevents block officials from doing malpractices in development works. Due to RTI campaign 26 Indira Awas have been completed in Purumunda and Pandapada GP of Ghatagaon block which were pending since 2005 and the final bill was taken by contractors. 128 people in this GP got back their Job cards, which were kept by Panchayat, and more person days were entered against real working days.

Concern Worldwide, an international NGO headquartered in Dublin, has been working in Orissa through its country office in Bhubaneswar since 2002 on improving the lives and livelihood of the poor and marginalised. Its partnership with WOSCA dates back to 2003. The Tracking Entitlements project was supported by Concern Worldwide in August 2008 under its Governance and Livelihood programme as an endeavour towards achieving its strategic objective of informing and empowering the poor. The project presently is looking at exploring options for a revenue model by expanding the services and geography of the project.

2. Project Location

The project was implemented in Banspal and Ghatagaon blocks of Keonjhar district in northern Orissa bordering Jharkhand. Although the district has very rich mineral reserves with huge deposits of iron ore, it still remains one of the most underdeveloped districts of Orissa. It has a large tribal population constituting 44.52 percent of the total population of the district. While vast majorities of the target population lives below the poverty line (76.96 percent), the literacy rate of this district is 44.73 percent, which is low in comparison to most of the other districts of Orissa. A majority of the population depends on agriculture and forest produce as their major source of livelihood. Since the earning from these sources is inadequate to meet both the ends, seasonal migration and sometimes cases of acute starvation are common phenomenon among these communities. Ghatagaon and Banspal blocks are the two most backward blocks of Keonjhar District. Banspal block spreads over a geographical area of 1191.07 sq. km. and consists of natural dense forest and hills. Ghatagaon block is spread over an area of 547.29 sq. km. Both these blocks are home to a large tribal population, of which more than 80% live below the poverty line. The tribal population includes Bhuiyan and Juanga, which have the status of Primitive Tribal Groups.

The project is a first of its kind initiative where mobile technology has been used to monitor the entitlements of the rural communities. In the initial years there are some benefits that the communities have been able to get. The benefits that can accrue from this initiative is future is huge but the whole system has to be tested for a longer duration for its accuracy and most importantly whether it will result in ensuring entitlements to the marginalised. The two blocks were selected because WOSCA and its two other partners Centre for Youth and Social Development (CYSD) and Prakalpa, have been working there since long, in partnership with Concern Worldwide India. All organisations also have ongoing initiatives in the area, which are working towards ensuring rights and entitlements to the rural communities through community mobilisation. All partners have good knowledge and understanding of the area and good field presence to follow up on issues, which the mobile tracking outcome bring out with local officials in administration.

3. Problem Statement

The project too whole village as the development unit and all the persons being covered or were eligible to be covered under the MGNREGA, Public Distribution System (PDS) and Pension schemes are considered part of the target group. However, the project laid special emphasis on the vulnerable households especially those who were not getting the basic welfare facilities and lack bargaining power to demand the same from government. The project laid strong emphasis on addressing the needs of the women and landless poor towards their empowerment.

As is clear, a large majority of the population comprises tribal and Dalit groups who are living a life of insecurity and are barely able to make two ends meet. They depend only on agriculture and forests for their survivals and at times with any failure of the crop, which is largely rain fed, their lives is at stake very often. There are no savings or alternative resources to fall back on and wage labour is available in some seasons but at very exploitative terms and conditions. The problems of the poor and the marginalized have not gone unnoticed by the government in India and there have been many schemes and programmes, which if implemented properly could have resulted in bringing about significant changes in the lives and livelihood of these people. The major programmes are:

Public Distribution System

The Public Distribution System (PDS) in India evolved as a system of management of scarcity and for distribution of food grains at affordable prices. Over the years, PDS has become an important part of Government's policy for management of food economy in the country. PDS is operated under the joint responsibility of the Central and the State Governments. Under PDS presently the commodities namely wheat, rice, sugar and kerosene, are being allocated to the States/UTs for distribution. The families living below poverty line are entitled to 16 kgs of rice every month @ Rs. 4.75/kg and an additional 9 kgs is available @ Rs.6.30/kg. Under the Antyodaya scheme the poorest of the poor households, which includes all primitive tribal groups as well as some other categories fully, are entitled to 35 kgs of rice every month @ Rs. 3 / kg. These are highly subsidized prices and if the implementation is proper, it can provide a big relief to the poor.

However it is observed that the programme lacks proper monitoring and updating of records and some populations though entitled do not get access to PDS services. Distribution of PDS supplies and products is also an issue, besides corruption, delays and procedural bottleneck act as hindrance for provision of this entitlement in time to the beneficiaries. Sometimes even after allotment the material finds access to black market and is not received by beneficiaries. Government of India has officially recognized that in some states PDS corruption is upto 90%.

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)

Mahatama Gandhi National Rural Employment Guarantee Act (MGNREGA) ranks among the most powerful initiatives ever undertaken for transformation of livelihoods in rural India. The MGNREG Act guarantees 100 days of employment to all rural households and is a demand driven programme. The radical provisions of MGNREGA signal the possible inauguration of a new chapter in rural governance. But a radically new programme also makes dramatically new demands from the system. A bureaucracy that has its hand full with a whole host of pre-existing responsibilities can hardly muster the imagination and energy required by MGNREGA.

The scheme in spite of having exemplary transparency measures has suffered on many counts. The problems include - Job cards are not handed over to the people, muster rolls are fudged, false entries made in the job cards, delayed payments, pending work applications, continuing hold of contractors and many more. Orissa has been in the

limelight on MGNREGA for both the wrong and the right reasons. It is one of the two states where people have been paid unemployment allowance and it is also the state where according to an independent study almost 70% of the Rs. 7.3 billion spent under the scheme in 2006 – 07 was allegedly siphoned off by a corrupt system.

Madhu Babu Pension Yojana

There are schemes, which provide support to the old aged, differently-abled, widows, HIV infected and their widows in monetary form every month. The Orissa government, in 2008 beginning, brought all the pension schemes under one scheme called "Madhu Babu Pension Yojana" which provides Rs.200 every month to all the eligible persons. The scheme has had its share of implementation problems and many destitute persons have not been getting their entitlements. Problems include persons eligible but not on the official, persons on the official list but not getting their pensions and irregular and improper payments.

Causes of Problems

There are a number of reasons for the continued failure of the government programmes including the above-mentioned three programmes but the experience over the last two years has shown that the main factors are:

- Lack of awareness amongst the poor of their entitlements and benefits from the different government schemes, programmes and services. It is often in the interests of the government officials to maintain this level of ignorance.
- Lack of accountability of public officials and little pressure on them to perform and deliver. Monitoring and evaluating the performance of public servants is virtually nil. People lack information and confidence to challenge the government and government officials lack the political will to improve performance.
- Corruption is rampant and in many cases is institutionalized; it occurs at all levels and each official will be expected to take their cut leaving very little for the intended beneficiaries. In Orissa in 2006/07 it was estimated that out of Rs.7.33 billion spent under MGNREGA, around Rs. 5 billion was siphoned off by government officials.
- Inadequate Corrective Measures - Most efforts to improve delivery of services have focused either on the supply side (structural or public sector reforms) or have been post facto events (audits, enquiries and commissions) both of which have met with only limited success. Whilst post facto audits can contribute to improving the efficiency of delivery by pointing out gaps and bottlenecks (as well as at times implicating individuals), these reports are very rarely accessible to the pubic and certainly not accessible to the illiterate rural poor. There is often very little political will or public pressure to address the failures identified in the enquiries, audits, commissions meaning that there is little done to really change the system or root out the corruption.

4. Solution to the problem: MERComs

In order to capture actual information and generate a live database for a real time tracking of the entitlements of the rural communities it is necessary to develop a mobile phone enabled Management Information System (MIS). WOSCA, CYSD and Prakalpa with support of Concern approached Ekgaon Technologies for evolving the working model and provide the technology support for the project. Ekgaon developed an open-framework for a modular, Management Information System (MIS) for rural service and information delivery. MERComs MIS framework developed by Ekgaon allows central tracking and monitoring of rural entitlements programmes and its status through decentralized field based monitoring units and partners. The solution informs and empowers the people to capture information in real time and push for corrective measures, thus ensuring rights of the people.

5. Technology Framework

The MERComs framework provides a way to efficiently aggregate data from paper-based records in the field using mobile phones. The mobile phone has been described as the most likely modern digital device to support economic development in developing nations[10]. Several of its features (battery operation, solid-state memory, wireless connectivity, affordable price) make it a better-suited device for rural developing world conditions than a conventional PC. The lower cost of wireless infrastructure, deregulation in the telecommunications industry and the plummeting cost of handsets is putting mobile telephony in the hands of billions of people around the world.

Mobile handset models developed by several manufacturers provide an open application development platform and significant computing capabilities. However, current mobile software platforms are difficult to use, to develop for, and make the assumption of ubiquitous connectivity. MERComs is a framework for developing and deploying mobile based systems for monitoring tracking of rural entitlements.

In many rural places, wireless connection is not available. Using SMS, MMS and other SMTP-based methods, MERComs application is able to communicate asynchronously. Whenever data is collected, the SMS is cached in the phone's outgoing message queue. The message will automatically be sent when the phone gets connectivity (for example, when the field officer returns to the highway on her/his way to the next village). When the server receives the SMS, it sends back the appropriate response also as a message. The phone will automatically download the message when it is connected. The code for the application is cached on the phone for offline use. Application data is also stored in the phone's local memory, which serves as a cache of the server database.

MIS for MERComs is a modular, expandable and localized (in English, Hindi, Oriya) Management Information System (MIS) for NGOs, INGOs and volunteers for monitoring rural entitlements. MERComs MIS allows central tracking and monitoring of rural entitlements and its status through decentralize field based monitoring units and partners.

Features of the MIS for MERComs

The MIS monitors entitlement of the rural communities as given through identified government programmes to reduce corruption and increase access to services who have not been covered under the programmes due to access of "updated" information. The sub-modules for tracking and monitoring progress of various programmes are:

Mobile Data Entry Screens

The system captures the transactions, payments, status, availability, value etc. which stands as evidence for the delivery made respectively from / to the entitled members.

Sub Module I: Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA)
Sub Module IIa: Old Age Pension
Sub Module IIb: Widow Pension
Sub Module IIc: Disability Pension
Sub Module IId: HIV/ADIS Pension
Sub Module III: Public Distribution System

[10] The real digital divide. *The Economist*, Mar. 2005.

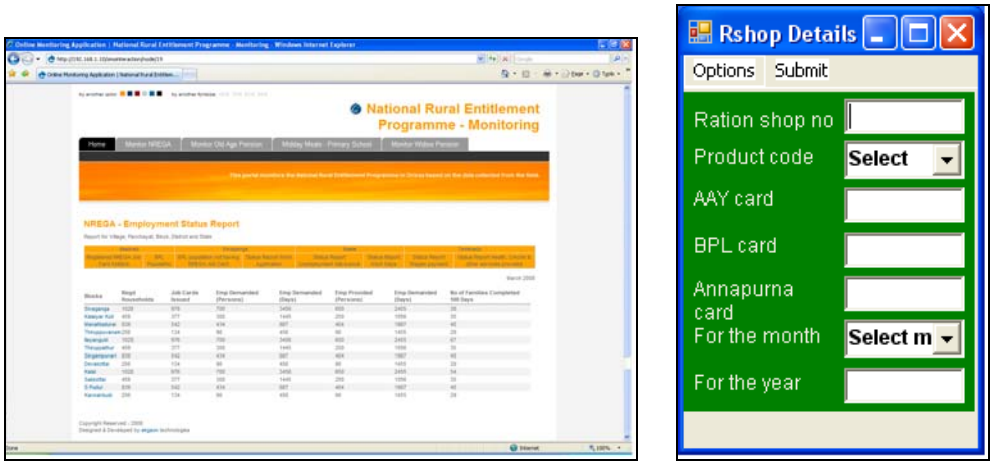

Fig 1-2: Screenshots of MERComs Mobile and MIS application

Figures 3-4: Screenshots of MERComs Mobile and MIS application

Reports

The system has facility to generate wide range of reports for user-defined period and save them as a pdf file, which can be viewed in any version of Adobe Acrobat Reader. These reports are as follows:

Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA). All report for Village, Panchayat, Block, District and State

- Registered MGNREGA Job Card holders
- BPL Population
- BPL population not having MGNREGA Job Card
- Status Report – Work Application
- Status Report – Unemployment Allowance
- Status Report – Work Days
- Status Report – Wages payment
- Status Report – Health, Crèche & other services
- Status Report - Work report as per GP Plan

Old Age Pension

- Registered Old Age Pensioner
- Population Database – Age wise
- Month wise pension status

Widow Pension

- Registered Widow Pensioner
- Population Database – Marriage wise
- Month wise pension status

Differentially Able Pension

- Registered Differentially Able Pensioner
- Population Database – Differentially Able
- Month wise pension status

HIV/AIDS Pension

- Registered HIV/AIDS Pensioner
- Population Database – Diagnosed with HIV/AIDS and dependents of HIV/AIDS
- Month wise pension status

Public Distribution System

- Registered PDS Card Holder and Supply entitlements
- Registered PDS – Distributors and Supply entitlements
- Status Report - Date wise distribution of supplies and quantity
- Status Report – Supply and sale at PDS Centre
- Status Report – Entitlements for various scheme types

6. Project Activities

A. Development of Entitlements Database

- Primary survey information of entitlements of all households under MGNREGA, PDS and Pension schemes of Banspal and Ghatagaon blocks
- Official entitlement lists for the three schemes collected from the two blocks and compared with the primary list for discrepancies
- A database for management of primary and secondary data and integrated with Mobile Phone Enabled MIS

Identified anomalies between the primary and official entitlements lists

B. Real time tracking of MGNREGA, PDS and Pension programmes through a Mobile Phone enabled MIS

- Generation and sharing of status reports on regular basis on MGNREGA, PDS and Pension programmes with the concerned government departments
- Sharing of status reports at individual and community level with the rural communities in the targeted blocks

C. Interface with the Government for ensuring Entitlements

- System set up for timely delivery of entitlements through issuance of alerts to government departments
- Interface of rural communities and concerned government departments organized every month for sharing of status reports and grievance redressal.
- Joint Project Steering Committee at state and district level to ensure follow up action on the status reports' findings

Steering Committees

The real time tracking of entitlements will serve any purpose only if there is corrective action taken by the concerned government departments. Interface meetings are a means of making that happen and the government officials have to closely involve in the whole process through an institutional arrangement. Project Steering Committees are formed at the state and district level to review the functioning of the system, review the progress of the schemes in the two blocks and take steps to address the problems. The committees meet every quarter and review the action taken on the issues raised in the interface meetings.

Liaison and Co-ordination with the Government and other Actors

There has been regular and close interaction with the district administration and the concerned departments, which include the Panchayati Raj Department, Food Supplies and Consumer Welfare Department and the Women and Child Development Department. Regular interaction has also been organized with other civil society organizations to share the experience and take suggestions.

7. Risks and Assumptions

- Government will cooperate fully and adopt this initiative as its own programme
- Community will act on the information provided to them regularly.
- Vested interests will not pose a threat to the field staff.
- The government's close involvement in the programme is must as the risks to the implementing agencies especially for field staff is apparently high.

8. Potential Returns

The project presently benefits 45,000 Households and is covering a population of 250,000. The project aims to cover a population of almost 400,000 people (approx. 72,000 households) out of which 95% are eligible for MGNREGA, almost 70% live below poverty line (BPL) 15% can be classified as 'poorest of poor' and 12% are eligible for pension (old age, widow, disabled, HIV positive)[11]. Taking these numbers and percentages the benefits that this population is entitled to is over 459 million India rupees per annum. Therefore assuming that real time tracking is able to eliminate all corruption and leakage under these three social security schemes the potential return on investment is almost 100 times. That means an investment of 1 Rupee is likely to result in a return of 100 Rupees to a poor family, this simply by getting the system to function effectively.

[11] This is calculated as per the state averages for the geographic locations and population groups that we are proposing to work with.

Advocacy

The poor have suffered as they have little knowledge of their rights and entitlements and lack the collective strength to raise their voices. The project is focusing on informing them about their rights and entitlements and empowering them through regular interface with the government to push for corrective measures. People centered advocacy with strategic inputs at the appropriate levels by the civil society organizations will help in ensuring the streamlining of the selected programmes.

Community Participation

Community is at the centre of this initiative and they are fully involved in tracking their rights and entitlements with the help of information updates shared with them regularly. The interface meetings provide them a space to raise issues and put pressure on the administration for corrective measures. The village level cadre already promoted by the three implementing agencies are closely involved in tracking and following up on the issues.

Rights of Women and other Disadvantaged Groups

The database which has been developed in the project has information down to the individual level which helps in tracking the benefits that are flowing to the disadvantaged groups. The follow up on issues identified through tracking clearly prioritizes the marginalized groups. The Financial Return matrix is as under:

Entitlements	**No. of HHs/Population, eligible under the scheme.**	**Per Household entitlement per year**	**Amount of entitlement per year (Million INR)**
MGNREGA – 100 days of employment @ mini-mum Rs.70/day to all rural HHs every year	45000 (100% coverage of rural HHs)	Rs. 7,000	280
Targeted Public Distribution System – BPL Families get 25 Kg of rice per month at an average price of Rs.5.525 / kg (Market price of same is Rs. 11/kg so there is a subsidy of Rs. 5.475 per kg)	28,000 (70% BPL HHs in the target area)	300 kgs per annum with a subsidy of Rs. 1,642.50	46
Antyodaya Anna Yojana – 35 kg of rice to poorest families per month @ Rs.3.00 per kg, saving Rs. 8 per kg (Market price of same is Rs. 11/kg)	6000 HHs (15% of total Households)	420 kgs with a subsidy of Rs. 3,360	20.16
Madhu Babu Pension Yojana – Pension of Rs.200/month for aged (above 60), Widow irrespective of age, physically challenged person, HIV+ patient	20,000 persons (10% of population including all categories)	Rs. 2,400	48
Total			394.16
In Words	Three Hundred Ninety Four Million Rupees		

9. Impact & Future Plan

MERComs identified discrepancies in records of entitlement delivery, this included 1398 NREGS Job Card held by contractors, 127 bogus PDS cards identified, 19769 Households got their full quota of PDS and 334 differentially able persons identified applied and received entitled pension, while 3962 beneficiaries of pension were identified not receiving benefits by the system and are now receiving pension regularly.

It is clear from the very initial results that the potential gains are massive; the technology can help to ensure the efficient functioning of the system and ensure some of the gains are met. There will also be significant benefits to government in terms of the efficient management of their social security systems, the flow of resources and funds becomes easier to manage, leakage is reduced and inefficiencies removed, under performers would not be able to hide and government can monitor its personnel more effectively. Given the relative simple framework there is a great potential that this pilot can be adopted by the government and scaled up across the whole state of Orissa and other states in India for ensuring social security system deliver livelihood support to populations.

Contemporary Research on Mobile Government

Asiimwe Edgar Napoleon, M. Shakhawat Hossain Bhuiyan

Abstract:

Continuous developments in mobile technology have led to massive acquisition and adoption of mobile devices at a fast pace. The penetration of mobile use is higher in developing countries than that in developed countries. The emerging developments as well as rapid adaptability of mobile technologies have raised research interests in the field of mobile government (m-Government). The aim of this study is to investigate the current status of mobile government research. This study is based on literature reviews. Different terms describing m-Government were used as keywords to retrieve relevant literature published in leading international journals and reputed conference proceedings. Then the main thematic views of each retrieved literature have explored. The papers addressing similar thematic views in terms of contents and contributions grouped in order to compare the research works. It is expected that this study will contribute putting different themes together to show research similarities as well as differences. In-depth examination of the unit of analysis for each article will further articulate the dimension of the research domain. Thus, the study will provide researchers with extended understanding of research trends on m-Government.

Keywords: M-Government, mobile government, mobile e-Government, m-Government services.

1. Introduction

Information and Communication Technologies (ICTs) usages in public sectors emerged in late 1990 as a result of internet boom (Grönlund & Horan, 2005). Practices that involve use of ICTs by public sectors are referred to as electronic government (Heeks, 2006; Trimi & Sheng, 2008). M-Government is one of electronic government practices. Such practices are vital in government services delivery- for example, buying transportation tickets using mobile phones in some developed countries. It is not so long that research community has been investigating vigorously the utilization of mobile technology to foster m-Government initiatives. Hence, as a research domain mobile government is a very young field. In order to explore contemporary research on mobile government, we define the term 'mobile government' and describe some implications in introduction section. Then section-2 describes the method of our study; where selection of contemporary research articles on mobile government domain is described. This section also explains how those articles are assessed or reviewed. Section-3 represents the results and finding based on review and analysis of selected research works and outlines the research dimension and research gap. Finally, section-4 represents the conclusion and recommendation.

Mobile Government or m-Government

Mobile government (m-Government) refers to the use of ICTs by government institutions with the help of mobile technologies to deliver electronic services to the public. This definition is derived from the definition of electronic government because m-Government is its subset of electronic government (Ntaliani, Costopoulou & Karetsos, 2007), which is a new and important development in electronic government (Ghyasi & Kushchu, 2004). M-Government can also be defined as "use of mobile and wireless communication technology within the government administration and in its delivery of services and information to citizens and firms" (Kiki & Lawrence, 2006).

M-Government Services

There are many services that can be offered to citizens through mobile governments. Some of these are:

- M-medicine: delivering health care to citizens with the help of mobile technology
- M-voting: use of mobile technology to participate in electoral processes and participating in democratic reforms
- M-agriculture: use of mobile technology to support farmers by providing updated information on market statistics, weather forecasts, best farming practices and disaster alerts.
- Information broadcasting: use of mobile technologies to disseminate information to citizens.

Objectives of the Study

The main objective of this study is to explore current status of m-Government research. As long as mobile phone growth is increasing, the social and economic implications of m-Government research are becoming vital day by day. According to ITU (2010), the steady growth of the number of mobile phone subscriptions reached an estimated 4.6 billion with penetration of 67% globally at the end of 2009. On the other hand, the share of mobile penetration in developing countries (70%) is higher than that of developed countries. This creates more scope for practicing m-Government in developing countries with limited internet penetration. Wider coverage of remote places, cheaper and easily accessible mobile devices or services and faster adaptation of mobile technology are some of the considerations to promote mobile government with applications or services, ranging from internet services to payment of utility bills, buying tickets etc. But governments are facing several challenges in implementation and diffusion of mobile based integrated services. These challenges emanate either from socio-economic or infrastructure constraints, which have attracted researcher to explore m-Government research domain. Under this situation, the study is intended to investigate contemporary mobile government research to address the following two major research questions:

- What is the current discourse on mobile government research?
- How does contemporary research contribute to mobile government practices?

2. Method

Since m-Government is an inter-disciplinary domain spanning many research disciplines and relevant articles are scattered in different places (journals, conference proceedings, government reports, etc.), it is very critical to choose a representative sample of articles from the research domain. There are several methods to cope with such situation. For example, Andersson & Grönlund (2009) used 'snowball method' to maximize extracting relevant articles. Norris & Lloyd (2006) used a similar method to search more articles based on the bibliographies in the primarily obtained articles. However, none of these methods are sufficient and independent for searching and selecting articles from online databases. Under this consideration, a systematic approach or model was designed (figure-1) combining the search and selection process to select a representative sample of published articles.

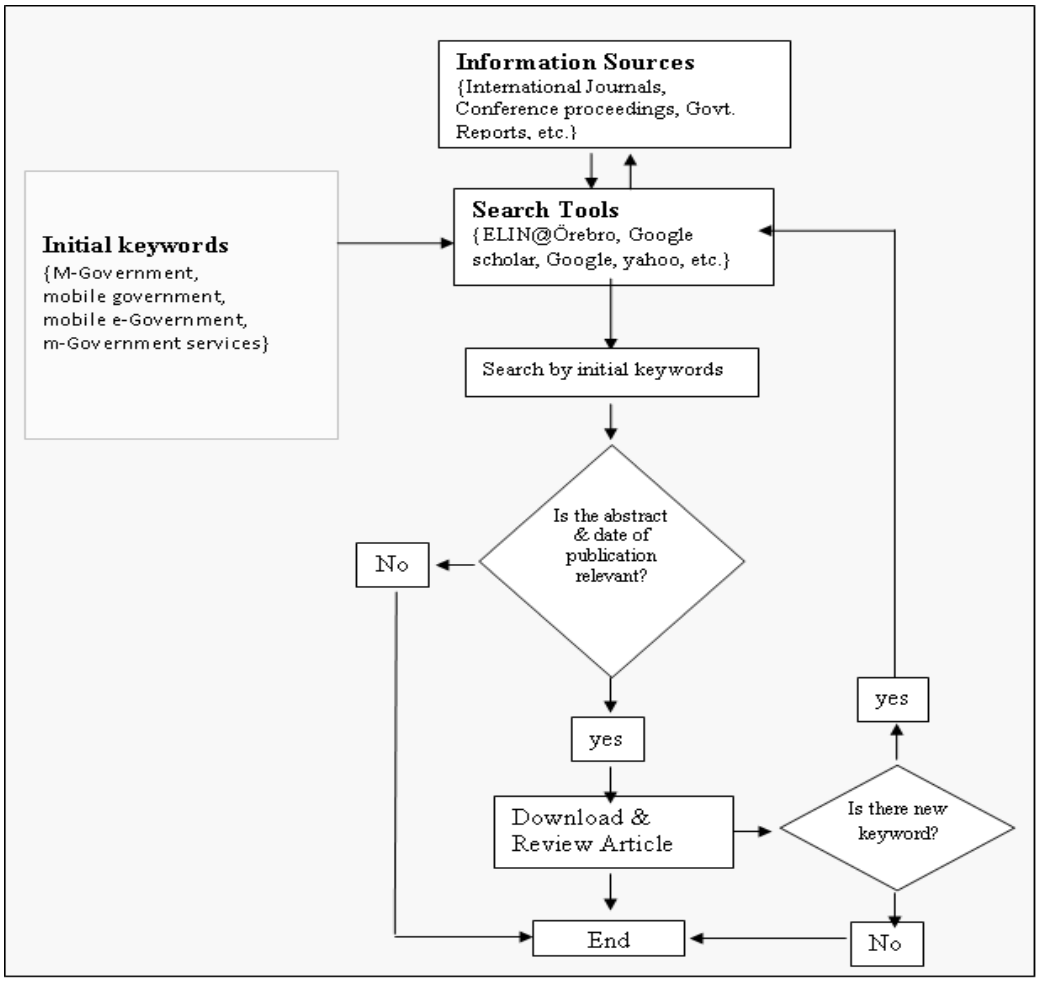

Fig 1: Flowchart Showing Searching & Selection Process of Articles.

In order to retrieve literature, especially the articles, the following primary keywords were used: m-Government, mobile government, and m-Government services. The main thematic views of each retrieved literature are explored. The papers addressing similar thematic views in terms of contents and contributions are grouped in order to compare the research directions.

2.1 Designing the Search Process and Searching Articles

The process of searching articles is an important factor. None of the searching tools (e.g, online library database, search engines like Google, Yahoo etc.) can independently extract all relevant articles from a particular research domain. Therefore, there is necessity to have some systematic process which integrates several searching tools so that relevant articles may not be excluded during the selection process.

Determining the sources (e.g. journals, conference proceedings, etc.) also plays a good role in retrieving the best articles. The prime searching tool for finding articles in this study was ELIN@Örebro, an electronic library information navigator; which is a general search interface of Örebro University Library (http://www.oru.se/English/Library). The tool ELIN@Örebro provides a list of printed and electronic journals from several databases of well-known content providers such as Directory of Open Access Journals (DOAJ) which contains about 2,800 free journals. Some other content providers are Emerald, Sage, Springer, ScienceDirect, Oxford journal, Cambridge journal, etc. The second searching tool used is Google Scholar search engine (http://scholar.google.com) while Google and Yahoo search engines were also used to complement ELIN@Örebro.

The articles and research papers were searched on the basis two criteria. The first criterion was use of key-words i.e. m-Government, mobile government, mobile e-Government, m-Government services to retrieve relevant articles. Secondly, the snowball method was used to search relevant articles. According to snowball method, it is assumed that examining the bibliographies of available articles might provide more new articles. For example, 17 out of 41 selected articles were obtained using snowball method

2.2 Selecting Articles

Selecting relevant articles is always a subjective matter as someone may consider an article as more relevant while another person may not consider so. The systematic approach of selection (figure-1) somewhat guided the authors to avoid subjective selection. On the basis of each keyword (as mentioned in section 2.1) a search tool was used to retrieve articles. As the study focuses on contemporary research, the authors considered articles published in 2001 onwards.

If the title of the retrieved article seemed to be relevant to mobile government, the abstract of the article would be reviewed. If the context of the abstract clearly reflected the research domain i.e. mobile government, then the article would be selected. This facilitated to identify the relevant unit of analysis (i.e., Organization, Group and Individual) of the papers with the research theme as suggested by Webster & Watson (2002). It was found that some of the abstracts were not well articulated and did not clearly reflect the research domain. This called for the authors' in-depth review of other sections of the retrieved papers to identify the research fundamentals. In such cases, some articles could not be explored in-depth as the source database has only the abstract and did not provide full-text article. So we had to abandon those articles. Finally, if the article content seemed to fall under the research domain, it would be included in the list of articles. If the retrieved article contained new relevant keywords, the keywords would also be used in next search. This process was repeated to get adequate number of articles.
Our initial target was to collect at least 50 research articles focusing on m-government published since 2001. We tried to maximize our available resources (search tools) and only a total of 41 research works were finally selected from various sources as mentioned in results section 3.0.

2.3 Reviewing Selected Articles

The contributions of selected articles were summarized according to three thematic areas i.e. "General", "Infrastructure and Implementation frameworks" and "Service delivery, usage and improvement". Since there are several issues like accessibility, digital divide, infrastructure development, service delivery, security and so on, the motivation of grouping similar issues and works in a thematic area is to have interrelated discussion and reflection in the analysis. However, the differences and common aspects discussed in several sections of the selected articles especially, abstracts, methods and conclusions were also analyzed and described in the content analysis (section 3.1).

3. Results and Findings

The study is based on a total of 41 research articles (as shown in table-1) out of which 8 are journal articles and 30 were published in conference proceedings. The rest (3 articles) are in 'others' category which contains one government published reports and two from book chapters. Table-1 shows number of selected research works on m-government presented according to publication category and year of publication. Most of the articles on m-government were found in the conference proceedings (30) while a few (8) were found in the journals like Electronic Journal of E-Government (EJEG), Electronic Government, an International Journal (EGIJ), Government Information Quarterly (GIQ), Technology Analysis & Strategic Management and Journal of Information, Communication & Society.

Table-1: Number of Selected Research Works on m-government (2001 and onwards)

Publication Category*	**Year**										**Total**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	
Journal Articles						2		5	1		8
Conference Proceedings			2	1	11	4	4	1	7		30
Others (e.g. Govt. Report, books, etc.)	1			1					1		3
Total	**1**		**2**	**2**	**11**	**6**	**4**	**6**	**9**		**41**

The year-wise breakdown of research works in table-1 shows a trend in research progress. It shows that m-Government research domain basically came to attention by the researchers since 2003. The number of research works is higher in 2005 e.g. among selected 41 articles 11 are from the year 2005. The work steadily declined in 2006 (i.e. 6 articles) and remained same on an average up to 2008. In 2009, research on m-government increased e.g. our sample contains 9 articles in the year 2009. As the year 2010 is just beginning, no article was found.

The selected research works are also classified according to three main thematic areas as in table-2. The table counts only the 38 articles from journals and conference proceedings and 3 articles in 'Other' category are excluded. Out of 38 articles, "General" thematic area has 19 articles; "Infrastructure and Implementation frameworks" thematic area has 8 articles while "Service delivery, usage and improvement" thematic area has only 11 articles. Out of 3 articles, as shown in publication category 'Others' in table-1, two articles i.e. one government report and one article from a book chapter are in the 'General' thematic area; while the third article is in the "Infrastructure and Implementation frameworks" thematic area.

Table-2: Classification of Research Works on m-government according to Thematic Area (2001 and onwards).

Thematic Perspective➔ Year ↓	General		Infrastructure and Implementation frameworks		Service delivery, usage and improvement		**Total**
	Journal	Conference	Journal	Conference	Journal	Conference	
2001							
2002							
2003		2					**2**
2004		1					**1**
2005		4		4		3	**11**
2006	1	1			1	3	**6**
2007		2		1		1	**4**
2008	3		1	1	1		**6**
2009		5		1		2	**8**
2010							
Total	**4**	**15**	**1**	**7**	**2**	**9**	**38***

* The table excludes 3 articles, categorized as 'Others' publication in table-1

Categorizing of articles into relevant thematic areas is a cumbersome and sometimes dubious task during the literature review. According to Webster & Watson (2002), concept-centric literature review determines an organizing framework of the review. It helps to identify concepts by synthesizing the literatures and thereafter to compile a concept matrix. Then a logical approach can be applied through grouping and presenting the key concepts or themes. Table-3 shows the categorization of selected articles in a concept-centric approach.

Table-3 shows that out of 41 selected articles, 22 are in the thematic group 'General', 9 articles in 'Infrastructure and Implementation frameworks' and the rest 10 articles are in 'Service delivery, usage and improvement'.

Table-3: Concept-centric Categorization of Articles

Concepts / Themes	Authors (years)
General (22)	Li et al. (2009); Nan et al. (2009); Mengistu et al. (2009) ; Xin et al. (2009) ; Gianluca (2009); Kuscu, et al. (2009); Ntaliani et al. (2008); Silvana & Hong (2008) ; Hong & Silvana (2008); El-Kiki (2007a); El-Kiki (2007b); Rossel et al. (2006); Al-khamayseh et al. (2006); Gang (2005); Patel & White (2005); Tozsa & Budai (2005); Abanumy & Mayhew (2005); Borucki et al. (2005); Cilingir & Kushchu (2004); Kushchu & Kuscu (2003); Ostberg (2003); NECCC (2001)
Infrastructure and Implementation frameworks (9)	Fasanghari & Samimi (2009a); Amailef & Lu (2008); Singh & Sahu (2008); Cao & Luee (2007) ; Mukherjee & Biswas (2005); Foghlú (2005); Gouscos et al. (2005); Antovski & Gusev (2005); Kim et al. (2004)
Service delivery, usage and improvement (10)	Fasanghari & Samimi (2009b); Naqvi & Al-Shihi (2009); Vincent & Harris (2008); Antovski (2007) ; El-Kiki & Lawrence (2006); Griffin (2006); Song & Cornford (2006); Antovski & Gusev (2006); El-Kiki & Lawrence (2005); Abramowicz et al. (2005)

Source table: Webster & Watson (2002), table-1.

In addition to concept-centric approach (table-3), Webster & Watson (2002) also suggest to structure the review through:

- Compiling articles in a form of concept matrix.
- Adding further dimensions to the concept matrix to handle the unit of analysis. This helps in isolating concepts by units of analysis.

Accordingly, the concept matrix along with unit of analysis is combined and presented together in the table below (table-4). However, the table was extended to enlist the retrieved articles according to publication type and year.

Table-4: Concept Matrix along with Unit of Analysis (Year-wise)

SN	year of publication	*Source type	Article Name **Unit of analysis→	Concepts								
				General			Infrastructure & Implementation frameworks			Service delivery, usage & improvement		
				O	G	I	O	G	I	O	G	I
1	2009	CP	Analysis of Mobile Government's Influences on Government Management	X								
2		CP	A MCT Acceptance Model from the Cultural Perspective and Its Empirical Test in the Mobile Municipal Administrative System Application			X						
3		CP	M-government: Opportunities and Challenges to Deliver Mobile Government Services in Developing Countries	X								
4		CP	A Security Protocol for Mobile E-service Oriented Architecture (MSOA): Design and Implementation		X							
5		CP	A Novel Framework for M-Government Implementation				X					

SN	year of publication	*Source type	Article Name **Unit of analysis→	Concepts								
				General			Infrastructure & Implementation frameworks			Service delivery, usage & improvement		
				O	G	I	O	G	I	O	G	I
6		CP	A Novel Methodology for M-Government Performance Evaluation in Fuzzy Area							X		
7		J	e-Government 2015: exploring m-government scenarios, between ICT-driven experiments and citizen-centric implications			X						
8		Ot	Mobile Computing: Concepts, Methodologies, Tools, and Applications			X						
9		CP	M-Government Services Initiatives in Oman							X		
10	2008	J	Mobile government: A challenge for agriculture	X								
11		J	Emerging Trends in M-GOVERNMENT		X							
12		CP	m-Government: A framework of mobile-based emergency response systems					X				
13		J	Effective use of mobile communication in E-government: How do we reach the tipping point?								X	
14		J	M-government: technologies, applications and challenges	X								
15		J	Integrating Internet, telephones, and call centers for delivering better quality e governance to all citizens						X			
16	2007	CP	mGovernment: A Reality Check			X						
17		CP	Improving Service Matching in M-Government with Soft Technologies								X	
18		CP	Application of M-government system in Beijing Municipal Government					X				
19		CP	Emerging Mobile Government Services: Strategies for Success	X								
20	2006	CP	Government as a Mobile Enterprise: Real-time, Ubiquitous Government									X
21		J	"Mobile" e-Government Options: Between Technology-driven and User-centric			X						
22		J	Using SMS Texting to Encourage Democratic Participation by Youth Citizens: a Case Study of a Project in an English Local Authority								X	
23		CP	"Mobile Government: Towards a Service Paradigm"									X
24		CP	Towards Understanding Success Factors in Interactive Mobile Government			X						
25		CP	M-GOV: The Evolution Method							X		
26	2005	CP	Simple implementation framework for m-government services						X			
27		CP	Transcending e-Government: a Case of			X						

SN	year of publication	*Source type	Article Name **Unit of analysis→	Concepts								
				General			Infrastructure & Implementation frameworks			Service delivery, usage & improvement		
				O	G	I	O	G	I	O	G	I
			Mobile Government in Beijing									
28		CP	"M-government: South African Approaches and Experiences"					X				
29		CP	A MULTI-PERSPECTIVE EFFECTIVENESS EVALUATION METHODOLOGY FOR MGOVERNMENT (MPE2M-mG)									X
30		CP	M-Government in Hungary		X							
31		CP	USE-ME.GOV (USability-drivEn open platform for MobilE GOVernment)								X	
32		CP	A Proposed Architecture For Mobile Government Transactions						X			
33		CP	Infrastructures for Mobile Government Services						X			
34		CP	M-government Implications For E-Government In Developing Countries: The Case Of Saudi Arabia		X							
35		CP	M-Government Framework					X				
36		CP	Mobile Government and Organizational Effectiveness	X								
37	2004	CP	E-Government and m-Government: Concurrent Leaps by Turkey			X						
38		Ot	Architecture for Implementing the Mobile Government Services in Korea					X				
39	2003	CP	From E-government to M-government: Facing the Inevitable			X						
40		CP	A Swedish view on mobile government.	X								
41	2001	Ot	M-Government: The Convergence of Wireless Technologies and e-Government	X								
			Total = 41	**8**	**4**	**9**	**1**	**5**	**4**	**3**	**4**	**3**

Source table: Webster & Watson (2002).
* Source type: **J=Journal, CP= Conference Proceedings and Ot=Others**
** Units of Analysis: **O= Organizational, G= Group, I= Individual.**

In terms of unit of analysis, table-4 shows that most of the selected articles (12) focus on organizational aspects while the remaining articles are focused on group (13) and individual (16).

3.1 Content Analysis: Mobile government Research and Several Scholars

M-Government is an emerging discipline and it is in its early stages of development (Antovski & Gusev, 2005) and it has been regarded as the next inevitable direction of evolution of e-Government (Amailef & Lu, 2008). The discipline is growing in terms of research as shown in results. We found that selected researches on m-Government focus on the areas of service delivery improvements, digital inclusion, infrastructure and implementation frameworks, future prospects and challenges, security, acceptance, etc.

Infrastructure and implementation frameworks

Public service delivery, quality improvement, infrastructure and implementation frameworks are the most discussed areas in literature. Building robust mobile technology infrastructure is considered to be a sustainable strategy. Implementation processes have

an impact on technology adoption. Therefore implementation requires an understanding of public sector organizational structures, citizen's needs and cultural factors to adopt technology. A study by Nan et al. (2009) indicates that non-tech factors such as cultural perspective show "more significant impacts in the process of innovation diffusion and service utilization in the ubiquitous network society".

In the past few years, there were "no well-defined methodologies available on how to implement government services to the different parties from present e-Government facility to future m-Government one" Mukherjee (2005). But many studies today including Mukherjee & Biswas (2005) have suggested implementation frameworks for mobile government services to different parties like citizens, businesses and governments. Amailef & Lu (2008) recommends a framework of MERS (Mobile-based Emergency Response System) that offers new opportunities for interaction between governments and other parties in case of emergency. For example, weather forecast can be broadcasted through mobile based Short Message Service (SMS) to fishermen and residents of coastal areas in order to help them to have shelter and precaution measure in time. Thus infrastructure and implementation frameworks suggested in literature aim at improving service delivery.

Service delivery

Robust frameworks would guarantee quality of service delivery. Antovski & Gusev (2005) recommends frameworks for public services delivery in m-Governments to focus on principles of: interoperability, security, openness, flexibility and Scalability. These principles can help in overcoming problems related to infrastructure development and raise the common like privacy, security, legal and interoperability as in e-government infrastructure. Fasanghari & Samimi (2009a) provides m-government model that can be used as an implementation framework. This model includes six phases of e-Government, migration, primary interaction, fully interaction, transaction and ubiquity. Numerous mobile services are provided at each phase of implementation.

Besides infrastructure and implementation frameworks, there are other frameworks that would improve on service delivery in m-governments in terms of operations. Ntaliani, Costopoulou & Karetsos (2007) suggest a framework for identifying appropriate and cost-effective m-Government for the agricultural sector. He emphasizes that the future challenges for the implementation of m-Government is the creation of effective business cases (e.g. tourism, health, agriculture) and thus considering issues of cost, which would benefit m-Government sectors especially mobile agriculture (m-Agriculture). Antovski (2007) also discusses the M-Gov architecture based on technical and a financial perspective and that can be used in integration scenarios (small to large administration agency scenarios). The architecture aims at service delivery improvement focusing on major components like access, service discovery directory and the collection of public electronic services from different sources.

Historical evolution and transformations

Other studies analyze historical evolution of m-Government. Rossel, Finger & Misuraca (2006) provide an illustration of the activities that have led to positive transformations in delivery of public services through use of mobile forms of Information and Communication Technologies (ICTs). Kiki & Lawrence (2006) also highlights some of electronic service categories, i.e., m-Communication, m-Services, m-Democracy, m-Administration that have merged due to advancements in mobile government. It is clear that all these developments lead to positive transformations in government agencies.

Measuring effectiveness

Lastly, measuring the effectiveness of m-Government services is one of the major areas which have been investigated in efforts to improve and enforce quality service. Measuring service quality is carried out through service performance evaluations as suggested shown by Fasanghari & Samimi (2009b). Kiki (2007) highlights the barriers to the success of m-Government service projects e.g. limited participation of local and government authorities

and interoperability issues between departments. It is therefore imperative to carryout evaluations on m-government services and projects so that service quality is improved and failures are overcome.

Prospects and challenges

M-Government challenges, success factors and application are also widely discussed in m-Government research. According to Mengistu et al. (2009), providing mobile services involves many challenges due to "complexity of different mobile technologies, creating secured networks to deliver reliable service, and identifying the types of services that can be easily provided". Challenges include security, privacy and legal issues. Kiki & Lawrence (2006) mentions some of the challenges as theft and loss of handheld devices, password cracking, data interception and viruses. Though these challenges can acts as setbacks, the adoption of mobile technologies is relatively high. M-government provides faster services which is a success factor. For example, after implementing an m-government System in Beijing municipal government, the average repair time for one asset reduced rapidly, from one week to several hours (Cao & Luee, 2007). Besides, less time in operation processes, there are other benefits of m-government e.g. reduced costs, fulltime (24/7) service delivery and effective communication. In addition, Singh & Sahu (2008) urge that multi-platform approach of service delivery (where both mobile and fixed line phones are used) leads to enhancement in delivery of e-government services via internet and can eventually bridge the digital divide gap. A majority of literatures show that the higher prospects of m-Government application areas include m-Health, m-Agriculture, m-Learning, communication, etc. Vincent & Harris (2008) show that effective use of mobile communication can lead to communication improvements in government agencies.

Policy formulation and legislation

Other important aspects discussed in m-Government literature include policy formulation and legislation. There is a need to have policies that can act as guidelines and assurances for m-government.

3.2 Methods used in m M-government Research

The methods used in the selected articles were reviewed. The reviews find that there are various methods used in m-Government researches. Some of them are based on empirical studies (qualitative or quantitative) like case study or survey, while others are based on theoretical analysis like policy reviews. For example, literature review (Singh & Sahu, 2008), case studies (Mengistu et al., 2009; Vincent & Harris, 2008), questionnaire survey (Nan et al., 2009), comparison test (Antovski, 2007), etc.

3.3 Knowledge Gap in M-government Research

Research similarities and differences are explored and summarized to identify the knowledge gaps. As discussed in the previous section, literature on m-Government domain discusses a wide range of issues which empower m-Government research. While many authors used various methods in their research processes, it was realized that most of the research articles excludes user (citizen) involvement. We believe, this is one of the research gaps to be filled especially when researching on service quality in m-Government. In this case, it is necessary for researchers to investigate citizens' opinions. M-Government is an emerging phenomenon and is influenced by other research domains. There is a need to have elaborative theories focusing on m-Government as an independent research domain. It is therefore necessary to foster researches on elaborative theories, practical implications, relative advantage and disadvantages, etc. of m-Government.

4.0 Conclusion and Recommendation

The study shows that common research areas of m-Government focus on public service delivery, implementation frameworks, historical evolution, challenges and measuring the effectiveness of mobile based services. Since most research methods used in m-Government research do not involve users, we recommend researchers to use methods that involve user surveys in order to serve user preferences and improve the service

quality. On the other hand, some articles identify the most important barriers to m-Government, but do not suggest practical solution. We believe, this study will help potential researchers to identify major thematic views for future research in the field of mobile government. We also observed that different researchers use the name of the research domain differently. For example, 'm-Government', 'mobile e-Government', 'mobile government'. We argue the research community to agree on usage of a standard form such as 'm-Government'.

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Make M-government an Integral Part of E-government: An Agenda for Action

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Abstract

The paper defines m-government, discusses types of mobility and an m-government framework suggested by Antovski and Gusev (2005). Importance of m-government for economic development is highlighted citing various studies along with the potential, uses and limitations of m-government. The paper then presents two types of M-government and discusses its pros and cons. To tap the vast unrealized potential of m-government the paper draws a 10-point agenda for action. The paper is wound up by concluding remarks noting that efforts in the direction of m-government so far in India have been sporadic and piece-meal. No holistic view of m-government has so far been taken as a result of which the vast potential of m-government continues to be unrealized. It is believed that if this agenda is implemented, it will promote and support the cause of m-government.

Keywords
E-government, M-government, Types, Economic Development, Potential, Uses, Limitations, Short Message Service (SMS), Agenda for Action, E-business Plan, Mission Mode Project, National eGovernnce Plan, Flagship Programmes, Disaster management Plan, Instant Messaging on Phone, Awareness Campaigns, National Mobile Portal, M-banking, Financial Literacy, "Spoken Web," "Voice Sites"

1. Introduction

The Web-based e-government in the current phase has been conceived to consist of three sub-phases: (a) Customer Service (1995-2000) (E-commerce inspired) (b) Virtual Agency (2000-2005) (Portal-inspired), and (c) M-government (2005-) (Technology-inspired) (Misra 2010). A sub-set of e-government, m-government, is 24/7 "everywhere" e-government mainly, but not entirely, relying upon cellular or mobile telephone whose rapid penetration in India has been astonishing by any standard. There were 380 million cellular subscribers in India as of December 2009 (COAI 2009). Worldwide there were 4.1 billion subscribers as on January 19, 2010 (GSM World 2010). According to International Telecommunication Union (ITU 2009), "Mobile cellular has been the most rapidly adopted technology in history. Today it is the most popular and widespread personal technology on the planet, with an estimated 4.6 billion subscriptions globally by the end of 2009."

India is the second fastest growing market in the world after China (Next Billion 2009). The mobile telephone subscribers constitute an excellent base of people who are literally available to governments worldwide for contact. No wonder, many countries like Malta, Dubai, UK, USA (State of Idaho), Korea, New Zealand, China, etc. have made m-government a strategic objective (Rossel, Finger and Misuraca 2006:82). The message here is clear: e-government is now required to deliver public services on mobile phones, giving birth to m-government.

Definition of M-government

Defined simply, m-government is public service delivery including transactions on mobile devices like mobile phones, pagers and personal digital assistants (PDAs). Kushchu and Kuscu (2004:3) define it as "the strategy and its implementation involving the utilization of all kinds of wireless and mobile technology, services, applications and devices for improving benefits to the parties involved in e-government including citizens, businesses and all government units." M-government is an integral part, a sub-set, of e-government (Figure 1).

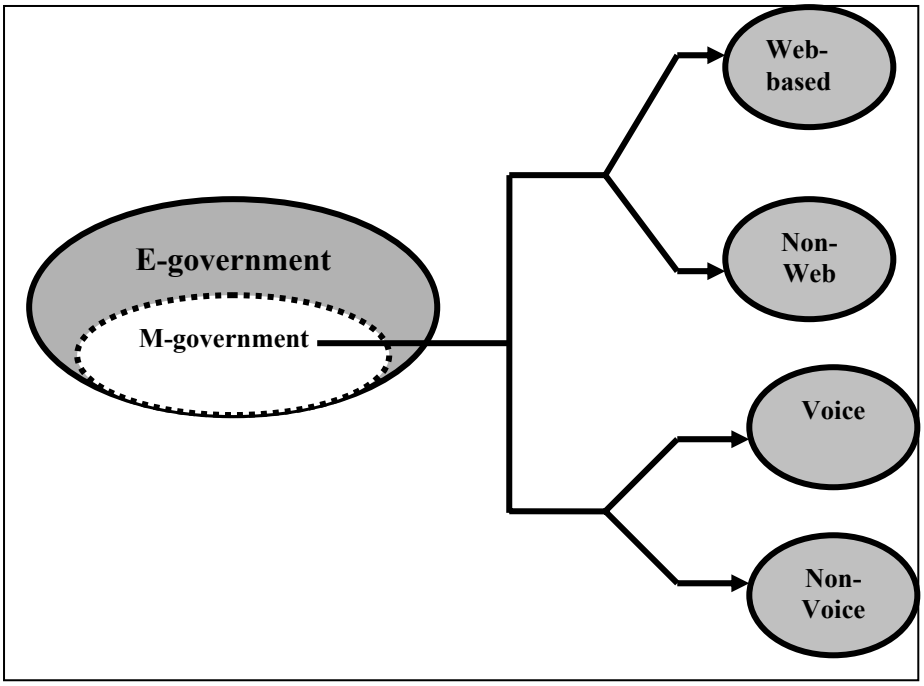

Fig.1 M-government as an Integral Part of E-government
Source: Compiled by the Author

Some call it as an extension of e-government, while others call it an evolution of e-government. M-government is of two types: (a) Web-based, and (b) Non-Web. Again it can be classified as (a) Voice, and (b) Non-Voice.

Apart from the convenience of carriage (small size of mobile phone) and mobility (anywhere e-government), an important feature of m-government is that it can be independent of Web, which is a very attractive feature due to low Internet penetration in developing countries. The momentum to m-government
is provided by the mobile phones and e-government can make use of short message service (SMS). Also, official portals can be accessed through mobile phone browsers.

Mobility
At the heart of m-government is mobility. Roggenkamp (2004) mentions six types of mobility: (i) physical, (ii) social, (iii) virtual, (iv) spatial, (v) temporal, and (vi) contextual mobility. Again, he splits mobility into three categories: (i) device mobility**,** the continued access to services with a device while moving; (ii) user mobility**,** apart from the mobility without physical constraints, this refers to location- and device independent service access; and (iii) service mobility**,** the capability to provide a certain service irrespective of device and user (ibid.:5).

M-government Framework
Antovski and Gusev (2005) suggest an m-government framework. It is based on five principles of interoperability, security, openness, flexibility and scalability. According to them, "the development of m-government standard unites innovation of architecture, technology, feasibility and citizen's education and awareness (ibid.:37). In their survey in Macedonia, a developing European country, "the major part of the participants were not informed about e-government (66%) and even more 68% did not have a clear picture what is m-government." (n=101, 20-35 years old with strong IT knowledge).

Importance of M-government
Sridhar and Sridhar (2004: 20), studying 28 developing countries over a 12-year period 1990 to 2001, show that landlines contribute on average about 1.62 percent to growth of GDP in developing countries, and cell phones contribute positively to national output, on

average, 16.2%. A 1% increase in mobile phones penetration increases growth by 6.75%. Their estimates show that a 1 percent increase in tele-density (total telephones per 100 population) increases national output by 0.15 percent without fixed effects and by 0.10 percent with fixed effects.

Waverman, Leonard, Meloria Meschi and Melvyn Fuss (2005:2), in their study of 92 countries from 1980 to 2003, found that mobile telephony has a positive and significant impact on economic growth, and this impact may be twice as large in developing countries compared to developed countries. Further, a developing country that had an average of 10 more mobile phones per 100 population between 1996 and 2003 would have enjoyed per capita GDP growth that was 0.59 percent higher than an otherwise identical country

Jensen (2007) has reported that between 1997 and 2001, mobile phone service was introduced throughout Kerala, a state in India with a large fishing industry. Using microlevel survey data, he shows "that the adoption of mobile phones by fishermen and wholesalers was associated with a dramatic reduction in price dispersion, the complete elimination of waste, and near-perfect adherence to the Law of One Price. Both consumer and producer welfare increased." Volpini (2009a) notes:

> With M-Government Public Administrations have an ideal means to realize their mission: to serve and involve citizens within the Communication – Access – Participation vision. Creating new services, cutting costs, increasing efficiency, fostering a rapid growth of user base – these are the key contributions of mobile communication to re-launch and empower public services.

Potential, Uses and Limitations of M-government

According to an estimate approximately 50%–60% of government services in India can be delivered via mobile channel (WB 2007). Caroll (2005:85) in her study of Australian mobile phone users has reported that "Unless the services and applications of m-government meet citizens' needs, they will not achieve long-term, persistent use." After studying m-government in Beijing, Song (2005:483) goes a step further and suggests that local government should pay attention to the new mobile technologies and theirs impact on organizations, and face up to the challenges and opportunities it offers to transcend the traditional e-government model, a model which pays undue attention to online Internet portals. (emphasis supplied).

The "lowly" SMS, whose importance was initially not realized by many, has great potential for e-government. It has already found application in banks (for balance, withdrawal, etc.), schools (for declaration of results), railways (reservation status), airlines (flight status), and traffic police (for overcharging by auto rickshaws, complaint about traffic signals not working). Other important areas include bed availability in hospitals, health and educational campaigns and emergency messages/warning to citizens. In an innovative step, nine deputy commissioners in the national capital territory of Delhi have also introduced SMS service to know the status of a citizen's application for 11 types of certificates[1] by sending a SMS at 9868231002 (Kumar 2006:5).

Three types of benefits from mobile phones have been noted: (i) incremental benefits, (ii) transformational benefits, and (iii) production benefits (id21 2007). Many citizens, however, are not aware of these services, which require publicity. Much also depends upon the governments to avail of SMS as an important channel of e-government in reaching citizens. Due to limitations placed on them, mobile devices can never be substitutes for computers. As such m-government is not a substitute of e-government but it can complement e-government a great deal.

2. Web-based M-government

Web-based m-government may be defined as m-government which can be accessed through the World Wide Web. This has given rise to World Wide Web on the mobile devices known as Mobile Web. For browsing the mobile Web, mobile Web browsers are needed as Internet browsers like Internet Explorer, Firefox, etc. are needed for browsing the Internet. A number of mobile Web browsers have already come into existence. These include Opera, Google Android, Internet Explorer for Mobile, etc. Similarly a number of operating systems like Symbian, iPhone, BlackBerry, and Windows Mobile have come into existence.

Mobile Web

The small screen of the mobile devices pose enormous challenges to engineers to put more and more matter in limited space. Apart from the small screen of the mobile devices, there are issues of interoperability, usability and operation which need to be and are currently being sorted out. A consortium of prominent companies have launched a top level domain (TLD)- ".mobi" – to tell the consumers "This site will work on my phone." (Source: http://mtld.mobi/company). Developed countries have made use of mobile Web for m-government.

Mobile Web Best Practices Guidelines

The World Wide Web Consortium, popularly known by its abbreviation W3C, Mobile Web Best Practices Guidelines (W3C 2008). The Guidelines, which are in the nature of recommendations, cover a wide variety of subjects. According to the Guidelines, the popularity of mobile devices for delivery of Web content largely stems at present from them being: personal, personalizable, portable, connected and increasingly multi-functional beyond their original purpose of voice communications. (ibid.). In addition to these factors, the advantages of mobile devices will increasingly include: location awareness, one-handed operation, always on and universal alerting device (ibid.). The Consortium makes a bold assertion that:

> Finally, today, many more people have access to mobile devices than access to a desktop computer. This is likely to be very significant in developing countries, where Web-capable mobile devices may play as similar a role in deploying wide-spread Web access as the mobile phone has played for providing "plain old telephone service". (ibid.).

Volpini (2009b) analyses Italian mobile Web portals on two parameters of discoverability and accessibility. The following information is available on mobile Web portals: institutional contents, contacts info, URP (public relations office), services available, institutional news and press releases, agenda, availability of consulting and downloading documents, information about other public bodies, economic information and public utility services (ibid.).

3. Non-Web M-government

Short Message Service (SMS) occupies the central place in non-Web m-government. The characteristic feature of non-Web m-government is that it does not require any Internet connection. SMS has found a wide variety of uses in e-government as has been noted in brief in Introduction. Let us have a look at SMS in some detail.

Short Message Service (SMS)

Short Message Service (SMS), which enables us to send and receive text messages on mobile phones limited to 160 alpha-numeric characters without any images or graphics, has taken the world by storm. It has turned out to be a very powerful tool for communication with human ingenuity on text limitation (for example, how r u? for how are you?). Indeed, a Finnish author, Hannu Luntiala, has written a 332-page novel- The Last Messages- containing 1,000 messages based on the travel of a fictitious former information technology (IT) executive to Europe and India who keeps in touch with his friends and relatives through text messages (AP 2007). The extra-ordinary popularity of SMS in India is

due to its low cost (Rs 1/- for local and Rs 2/- for national SMS earlier, 50 to 100 times costlier than what it cost to service providers; now 1 paisa per SMS since November 2009) and the timeliness of the message. Private sector has found profit in it if large volume could be obtained. For example, India's TV programme, "Kaun Banega Crorepati" reportedly generated 58 million SMSes over three months giving a revenue of Rs 174 million (assuming a charge of Rs 3/- per SMS), which was shared between the TV channel and the cellular operator (Tewari 2007).

The power of the SMS can be gauged from the fact that "The President of the Philippines was deposed in 2001 in an SMS-organized mobilization he called a "coup de text" when just 15% of Filipinos had mobile phones (Res Publica 2007:4). Incidentally, Philippines has been called as the "text messaging capital of the world." More than one million SMS messages were traversing every day as text messages over cellphones in India (Pandya 2002). An estimated 12.3 billion SMS messages were sent by Indian subscribers in 2004, projected to grow to 180 billion in 2010 (Tsuchiyama 2007).

Growth of Short Message Service (SMS) Messages in India

The growth of SMS messages in India has, however, not been as astonishing as, say in, China. Tsuchiyama notes that the key differentiator is in Indic "vernacular languages" and "a key barrier to SMS growth in India is the lack of handsets embedded with predictive text software in vernacular languages, as well as the lack of awareness, education, and promotion programmes."(ibid). Overall 65% of Indians queried want to type text messages in their own language (and not in English) (ibid).

4. An Agenda for Action

It is found that the vast potential of m-government continues to be unrealized. A systematic approach, currently lacking, is required to promote m-government as an integral part of e-government so that its benefits accrue to all concerned. With this view in mind the following ten-point agenda for action is suggested to promote m-government. Note that items can always be added to the agenda but it is useful first to lay firm foundation for m-government and then build upon it.

(i) Make m-government an integral part of e-government

Despite e-government being more than a decade old in India and despite substantial investments made in e-government, e-government continues to be at the periphery of governance and not in its mainstream. Similarly, awareness about e-government among the common man remains peripheral. Moreover, application of e-government has been piece-meal, ad hoc, and not holistic. Also, m-government is being treated as an independent entity and not as an integral part of e-government. As a result, the potential of e-government is not being realized. It is thus essential to make m-government an integral part of e-government and promote e-government in governance with renewed vigour.

(ii) Make m-government an integral part of e-business plan for e-government

Currently, e-government is not being introduced in governance in any systematic and planned manner. In order to realize its full potential, it is essential that organization-wide e-business plan for e-government is prepared and m-government is made an integral part of the e-business plan for an _rganization. This will ensure that the possibility of introduction of m-government is examined, particularly as it relates to public service delivery, and m-government is introduced wherever it is feasible to do so.

(iii) Include m-government as a mission-mode project in National eGovernance Plan

In order that full potential of e-government is realized, it is essential that a mission mode project (MMP) under India's National eGovernance Plan (NeGP) is launched. The project will become a clearing house for various technologies under m-government, a repository of

best practices in m-government at national and international levels, and pay particular attention to application of m-government at the district level where important national-level programs are being implemented. Ideally, m-government should become an integral part of the e-business plan for e-government at the district level and innovations in the application of m-government accorded priority for encouraging 'out-of-the-box' thinking.

(iv) Include m-government in India's flagship programmes

In recent years the government has introduced a number of ambitious flagship programmes. These include the omnibus four-year (2005-2009) Bharat Nirman (Build India) aimed at strengthening rural infrastructure including water supply, power, housing and roads with an outlay of Rs 1,74,000 crore, Rajiv Gandhi Bharat Nirman Seva Kendras (Rs 28,000 crore), Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGP) (Rs Rs 39,100 crore), National Rural Livelihood Mission (NRLM) (Rs 10, 000 crore), and Sarva Siksha Abhiyan (SSA) (Rs 71,100 crore). Not to speak of e-government, in none of these programmes even e-government has been assigned a central position. As a result potential benefits of m-government/e-government are being denied to these flagship programmes. (1 crore=10 million).

(v) Make use of m-government in disaster management plan at the district level

In disasters lines of communication are usually the first casualty, particularly the landlines. Similarly, lines of communication for mobile phones too need to be protected. Moreover, in emergencies the lines of communications also get clogged due to heavy traffic. Subject to the condition that mobile phones are operational, m-government can be a very useful ally in dealing with emergencies, particularly in organizing rescue and relief operations. Ideally, m-government should form an integral part of the district disaster management plan.

(vi) Adopt instant messaging (IM) on phone

A more promising development is proposed launch of instant messaging (IM), like Yahoo! And MSN on the Internet (who have an estimated 300 million IM subscribers worldwide), on phone by telcos in India in July 2007. Much cheaper than SMS and likely to be based on monthly subscription of, say, Rs 100 per month with unlimited messaging with telephone number as the user id (SMS generates 8% to 10% of revenues for Indian telcos) (Luvangal 2007:11). This will provide another communication channel to governments in relating to citizens in real time. E-government has, therefore, also to take this development into account in designing any strategy.

(vii) Use m-government for launching important awareness campaigns

M-government can be very useful in launching important awareness campaigns, for example, in the field of education, public health, safety, etc. Care should, however, be taken to ensure that m-government is used selectively here and phones are not inundated with all sorts of messages ranging from, say, from "save electricity" to "pay your income tax." Messages too should be short and crisp and should be so drafted as to catch the attention of the man on the move without distracting him.

(viii) Set up a national mobile portal

Canada has already taken initiative in setting up a mobile portal at http://www.wap.gc.ca/mobile/wireless-eng.html. Services currently offered include border wait times, Canada business service centres contact information, Canadian company capabilities, currency converter, economic indicators, exchange rates, government of Canada employee phone numbers, government of Canada news releases, media advisories, background news, and more, member of parliament contact information, passport offices, national parks, 1 800 O-Canada international toll-free numbers, and weather. India too needs to set up a national mobile portal. If for any reason this is not possible, a sub-portal for m-government in national portal of India (http://india.gov.in/) should be set up.

(ix) Promote m-banking and provide financial literacy

Verclas (2010) notes that financial services conducted via mobile networks and devices include (i) mobile payment and banking services, (ii) wage and social benefit payments, and (iii) financial literacy and education. While progress has been made in India in m-banking, notably through short message service (SMS), wage and social benefits payments are yet to be made through mobile phones. Similarly, no steps have so far been taken in educating people in financial literacy. Wage and social benefits payments fall within the purview of district administration in India's flagship programmes, most notably in scheme the under Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) (Check the website for details at http://nrega.nic.in/netnrega/home.aspx).

(x) Adopt "spoken web" and set up pilot "voice sites"

It has been estimated that 10% of wages earned (from Mahatma Gandhi Rural Employment Guarantee Scheme (MGREGS) are expended on mobile phones (Sharma 2009). This not only shows the importance even poor attach to communication but it also offers unique opportunity to policy-makers to utilize the medium of mobile phone for addressing the needs of the poor.

IBM India Research Laboratory (IRL) under its Director Dr. Guruduth Banavar in its "Project Spoken Web" (http://www.research.ibm.com/irl/projectspokenweb.html) is developing "Spoken Web" and "Voice Sites" on the lines of "World Wide Web" and "Web sites." Prakash (2009) explains:

> When you want to create a voice site, you dial a specific number at which point software called VoiGen helps you create a new site. You get a unique phone number which is analogous to a URL and when other users access this voice site they get to hear the content uploaded there. Interlinked VoiceSites, similar to hyperlinked Web sites, creates a parallel infrastructure to the World Wide Web.

The research offers path-breaking innovation for bridging the digital divide and, in particular, reaching the illiterate poor currently being served by schemes like Mahatma Gandhi Rural Employment Guarantee Scheme (MGREGS). An eligible person under the scheme can, for example, register on phone dialing a specified number. He can also have account on "voice site" and also receive intimation/confirmation of his payment. A number of other educational, health, and other services can be provided through the "Spoken Web."

5. Concluding Remarks

Efforts in the direction of m-government so far in India have been sporadic and piecemeal. No holistic view of m-government has so far been taken as a result of which the vast potential of m-government continues to be unrealized. Moreover, innovative uses of m-government are also denied. Time has come to take a holistic view of m-government and draw an agenda for action so that benefits of m-government are realized by all concerned. An attempt has been made in this paper to draw an agenda for action. It is believed that if this agenda is implemented, it will promote and support the cause of m-government.

Notes

[1] 1. Registration of Marriage Certificate, 2. Surviving Member Certificate, 3. Orders for Death Certificate, 4. Nationality Certificate, 5. Schedule Caste (SC) Certificate, 6. Domicile of Delhi Certificate, 7. Handicap Certificate, 8. Solvency Certificate, 9. Other Backward Classes (OBC) Certificate, 10.Orders for Birth Certificate, and 11. Income Certificate.

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Regulatory Framework For Mobile Financial Services

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Abstract:

Regardless of the details of a 'mobile-money' regime, mobile operators take increasingly part in mobile financial services, playing a crucial role in expanding the business. From a regulatory and supervisory point of view, the question must be answered whether the execution of mobile financial services is so close to a deposit-taking activity (as the provider starts acting in a bank-like manner) that compliance with banking regulation is a matter of public interest. In any case, the growing importance of mobile financial services providers implies that telecommunications regulators and banking regulators will inevitable have to coordinate their activities and share information and know-how. India would be an ideal place to become an experimental 'legal laboratory' tackling the difficult question of when banking regulation should be applied to providers of mobile financial services and to what extent the specificities of mobile financial services imply a different regulatory treatment. It is in the interest of both the private providers and the public to make the offering of mobile fi- nancial services a reliable, safe, and promising business that acknowledges the importance of customer protection.

Keywords: mobile banking, mobile payment, telecommunications vs. banking regulation

Introduction

The use of mobile phones in order to effectuate financial transactions is prone to increase significantly in the near future. According to the International Telecommunication Union (ITU), the number of mobile cellular subscriptions globally is likely to reach five billon in 2010. This development is at least in part driven by an increased take-up and advancement of mobile banking services around the world. The growth of mobile financial services does not only depend on technological advances but also on consumer confidence in the provided services.

In the industrialised countries, the additive model applies, meaning that mobile financial services constitute a further (suitable) channel for customers already demanding financial services. In the developing world, the transformative model aims at offering these services to customers that have previously not been involved in financial services transactions.

While the achievement of mobile financial services facilitates access to payment and banking transactions—especially for areas without an established net of (physical) banks—, it may also involve certain risks. If mobile financial services providers perform depository-like functions, the threat of large depositor losses has to be met by according means of depositor protection. Furthermore, mobile financial services providers, particularly if they operate on a global scale (perhaps by liaising with an international financial group), may become so large and interconnected over the years that their failure could cause disruptions within the wider financial markets. This threat is perhaps even more distinct than with respect to 'conventional' providers of banking services as the channels of risk distribution may be less 'visible' in the mobile world compared to financial institutions with physical branches and subsidiaries.

These considerations reveal how essential it is to clearly define the scope of mobile banking and payment services in the larger context of the financial industry. More specifically, mobile financial services could, if not handled properly, turn into a new

shadow banking system, undermining government supervision and the rather comprehensive regulation of traditional banking. Finally, there are private law issues that should be given due consideration in the discussion on mobile financial services to provide for appropriate consumer protection, especially with regard to sensitive data.

1. Elements of Mobile Financial Services

The development of mobile financial services depends on the economic circumstances as well as on the suitability of the legal framework regulating the services' application. The user- friendliness of the offered services is certainly a key aspect of the success of mobile financial services. The idea of handling financial transactions through mobile phones attracts customers due to its sheer convenience. Economically speaking, mobile financial services will only be widely used if they imply a reduction of costs in comparison with the traditional financial services tools. On the one hand, WAP (wireless application protocol) technology has become an appropriate technique for customers since the transmission speed has increased substan- tially in the past years. On the other hand, it is essential that providers of mobile financial ser- vices obey the quality objectives of simplicity, inexpensiveness, and timeliness. To promote customer confidence in the provided services, data security should be a focal point of atten- tion of mobile financial services providers.

Mobile financial services encompass two main types of business activities, namely mobile payment and mobile banking:

(1) Services providers engaged in the mobile payment business fulfil an intermediary function between buyers and sellers (often in e-commerce or m-commerce transactions) by facilitating the purchase of goods or services with the help of mobile devices. Two basic mechanisms of mobile payment can be distinguished: First, the easiest way of implementing the data transfer is by charging mobile payments directly to the phone bill. In this case, the mobile operator only acts as an intermediary arranging for payments to be made to a third-party supplier. Second, mobile payments can also be settled trough customers' prepaid accounts. However, in this second setting, it may cause difficulties to clearly identify an account as a prepaid account as the demarcation line between prepaid and deposit accounts becomes increasingly blurred.

    In the developing world, innovative mobile-money schemes have emerged, which offer their services in various fields and for multi-faceted purposes. For example, 'Safaricom'— Kenya's largest mobile operator—launched the money transfer service 'M-PESA' in 2007. M-PESA, besides is primary use to transfer money, allows customers to execute daily payments for everything from school fees to taxis rides; more recent applications also concern health insurance premiums and similar kinds of payments. M-PESA's concept enjoys great popularity in Kenya: In 2009, it had already seven million subscribers out of a 38 million population.

(2) Mobile banking includes the whole range of services in which a banking activity is involved, including mobile accounting, mobile brokerage, and the complementary service of mobile financial information. Mobile accounting encompasses transaction-based banking services revolving around a standard bank account. Mobile phones are used to make money remittances, give payment instructions, execute payment transactions, or cancel orders. Mobile banking is gaining momentum in the developing world: For example, MTN—a South-Africa-based telecommunications company—launched a mobile account- ing service in Uganda in March 2009 that allows the execution of transactions through text messages and the storage of money on mobile devices. Mobile brokerage, in contrast, refers to intermediary services in both capital markets and markets for goods and services. For example, the Danish

Saxo Bank provides through the 'SaxoMobileTrader' a flexible trading platform, enabling customers to trade in various capital markets. 'Google Trader' is a marketplace application which allows customers to buy and sell goods and services through their mobile phones via text messages. Further examples of mobile brokerage providers are 'TradeNet' in Ghana and 'CellBazaar' in Bangladesh. Lastly, mobile financial information, as a complementary service, helps customers to execute mobile financial transactions more smoothly. For example, 'First Direct', with headquarters in the United Kingdom but branches around the world, sends mini-statements as text messages alerting customers to keep their accounts up-to-date.

In the developing world, the substantial growth in mobile financial services depends to a large extent on the fact that mobile phone penetration and the use of mobile phones are much higher than the availability of cash machines and bank branches. It is likely that the facilitated access to financial services will increase the overall customer basis in the financial industry and reveal some of the latent potential of developing financial markets. In fact, one can expect that the use of mobile devices will raise the potential of developing financial markets to compete with established global financial markets.

The fundamental social and economic benefits resulting from mobile financial services, how- ever, should not make blind in view of the legal risks inherent in such development. In other words, mobile-money schemes must be organised and regulated in such a way as to ensure that financial markets function soundly and efficiently. In particular, it has to be ensured that mobile financial services and their providers do not cause or increase systemic risks. Further- more, mobile financial services must meet certain standards with regard to consumer protection. However, such regulations should seek to hamper innovation and growth of the mobile financial services industry only to the extent that is indispensable to provide for financial stability and consumer protection.

2. Appropriate Legal Framework

International regulatory frameworks have not yet established a specific supervisory regime for mobile financial services, and national regulators are generally reluctant to intervene in a promising business for less developed countries and, in particular, rural and remote areas. Designing the regulatory and supervisory regime depends less on the use of mobile telephony to undertake banking transactions than on the targeted banking activity, such as deposit taking or brokerage. Nevertheless, regulators and supervisors in both the finance and the telecom- munication sector should be aware of several distinctive features in mobile banking.

Since the regulatory regime for rendering financial services is regularly more elaborated and encompasses more stringent structural and behavioural 'guidelines' than the legal framework in the telecommunications sector, the key question concerns the possible application of banking law on a mobile financial services provider. Very commonly, the competent financial market authority is entitled to specify the scope of banking business executed by a financial institution and to issue banking licenses as a condition to enter the financial services market and to carry out a regulated activity. Whether mobile financial services and their providers are considered as being subject to banking regulation thus depends on the determination of what constitutes a banking activity on the one hand and on the definition of banks on the other hand. The core principle in banking law is expressed in the notion that only banks are authorized to publicly take deposits and grant credits; correspondingly, depositor protection is an important aspect of banking regulation.

As far as the offering of mobile financial services is concerned, the question must be an- swered whether the execution of mobile financial services is so close to banking

activity (and the provider in fact act in a bank-like manner) that compliance with banking law is a matter of public interest. Two different settings can be distinguished:

(1) If a mobile operator charges customers through their phone bill in the process of collecting a payment for a provider of goods or services, the mobile operator acts as a mere intermediary. The operator takes the risk inherent in the particular transaction as far as the aspect of proper execution is concerned; furthermore, remuneration may depend on a scheme of sharing a part of the gain with the content provider. However, the key function of the mobile operator is to make the financial transaction between the provider of goods or services and the customer possible without being directly involved in the deposit-taking business.

(2) If the mobile operator creates prepaid accounts to facilitate the execution of payments, the activity typically implies a certain deposit-taking function. The mobile operator's risk is not any more limited to the proper execution of the particular transactions, but it bears certain counterparty risks with regard to its customers' ability to meet their financial obligations. The use of prepaid accounts as such does not necessarily constitute a banking business; however, a grey area begins as soon as high amounts are deposited on such an ac- count for longer periods or if it is used for investment purposes. A mobile operator also acts in a bank-like manner if it pays the customers interest on their accounts or reinvests the money received in other businesses or capital markets. Under such circumstances, the activities of mobile operators resemble banking activities, and the balance sheet of the operator may begin to look similar to a bank's balance sheet.

Obviously, a clear and easily applicable demarcation line between sheer intermediary services of mobile operators and a deposit-taking function does not exist, even though it would be desirable with regard to avoiding legal uncertainty. In particular in the developing world, mo- bile-money schemes have developed outside the regulated banking sector, which is only un- problematic as long as mobile-money schemes limit the balances they raise and do not pay interest when these balances are used like savings accounts. Nevertheless, problems might occur in the case of irregularities, such as financial fraud, or bankruptcy of the mobile financial services provider. In the latter case, customers would certainly call for depositor protection, which could only be made available under an established financial supervisory system.

At any rate, regulators should seek to avoid that financial institutions try to associate with mobile operators as a means of circumventing the stringent banking regulations. The recent financial crisis has demonstrated (like many of its predecessors) that the emergence of a shadow banking system—executing bank-like functions without being subject to banking regulation and supervision—has the potential to destabilise the entire financial industry in case of market disruptions. However, it may be difficult for banking regulators to capture on their own the novel use of mobile devices to execute financial services in an appropriate way. At least with regard to the technical issues, banking regulators clearly rely on the knowledge of the telecommunication regulators.

Therefore, the establishment and institutionalisation of co-operation and information sharing between the telecommunications regulator, supervising the provision of value-added services by a mobile operator, and the banking regulator, supervising the deposit-taking business of a provider, will be essential for effective supervision of mobile financial services providers in the near future. The legal framework of mobile financial services should encompass an inter- related regulatory approach which recognises the distinctive features of telecommunications and financial services requirements. For instance, the consumer identification process in mo- bile financial services should be more formal than for buying a Subscriber Identity Module card

(SIM card) but less rigorous than for opening a bank account.

The development of mobile financial services is not yet being reflected in the regulatory framework at the global level, nor has it been given due consideration in the ongoing international discussions on regulatory reforms of the financial system. It is to be expected that India—as a technologically advanced country with large rural areas—has both economic and political interests in advancing the business of mobile financial services that may help under- pin India's position as an emerging financial market. For these reasons, India appears to be an ideal place for conducting research on the creation of a regulatory framework that does not unreasonably hinder the innovation of mobile financial services but takes into account the need for adequate customer protection.

3. Private Law Issues

In the contractual relations between the mobile financial services providers and the customers, three aspects play an important role:

(1) Data security must reach a high standard: On the one hand, mobile providers should under normal circumstances not be allowed to disclose personal data to third parties. On the other hand, data security implies that mobile providers prevent unauthorised persons from misusing personal data. The security issue is crucial to the success of the provided ser- vices since the customers want assurance that the wireless communications are not inter- cepted as they may contain rather sensitive information about customers' asset and in- come situation. Therefore, mobile operators must take technical and organisational meas- ures to protect the processing of personal data via the mobile network. For example, after having executed a mobile financial transaction, the mobile transaction number (mTAN) process would have to involve a transaction confirmation through the mobile phone. In addition, typical malware scenarios are to be tackled and risks of falsified websites should be mitigated.

(2) Mobile financial services providers need to use reliable methods for the verification of customers' identity and authorisation, such as the implementation of a Public Key Infrastructure (PKI). For the time being, the application of digital signatures is still remote and alternative measures such as PIN numbers, passwords, and smart cards do not reach the same level of security. In the future, biometric technology, fingerprints, and voice recognition may become promising tools for identification. In India, pilot projects aim to intro- duce fingerprints in mobile banking to support illiterate people in undertaking banking transactions. Apart from the technical issues, the 'know-your-customer rule' must also apply in relation to mobile financial services. In particular, mobile operators should be obliged to verify—before taking up a business relation—a customer's risk profile and financial situation. Further-reaching identification may be necessary in case of a suspicion of money laundering or similar crimes, including an obligation to report such suspicion to the responsible authority according to the international money laundering standards.

(3) However, consumer protection goes beyond data security and customer identification; it begins already before the business relation with the mobile operator is taken up. To establish market discipline it is of utmost importance that customers can take informed decisions. Transparency requirements, accompanied by appropriate fiduciary duties of mobile providers, would be appropriate means of covering customers' information needs. Consumer protection is also in the interest of the providers of mobile financial services; if the providers acquire customer confidence, costumers adapt to the mobile provision of financial services more easily.

Consequently, in order to further develop mobile financial services, much concern must be directed towards the creation of an environment which fosters customer trust in the respective services and ensures market integrity. Failure to do so could hinder a successful advancement of mobile banking and payment and, perhaps worse, threaten financial stability. Consumer confidence is a fragile good that gets quickly lost and is hard to be won back. Furthermore, a loss of confidence is not necessarily confined to a particular provider or the mobile financial sector but may have negative implications for the financial services industry in general.

4. Outlook

Regardless of the chosen regulatory model and the density of supervisory rules, it cannot be overlooked that mobile operators take increasingly part in mobile financial services. Insofar, mobile operators play a crucial role in the expansion of the financial industry. From a regulatory and supervisory point of view, this appreciation implies that telecommunications regulators will inevitably have to coordinate their activities and share information with financial regulators. Quite often, financial institutions and mobile operators arrange for an outsourcing of the front end of the deposit-taking business. Even if regulatory regimes do not contain explicit prohibitions, regulators should be very cautious in respect of financial institutions at- tempts to outsource deposits to agents due to the risk of regulatory arbitrage and loss of reputation of the financial services sector.

Typically, customers first execute mobile payments, and they would not demand other mobile financial services if they were not satisfied with the execution of mobile payments. Mobile financial services may thus enjoy positive externalities from the success of mobile payments in the light of the customers' expectations. Consequently, the specific aspects relating to consumer protection play a particularly important role in situations in which mobile operators try to serve as financial institutions by granting credit for micro payments. If mobile operators are allowed to provide mobile phone holders with a loan, legal provisions have to apply to ensure compliance with the customers' needs. Notably, legal frameworks must protect consumers against unfair or misleading practices.

Beyond the ongoing attempts to regulate mobile financial services and their providers at the national and regional level, it is essential for several reasons that certain core standards apply on a global scale. First, at latest since the recent financial crisis it has become apparent that fundamental differences between national financial regulatory regimes lead to regulatory arbitrage, thus threatening the goal of international financial stability. It can be expected that the development of mobile financial services will change the global 'financial services landscape' and potentially increase competition between financial institutions located in different national jurisdictions. In such an environment, it is likely that financial institutions will seek to circumvent costly compliance with national regulations in order to avoid disadvantages in competition compared to rival financial services providers. Second and more practically, mo- bile financial services do not involve much stationary infrastructure, and mobile operators can—as their name implies—operate from different and varying places in the world. If they are not associated with a 'partner' financial institution, it will be almost impossible to capture mobile operators with nationally-oriented regulation or supervision.

The core standards to be introduced internationally for mobile financial services providers especially relate to anti-money laundering provisions and depositor protection. International attempts to combat money laundering are useless if they are only applied to selected providers of financial services as sparing mobile financial services providers will likely promote regulatory arbitrage. Furthermore, expansion of mobile financial services providers into deposit- taking activities must come along with appropriate depositor protection—be it through an extension of existing depositor protection schemes for

banks or the establishment of special schemes for the mobile financial services sector.

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Universal Financial Inclusion through Electronic Payments

Laveesh Bhandari, Sumita Kale

Abstract:

This paper argues that universal access to electronic transactions is critical for ensuring financial inclusion. The RBI has through its recent actions created a highly progressive regulatory regime that would enable both innovation and entry of new providers of financial and e-transaction services. Moreover, the ideal mode or 'pipe' through which such services can be provided – the mobile phone – is already widely accessible for the underprivileged. However, constraints in the mobile VAS sector are preventing further movement in this space. An enabling environment requires the Mobile Service Providers to be more accepting of competition and transparency, barring which regulatory action in the MVAS will become critical to ensure greater financial inclusion. Just as the RBI has created an enabling environment in the financial regulation space, TRAI and the mobile industry need to create an enabling environment in the electronic communication space. Only when this is achieved can we hope for further cost efficient innovations in the micro-credit space that will finally ensure universal financial inclusion.

Key words: Financial inclusion, Mobile banking, M-commerce

1. Introduction

Financial inclusion, defined by the Rangarajan Committee as "the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low income groups at an affordable cost" has pushed the boundaries, making the concept more inclusive and deeper than standard definitions. Financial inclusion now incorporates not just banking, but also elements of insurance, and very significantly payments and remittances. More importantly, it is being increasingly accepted that financial inclusion is not about who provides the services – banks or non-banks, large or small, formal or informal – but the type, quality, and terms at which such services are being provided.

This paper argues that universal access to electronic transactions is critical for the ensuring financial inclusion. The RBI has through its recent actions created a highly progressive regulatory regime that would enable both innovation and entry of new providers of financial and e-transaction services. Moreover, the ideal mode through which such services can be provided – the mobile phone – is already widely accessible for the underprivileged. An enabling environment requires the Mobile Service Providers(MSPs) to be more accepting of entry by non-MSPs, competition, and transparency, barring which regulatory action in the MVAS will become critical to ensure greater financial inclusion. Just as the RBI has created an enabling environment in the financial regulation space, TRAI and the mobile industry need to create an enabling environment in the electronic communication space. Only when this is achieved can we hope for further cost efficient innovations in the micro-credit space that will finally ensure financial services for all.

The paper begins by examining the scope and scale of financial exclusion and the characteristics of the 'un-covered' households; low and irregular incomes and expenditures of underprivileged households, with significant proportion of credit requirements being for unproductive purposes, lack of collateral, and lack of recorded assets or transactions make these households unviable for the formal sector to service.

The next section highlights the advantages of electronic transactions - low cost, complete records of transactions as well as expanding the economic network. The important point is that electronic transactions enable easy and quick access to the complete set of transactions made by the un-covered, a crucial input in the information database for future credit needs.

Section 4 underscores the point that current mechanisms such as MFIs and bank correspondents cannot be expected to fully address the problem of financial exclusion. In fact wide use of electronic payments would strengthen such mechanisms as well, and may give rise to other innovations.

The importance of the mobile phone is highlighted next, as the most likely means of carrying information in the electronic form on a 24x7 basis between the household and the financial service provider. However, our experience with competitive forces within the mobile services industry has not been entirely positive where introduction of innovative services is concerned. Unlike the voice segment, the mobile values added services (or MVAS) segment has seen little competition and little innovation. This is due to the nature of the service, where voice and data are bundled commodities; regulatory action and competitive response have been limited to the voice segment. A set of coordinated or policy/regulatory measures are proposed that are essential to ensure that critical innovations are not stifled in the MVAS space.

Finally, the concluding section underlines the fact, that it is as yet unknown which kind of services and which type of models will be able to profitably meet the micro-credit requirements of the masses. But by loosening competitive forces at all points in the chain we would have created a highly enabling environment for innovations to occur.

This paper makes the case that financial inclusion will be possible only with widespread use of electronic payments. Increased use of technology that enables low cost delivery is a necessary precondition, but another precondition is that the un-covered have easy access to electronic payment mechanisms for their transactions. In the process, the electronic payments regime needs to ensure that no single group has sole control over these services – whether they are MSPs or banks.

2. The Problem of Financial Inclusion

The All-India Debt and Investment Survey conducted by the National Sample Survey Organization provides important insights into the problem of financial inclusion. The last survey done in 2003, though dated, showed that about 26.5% of rural and 17.8% of urban households have taken some form of debt. Of these the better off are far more likely to have their requirements met from institutional sources and the worse off rely mostly on the unorganised or informal sources. However, indebtedness is lower among the poor, and this is likely because of lack of availability of even non-formal sources for these households.

The non-formal sector typically provides lower amounts than the formal sector in both rural and urban areas, and at significantly higher Debt-to-Asset ratios. Among the non-formal means, the money lender, family and friends are the most important. The critical characteristic of these entities is that they capitalize on the repeated nature of their interaction with the debtor. Thus, where adequate collateral is not available, it is the repeated nature of other interactions that ensure some guarantee to the lender – this is the same principle that many micro-finance institutions(MFIs) work upon.

By far the easiest to ensure financial inclusion for would be households that have some assets – land, cattle etc. The lack of adequate security is an important issue – two-thirds of the rural indebted households availed credit only on the basis of personal security and this accounted for 48% of the total debt of such households.

However, the bulk of the uncovered require credit for what is typically classified as non-productive expenditure. It is highly unlikely that any financial institution would be able to provide such credit, whatever be the cost of provision. Yet, such credit is not un-important. Consumption expenditure – for health care, social functions, etc. - is crucial for a poor household's survival.

But the aggregates hide an important aspect of household debt in India – the majority of indebted households reported an average value of less than 10,000 in rural areas and 30,000 in urban areas. These figures would have increased since and there would be some under-reporting as well. Yet, the fact remains that most households' debt lies in a range that will be costly for formal institutions to service. Moreover, the cost of appraisal has many elements in it, but the human resource element will be among the most important components. What is needed is a system that minimizes the time taken in the appraisal of such loan applications.

Therefore, the problem of credit for underprivileged households is not just an issue of using technology to reduce transaction costs. It is a problem that originates in the occupational and asset structure of households and is further worsened by the large spread of the un-organised sector with consequent lack of records; a problem that is made even more difficult for the higher cost formal FIs because of the low ticket value and 'non-productive' requirements of poor households. What is needed is a solution that takes into account the peculiar needs of these households.

3. Using the mobile phone for a transaction based approach to financial inclusion

For the requirements at hand, and given the characteristics of the debt and the households taking it, the first step is to ensure that households make greater use of electronic payments. Why? Because a history of transactions will eventually facilitate provision of credit. Given the large component of unorganised sector and unrecorded transactions, the best way of creating a history of transactions is through the use of electronic transactions, through the use of electronic money.

E-money can be defined as '……..monetary value as represented by a claim on the issuer which is[12]:
(i) stored on an electronic device; and
(ii) accepted as a means of payment by persons other than the issuer.'

E-money may be carried on a number of electronic devices and may be downloaded from an ATM, a shop-based terminal or the Internet or be stored on a mobile phone instrument.' Depending upon the regulatory framework, e-money can be provided by banks and non-bank entities. Here a distinction will need to be made in that the non-bank entities (such as those providing pre-paid cash cards) are not allowed to undertake activities that are not closely related to e-money issuance e.g. granting of credit by e-money issuers would need to be specifically prohibited.

Despite many different models in operation it is not clear which systems would be best suited for Indian conditions. This is the foremost policy and regulatory issue – ensuring that a flexible regime is developed that encourages innovation and experimentation, entry of many types of new players, and at the same time ensuring security and stability of the financial system.

The mobile phone can well be a key component of ensuring universal access, for purely one reason – the mobile phone enables electronic delivery and electronic log-keeping on a 24x7 basis and eliminates travel costs of the consumers. But this advantage of the mobile phone

[12] This and the following two paragraphs borrow liberally from "The Regulation of Electronic Money Issuers," Consultation Paper 117, The Financial Services Authority, UK, 2001

also suggests that the mobile phone should merely be treated as a direct pipe to the consumer, nothing more and nothing less. The regulatory/policy regime therefore needs to ensure that different types of entities are able to provide financial and transactional services on this electronic pipe – not just banks or MSPs.

4. What the underprivileged require

While financial inclusion is largely seen as a problem affecting rural areas, the crux of the problem actually lies in the income characteristics of the household. RBI data show that 72% of those earning less than Rs. 50,000 lack a bank account – when it comes to access to banks, the distinction between rural and urban matters less than the income differential. Without appreciating the particular needs of the poor, it would not be possible to create appropriate policy responses.

At the cost of repetition, the poor have certain characteristics making them unattractive for conventional credit services.

- Incomes are irregular, transactions are also irregular, casual wage labour is typically on a daily basis, self-employment, in agriculture or otherwise, has many uncertainties and a high degree of seasonality.
- Each transaction is also of low value.
- Credit requirements and deposits also tend to be of low value.
- Few assets.
- Poor records of the assets that they do possess.
- Highly time constrained, cannot easily take time out during peak hours.
- Credit requirements are mostly for non-productive consumption purposes.

Government policies so far have had some success in reaching out to underprivileged, but never has it been enough. Even in Brazil where Bank Correspondents are considered to be most successful, users tend to be those who receive welfare payments, or use it for utility bill payments etc. Only a minority of the users use services such as savings deposits etc. Despite more than three decades of microfinance institutions operating in South Asia, their household penetration has not increased beyond 3 percent.[13]

So what is the problem? Formal credit organizations require some appraisal of credit worthiness. Lack of assets, missing records, irregular incomes and transactional history, loans for consumption, all conspire against formal sector credit – whether it is given directly by banks or through entities such as Bank Correspondents. That leaves network-based credit mechanisms such as those followed by self help groups (SHGs). The problem here is that of stability of community based networks. Traditional communities are being weakened rapidly with migration and rapid economic growth. Multiple credit from multiple networks, high cost of credit, interest rate arbitrage, dependence on subsidy or benefits from government are some elements affecting their ability to provide credit universally. SHGs and MFIs do have a long term role, but they have certain weaknesses that will prevent them to serve the needs of the underprivileged universally.

Granting of credit requires that the borrowers have the ability to repay. In the absence of adequate collateral, or organised sector regular employment, a history of transaction becomes critical. Given that the poor are typically employed in the unorganised sector, transactional history is missing as well. Electronic transactions have the great advantage of being recorded and logged and easily accessible. With the Unique Identification(UID) project on track, such transactional history can easily be accessed for each citizen. Moreover, modern analytic methods further enable the identification of economic

[13] Gonzalez and Rosenberg , 2006, "The State of Microfinance – Outreach, Profitability, and Poverty: Findings from a database of 2600 microfinance institutions", mimeo., CGAP, World Bank.
(http://info.worldbank.org/etools/docs/library/232702/Rosenberg_OutreachEfficiencyProfitability.doc)

relationships that the prospective borrower typically has and such information can be shared with prospective lenders.

Focusing on transactions where transferring cash is vital but entails high transaction costs for the poor is the best way to bring people into the fold of the modern financial system e.g remittances to villages, business payments (about half of all Indians are self employed, a percentage that is much higher among the poor), insurance payments, salaries and wages for schemes such as NREGA etc.

> "As more people become connected to the network, the value to each individual of acquiring a mobile phone increases, as there are more people who can be called. A similar effect is to be expected in terms of m-transactions and if so, it is at the point where network effects are triggered that we will see truly transformational impacts. Before any such point is reached, the role of financial and telecoms regulators will be key." Nick Hughes, Head of International Mobile Payment Services, Vodafone in "The Transformational Potential of M-transactions", Policy Paper Series, No. 6. July 2007.

The above discussion underscores an important component of our argument – that day to day or irregular e-transactions will enable greater access to financial services. The second component of our argument is that e-transactions do not necessarily require a bank account.

Experiments on financial inclusion through digital payments have been successful in many parts of the world, with significant impact on financial inclusion. There are various models e.g. M-PESA, G-Cash, ITZ Cash etc. that work through the Internet, mobile phones, agents, POS terminals etc. and allow consumers to make retail transactions in a secure and convenient environment.

Mobile density and broadband connectivity are rising in India; the wireless subscriber base has crossed 525 million[14]. Under the government's national e-governance plan of Common Service Centers more than 50,000 centers have been set up[15]. Payment systems that use this growing network will be in a position to reach the masses that have so far been excluded from the formal banking system.

But it is important for retailers to connect with these payment systems in a way that allows the spread of the service amongst low income unbanked consumers. For instance, in 2008-09, more than 40 million railway tickets were booked online, a 130% rise over the previous year[16]. Cash cards accounted for 26 percent of the online business of more than Rs. 450 crores in August 2008. [17] The average amount transacted was Rs. 878. The typical customers for cash cards are those who do not have credit, debit cards, or net banking facilities, those who are not potential bank customers. They can, however, use POS terminals to purchase cards and make retail transactions in amounts as small as Rs. 100. It is for users like these that e-payments can prove to be a boon.

In other words, even if regulations limit provision of credit to banks, they need not limit provision of electronic transaction services to the banking sector alone. Till very recently this was a critical issue, however, recent announcements by the RBI following the Payments and Systems Bill of 2007, have opened the sector for non bank entities, loosened their coverage to include semi-open systems, and increased the amounts that can be transacted. In the space of electronic payments Indian financial regulation is perhaps the most advanced among all countries of the world.

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[14] TRAI data as on 31st December 2009.

[15] December 2009 http://www.mit.gov.in/download/csc130110.pdf

[16] http://www.medianama.com/2009/10/223-130-rise-in-online-ticket-sales-for-irctc-in-2008-2009/

[17] Medianama September 8th 2008.

On the financial regulation space, we do not believe any more loosening is desirable or possible. The RBI has taken a highly pro-active stance as reflected in its order entitled "Issuance and Operation of Pre-paid Payment Instruments in India (Reserve Bank) Directions, 2009". But despite this highly liberal take at the regime governing electronic transactions, the MSPs have not followed up by loosening of their highly constraining practices. Indeed, the last bottleneck in enabling widespread access to such electronic transactional services is in the domain of telecom industry.

5. The MVAS market space

Of all the electronic transaction delivery mechanisms the mobile phone is by far the best candidate for providing a cost efficient pipe to masses. It is here that policy attention now needs to be focused. The last component of our argument is that the mobile phone is an unparalleled tool to provide electronic transactions, it is too important to be left solely in the hands of the MSP.

At the core the MSPs provide the consumer with a service that transfers data packets from one instrument to another. Whether it is voice or data, the conversion from the input to data packets and back to the output mode is done at the level of the instrument. We therefore argue that the MSP is in effect providing a pipe to the consumer, and charges for its services of transferring data-packets from one instrument to another. This is an important characteristic of the MSP. All other services that it provides such as access to the Internet, MVAS (Mobile Value Added Services), etc. are add on services that are in many (though not all) cases tied to the main service of enabling the transfer of data packets.

The MVAS market, which includes financial transactions, has grown sub optimally in India. The share of VAS revenues is barely 10% after a decade of introduction of such services – the bulk of it being person-to-person SMS. In China and Japan, VAS revenues account for about 30% of the total revenues, in Europe they contribute around 20%.

Firstly, despite the increase in the range of VAS services on offer in India in the last decade, the usage on a per user basis has not increased, and may in fact have fallen. Second, the problem is systemic, not limited to a few operators. Third, most MVAS are concentrated on entertainment, few other options are available eg. social networking, education, health, employment. Even entertainment services are mostly consumed by urban youth, with limited usage among higher age groups and in rural areas.

MSPs in India tend to keep a high share of the revenues, 60% - 70%, content aggregators receive 15-20% and content providers 10-15%. Where intellectual property rights are involved, the share to content or financial service providers is larger (around 35-40%), but since this includes compensation for IPR, the actual share to content providers remains low. The entire revenue from P2P SMS goes to the operators and revenue sharing is only relevant for the remaining 60% of business, though each operator has a different revenue sharing model. Moreover, content that is sold more gets the same share as content that interests a limited market. The prices to the consumer are also rarely determined by the content provider. This practice is typical to India – in Europe, Japan, Korea etc., the share of the MVAS content provider is far higher at around 70%. They also have greater freedom in choice of content, software or services that can be loaded on the mobile.

Moreover, there are (admittedly un-proven) claims of billing and revenue leakages between the operators and the content providers, lack of transparency in statistics of content transactions, efficiency in settlements, of credible systems to address disagreements and grievance redressal mechanisms. Further, when information systems connecting the end user, operator and content provider are not in place, it is difficult to keep track of the revenues accrued and actual and the optimal potential of earnings is not achieved. Content providers (that could include financial service providers) are at the end of the stream and unless they have a system of validating usage, they must be content with the billing

accounts given to them by the operator. Delays in payments compound the problems, especially for small VAS providers. This problem would also affect SHGs, community based financial services, and small NGOs in providing innovative solutions.

Flexibility in billing models are also crucial – whether the consumer subscribes to a service or whether content can be provided on pay-as-you do principles – currently such models are offered to only a limited set of larger content providers. Typically the MSPs are not built to address the requirements of a small entity providing such services or piloting innovations.

Further, and this is significant given the nature of electronic transactions, the MSPs do not share information on the type of mobile instruments being used by different types of consumers. This affects the development of software that is in line with technical specifications of the instruments being used.

The point being made is that there is a market failure in the MVAS segment that is a result of bundled services. Competitive pressures have not been generated adequately where-in the MSPs compete for better content and services that can be loaded on the 'mobile pipe'. This failure is also affecting the progress of the financial transactions on the mobile space.

Greater entry of transaction service providers needs to be enabled by a range of changes, summarized as follows:

Short Codes: Unique for each Content Provider and Universally Accepted by all MSPs: A short-code assignment system needs to be put in place that is integrated across all operators. That is a single number should be assigned to every content provider, and this code should work across all MSPs whether they are GSM or CDMA, or for that matter whether the service is 2G or 3G. This would be an important shift from the current system – the short code needs to be content/service provider specific.

For a country such as India with a highly heterogeneous population with highly varying tastes and preferences, a large range of content and content providers would need to be accommodated. Therefore, adequate numbers of short-codes need to be made available freely and fairly. This would entail certain one-time costs for MSPs to shift to the new system.

Building Transparency on Users and Usage: For a level playing field, all information that is available to the MSP on users and usage should be made available to the content providers as well (subject, of course, to privacy considerations). Information on user, handset, transactions that is available with the MSPs need to be transferred to the content provider. Typically larger content providers and aggregators are able to negotiate better deals with the MSPs. Information on such prices needs to be openly available in the industry.

The sharing of information in a free and fair manner is one of the most important aspects of a vibrant industry. Such information will enable greater investment, better and more appropriate design, and better targeting of content. Since the credibility of information is a key issue, auditing of this information sharing process by external entities can create such an environment.

Infrastructure Improvements and Better Integration

- Infrastructure issues such as bandwidth congestion are set to clear soon once the spectrum allocation is sorted out.
- The lack of a digitised map is constraining growth of location-based services. A coordinated approach will help accelerate the development of an exhaustive all India digitized map.

- A high level of integration between the MSPs systems and the handset can ensure the smooth delivery of a range of MVAS options. This requires that hand-sets be well integrated with the MSP through a standardized system.
- Some MSPs and content aggregators claim that they lack built-in software that enables generation or sharing of information on content specific usage. Such information systems that are integrated across different players should be a precondition for entry into this market.

Greater, Flexible and Simpler Revenue Sharing: The broad principle here should be that the MSP is merely a facilitator of financial service/content provider-consumer interaction. The provider needs to have the flexibility over pricing of his content and the manner in which it is implemented. The MSPs need to provide

- separate pricing for the various services rendered. For instance, the MSPs need to separately report charges for packet delivery, platform, marketing costs, and various other items.
- flexibility to the service/content provider to choose only those items which he desires.
- the service/content provider with the flexibility to adequately price its product.
- the content provider an option to chose between (a) payment on a rupee amount per unit/packet, and (b) percentage of revenue sharing basis, or (c) a one time single user charge.

Other

- Authentication standards for downloads of content need to be set up and implemented across the board.
- Security of transactions need to be encouraged through proper identification and transactional cross-checks.
- The universal acceptance of IPR and an industry backed monitoring system also needs to be put in place.
- MSPs need to work with handset manufacturers to create certain industry standards that incorporate local language options.

The solution to financial transactions on the mobile pipe lies in the realm of ensuring broad principles of transparency, flexibility, coordination, and fairness to all concerned. If industry cannot through collective action create such an environment, then regulatory and policy oversight become necessary to achieve these ends. This has to be done in both the financial as well as in the telecom space.

6. Conclusion

Despite decades of progress in the financial systems and markets in India, the masses continue to transact in cash and remain outside the scope of the formal financial sector. There is a vast and diverse group of people whose financial needs are going unmet – marginal farmers, agricultural labourers, migrants etc. Their cash flows of income, savings and consumption are of low levels and often of uncertain, irregular nature, making them unattractive clients for the formal financial sector. Yet, bringing the poor and poorest into the system is an imperative for achieving inclusive growth.

For long policy makers have emphasized the role of the banks, even though it is clear that market failure has arisen in meeting the goal of financial inclusion precisely because of a mismatch of the needs of the formal financial sector and the low income consumer. In the last two years, though, there has been a welcome shift with the RBI repeatedly making it clear that if banks fail to deliver on the financial inclusion front, a non-bank led model will be put in place.

Looking ahead, there is significant activity expected in the m-payments sphere. An Inter-Ministerial Group for Financial Services on Mobiles set up in November 2009 is on track with formulating guidelines for further progress. The Group has focused on facilitating the

management of large number of small-value accounts and micro-transactions involved in the delivery of basic financial services. Of all the possibilities of electronic transactions, the mobile is the most suitable candidate for ensuring rapid growth of inclusive services. It is critical to address the issues that have constrained the growth of MVAS, as these will be the key to enabling financial inclusion in the real sense. It is here that TRAI and the telecom industry have a large role to play- create a data-friendly environment by improving competitiveness in the VAS market and incentivising innovation.

Clearly, the intent to cater to the needs of the poor is there; if all agencies and regulators work in tandem, the next few years could well see a dramatic transformation in the way majority of Indians make their financial transactions. To sum up, the RBI in its order of April 2009[18] has already created an environment that facilitates an enabling regime and a level playing field for all players, bank as well as non-banks. The Mobile industry and TRAI now need to take up the baton that will finally bring in true financial inclusion.

[18] Amended in August 2009 to allow non-banks to issue pre-paid financial instruments

"Behtar Zindagi" – Empowering Rural Lives

Sudhanshu Jain

Abstract:

The paper presents a mobile Interactive Voice Response service (IVRS) system -**'Behtar Zindagi',** dedicatedly designed to empower the rural community of the country. This mobile service on regional voice delivers Information on improved Package of practices in Agriculture, Free Commodity Prices (Mandi rate), Weather Forecast & Agromet advisory, Advisory for Fisherman & management of Inland Fisheries, Information on managing Livestock, Advise on women & child Health, HIV & STDs and towards reducing mortality rate, Rural Finance & ongoing Govt. schemes, Education & Self employment options in rural sector

Mobile, gradually has become the only medium in India to reach the unreached. It is more powerful than the Internet ever was. It has greater reach and is convenient to use and needless to say that it has a huge potential to touch the rural population. No one needs any training to use it even being literate is not required. All you need to know is how to talk, and how to hear. The 'It' thing that we are talking about here is nothing other than a Mobile and that is where the power is which is going to bridge the great divides that exists in our surrounding.

But is that potential being explored? If we were to have a look at Handygo, the answer to that question is YES and although it is just a starting but at least it has begun and is already creating waves.

With rural mobile tele-density still around 18%, the need today is to design sustainable and robust revenue streams through mobile users who would be joining the approaching rural mobile revolution. This calls for expanding the horizons of the mobile as a communication device and using the same as a tool for Empowerment and Social upliftment by introduction of innovative mobile applications and services for Inclusive Growth and Sustainable Development. By 2012, 60% or approx. 400 million of India's projected 650 million total mobile subscriber base will be rural. With saturation in urban mobile value added service (VAS), growth in mobile penetration, awareness and need for relevant and quick information, VAS market stands firm and promising in rural part of the country.

Having strong presence in VAS industry and in urge to enter the rural market with a high utility based value added service, Handygo's product team came up with the concept of **"BEHTAR ZINDAGI"**, an exhaustive regional info based rural interactive voice response service on mobile. After the conceptualisation of the idea, along with the help of rural experts, NGO activists, agri-consultants, Sarpanchs and agricultural university students, a detailed research was conducted in parts of UP, Bihar, Rajasthan, Andhra Pradesh and Punjab to understand the dynamics of the rural and to decide upon the service incorporations. Based on the inference of the research a detailed outline of the service was designed and the in house team started the content development for "BEHTAR ZINDAGI". After the company's extensive research before extending its hand out to the rural community, the team shortlisted eight areas including education, health, rural finance, weather, fisheries and others. It was then Handygo came up with this

community service for rural. **'Behtar Zindagi'** is a mobile Interactive Voice Response service (IVRS) dedicatedly designed to empower the rural community of the country, this mobile service on regional voice delivers:

- ☐ **Information on improved Package of practices in Agriculture**
- ☐ **Free Commodity Prices (Mandi rate)**
- ☐ **Weather Forecast & Agromet advisory**
- ☐ **Advisory for Fisherman & management of Inland Fisheries**
- ☐ **Information on managing Livestock**
- ☐ **Advise on women & child Health, HIV & STDs and towards reducing mortality rate**
- ☐ **Rural Finance & ongoing Govt. schemes**
- ☐ **Education & Self employment options in rural sector**

The content in mobile service named "Behtar Zindagi" is customized state wise across segments and is available in 20 regional languages to make it understood and acceptable across the country. Through this rural initiative, the company is poised to reduce the dependency of rural people on any middle man for basic information. The service can simply be accessed by dialing the number 556780 (toll free) from mobile. The service consists of more than 15,000 regional voice prompts, providing a vast variety of information that would lead to empowerment and will help rural masses to head towards a better life -**'Behtar Zindagi'.** The content development and incorporation in Behtar Zindagi comprises of a dual approach – (1) in house development of content on improved package of practices in Agriculture and (2) compilation and framing of content from the raw data received through various alliances which includes Govt. bodies and other expert agencies. The recorded audio content undergoes a rigorous testing and quality check before it is made live for the users.

The Weather based service is primarily for the farmer community and provides

information on selection of crops and their varieties, proper sowing time, and other weather based farm decision making. It is basically aimed to minimize the crop losses due to adverse condition, improper animal health and other agricultural factors which are directly or indirectly affected by weather. In weather based advisory, the information delivered mainly consists of all the weather sensitive agricultural operations from sowing to harvest, weather alerts and weather based animal advisory. The relevancy of information is supported by Indian Meteorological Department (IMD) which has a strong backup support with the state agricultural universities and ICAR institutions. The service delivers data for defined 128 AMFUs covering 596 districts across states. To make the weather services more users friendly and diverse, the information is provided in regional languages.

Agriculture is the backbone of Indian Economy. About 65% of Indian population is dependent on agriculture for their livelihood and it accounts for around 22% of GDP. Agriculture provides not only food but also raw materials for manufacturing industries like textiles, sugar, vegetable oil, jute and tobacco.
Agriculture sector has strong forward and backward linkages and its performance affects each and every sector of the country. As India is a land of diversities and agriculture here displays the similar character therefore, Behtar Zindagi provides state-wise information on package of practices for all the major field and horticultural crops based on the varied agro climatic zones. This information includes: **climatic conditions and soil type -** India has fifteen different agro-climatic zones, therefore there is varied agricultural production from tropical to temperate crops, **Seed varieties** - Seed is a critical and basic input for enhancing agricultural production and therefore knowledge of different seeds in different agro-climatic regions is necessary, **Seed menu -** Appropriate spacing and pit size is important for each crop so as to avoid any harm to the production and to get uniform and healthy growth, **Fertilizers** - High crop yields cannot be obtained without applying sufficient fertilizers to overcome existing deficiencies. Therefore, right quantities of the right kind of fertilizers at the right time at the right place should be applied to ensure maximum profit, **Irrigation** - Most of the parts of India do not receive rain throughout the year and sometimes it is quite insufficient and it is neither uniform nor certain but it is the most important input for agriculture and vital for food security, **Pesticide and Weed Control** - Approximately, 30% of Indian crop yield potential is being lost due to insects, disease and weeds which in terms of quantity would mean 30 million tonnes of food grain. Right quantity of Chemical pesticides safeguards crops and improve farm productivity, **Harvesting and storage -** Crops are harvested timely to avoid losses by decay, attack by pest and insects, birds, etc. Timely harvested crops and safely stored crops help in maintaining the crop quality and yields better income. This farmer friendly service gives information on all the major crops categorized under following heads:

Field crops - Rice, Wheat, Sugarcane, Pulses, Cotton, Jowar, Bajra, Ragi, Maize, Gram
Vegetable crops - Cauliflower, Onion, Cabbage, Brinjal, Potato, Tomato, Bottlegourd, Pumpkin

Fruit crops - Mango, Banana, Sapota, Acid lime, Guava, Mandarin, Papaya, Pomegranate
Spice crops - Cloves, Cardamom, Cinnamon, Cumin, Fenugreek, Fennel, turmeric
Plantation crops -Tea, Coffee, Coconut, Cashew and many more.

Apart from the information on crops, this section of the service also educates farmers on **best practices**, these are agricultural allied practices to improve the farm income, involves recent technology and integrated farming system. These allied activities can be carried out separately or it can be done along with main agricultural activities like bee-keeping, sericulture, lac culture and mushroom cultivation. Suggestions for increased and healthy production through use of recent technologies like SRI (System of Rice Intensification), Green House technology, Bio-gas Plant, vermi composting and farm

mechanization have been well incorporated in the service. Farmers can best utilize their land and can get rid of farm income loss by adopting Integrated Farming System where two or more enterprises can be practiced on the same farm. In this case if farmer's one crop gets destroyed the loss can be compensated with other enterprises.

Other than this, Information on complete crop life cycle (Field Crops, Vegetables, Fruits, Flowers and Spices) and other Agricultural Best Practices is the important part of the service delivery. This section of agricultural service advocates on:

- ☐ Safeguard natural resources
- ☐ Share knowledge regarding best farm practices
- ☐ Build local access and capacity
- ☐ Enhance agricultural output/rural output
- ☐ Enable access to markets

India has vast resource of livestock and poultry, which play a vital role in improving the socio-economic conditions of the rural masses. India has the largest livestock populations in the world. It has 57 percent of the world's buffalo population and 16 percent of the cattle population. It ranks first in respect of cattle and buffalo population, third in sheep and second in goat population in the world. The livestock population shows high degree of diversity in its composition. Out of total livestock in the country, 38.2 percent are cattle, 20.2 percent are buffaloes, 12.7 percent are sheep, 25.6 percent are goats and only 2.8 percent are pigs. All other animals are less than 0.50 percent of the total livestock. The country has 97.92 million buffalo population. As per the figures of 2003 livestock census India has 187.38 million cattle out of which 22.63 million were crossbred. The states of Tamil Nadu, Maharashtra, Kerala, Uttar Pradesh, Karnataka and Punjab account for about 60 per cent of the crossbred cattle population. Although 70% of India's rural population owns cattle, milk yields are abysmally low due to poor quality stock.

In order to bring the rural community a step closer to the real and relevant information regards to this important aspect of rural life, Behtar Zindagi provides guidance towards Cattle, Sheep, Goat, Pig, Camel and Poultry in alliance with its partner institution. The key areas focused in this regional voice based service are - the disease of different animals with symptoms and details of their cure and vaccination. This section includes detailed information on Foot and Mouth Disease (FMD) in Cattle. Parasitic Disease, Bloat, pneumonia in Goat, Poultry information on Broiler and Layer farming and details of its diseases and cure. It also includes nutrition management for livestock like Azolla fodder preparation and its efficient use. The key focus areas are basically related with nutrition and disease management of the livestock. Also, tips on proper milking & care of breeding animals play an important role in updating the rural community with modern methods of managing livestock health.

Animal Husbandry & Dairying is regarded as a prime source to create the employment in rural areas all round the year. Dairy farming, sheep and goat rearing, poultry production, pig farming rabbit rearing are the alternate sources of mix farming. With our initiative, we educate the benefits of these and make people aware with the employment opportunities for the farmers as well as land less labourers who can do this job themselves or it may be possible to employ the young and the female members of the family as a side business.

Important concept like livestock integrated farming system such as Poultry-Fish Farming, Cattle-Fish Farming, Duck-Fish Farming etc which has immense growth opportunity in rural areas and considering the benefits to the rural community with such practices, this has become a major focused area under the information delivery on

livestock.

Coastal Fisheries Advisory is a unique initiative under this voice based service for the fishermen of India and spans all along the coastal regions of Arabian, Indian ocean and Bay of Bengal covering all the states like Maharashtra, Gujarat, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa and West Bengal. This specific vertical has been introduced keeping in mind the unpredictability attached with the fishing trade and to ease the navigation in the vast coastal waters.

Using this service, the fishermen can find out about the Potential Fishing Zones (PFZ) ranging from 277 nodes across 8 states, wind speed, wave height, Cyclones and Earthquake Alerts in the oceans along with the weather suitable for fishing. The information delivered through this service is technically supported by Indian National Center for Ocean Information Services (INCOIS). Once the data is received, it is processed by in-house experts & researchers and then the final information is disseminated in the local regional languages to the fishermen. The information for fishermen is disseminated district wise. This service suggests fishermen where to fish, when to fish i.e the potential fishing areas and suitability of weather to enter the sea. This specific information on PFZ is highly dynamic in nature and is updated thrice a week and the information on wave height and wind speed is updated on a daily basis.

An additional intent of this service is also to impart knowledge to the fishermen community, processing workers, technicians etc about fish quality management, conservation of fish resources and sustainable fishing. Fishermen from all said locations can dial 55678 and get access to the service thereby minimizing risk and increasing their productivity.

The cultivator's poor economic condition resulting in distress sale of agricultural produce is perhaps the foremost cause of defective marketing, particularly in case of fruit and vegetable marketing. Therefore, if the farmer's share in the consumer's price is inadequate he will not be encouraged for further production.

As a step towards globalization of agriculture, Behtar Zindagi service has initiated to bridge the gap between the commodity price and Farmers. This has been done with a view for reduction of distress sale. The main advantages for free mandi price on mobile accrue to the farmers as they have a choice to sell their produce in the nearest market at remunerative prices. This service is an effort to bring rural people in the main stream economy. The real challenge was data updating in real time frame. The information dissemination to the farmers is in different regional languages PAN India free of charge and is updated twice a day. This service covers more than 150 markets PAN India providing price of 7-10 commodities in said markets. The nation-wise information is provided for wholesale produce in respect to sale and purchase of key commodities. The knowledge of price rise and fall of the key essential commodities such as rice, wheat, pulses, vegetables etc plays prominent role for fetching the farmer right price of their produces. Very soon the service will experience delivery of Mandi Prices at the PIN Code level.

While designing the Education Vertical of **'Behtar Zindagi'**, the product team decided to move beyond defining education as just academic learning but defined it as having all content and information which leads to: Improving Livelihood and Transforming Lives. This ultimately, would be an enabler towards empowerment of the Rural community. This part of service comprise of four sections: **Children Welfare** - This section is all about encouraging rural people to send their children to schools. This is done through educating them about state wise Government incentives towards primary education, scholarships and financial incentives for students. **Learn English** - provides an

extensive English Language learning module through which people can learn English through their vernacular language by listening to voice module on their own phone and can practice the same on mobile as well. **Government Schemes -** option to understand and utilize various Government schemes and programs for one's benefit have been well crafted under this head. **Self Employment options –** detail guidance is provided on various self-employment options that can be made available in rural areas like Atta-chakki, Bee keeping, Sericulture etc. under this part of the service. This vertical also educates the users on Energy saving concepts, technologies and their benefits like organic farming, solar energy etc which are specially designed to enhance the daily working and achieve cost effectiveness.

On seeing the increase in number of health related deaths in rural areas due to lack of health awareness, gaps in healthcare delivery, lack of feedback/response mechanism ,'Behtar Zindagi' team took an initiative to enable the rural masses with use of mobile as a medium for improving access to information on health, where distance forms a critical factor. The main focus is on accessibility, affordability, accountability in primary health care information. The health information available on 55678 is **Health related schemes and campaigns** e.g. Janani Suraksha Yojna, Arogya Kosh, etc. **Women Health** especially divided into the adolescence, pregnancy and reproductive health, **Child Health** child related diseases and nutrition, **Common Diseases** Vector borne diseases, infectious diseases and nutritional disorders, **Better Health** Hygiene & Sanitation, Home made remedies and benefits of healthy eating. Apart from all these information, 'Behtar Zindagi' also provides a platform to the rural population wherein they can login their complaints regarding any malfunctioning in the process of health related Govt. schemes and campaigns to which they are entitled. This section of service comes in association with **CARE India** – a leading global humanitarian organization.

The banking industry has shown tremendous growth in volume and complexity during the last few decades. Despite making significant improvements in all the areas relating to financial viability, profitability and competitiveness, there are concerns that banks have not been able to include vast segment of the population, especially the underprivileged sections of the society, into the fold of basic banking services.However, the expansion of financial services to all sections of society (financial inclusion) is important, in order to leverage development and growth benefits.

Let's consider few facts: Barely 34% of the Indian Population is engaged in formal banking, India has second highest number of unbanked households in the world (approx. 135 million), 40% of Indians who have a savings account use it less than once a month. After considering all this, Finance section was designed in Behtar Zindagi. It consists of information on 4 sections- Financial Literacy, Credit Schemes, Insurance Options, Savings / Investment

Financial Literacy provides basic banking & banking-related information. In Credit Schemes, the service delivers the best loan and credit options for the rural consumer offered by a major PSU bank/s. Under Insurance, both agricultural and non-agricultural insurance schemes are provided. Fixed deposits in banks, post-office saving options like NSC/KVP etc. come under Savings/Investment. As, the finance vertical is a new entry in Behtar Zindagi, lot of refinements in terms of content & flow keep is taking place. The team has already started working to introduce Microfinance on the Mobile service, a first of its kind initiative.

Key Features of voice based mobile rural service – "Behtar Zindagi':

- ☐ PAN India presence
- ☐ Information delivery in 20 regional languages
- ☐ Covering a wide range of information touching every aspect of Rural Life.
- ☐ Content sourced from Govt. institutions and State level Universities
- ☐ More than 12 associations towards the service (Govt. & non- Govt.)
- ☐ Giving platform to many Govt. organizations for dissemination of information
- ☐ State level content segregation delivered through regional voice based menu
- ☐ Handset irrespective and 24X7 availability

To design such a service, it is very important that the information delivered to the masses is of higher accuracy and authenticity. To keep the advice and information reliable and robust the project team not only worked towards content generation but made alliances with ultimate authorities & institutions for respective verticals of Behtar Zindagi. The major contributing alliances are:

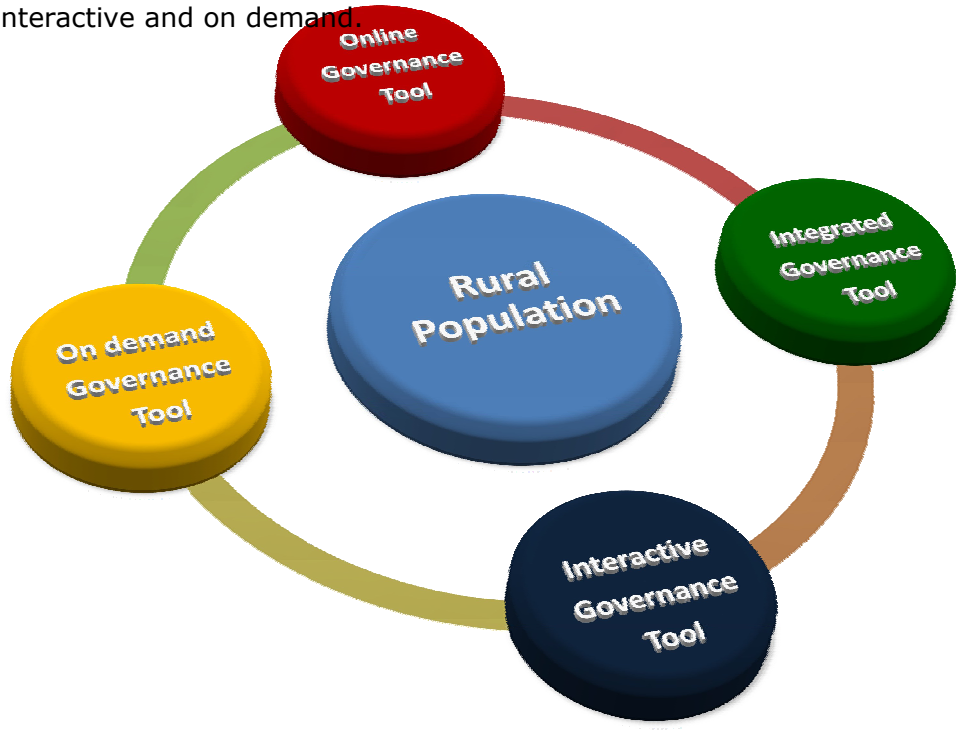
Indian Meteorological Department, IMD, supporting the service for the delivery of weather forecast and advisory. India Development Gateway, INDG is an initiative under CDAC and is extending its kind support towards varied informative content. The fisheries data under this service is sourced from Indian National Centre for Ocean Information Services, INCOIS at Hyderabad. The detailed information on women and child health related areas has been framed by professional from CARE India. Network for Fish Quality Management and Sustainable Fishing, Net Fish is disseminating information on fish quality (tips and advise) through Behtar Zindagi. Eko India financial services pvt ltd and Aviva Life insurance have shown confidence in this rural initiative and have partnered to extend their reach to the rural boundaries. To promote the service and ensure enough penetrated reach association with Haryali Kissan Bazaar (DSCL) came into force wherein the service would be promoted through the HKB stores, students from National Institute of Agricultural Extension Management (MANAGE) and GB Pant University of Agriculture & Technology, Pantnagar got involved at the ground level activity and in the research.

The students from these universities carried out the research project in different parts of the country covering maximum villages in their allocated territories. The research was conducted in different states involving more than 3000 respondents, and was based on questionnaire designed specifically to touch each and every aspect of the rural life and their needs. The major focus of the research was to incorporate more need- based solution & information along with the improvement in the existing service. The findings from the research helped us to understand the need gap and accordingly the team worked on the service modification & enhancement.

The contribution from said alliances is one side of the coin, until the service is promoted in the rural parts of the country the whole effort and the intent behind the development of this unique service would not result in desired output. The challenge ahead was to penetrate deep in the rural pockets and make the community aware of the service and establish its acceptability. The varied characteristics of the service were kept in mind while choosing the most appropriate medium for promotion. In a country like India where print media plays an important role in spreading awareness, Behtar Zindagi was well promoted through both national as well as regional prints like The Statesman, The Hindu, Business Standard, Deccan Chronicle, Economic times, Hindustan Times, Financial Express, Amar Ujala, Dainik bhaskar, Dainik Jagran, Jan satta and other

regional ones. Apart from print media the service is also being promoted through alliances

The next level ahead is to offer a platform on mobile to the rural community through regional voice based service that will make the entire governance system online, integrated, interactive and on demand.



According to the author, the team working on this project at Handygo is a set of path breakers who have embodied the company's philosophy of continuous innovation perfectly by conceptualizing and executing such a diverse and one of its kind voice based mobile infotainment service "BEHTAR ZINDAGI". We are continuously exploring new ideas that will take this service to the next level in terms of not only acting as a platform to deliver information but would possibly take e-Governance to m-Governance and would transform millions of lives. Behtar Zindagi is no more a VAS infotainment initiative in telecom but we look forward to deliver End to End Solutions through Behtar Zindagi.

M-Learning: Mobile - enabled Educational Technology

Divya Datta and Saswati-Saha Mitra

Abstract:

The proposed paper will exemplify the dynamics of M-learning and its pedagogical implications within the Indian rural education ecology. This study seeks to benefit various stakeholders in the education, telecom, rural industry and policy making sectors by providing meaningful insight into the macro and micro challenges and proposing innovative application, service and system solutions to address the same.

Keywords: M-learning, applied innovation, future mobile applications, education, knowledge, literacy, connectivity, rural development, VAS

India faces profound hard infrastructural challenges especially in its villages. Education has been acknowledged as one of them.

About 35% of world's illiterate population is Indian. Despite seemingly optimistic Gross Enrollment Ratios (GER1) being recorded and proactive literacy schemes (SSA2, NLM3 and Mid-day Meal Scheme) being introduced, there is a disparity between these positive indicators and actuality. A high dropout rate of 41.2% is seen at the elementary level. The national literacy rate of girls over seven years is 54% against 75% for boys. In the Northern Hindi-speaking states of India, girls" literacy rates are particularly low, ranging between 33 – 50%. Quality of instruction and learning is low. Students" understanding and application of written and verbal expression, logic and reasoning, numeric and quantitative knowledge is inadequate.

Geographical remoteness and access challenges, regional, gender and socio-economic inequity, poor infrastructure, amenities and non-conducive learning environments, academically inclined content (often in contrast to practical applicability), corporal punishment, apathetic and untrained teachers and theoretical pedagogy, are key causative factors for poor accomplishments in the education sector.

Education in the current scenario should be seen as a semi-hard infrastructure challenge. Of all infrastructure concerns that India faces, education is one that can be rapidly addressed through strong soft infrastructure networks. Compared to highly tangible services like healthcare, finance, electricity, transportation, governance which can be only partially and gradually addressed through soft-infrastructure, education holds a definite advantage.

This is due to the sheer nature of knowledge, by the virtue of it being intellectual and intangible property it can be disseminated through most communication mediums, including mobiles. We have instinctively always looked at education as institutional infrastructure dependant, but looking at it independently opens up diverse platform possibilities, more so now, when societies are increasingly becoming technology trusting and receptive.

An evolution of wireless technology platforms, from addressing community needs to

attending personalized needs, has been seen over the last decade. ITC e-choupals, Intel village Kiosks and Nokia Siemens Village connection; information initiatives for community access, have progressed into individual tailored usage services such as Nokia Life Tools. Consumers seek need and skill based customized knowledge and therefore the shift in platform preferences.

Mobiles hold various advantages as the preferred media for education, they are multi dimensional levelers. They flatten socio-economic hierarchies; counteract competency insecurities, cut across geographies and require minimal hard infrastructure. What makes them the sought after technology for the education sector is also that they are a deep embedded medium of communication in India today, due to increasing tele-density. They are a personalized and non-infrastructure dependant medium, not disrupted much by natural and social calamities; therefore consistent and sustainable. Key characteristics of the media like audio and voice, still and interactive graphics and numerics work naturally well to build accurate phonetics and oral expression, number intelligence, associative, cognitive and logical ability, overall comprehension and application skills. Learning has mostly never been tailored to user needs. Individualized instruction can be easily achieved through mobiles thereby overcoming challenges posed by varied degrees of learner competencies. Since mobiles respect privacy and are nonjudgmental they have the potential to provide skill / need based learning, focused attention on specific areas, extra mentoring and counseling. In case of varying degrees of learning abilities, slow learners can subscribe to elaborate lesson explanations; this cultivates interest in learning, builds confidence and empowers the student.

Mobile - led pedagogy can effectively foster autonomous learning among students. Research establishes that interactive and participatory approaches, lead to practically relevant learning, holistic aptitude building and functional skill set development, thereby furthering valuable application of knowledge.

New service initiatives in Interactive-learning have been made. Nokia Life Tools launched English vocabulary building and test preparation offerings. While this service has overcome comprehension issues, it does not address the holistic tele-learning challenge; services are not adequately contextualized; only mobile-literate people can effectively use services, illiteracy remains unaddressed and scope of the service" value is relatively less within the large rural education ecology. Educomp introduced interactive technologies for classroom teaching. These solutions work well for urban schooling scenarios, but the same cannot be said for rural and peri-urban scenarios; technologically advanced teaching aids that are not immediately scalable, hard infrastructure requirements and technology literate teachers; such pre-conditions make this proposition unrealistic in rural ecologies. IGNOU will also launch vocational training modules through mobiles, though the effectiveness of this service is yet to be seen. While a start has been made, proactive, effective and robust service innovations are yet to materialize within the existing technology.

The true mettle of any technology is realized when it is put under a versatility test. The crux of the issue is exploring and realizing the full possible potential of mobile media technology. Consequently mobiles could be the next education media platform. This can be achieved through development and introduction of innovative and contextualized services that broaden the functional limits of the media.

The proposed paper will present services for M-learning in urban and rural contexts, empowering various stakeholders in the education ecology.

- Educating students, informing and educating parents about literacy and training teachers.

- Enabling self skill building and income generation abilities through „Learn while you

earn" services for professionals.

- Contextualizing learning services for disabled.

The proposed paper will explore, in detail, various new and contextualized service innovations and applications and their potential. Some of these are listed below.

- Do-it-yourself literacy and knowledge kits with handsets, instruction guidelines, subject packages and knowledge subscriptions, in a holistic permutation of video, audio and textual applications.
- Creation of wireless communities and virtual / real study groups within existing rural education initiatives.
- Transferable knowledge credit and recharges, M-knowledge vouchers, subject credits, and credit earning scholarships.
- Interactive educational video games, logical reasoning and problem solving aptitude games.
- Public forum competitive challenges such as subject Olympiads and spelling bees. Disability assistive technologies such as Braille lettered screen / pad phones, audio to text and text to audio applications.
- Preparatory audio recaps and archived lessons. Subject email and SMS subscriptions.
- Subject specific Tele-meets and Live Q & A sessions. Out of the classroom assessment plans.
- MMS live classroom sessions and web and podcasting. Transferable note images.
- Phonetic guides (audio and visual)
- Form sensitive touch-screens for alphabet formation; screens as corrective slates. Virtual scenario building to assess practical application of knowledge.
- Co created knowledge database for teachers and query search service.
- Practical training for „teaching through mobile mediums" for educationists.
- Media multitasking burgeoning and becoming a strong social trend, urban education capitalizes on it, by devising education networks.
- Mobile whiteboards for interactive discussions.

1.0 Educational Context in India

India is an emerging economy whose core strength for the next 25 years is expected to be its youth. The youth (aged below 25 years of age) constitute 41.05% of the overall population. While this 'Demographic Dividend' can yield enormous benefit, it also comes with considerable challenges around the need to prepare the youth with basic education and

employment in order to provide youngsters with the skills that can help them lead productive lives rather than degenerate into lawlessness, illegal activities and terrorism which the subcontinent is already groping with.

The challenge in front of India today is that of providing the fundamental right to education to its next generation. About 35% of world's illiterate population is Indian. Despite seemingly optimistic Gross Enrollment Ratios (GER1) being recorded and proactive literacy schemes (SSA2, NLM3 and Mid-day Meal Scheme) being introduced, there is a disparity between these positive indicators and actuality. A high dropout rate of 41.2% is seen at the elementary level. The national literacy rate of girls over seven years is 54% against 75% for boys. In the Northern Hindi-speaking states of India, girls" literacy rates are particularly low, ranging between 33 – 50%. Quality of instruction and learning s low. Students" understanding and application of written and verbal expression, logic and reasoning, numeric and quantitative knowledge is inadequate.

Geographical remoteness and access challenges, regional, gender and socio-economic inequity, poor infrastructure, amenities and non-conducive learning environments, academically inclined content (often in contrast to practical applicability), corporal punishment, apathetic and untrained teachers and theoretical pedagogy, are key causative factors for poor accomplishments in the education sector.

2.0 Current Educational Initiatives and their Impact

The nature of educational content available in India today is highly diverse. The urban youth has been the prime focus of interactive educational content ranging from educational lessons to game series on DVDs to e-learning methodologies in classrooms like Educomp's Smart Class to interactive programs on Tata Sky. The rural youth on the other hand, can be seen to have access to computers at best and facing a shortage of even a basic instructor at the worst. Such a wide gulf in resource distribution and access, coupled with the considerable price tag of interactive educational services, make existing content and systems unviable for the cause of universal education.

Consequently, the areas of change that have been possible in national education has to do more with the nature of teaching methodology and content type than content representation, interactivity and access. There has been a shift from a Behaviouralist approach to teaching to a more Communicative one and more Indian writings by the likes of Sarojini Naidu, Vikram Seth and Sudha Murthy, have been included to integrate Indian sensibilities in text in order to facilitate comprehension in students. These aspects, however, have very little to do with making the content accessible to all in an interesting and comprehensive manner.

National education, especially at the primary and secondary levels, has also failed to adapt the benefits of diverse technologies that are available today for the cause of education. An evolution of wireless technology platforms and mobile enabled solutions, from addressing community needs to attending personalized needs, has been seen over the last decade. ITC e-choupals, Intel village Kiosks and Nokia Siemens Village connection; information initiatives for community access, have now all progressed into individual tailored usage services such as Nokia Life Tools but the mechanisms of none of these services can be said to have been exploited as richly as they can be for the purpose of making education accessible.

3.0 Innovating for the Educational Segment

It is in this context of a surplus amount of technical capacities being existent that can be

deputed to the purpose of education, that this paper on M-learning now proposes to explore various interactive ways in which innovative educational tools and methods can be made accessible to the masses at effective value points.

3.1 Self Learning

Students" comprehension and application of subjects when taught well initially, is mostly a self-regulatory process. There is evidence that self teaching and learning abilities in lower age groups are very high. The natural inquisitiveness and curiosity of today's youngsters can work to the advantage of M-learning. Tapping into natural propensities for knowledge acquisition, major parts of the learning process can be effectively self directed by student groups themselves with light teaching and the provision of the requisite material for self practise.

To enable such self learning, our first proposed solution is 'Do-it-yourself Knowledge and literacy packages. These self learning kits can be customized for diverse grades of learning – from basic primary education to middle and high schooling and for self skill building purposes as well for the 'self scaling sector,' that is, lower than class ten pass but with positive motivation around adult learning. Such a kit would ideally constitute of a usage instruction guideline, knowledge subscriptions and subject packages, all of which can be delivered on mobile.

A visually intensive diagrammatic guide for package induction, handset usage and application introduction and navigation can facilitate clear communication and independent usage of the kit. These guides can be parent assistive when learners are too young. A visual index with the service will provide a guide for ease of use navigation and understanding. An audio visual induction of the subject will be done for the student around the stipulated syllabus. Subject content will be disseminated through dynamic applications which will be in holistic permutations of video, audio and text.

As discussed earlier in the abstract, natural characteristics of mobile media such as audio and voice, still and interactive visual graphics and numeric"s work well to build accurate phone tics and oral expression, number intelligence, associative, cognitive and logical ability, overall comprehension and application skills. The potential of these features has hardly been exploited adequately for the purpose of education.

This proposed self-learning kit utilizes these basic features of most mobile phones today to build customized applications for educational technology.

Audio books and lessons will be introduced and chapter-wise transmission will be conducted. Rhymes, jingles and poems will form a part of the syllabus. Audio dictionaries, thesaurus and grammar correction applications will facilitate a stronger grasp over the language. Audio visual phonetic narrative applications will help build verbal articulation. An audio record, speech recognition and playback corrective mechanism can be easily used as a testing application for improving reading and pronunciation. Students will read with much less hesitancy and more enthusiasm. With an error tolerant and non-judgmental application or device as a listener there will be no intimidating figure of authority; parent or teacher pointing out every slip-up. This would encourage self practice, fluency and confidence.

Numbers and calculations will be shown with corresponding visual representation for better associative understanding. Audio calculators can help in building speed and accuracy in calculation abilities. Speed math and number puzzles, teasers will help build basics that are strong and context independent so that application of theories can be universally relevant. Math concepts such as algebra to logic, applied math to number theory, statistics to geometry can be taught well in a stepwise progression and with visual accuracy and

animation that are achievable even in a simple mobile media.

Case studies, virtual scenario building and story-telling, demonstrations and virtual 3D simulations of content will help in modeling information for effective learning in most subjects. Chapter-wise transmissions in presentation and audio formats can also be done easily. Live classroom sessions can be sent through MMS. Image transmission of notes can be done which can be archived for later use by students.

M-book references, participations in interactive bulletin boards and discussion groups, quick facts and tips and FAQs will also be component parts of this knowledge subscription. Each subject along with subject packages will have on offer, educational gaming applications for learning and testing. Interactive maps for geography puzzles, highlighting topography and profiling landscapes are interesting propositions to learn applicable geography. Visually intensive historical timelines, people, places and events would make retention in history, particularly, high. Dynamic graphs and
speed math games, logical reasoning and problem solving aptitude brainteasers can help in building associative, cognitive and logical ability, overall comprehension and application skills. Textual and audio para building, visual word jumbles and riddles would help build communicative linguistics.

Multi sensory stimulus, as in this case, will ensure focused attention for longer time periods, high retention and holistic engagement of the mind.

3.2 Customized Knowledge

Knowledge is most likely to be retained and applied when it is student-tailored. The fact that mobile content can be dynamically modified and updated quickly, also helps in countering challenges posed by obsolete and theoretical content. The ability to customize learning to the needs of each student has almost always been an impossible challenge for any universal education delivery mechanism. Such a solution, however, can actually be possible today due to the possibilities offered by mobile ownership.

The most convenient way through which M-learning can facilitate customized knowledge is by the simple playback mechanism that can be found in all handsets in the market today. Subject content is accessible at all times and can be repeatedly reviewed for better comprehension and understanding. Revisions can be self-paced. Mobile mentors can send preparatory audio recaps of lessons before exams. Archived audio lessons are accessible on phone. Timed subject specific tele- meets, Live Q and A and FAQ sessions can be held to clarify doubts and practice effectively. Mobile interactive bulletin boards can help in these sessions, where dynamic note taking and summarizing is done and archived. These formats of robust preparations and continuous guidance ensure that subject knowledge is thorough and therefore applicable.

Customized knowledge is also the most sought after post assessment where loopholes in learning emerge. This is a time when mobile mentoring can be made possible wherein, following testing; focused attention on specific areas and elaborate lesson explanations can be prescribed. Personalized coaching and rigorous tele - meet participation and frequent testing can be done. Challenges posed by different degrees of learning ability versus the inability of current standardized instruction formats to meet the needs of different learners can thus be overcome by such simple mechanisms of repeat exercises, practising and doubt clarifications.

3.3 Knowledge Testing

The rationale of education is not limited to learning but also retention and realistic

application of knowledge. In order to achieve testing that is ongoing, immediate and resonant with the needs of the learner, one can propose out of classroom assessment formats.

Our first proposed Multiple Choice Question format of testing, is easy to achieve through existing SMS technologies. Ten or more questions can be asked in an extended number of smses and learners will only have to click on their answers before sending the questionnaire back to the centralized content server for review and correction. Specialized cost structures can be introduced for the extended smses.

Secondly, another proposed solution around testing can also be audio exams that are in viva formats. The viva could be either live tele - vivas that can be conducted on call or recorded submissions using the mobile recorder, the audio file from which can be shared using data transfer channels.

Thirdly, for more exhaustive written exams, answer sheets can be clicked through camera phones and images transferred for collective checking. Each community schools can have a stipulated ratio of inexpensive smart phones to students and outside community examiners can be brought in for fair invigilation. Timings for the exam can be self selected and tests can be time bound and held in local community schools without having to travel the distances to bigger city examination centres.

Such amalgamation of voice and image based formats have multiple advantages. Firstly, students develop fluency in communicative languages which is one of the biggest challenges for Indian learners today with their heavy theoretical focus. Secondly, knowledge across theoretical subjects is expressed orally requiring students to prepare more exhaustively since the exam tests their understandings more than memory. Lastly, since such testing can also be done through mobile applications, virtual scenarios can be narrated through audio. Students are provided with mini visual case studies and their comprehension of the subject and its fundamentals is assessed. This de- contextualizes their previous learning and assesses the learner on practical application of fundamentals within a wide variety of situations. Finally, such methods also reduce the stress of travel and infrastructure which students in India continue to face today when they have to sit for an exam outside their own community. Such testing mechanisms, thus not only enable vocal participation, expanding knowledge of the curriculum and reducing effects of learning by rote, but this also enables the learner by making available an infrastructure that is always there and for which they do not have to go additional stress above and beyond that of exam worries.

3.4 Mobile Libraries

Successful education is dependent not merely on what is taught and how well is it taught but also on how what is taught enables the learner to seek additional information on their own. The interrogative abilities that lead to a researching interest have very little scope in the context of primary and secondary education in India. This is often, largely because of a gap in the curriculum which is then justified by infrastructural challenges of not having libraries. Our proposed solution to this scenario is that of M-Libraries. An M-Library is a system whereby all students can download content from online educational portals and store them on mobile or burn them in DVDs for future use.

The technical requirement for this is an average to low cost handset but which could progressively have greater memory capacity. The operating mechanism of the service will require an educational board to prepare a long list of additional reading and reference materials which they can make accessible to schools in a document. The school can distribute this to parents for them to consult with their children and order as and when required in the academic year. Going digital with the content, has several positives. Firstly,

parents do not have to make a high down payment on books which the children may or may not use through the year, resulting in wastage. Secondly, such books being low in size, can be stored more easily than proper books. Thirdly, being lower in the cost front, more M-books can be purchased than actual books.

The solution also has several clear benefits for authors. More authors can be enlisted and become accessible to students without challenges of lack of delivery mechanisms. Each author has the choice of whether to publish in hard format or not. Not only do they save on print and distribution costs, but by going digital, each author will also be able to reach out to an unprecedented number of students which current mechanisms cannot even make possible. Fears around peer sharing can
also be allayed by integrating security mechanisms that prevent sharing through Bluetooth but sharing via content send should be allowed to increase revenue mechanisms.

3.5 Wireless Communities

Media multi-tasking is a strong social trend; both urban and rural communities are increasingly becoming technology trusting and receptive. Education should capitalize on this fact and devise strong soft educational infrastructure networks. In the context of mobile enabled education, a proposed solution is the creation of wireless education communities. Firstly virtual and real study groups can be created; these can constitue same grade peers or senior and junior grade peers. Public forum competitive challenges through mobiles such as subject Olympiads, spelling bees and speed educational gaming can be conducted within these student networks and knowledge credits on performance evaluation. Same grade peers could dynamically work together as projects teams, hold team discussions and participate in tele-meets as well as exchange notes and study collectively. Senior grade peers can play partial mentors and teach junior grades through mobile mediums. This arrangement will have two expected outcomes; firstly this arrangement will compel seniors to look at the subject in deeply explorative ways. They will seek to gain a thorough understand of the subject to effectively teach it and therefore will add to their own detailed and
comprehensive learning. Secondly, since a teacher like figure of authority is absent, the juniors" will be relatively uninhibited to ask questions and probe newer possibilities into the subject. This format could also be an effective way of testing senior students on their understanding of the subjects. Also since the teaching will happen through a mobile medium with, predefined content and applications scope of subjectivity will not be much.

Secondly, teachers teaching teachers wireless communities can also be created. Within these wireless communities educationists are provided with practical training and internships for teaching through mobile mediums. A district to block or an urban to rural knowledge transfer system can be created within these communities. One urban and one rural teacher will be in a peer or mentor and protégé roles; this arrangement will serve in counseling and assistive functions. Retired teachers could contribute in this arrangment as well; their knowledge and expertise gained over the years could be capitalized on by this format, without them having to travel and be physically present to teach. Teachers will build a centralized co-created knowledge database with a query search service accessible through mobiles. While this database will have syllabus content and archives, it will also be dynamically updated with urban and rural information that can be shared and brought together for the greater benefits of their respective students. Audio and Video Blogs will be uploaded, streaming of classroom live transmissions could also be done. This arrangement will
facilitate sharing of innovations in pedagogy and aids in educational technology. Teachers could also earn scholarships; self skill building and M-teaching training subscriptions and credits, on students performance evaluation.

3.6 Gifted Knowledge Recharges

Transferrable knowledge M-vouchers, credits and subscriptions can be gifted or distributed. The content in these recharges facilitates flexible learning without restrictions in terms of timings and tests, unlike in the case of literacy kits. Transfer and distribution mechanisms of these can be very diverse. Community Schools could get a subject wise credits, which they could then distribute to eligible students in their purview, regardless of enrollment. Upper and Middle class can buy knowledge credit and pass it on to their domestic helps, vendors, drivers, low income group acquaintances to teach their children. For the self scaling segment, the community can fund knowledge credit for self skill building. Knowledge credits act as a advertisement for the self learning kit. They generate the initial interest and users are motivated to self learn in larger sense.

4.0 Solution Viability for Interested Stakeholders

The M-learning based solutions that have been discussed above are all dependent on existing and available mechanisms. They rely on entry level handsets worth 5000 INR and at the maximum can go upto a smart phone which market specialists" claim will be available within 8000 INR in less than 2 years. Aircel is already directing itself to such directions by launching a full QWERTY phone in 2999 INR in the last week. All these devices are expected to have basic audio recording and hearing facilities, video transmission abilities, GPS enablement and a Hindi - English or local language enabled key pad. Considering that the technical requirements from the devices
that can support such M-learning content, are very basic and do not pose any challenge to uptake, in order to assess their viability further, we now have to further assess these solutions under two other heads- need for additional support infrastructure and costing.

The support infrastructure that these M-learning services require is no more than the basic voice and SMS and MMS channels. It is true that GPS enablement will be a major boost but the activities that one has delineated above can be equally attempted with the basic mobile networks. Within this existing mechanism, certain technical improvements stand to make the user experience of such content rich services better. For example, if the size of smses can be expanded from 140 characters to unlimited but can be charged as per 140 characters without breaking the message up, this will be a significant improvement. Similarly, the evolution of audio blogs, while it exists in recorded customer servicing functions, if expanded to generate real time directional and feedback mechanisms, can also make the community and problem solving services possible without any substantial rework.

Finally, from a value assessment, it is evident that as a nation, Indian parents are highly education oriented and motivated to provide their children with the best options available. Such aspirations, which can lead to consumption of educational content, may be the highest in the higher SECs like A to C but the need for it, is felt much more acutely in the lower SECs like D and E, since education is the only empowering factor that can help them rise above their current status.

Our initial field research with parents of SEC A to E indicate that educational content is actually one of those very few content areas for which there is an unanimous need. Given the challenging context of Value Added Services, where very few content types have managed to capture the attention of the national audience, education clearly emerges as a source of information which is most likely to be pulled by immediate and potential users than having to be pushed by operators. However, educational content comes with a noble perception association.

Parents feel that while M-learning solutions will be much sought after, it is their pricing

which will decide the extent of their outreach. Due to the nature of India's mobile penetration, parents foresee increased consumption. They, however, point out that since education is a noble service, all stakeholders in this domain will be expected to reduce premium pricing. The services also using soft infrastructures and doing away with hard printing and distribution mechanisms, should come within reasonable amounts. Bypassing challenges around acquisition, maintenance and distribution, M- learning concepts should enable the learner to decide what they want to study, how they want to study and how they want to use this knowledge. Encouraging the desire to learn on one's own, making learners more inquisitive, able in decisioning and a proud in success and undefeated in failure should be the aim of M-learning initiatives in order to help shape the nature of Indian education for tomorrow.

5.0 About the Research

Developing ecology for holistic education and to be able to give access to such education to all youngsters, irrespective of their socio-economic background or abilities and disabilities, is a vision statement for CKS. The organization internally funds small grant projects, conducted by its internal researchers as well as other external participants, to try and understand how better educational solutions can be generated for India, given its challenge with literacy. The current paper is an outcome of a research conducted around December 2009, on the topic of the value of education as a Value Added Service and ways in which to integrate new teaching tools into VAS offerings to encourage mobile based education overcoming challenges of pricing, access and remoteness.

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Definitions

1 GER: Gross enrolment ratio is the percentage of the estimated child population in the age group 6 to 14 years enrolled in classes" I-VIII.

2 SSA: Sarva Shiksha Abhyan is a flagship programme of the Government of India for achievement of universalization of elementary education, making free and compulsory education to children of ages 6-14 a

fundamental right.

3 NLM: National Literacy Mission was set up by the government of India on 5 May 1988 with an aim to eradicate illiteracy in the country .It aims to make 80 million adults in the age group of 15 - 35 literate over an eighty year period.

The Key to Inclusive and Sustainable Development in Common Man's Market

Girijesh K. Srivastava, Girija K. Varma, Bhawna Sharma

Abstract:

The paper presents Mobile Intellectual Property Exchange (MiPEX), a system that can provide money-making opportunity to the common man in exchange of their Intellectual Property via mobile telephony. Intellectual property is manifested in two forms: voice (verbal) and data (written). Similarly, mobile telephony is nothing but transmission of voice and data from one source to another. Therefore, if the voice and data being transmitted over the mobile is not just voice and data but someone's intellectual property (in the form of voice and data), mobile will become a money- making proposition, thereby, facilitating two-way flow of money. The MiPEX solution and its business model gives due consideration to all the three inclusiveness parameters viz. financial, demographical and technological inclusiveness.

Exposition

The output of all business activities can be categorized under two heads: products and services. These products and services are in fact solutions to some or other problems. Following are some examples of real life problems and their corresponding solutions:

Problems	Solutions (Product/Service)
Extreme temperature control	Air-conditioner
Storage of perishable food	Refrigerator
Costlier manpower	Outsourcing

Broadly categorised, problems can be either or combination of the following problem-types:

- Social problem
- Economical problem
- Geographical problem
- Political problem

Solving these problems lead to creation of diverse business opportunities which have their own set of problems: Business-problems!

Inclusive growth and sustainable development of mobile telephony is one such business problem that needs urgent resolution for fostering symbiotic relationship between mobile consumers and mobile businesses.

Unlike other business activities which are either product-oriented or service-oriented, Mobile business holds a unique positioning in the sense that it is an amalgam of such

products and services which are mutually interdependent. For example, mobile (the product) makes no sense without mobile (the service) and vice-versa.

Therefore, to propose a framework or a solution for inclusive growth and sustainable development, we first need to identify the underlying problems and challenges.

Understanding the Problem

Having achieved almost 40% tele-density, the Indian telecom industry has come of age and is raring to go for the remaining piece of cake. However, penetrating the remaining 60% market would not be a cakewalk because this portion of market is quintessentially the proverbial "common man's market" or the "bottom of the pyramid", where making a living is more important than making a phone call. Therefore, an inclusive and sustainable solution shall be such that it addresses the financial constraint, i.e. lack of purchasing power, inherent within this market segment. Another constraint to penetration in this 60% market is the demographic profile of Indian population. As per July 2009 estimates, the total population of India stands at 1.17 billion. Of this total, approximately 31% fall in the age group of 0-14 years, which cannot be regarded as potential customers. This implies that only 69% of the population is the viable target market. However, since we have already achieved the theoretical 40% tele-density, the remaining marketable population is merely 29%! This may sound scary to mobile businesses but there is no avail unless we devise some demographically-inclusive mobile solutions that can convert these 31% non-customers into potential customers.

The third and most-critical constraint to developing a solution for inclusive growth and sustainable development is access to technology. As stated earlier, mobile business is a unique amalgam of mutually interdependent products and services. However, the degree of dependency is more on mobile—the products, than on mobile—the service. Therefore, an ideal inclusive and sustainable solution shall be such that it takes into account the technological common denominator of mobile—the product, i.e. technologies supported by those mobile handsets which the common man can afford to buy.

To conclude, promoting inclusive growth and sustainable development of mobile business is possible only if we are able to devise solutions that are:

1) Financially-inclusive

2) Demographically-inclusive

3) Technologically-inclusive

Fortunately, there is a ray of hope in the concept of inclusive growth and sustainable development.

Mobile, Inclusiveness and Sustainability

Inclusiveness and sustainability are primarily socioeconomic concepts aimed at bringing about social and economic equality among one and all, more so among the historically underprivileged section of society. Thus, inclusive growth and sustainable development, in our context, refers to socioeconomic benefits that can be derived from mobile telephony and its applications.

From the perspective of a mobile user, existing social benefits of mobile telephony encompass getting in touch with the near and dear ones anytime, anywhere irrespective of geographic limitations. Also, the ease of acquiring a mobile (product and service) has helped bridge the societal gap between people who can own a home-based landline phone and those who cannot (because they don't even own a home). However, these social benefits do not possess enough firepower to drive 'mobilization' in the common man's market.

Similarly, economic benefits of mobile telephony hinges on the concepts of time and money—precisely, conversion of time into money. However, these benefits are equal to no benefits in the common man's market because people in this section have more time and little money at their disposal. So, philosophies such as "time is money" and "money saved is money earned" aren't rewarding enough to lure the common man into buying the mobile (product and service).

When we talk about inclusiveness and sustainability in the context of mobile telephony, the users' point of view states that "a common man shall be able to get this service and be able to use it over a sustained period of time without straining his finances." Similarly, the operators' point of view states that "an operator shall be able to provide product and services which the common man can afford without straining his finances and, yet, the operator be able to sustain the business".

This comparison of users' and operators' point of view illustrates that the concept of inclusiveness is more societal and that of sustainability is more economic. So, while the inclusive aspect is a push, the sustainable aspect is a pull. This implies that if we can weave the right mix of push (social benefits) and pull (economic benefits), penetrating the common man's market would be relatively easier. However, the core problem still remains that existing social and economic benefits lack the charm to lure the common man. Therefore, catering to this segment of market requires creating new socioeconomic benefits that promote inclusiveness and sustainability from the perspective of both, the user and the operator.

Innovative mobile applications and innovative usage of existing mobile applications is the ways forward in this direction.

MiPEX: The Solution

MiPEX, being developed by Radical Research, is one such mobile application system that could prove a panacea for inclusive growth and sustainable development of the entire mobile business ecosystem.

While developing the MiPEX solution and its business model, we have given due consideration to all the three inclusiveness parameters mentioned above, viz. financial, demographical and technological inclusiveness.

To understand the underlying principle of MiPEX, we first need to understand the following two aspects:

1) Actors and factors that comprise the mobile business ecosystem

2) The flow of economic benefits (i.e. money) within the ecosystem

A typical mobile business ecosystem comprises of the following groups:

1) Regulator Group (people regulating the industry and its practices)

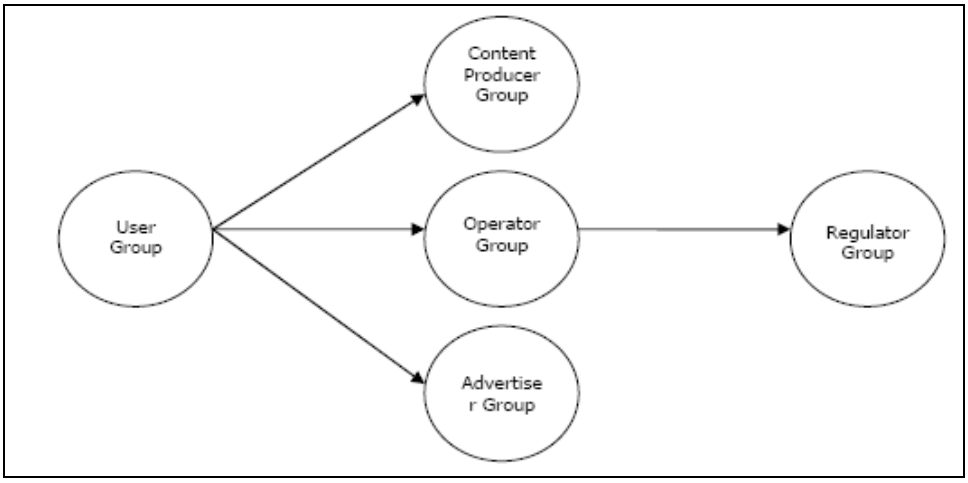
2) Operator Group (people involved in selling mobile products and services)

3) User Group (people who consume the products and services)

4) Content Producer Group (people using mobile as media vehicle)

5) Advertiser Group (people using mobile as advertisement vehicle)

If we analyze the flow of money within the ecosystem from the perspective of a mobile user, it turns out to be unidirectional, as shown below:



From the perspective of the User Group, this unidirectional flow of money presents mobile as a money-loosing proposition. So, for them it's expenditure not an investment. Since a common man doesn't have large disposable income, it effectively transpires that current mobile business ecosystem is not conducive for doing business in the common man's market. And, it will continue to do so unless owning mobile becomes a money-making proposition—precisely, a two-way flow of money.

But the question is 'how'? The solution lies in the problem itself.

What is attracting the operators and sellers towards the common man's market is the economic potential latent within this segment. So, if the users of this segment are provided with some kind of money-making opportunity to encash their economic potential through mobile, there is no stopping for the operators to spread into this market like a virus!

But money can be paid to the users in exchange for something. So, what is this 'something' that users can give in exchange for money?

Irrespective of their socioeconomic background, everyone is born with an innate property and makes money by encashing this property only. No, it's not the so-called Luck. It's called Intellectual Property!

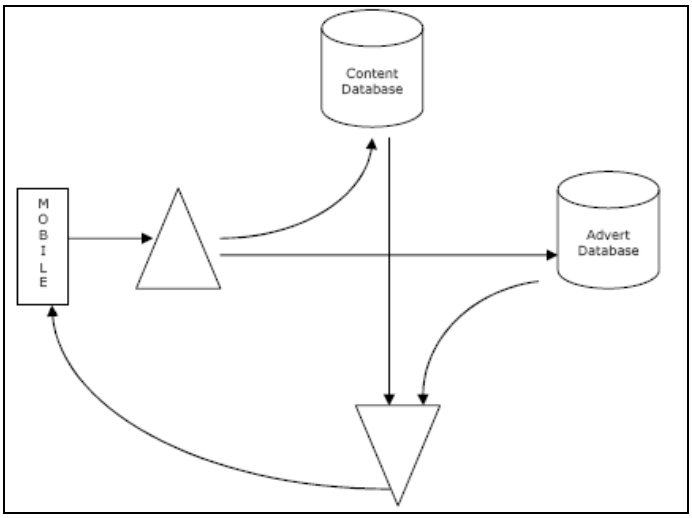
MiPEX (or, Mobile Intellectual Property Exchange) is a system that can provide money-making opportunity to the common man in exchange of their Intellectual Property via mobile telephony.

The business logic of MiPEX can be easily understood by drawing a parallel between Intellectual Property and mobile telephony. Intellectual property is manifested in two forms: voice (verbal) and data (written). Similarly, mobile telephony is nothing but transmission of voice and data from one source to another. Therefore, if the voice and data being transmitted over the mobile is not just voice and data but someone's intellectual property (in the form of voice and data), mobile will become a money- making proposition, thereby, facilitating two-way flow of money.

This intellectual property can be creative, informative and educative mobile content contributed by individual mobile users and stored on MiPEX SMS servers.

The content database of MiPEX can be access by all mobile users through SMS Keywords, as it happens currently. However, unlike the current business model, the cost of SMS will be borne by MiPEX, which in turn will derive its revenue through "Contextual Advertising".

Currently, mobile content and mobile ads are delivered as separate entities. In MiPEX, we intend to combine these two on the basis of SMS Keyword. For example, if a user sends LOVE as keyword, the query will be redirected to two database servers—one containing the content and the other containing advertisements. The result will then return in the form a combo of content and advertisement, as shown below:



We know that due to payload length constraint, an SMS can contain only 70 to 160 characters depending on its encoding type (which can be the default GSM 7-bit, the 8-bit data alphabet, or the 16-bit UTF-16 alphabet). Therefore, MiPEX will utilize the Concatenated SMS technique to send content that are larger in size.

For example, in the default GSM mode, the entire content will be split into 153 7-bit character parts. Each part will then be sent with a User Data Header containing segmentation information.

MiPEX & Financial Inclusiveness

MiPEX will work like a 'mobile publication' where independent users can submit their creative and informative mobile content through SMS/MMS along with a copyright

declaration that it is their original work. In exchange, MiPEX with pay these users a one-time fee for transferring irrevocable copyright to MiPEX.

Before the advent of SMS and MMS, creative and informative content were disseminate to masses through suitable media such as print, TV, radio, etc. and the creator of those content used to get money in exchange. However, with the advent of mobile technologies such as SMS and MMS, the only party which is making money is the operator. Individual content creators don't even get the credit of their work, forget the money.

MiPEX effectively addresses this concern, thereby, promoting financial inclusiveness by enhancing the purchasing power of intended target market.

MiPEX & Demographic Inclusiveness

Meeting the demographic inclusiveness parameter is critical for rapid market expansion of mobile business, as it will automatically open an entirely untapped market for one and all. However, the bigger the opportunity, the bigger is the problem.

To solve this problem, we did further segmentation the 31% population by age group to arrive at a potential target segment and then arrived at a solution which fulfils some of their needs.

This segment comprises of 0-14 years old kids and teens. As per standard Indian practice, by the age of 14 years a child is enrolled either in class 8th or 9th. Although children can read SMS by the age of 5 or 6, it is by the class 5th or 6th when they can actually put it to some good use independently. However, even in the most affluent families, majority of children within this age group don't own a personal mobile phone.

Therefore, in due course, we intend to introduce a low-cost, pre-configured Student Mobile that can be recharged with a service provider co-branded MiPEX card to access educative content from MiPEX database.

We also intend to bring about demographic inclusiveness by providing inclusive employment to people across all 23 telecom circles. For this, we intend to use circle-wise, provider-wise GSM SMS technology instead of universally accessible IP SMS technology. This will also ensure that there is no IUC burden for service providers.

MiPEX & Technological Inclusiveness

Since the underlying technology of MiPEX is SMS, which is supported by all mobile handsets and service providers, it fulfils the common technological denominator requirement, thereby, promoting technological inclusiveness.

MiPEX & the Government

Three of the flagship Government of India schemes that are launched with the intent to promote inclusiveness are:

1) Sarva Sikhsa Abhiyaan (SSA)

2) Right to Education (RTE)

3) National Rural Employment Guarantee Act (NREGA)

To implement the aforesaid demographically-inclusive MiPEX solution in rural India, we envisage an m-tutoring model where the "cost incurred on learners" can be borne by the

SSA and/or RTE funds, while the "cost incurred on tutors" can be borne by the NREGA fund.

MiPEX & the Regulator

Currently, we have only one NDNC registry to stop unsolicited marketing activities. However, when opted it stops both the voice as well as SMS. However, a user who is not interested in unsolicited calls might be interested in SMS, as it doesn't need immediate attention. So, using MiPEX we can arrive at separate Do Not Call (DNC) and Do Not SMS (DNS) registries.

Salient Features of MiPEX

Some of the salient features of the MiPEX system are as follows:

1) Inclusive and sustainable market expansion for mobile phones as well as services because when people will know that they can make money using their mobile, they will readily purchase mobile as an investment instead of expenditure.

2) Independent content creators will make money and get the credit of their intellectual property rights, which has been sabotaged by SMS.

3) Winning proposition for advertisers because their ads would be read by a user who in all likelihood could be a potential customer. For example, a customer searching quotation/joke/tips using LOVE as keyword, could be a potential buyer of gifts, greetings, etc.

4) Less pain for the regulator (TRAI/DOT/Govt.) as MiPEX can lessen or share the burden of implementing a DND registry for unsolicited SMS and associated hassles and complaints.

5) MiPEX will increase the acceptance of m-Commerce among masses because people will use this service willingly as they are getting paid.

6) MiPEX has the potential to boost m-Learning and M-governance initiatives.

Economic Analysis of Business Model for Delivering Mobile Value Added Services in Thailand

Puree Sirasoontorn

Abstract:

In Thailand mobile penetration rate has dramatically increased at the faster rate than computer and internet penetration rate. A two-fold increase in number of mobile users within five years has confirmed that there is a voice and non-voice market potential for mobile operators and service providers. High market potential for mobile internet has attracted mobile operators and content providers into this market. The objective of this study is to gain understanding of what business model works in Thailand and what the explanatory factors determining success of the model together with barriers to become successful in Thailand. The scope of this study will be in the area of mobile internet. This study uses a single-case research design. The choice of BuzzCity was made based on consideration that BuzzCity is the multiple international award winner and its main customer base is from lower middle income group in developing countries.

Keywords: Mobile Advertising; Mobile Internet; Mobile Applications; Business Models

1. Introduction

In Thailand, the Mobile Internet phenomena have taken place since 2000 with the introduction of Wireless Application Protocol (WAP) technology by Advanced Info Service Plc. (AIS) and Total Access Communication Plc. (DTAC). Until 2003, technology was developed to GPRS and EDGE technology which are considered as a transition period to the new technological service, 3G, via mobile phone. Although 3G is not yet adopted in Thailand, it is predicted that the technological advancement and convergence will bring dramatic changes to the ways people communicate and create, transmit and consume information at the shortest time and to the ways mobile operators, network carriers and service providers in related industries do their businesses.

As shown in Figure 1, in Thailand mobile penetration rate has dramatically increased from 22.5 percent in 2003 to 52.8 percent in 2008 whereas internet penetration rate has increased at much slower pace from 10.4 percent to 18.2 percent. A two-fold increase in the number of mobile users within five years has reassured that there is a voice and non-voice market potential for mobile operators and service providers.

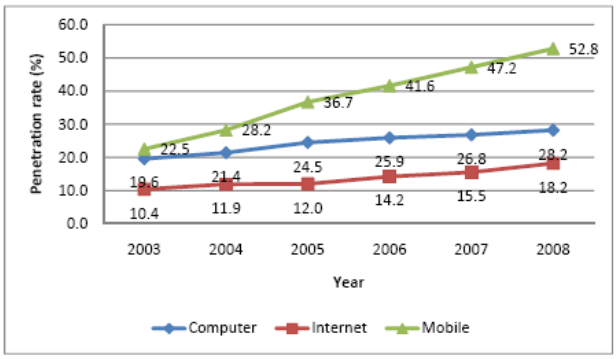


Fig. 1: Mobile, Internet and Computer Penetration Rate in Thailand During 2003-2008 (percent)
Source: National Statistical Office of Thailand

Although the number of both post-paid and pre-paid mobile subscribers have been increasing, as shown in Figure 2, average revenues per customer (ARPU) of major mobile operators[19], namely AIS, DTAC, Hutchison and True Move, from both post-paid and pre-paid services have shown decreasing trend, as shown in Figure 3 and 4. Therefore the value-added services (VAS) over the mobile are drawing increasing attention from operators and content providers. The former believe that this provides a way out of predicament of decreasing ARPU. The latter see this as a potentially powerful distribution medium, in light of the increasing likelihood that the mobile will become the primary method of accessing the internet for a majority of the population.

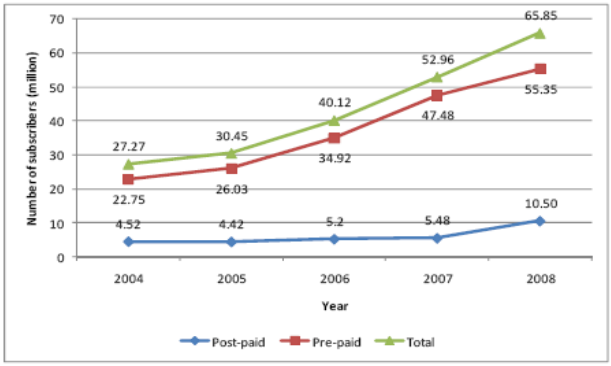


Fig. 2: Mobile Subscribers in Thailand During 2004-2008 (Million Subscribers)
Source: The National Telecommunications Commission

[19] Currently there are six mobile operators in Thailand, namely AIS, DTAC, TrueMove, Hutch, DPC and Thaimobile.

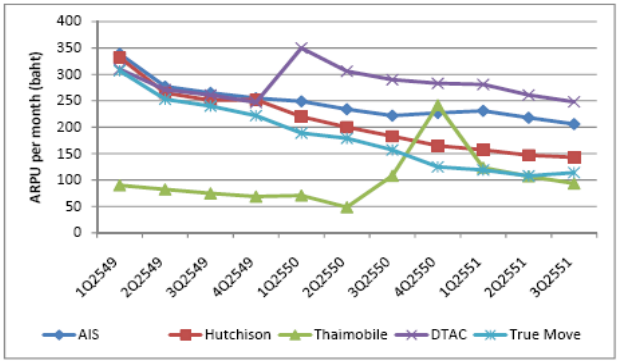


Fig. 3: Average Revenue per User: Pre-Paid Service (Baht per Month)
Source: The National Telecommunications Commission

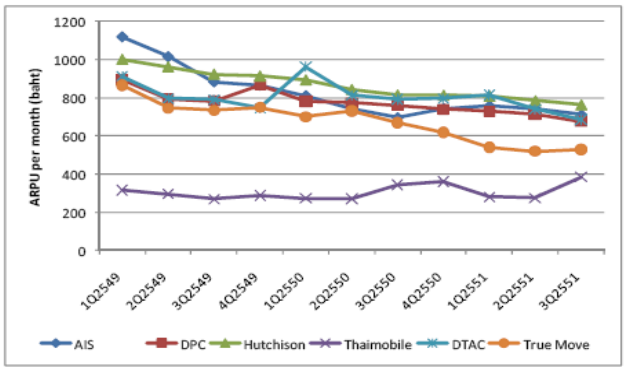
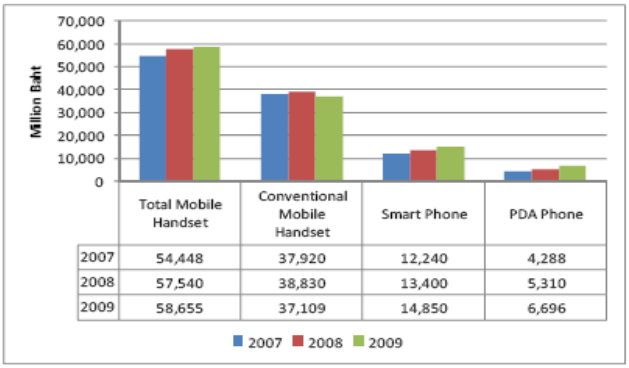


Figure 4: Average Revenue per User: Post-Paid Service (Baht per Month)
Source: The National Telecommunications Commission

Moreover, Figure 5 has revealed that market for mobile handset in Thailand has expanded from 54 billion baht in 2007 to 58 billion baht in 2009. In this market, although conventional mobile handset has highest proportion in this market, its market growth slowed down due to the price effect from Chinese mobile handsets, which is expected to drop significantly even the number of handsets has increased. On the contrary, the smart phone and PDA phone market has shown promising growth, particularly those handsets that support 3G.



	Total Mobile Handset	Conventional Mobile Handset	Smart Phone	PDA Phone
2007	54,448	37,920	12,240	4,288
2008	57,540	38,830	13,400	5,310
2009	58,655	37,109	14,850	6,696

Fig. 5: Market Value of Mobile Handset in Thailand During 2007-2009 (Million Baht)
Source: Thailand ICT Market 2008 and Outlook 2009, Software Industry Promotion Agency

As shown in Table 1, in 2008 mobile voice service in Thailand was worth 163 billion baht with 3.7 percent rate of growth whereas mobile non-voice service was worth only 16 billion baht but with high growth rate at 16.6 percent. The significant driving forces for the mobile non-voice communication service market are Short Message Service (SMS) and Multimedia Messaging Service (MMS) services. This evidence was confirmed by Internet User Profile of Thailand (NECTEC, 2007). In 2007 the survey has revealed that the most popular mobile activities of Thai mobile users are SMS, playing games, downloading pictures and ringtones, visiting websites, MMS, reading news and articles, exchanging photos, and checking and sending emails, as shown in Figure 6. NECTEC (2007) has conducted survey of Thai mobile internet users and found that the major factors of using mobile internet are convenience, novelty and modernity, and cheap mobile internet service.

Communication Services	Value (Million Baht)			Year to Year Growth (%)	
	2007	2008	2009	07/08	08/09
Mobile Voice	154,484	163,135	169,150	5.6	3.7
Mobile Non voice	14,197	16,213	18,904	14.2	16.6

Table 1: Mobile Communication Market in Thailand during 2007-2009
Source: Thailand ICT Market 2008 and Outlook 2009, Software Industry Promotion Agency

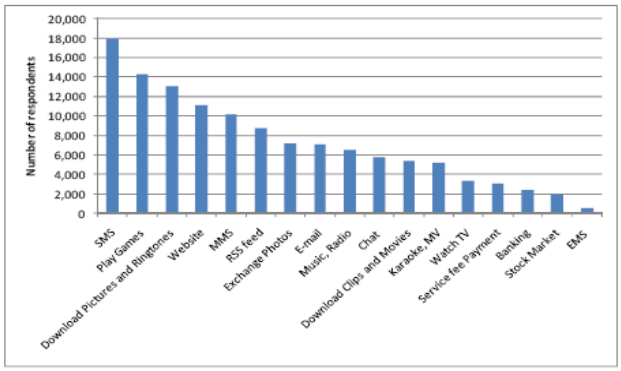


Fig. 6: Mobile Activities of Thai Users in 2007
Source: Internet User Profile of Thailand 2007, NECTEC

High market potential for mobile internet has attracted mobile operators and content providers into this market. Four of mobile operators in Thailand, namely AIS, DTAC, HUTCH and True Move, provide mobile internet services. Most of services are SMS/MMS, information, infotainment, and downloading services. Through their own portal, mobile operators provide mobile contents to their customers. Due to their dominant power over the network, Thai small and medium content providers could not survive in the content provision business by receiving small and unfair revenue sharing. Most of local content providers exit the market. Some survive. Some of business models for content providers have emerged to overcome these market dominances in Thailand. However, empirical evidence in Thailand on the analysis and development of mobile internet business models still lags behind those studies in the other developing countries. This study attempts to fill this gap.

The objective of this study is to gain understanding of what business model works and what the explanatory factors determining success and failure of the model in Thailand. The scope of this study will be in the area of mobile internet. The single case research design will be employed. The choice of BuzzCity as a single case study was based on the consideration that BuzzCtiy's main customer base is in developing countries.

In the next section, this paper will provide review of literatures on mobile contents, mobile internet and business models. In Section 3, research questions will be set and research methodology employed in this study will be explained. Next, BuzzCity business models will be explored and analyzed. The last section will conclude the paper.

2. Review of literatures

In literatures focusing on online and mobile content services, a 'business model' is defined as the method of doing business by which a company can generate revenue (Rappa, 2007) or as the strategy used to generate revenue by specifying markets, products, customers and the position of the business in the value networks (Yunos et al., 2003). It can be defined as the description of an organization or network of organizations involved in creating and capturing value from technological innovation (Reuver and Haaker, 2009). Shafer el al. (2005) attempted to parse the term 'business model' as 'business is fundamentally concerned with creating value and capturing returns from the value, and a model is simply a representation of reality'. By this definition, components of business model are value creation, strategic choices, value capturing and value network.

Alt and Zimmermann (2001), Afuah and Tucci (2003), and Osterwalder and Pigneur (2002) suggest different sets of elements that constitute an online business model. Although they are categorized differently, when applying with mobile business models, these elements can be clustered into four domains: service domain, technological domain, organizational domain and financial domain (Bouwman et al., 2008).

The design choices in business model components have to be considered together and should be balanced in order to develop viable business model. Reuver and Haaker (2009) have derived the generic mobile business model from Bouwman et al. (2008). Within the service domain, targeting, value-creating elements, branding and customer retention are key design issues. Security, quality of service, system integration, accessibility of customers and management of user profiles are major components in technological domain. Partner selection, network openness and governance are major design elements of the organizational domain. Lastly in the financial domain, pricing of a service, division of investments, costs and revenues, and valuing the contributions and benefits are key components. These design variables are important to investigate the viability and sustainability of any business model.

There are various categories of business models on the web as summarized by Rappa (2007). These include brokerage, advertising, infomediary, merchant, manufacturer, affiliate, community, subscription and utility models. In each model, it is implemented in diverse ways. A firm can combine several different models as part of its overall internet business strategy. For example, community or social networking sites can generate, create and capture value using different types of business models.

Enders et al., (2008) study two German social networking sites – StayFriends and XING and found that suitable revenue models for social networking sites are advertising, subscription and transaction models. Their key revenue drivers are the number of users, the creation of high levels of unique customer value, and a critical mass of users, respectively.

Feijóo et al. (2009) and Tsalgatidou and Pitoura (2001) found that from perspective of mobile operators, mobile businesses have been characterized by the dominant role of

mobile operators in ecosystem. As a result, from perspective of mobile content and applications, mobile business model is 'walled garden' or 'on-portal', where content and application revenues are generated by operators within their own value structure and where users are guided to stay within this structure as much as possible. While a business model for mobile carriers has evolved, demand for unrestricted and wide choice of content and application has been increasing. Mobile operators become mere providers of connectivity. In this connectivity model, revenues for mobile content accrue to content providers, enablers and brokers.

The choice of business model that various actors in mobile business, ranging from device manufacturers, equipment vendors, content providers, application vendors, payment agents, mobile network operators to regulatory authorities and users adopt, relies on economic characteristics underlying the mobile business: mobility, network externalities and exclusive control over network assets (Camponovo and Pigneur, 2003).

These characteristics draw attention from the marketers. Mobile marketing use the mobile network and its link to subscribers for consumer acquisition, sales promotions, customer interaction, m-commerce and awareness or loyalty campaigns whereas mobile advertising is used in combination with other marketing campaigns and channel activity in order to influence purchasing perceptions and also behavior (Sharmar and Wildman, 2009).

User behavior and attitude are important factors to determine success of mobile internet services (Taylor et al., 2008; Haghirian et al., 2008). The study of mobile internet motivations and behaviors of early U.S. mobile internet adopters revealed that awareness and desire to kill time or alleviate boredom were the most frequent motivation. They used their phone frequently even when a computer or laptop was available because of comfort and convenience. Since people used mobile internet in non-mobile settings, more value added mobile internet services can be targeted to stationary settings.

There are very limited literatures on online and mobile internet in Thailand. The only literature found focuses on consumer behavior and acceptance of mobile internet in Thailand. Phuangthong and Malisuwan (2008) examined the factors affecting the user acceptance of Multimedia Mobile Internet in Thailand by employing technology acceptance model incorporating with diffusion of innovation model. They found that entertainment service and application is the
most popular applications for both students and employees. Compatibility, usefulness, ease of use and result demonstrability are important factors affecting behavioral intention to use mobile internet.

Since there is a lack of empirical study on business model of mobile internet services in Thailand, this study will fill this gap.

3. Research questions and methodology

The research question will be addressed in this study is what the mobile internet business models work in Thailand. Moreover, this study attempts to explore the economic explanatory factors explaining why the models become dominant.

Single-case research design will be employed in this study. The case studies are epistemologically justifiable when research questions focus on reasons behind observed phenomena, when behavioral events are not controlled and when the emphasis is on contemporary events (Yin, 1989). Moreover, case method is appropriate and essential

where either theory does not yet exist or is unlikely to apply or where theory exists but the environmental context is different (Stuart et al., 2002). This study satisfies these criteria. Research on mobile internet is in an early stage of theoretical development especially in the developing countries. The generalizability of research conducted in the developed countries is questionable in context of developing countries.

In this study, the case of BuzzCity was chosen based on the consideration that BuzzCity is a multiple international award winner and its main customer base is in developing countries. It can serve well as the best practices model for a case research methodology (Eisenhardt, 1989).

BuzzCity was established in 1999 in Singapore as a web portal. BuzzCity is a multi-award winner. In 2008, BuzzCity's myGamma mobile advertising network was awarded the Most Innovative Infocomm Product/Service by National Infocomm Awards in Singapore. In the same year, BuzzCity won a Silver Medal for contribution to Web 2.0 in the Future Mobile Awards and myGamma was awarded the "Best Mobile Social Networking service" by the Mobile World Congress.

To collect secondary data, BuzzCity web site, press articles and internal company documents will be examined to identify the underlying business models. To answer research questions, this study will employ the secondary data to study the key features of BuzzCity's business.

The primary data gathering methodology through semi-structured interviews with experts and top management members of company will be used to capture the knowledge of practitioners and experts. The survey was performed within six-month period in 2009. Apparently within short period of time BuzzCity has changed focus from merchant business to advertising business, therefore the evolution of BuzzCity's business models in Thailand will be examined.

The interviews will focus on exploring the nature of BuzzCity's business models and economic explanatory factors explaining why the models become dominant. Referring to Bouwman et al. (2008)'s design issues, these factors determining choice and success of business models includes of such factors as technology, service targeting, market structure, pricing and revenue
sharing models.

4. BuzzCity business models

BuzzCity manages advertising-funded mobile community called myGamma. Through myGamma they market and distribute mobile content directly to consumers in Asia, Europe and the United States, serving more than 19.5 billion ads across the entire network in 2008. BuzzCity's growth rate is 48 percent quarter-on-quarter growth in the last quarter in 2008.

The company has two groups of targets for its mobile social networking services: the blue-collar workers in developed countries and the newly connected middle class across emerging markets. These unwired consumers are able to use the internet on their mobile phones.

As shown in Figure 7, comparing with other countries, Thailand was ranked as the sixth

largest myGamma members, following India, South Africa, Malaysia, China and Indonesia. Growth rate of myGamma members in Thailand, on average, was 4.07 percent in 2008 and declined to 2.64 percent in 2009. The most common reason for using myGamma in Thailand is to communicate with friends and to extend their social networks in order to gain social acceptance.

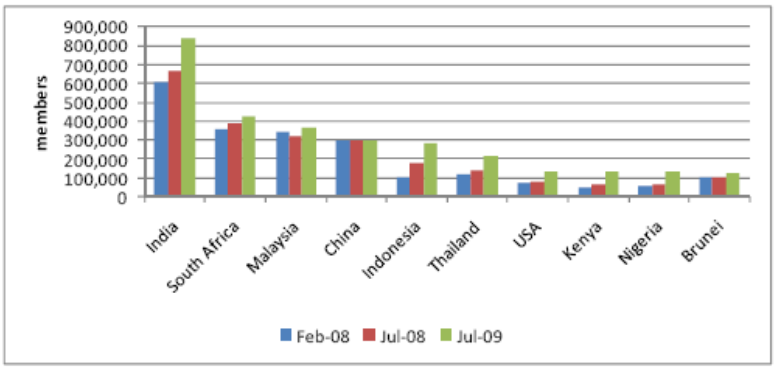


Figure 7: The Number of MyGamma Members in Top Ten Countries (Members)
Source: BuzzCity

In Thailand, advertiser banners served across the BuzzCity mobile internet advertising network has increased by 59 percent from 41 million in the last quarter in 2008 to 65.8 million in the first quarter in 2009. Although Thailand was ranked the eighteenth among top 20 countries in term of ad banners served, the growth rate is relatively high when comparing with other countries, as shown in Table 2.

Ranking		Country	Quarter 4 2008	Quarter 1 2009	Quarter on Quarter Growth
	Q1'09				
1	1	Indonesia	3,564,832,448	4,378,945,983	23%
2	2	India	726,935,723	841,620,420	16%
4	3	United States	382,450,258	527,622,153	38%
3	4	South Africa	465,312,929	427,839,867	-8%
6	5	Egypt	150,393,150	162,183,711	8%
7	6	Romania	135,501,235	161,369,084	19%
12	7	China	77,857,151	129,649,411	67%
9	8	Philippines	115,524,851	125,078,495	8%
14	9	United Kingdom	73,601,656	113,369,462	54%
8	10	Bangladesh	134,627,619	112,814,133	-16%
16	11	Nigeria	70,690,190	90,917,538	29%
10	12	Libya	100,801,729	86,307,837	-14%
11	13	Tanzania	97,661,460	83,765,354	-14%
5	14	Kenya	241,106,915	80,404,957	-67%
13	15	Malaysia	75,414,933	79,887,471	6%
17	16	Canada	65,115,586	75,565,080	16%
15	17	Brunei	73,466,562	73,019,631	-1%
21	***18***	***Thailand***	***41,350,200***	***65,813,320***	***59%***
25	19	Saudi Arabia	33,630,687	56,586,799	68%
22	20	Pakistan	40,102,760	46,374,608	16%
Banners served on Top 20 Countries			6,666,378,042	7,719,135,314	14%
Banners served across the network			7,546,469,278	8,523,586,447	11%
Top 20 countries represent 91% of all banners served					

Table 2: Ad Banners Served: BuzzCity Mobile Internet Advertising Network

As shown in Figure 8, in Thailand, ad inventory sold experienced fluctuating trend. The external publishers has more important role. Ad inventory sold via the external publishers has increased continuously since June 2008 and surpassed ad inventory sold via myGamma.

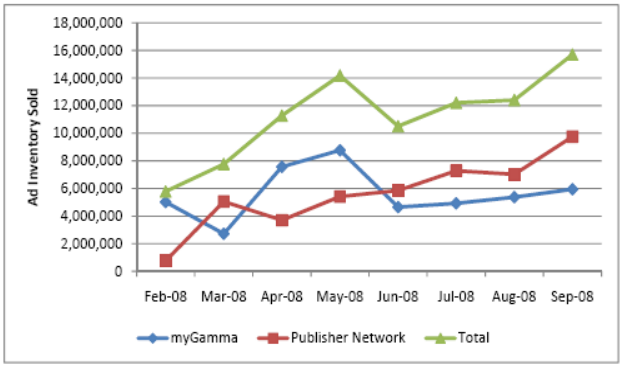


Fig 8: Ad Inventory Sold through myGamma and Publisher Network in Thailand
Source: BuzzCity

4.1 Key players and ecosystem

There are a number of players in the mobile business value chain ranging from technology platform vendors, infrastructure and equipment vendors to content providers and mobile service providers. Regarding the participating entities in a mobile internet transaction, they depend on the underlying business model.

BuzzCity primarily deals with advertisers, publishers, content providers or content aggregators and mobile operators or carriers including of access providers. BuzzCity also works with advertising agencies and media houses or broadcasters to persuade more advertisers to join BuzzCity mobile advertising network; and with service providers dealing with billing and mobile internet site building and hosting. In the ecosystem, BuzzCity serves as middleman to match advertisers with publishers in mobile advertising business. It should be noted that business actors and their roles refer to the various activities that have to be performed in order to create value in mobile internet. The activities are also connected to the technology used. Some actors may perform more than one activity, thus reducing the number of actors in the ecosystem.

In the case of BuzzCity, the following entities are the main participants in an ecosystem.

- Mobile operators or carriers. The roles of mobile operators can vary from simple and passive mobile network providers to a very active and dynamic by being strategically positioned between customers and content providers or aggregators and offer portal or trusted third party services. They can play roles of an intermediary, portal or publishers, advertisers or content aggregators.

- Publishers or web portal who own sites offer personalized and localized services to consumers. BuzzCity offer web portal or publishers which have their own sites both cost

per click and cost per impression models[20] in order that BuzzCity can place both graphical and text advertisement or banners on their network. Through BuzzCity's earning report, publishers can monitor their earning with detail such as number of exposure and click, click through rate, and cost per impression. This information assists publishers to maximize their monetization of their traffic. On average, BuzzCity offer publishers 65 percent of revenue received from advertisers whereas the rest belongs to BuzzCity.

- Advertisers who advertise their products or contents through myGamma and publishers. They can freely set advertising campaign and target worldwide. BuzzCity's ad management allows the advertisers to take full control and flexibility to set effective and productive targeted campaigns. Advertisers can work on their campaign budget through bidding system. They can bid anything higher than the minimum price of USD 0.01 per click. The higher they bid, the more frequent their advertisement will appear. BuzzCity's proprietary ad management system will allow targeting and up to the minute reporting to efficiently manage advertisers' budget.

- Content providers or owners who provide specific contents to a customer through myGamma and publishers. The contents are developed from the large or small and medium companies. Individuals also develop some user-generated contents and offer or sell it through myGamma. These contents are subsequently offered to mobile users.

- Content aggregators who aggregate contents and provide contents to consumers through myGamma and publishers. Contents can be distributed in the same ways as those distributed by content providers.

- Content providers or aggregators integrate the Gamma Wallet onto their sites in order to charge their visitors and reach the community of myGamma members, who have Gamma Dollar (G$) to spend on their contents. Contents include tones, games, pictures, news, byte-size content, discount coupons, horoscopes, fortune-telling, passes to premium areas, movies, mp3 and others. The most popular applications in myGamma are HugMe, Tarot card application and virtual gifting. They can monitor their site's transactions from the earning reports.

- Consumers who is online and/or mobile. Consumer will pay for internet or air time to mobile operator and/or purchase items or pay for downloading contents to BuzzCity.

  Depending on the way the participating entities are related to each other, the different BuzzCity's business models dealing with different entities are developed. The service and money flow of BuzzCtiy business models are shown in Figure 9 and 10, respectively.

[20] Cost per click is related to cost per thousand impressions. For example, if CPC is 15 US cent and click through rate is 1 percent, thousand impression will result in 10 clicks. Therefore CPM is USD 1.5.

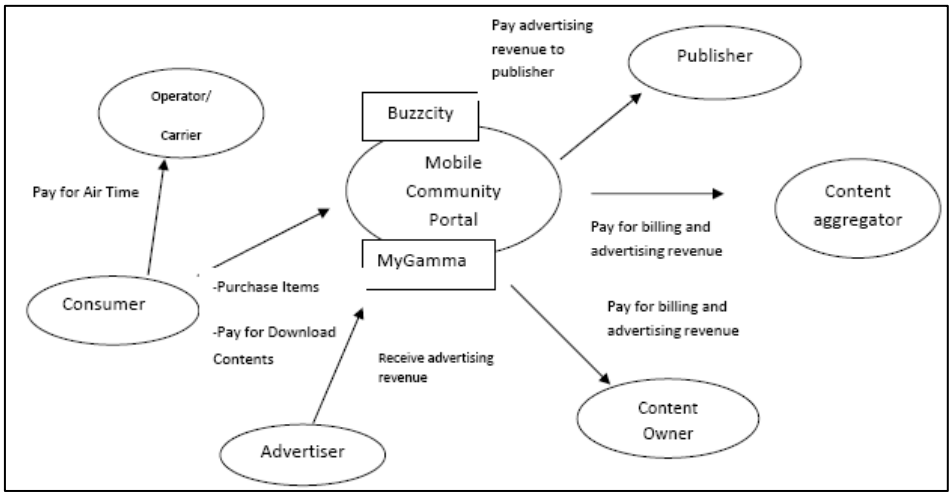


Figure 9: BuzzCity in Ecosystem: Money Flow

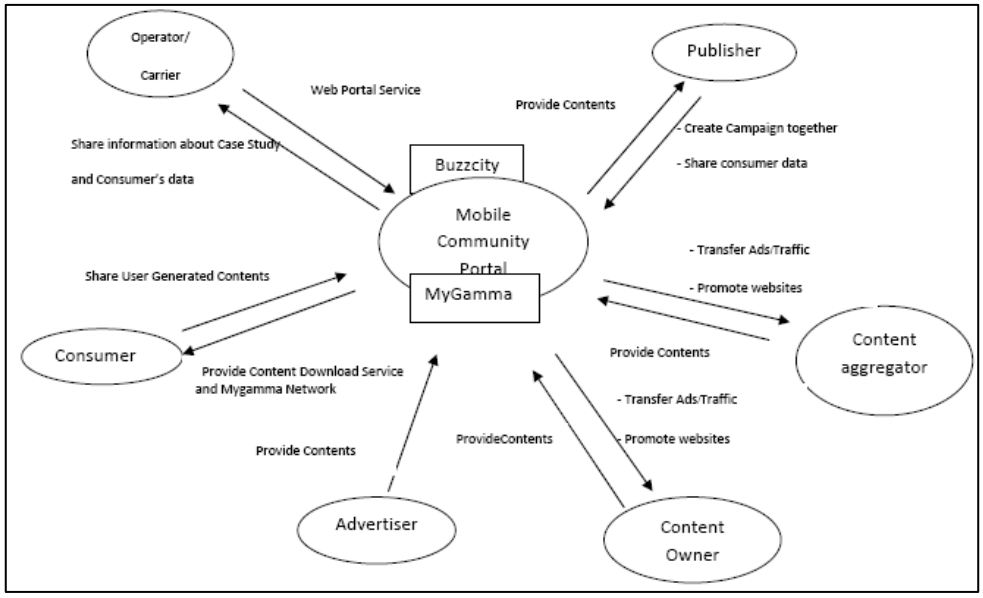


Figure 10: BuzzCity in Ecosystem: Service and Information Flow

5. Business model analysis in Thailand: Case of BuzzCity

BuzzCity's business model is a combination of community, advertising, and affiliation model. BuzzCity has its own social networking portal, as one of publisher, together with more than 2,000 publishers or affiliates. Business model of BuzzCity in Thailand is similar to BuzzCity in other countries. In this section, the factors determining the potential success of business model in Thailand will be analyzed as following.

5.1 Technology

One of the factors determining the success of BuzzCity's business model is its in-house technology. With the wide range of technologies, BuzzCity has developed simple platform for developers to create networking applications and has created mobile ad and international billing network. Standardization processes and open interfaces are seen as essential for an effective and fast development of mobile content services.

Ad optimization technology was developed to optimize click-through rate and frequency of banner appearance. This technology helps to enhance a bidding system. The higher advertisers bid for cost per click or cost per thousand impressions, the more frequent their advertisement will appear. Moreover, ad targeting technology will target ads to appropriate publishers. Both ad optimization and targeting technology will be run every 15-30 minutes to search for the optimized click-through rate and frequency of banner appearance and for appropriate publshiers.

Based on this technology, Buzzcity maximize revenue. The advertising platform needs to estimate the click-through rate for the bid and to allocate ad to bidders to maximize BuzzCity's revenue. The programs will balance the value of each bid of cost per click with their frequency in order that not only the highest-bid ad will appear on the screen all the time but the appropriate mixture of ads with various values of bid will also sequentially appear on the screen.

In addition, technological advancement of mobile devices also support the marketing message oriented functionalities in order to provide various mobile advertising campaigns offering links between consumers and advertisers with the various response mechanisms such as click to call, click to competition, click to survey, click for sample, and mobile WAP sites with a combination of text links, graphical banners (Sharma and Wildman, 2009). Markets for mobile phones in Thailand are broadened, selling and buying wide range of mobile phone from simple, old-fashioned mobile phones, to smart phones and PDA. Moreover the price of mobile has drastically decreased. However Thailand still lags behind most of developing countries, particularly in infrastructure like 3G which has not been fully functioning in Thailand.

5.2 Service Targeting

BuzzCity targets its services to the advertisers. In Thailand the number of mobile advertisers is limited because they do not have the knowhow, time or resources to

learn how to use new technology efficiently. Very few numbers of Thai advertisers reflects that slow adoption of mobile internet as new media. BuzzCity is aware of this limitation and provides advertisers assistance to create the mobile ads, insert the mobile ads into the system and set up the target criteria for the advertiser so that the advertiser only needs to follow the reports on the number of consumers that have been receiving the company's message. This service is offered to small advertisers who may lack in advertising knowledge and of an Internet connection so they can use mobile advertising as a new advertising channel. At the same time, large advertisers may use mobile advertising as a way to communicate with their loyal customers by using their own instead of the application provider's customer data bases.

Consumer attitude toward advertisements is considered a significant explanatory variable in measuring advertising response. Lee et al. (2006) stipulate that there is a strong relationship between the intention to receive mobile advertising messages and the attitude toward them. Leppaniemi and Karjaluoto (2005) found that consumers' willingness to accept mobile advertising messages is based on the design of the message and the related technology. For mobile advertisement to be successful, the key factors are the role of the mobile medium in the marketing mix, the development of technology, individualization and a regulatory framework.

In case of Thailand, Thai consumers' attitude toward SMS or MMS as mobile advertisement is not so positive. They found that these SMS are annoying and not relevant to their need and behavior and so tends to ignore or not read them. BuzzCity realized these problems and assist the advertisers to design the advertising campaign targeting the specific group of consumers, based on their user profile. Moreover BuzzCity provides services to the advertisers to make message more attractive. Advertisers should make sure that their mobile advertising messages contain information that is useful to the recipients (Haghirian et al., 2008).

However in Thailand, recently the advertising industry has been shrinking due to economic slowdown, as shown in Figure 11. Moreover, mobile advertising is very new and there is very few advertising agencies in Thailand who actively encourage their clients to advertise through this media. The examples of Thai advertising agencies who engage in mobile advertising are Set Digital, Media Connect and Group M. The advertising budget on online and mobile media is negligible comparing to television, as shown in Figure 12. Most of advertisements are on television since they are clear and understandable for consumers. Even in Thai agencies, there is no media buyer who is responsible for mobile advertising.

As of December 2009, there are 35 Thai advertisers who are using BuzzCity services and 15 foreign advertisers targeting Thai users. Most of them are mobile content providers. They are in content provision business such as N-content and Mobafone; fast moving consumer goods such as drinks, mobile accessories, contact lens; and small and medium enterprises such as massage chairs. Since small and medium enterprises do not have large marketing and advertising budget but aim to venture global, advertising through BuzzCity ad network can fulfill their goals.

In mobile advertising business in Thailand, the potential BuzzCity competitor is Mycombar, new ad network providing the mobile advertising services. Mycombar was introduced by cooperation of DTAC and BEC World (television media) in Thailand. However currently the price of cost per impression charged by Mycombar is 2,000 baht per CPM which is a lot higher than the rate that Buzzcity charges at 90 baht per CPM.

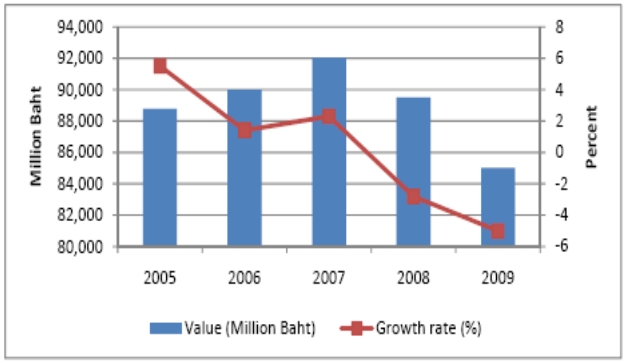


Figure 11: Market Value and Growth Rate of Advertising Industry in Thailand
Source: Neilsen Media Research
Note: 2009 data is from Kasikorn Bank Research Centre

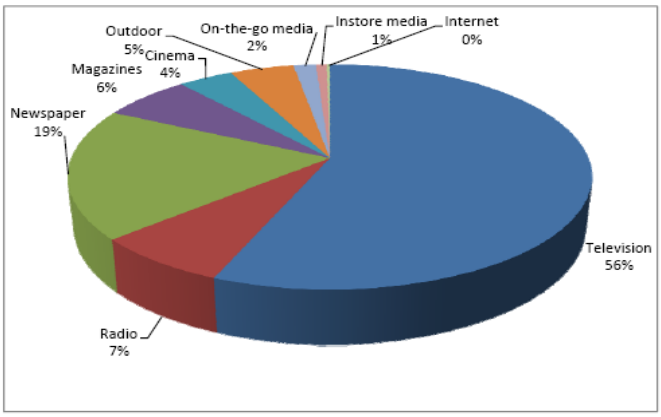


Figure 12: Proportion of Advertising Budget Classified by Types of Media in Thailand in March 2009
Source: Neilsen Media Research

5.3 Consumer targeting

Consumer behaviors are key factor to determine success of BuzzCity's business model in Thailand. BuzzCity targets at lower middle and middle income group in Thailand. These groups of consumers use mobile phone because of accessibility and convenience. They mostly use phones for normal activities, which are taking and receiving phone calls, and sending and receiving missed calls and text messages. With other features of the mobile phones, they use phone for checking bill and credit balance, listening to the radio and downloaded music, playing games and browsing

internet and sending or receiving or downloading or uploading other content such as ringtones, wallpapers, pictures, games and video clips.

Thai consumers are aware of non-voice services that can be accessed or obtained through either telephones or computer. Although they are aware of services, some chose not to use these services such as making or receiving payment or sending or receiving money. The major reasons for not using these services through telephone or computer are that they do not know how to use it; it is not applicable to them; and they are already satisfied with their present mode of obtaining these services. Moreover, most of consumers in lower middle income groups do not own computer. They may have heard about the internet but have not accessed it. For those who use the internet, they access the internet through computer whereas only few access through mobile phone (NECTEC,2008).

However, the evidence from study by Phuangthong and Malisawan (2008) revealed that there are market opportunities in non-voice mobile services in Thailand because Thai users are ready to accept and use mobile internet because it is convenient to access the internet when they are not be able to access the internet via computers. The major obstacle to hinder growth of this market is long period of Thai consumer technology adoption.

BuzzCity successfully target at consumers in the lower middle and middle income groups in Thailand. It can attract a large number of myGamma members in Thailand. However, BuzzCity's advertising business in Thailand has not expanded in the recent years. Thai advertising agencies and advertisers are also aware of their behaviors and doubt whether their advertisement banners will be able to reach and receive click response from audience.

Another reason of slow growth is that Thai consumers in lower middle income group prefer to consume content in Thai language and/or in Thai style. Therefore, advertisement in other language cannot attract them much. This is a major hindrance for foreign advertisers to target Thais. Moreover, Thai language is barrier for Thai advertisers to advertise their products abroad as well.

5.4 Role of mobile operators

The role of mobile operators is not clearly defined or separated. The role can vary from simple and passive to active and dynamic role by being strategically positioned between customers and content/service providers and offer portal services. Mobile operators can extend their operation to cover new roles such as content providers and/or aggregator, publishers and advertiser. Their roles can affect the billing and payment of mobile internet services. Mobile operators by nature already possess valuable information regarding their customers so they could also become important information providers. Mobile operators also already have a billing relation with most users of future services so they are expected to become powerful players within the emerging services.

Mobile operators in Thailand play dominant roles in billing business. Their revenue

sharing is at least as high as 60 percent, leaving the rest of revenue to content providers and aggregators. Therefore in recent years small and medium content providers and aggregators cannot survive with slim profit margin and finally exit the market.

In addition to facilitating transactions between customers and content providers or aggregators, Thai mobile operators also provide portal services. The operator can facilitate customers to locate appropriate service providers and at the same time enable content providers to reach customers through the mobile operators' portal. In Thailand, there are six major mobile carriers, namely AIS, DTAC, TrueMove, Hutch, DPC and Thaimobile. Currently four of them offer mobile internet service to their customers through their own web portals. AIS as a market leader provides the content services through "Mobilelife", DTAC through "Djuice", TrueMove through "Truelife" and Hutch through "Hutch". The services which are offered include a list of content and service providers with provided services, products and prices. The contents are in the area of entertainment, news, SMS, MMS, and lifestyle contents.

Owing to the dominant role of mobile operators and shrinking profit margin in billing and content services, BuzzCity have decided to shift from merchant business to mobile advertising business. Currently in Thailand mobile operators have not yet entered into this market due to lack of knowledge and specialization in advertising business. Therefore shifting to mobile advertising business will assist BuzzCity to avoid low revenue sharing from mobile operators in billing business and to retain 97 percent of revenue from mobile advertising on myGamma and 30-40 percent on external publishers. The low competition in Thai market and BuzzCity specialization in mobile advertising business worldwide are key factors for BuzzCity to enter into this business in Thailand.

5.5 Network externality

Direct network externalities exist in myGamma social networking. The utility of joining social network is positively related to the number of its members. A member joining myGamma confers a benefit to all other members because the number of potential interaction increases. Direct network effects are in the forms of being able to communicate with a larger number of other members. Moreover, the large ad network allows the advertisers to advertise in any publishers. Therefore due to the positive network externalities, BuzzCity can attract more members to join myGamma and subsequently more advertisers to join ad network and to be able to reach members in myGamma.

Communication network also show signs of indirect externalities, where users indirectly benefit from network size. For example, an additional member potentially increases the number of services available to other members. Due to the increasing demand for services, service provision become more profitable and more firms (merchants and advertisers) would be willing to offer them.

In addition, BuzzCity's long tail mobile advertising network aggregates around 2,000

smaller sites to capture value offered by the smaller sites so that advertisers are able to reach a diverse audience. Attracting few users from different sites is better than more users from the same site.

6. Conclusion

The study explores and examines the business models for delivering mobile value-added services that can be successfully employed in the developing countries. The BuzzCity case research design is employed. This study focuses on how BuzzCity's business model works in Thailand and examines the explanatory factors determining its success together with barriers to become successful.

The key factors explaining success of BuzzCity's business model are advanced in-house technology, technological advancement of mobile devices. Due to the positive network externalities, BuzzCity can attract more members to join myGamma. Effective service targeting benefits most to the small advertisers who may lack in advertising knowledge. Shifting to advertising business, in which mobile operators lack of specialization, can safeguard BuzzCity's business.

However, there are some barriers to become successful in Thai market. Firstly, the advertising industry has been shrinking due to economic slowdown. Proportion of advertising budget on mobile and online media in the marketing mix is still negligible comparing to television and radio. Mobile advertising is not yet to be an alternative media for large advertising agencies in Thailand.

Secondly, Thai consumers' attitude toward SMS or MMS as mobile advertisement is not so positive. They found that these SMS are annoying and not relevant to their need and behavior and so tends to ignore or not read them.

Last barrier is language. Thai consumers in lower middle income group prefer to consume content in Thai language and/or in Thai style. Advertisement in other language cannot attract them much.

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Clever Texting and Panini Keypad : New technologies to support Indian languages on mobile phones.

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Abstract :

It is imperative for all stake holders to support regional languages of India on the phone to take the data opportunity of the mobile phone to all users. Supporting regional languages on the phone has been a challenge regarding offering a usability technology that allows easy and convenient typing on the phone. Printed characters on keypad is unsuitable in a country with many languages and scripts. And multitap support that asks the user to tap upto 9 taps to type a character is cumbersome to use. A new technology of statistical predictive texting that pre-estimates characters that the user could be typing and places them on the screen for selection by the user by single keypresses has offered a viable means to support all languages on the same phone and yet offer a means of typing that is simple to use and is also very fast. This has many advantages and has turned out to be very popular with users as well as manufacturers. This new technology called CleverTexting developed by an Indian company called Luna Ergonomics has been developed for all Indian languages into one integrated platform called Panini Keypad which allows typing in all Indian scripts and also interoperation like transliteration between them. The technology is also applicable for all global languages and has already been developed for most major global languages and is being developed for the others. It is an opportunity for an Indian innovation to determine the way the world writes on digital devices.

Background

There are 90 million people in India who understand some English. But there are already 530 million mobile phone users, and 15 million new users are being added every month. Most of the mobile users of India are unable to type on their phones and hence they cannot store their address books, cannot send an SMS, shall be out of the scope of all the VAS and information enabling services of the government and shall stay out of the the 3G,4G opportunity. Unless we build the suitable regional language ecosystem for the phone, the whole data opportunity of Indian telecom will have to be restricted to the 15% of the phone users who know some English.

The regional language ecosystem shall consist of availability of Indian fonts on the phone with accurate rendering of complex character clusters, a technology for convenient typing of all Indian languages on the phone and finally an uniform standard based encoding of Indian language data between phones and network. Of the three, the challenging was the means to support convenient typing of Indian languages on the phone. The technology has to support all Indian languages, it

should be easy to use and it should offer the means to type fast.

There was a breakthrough in this field from an Indian company called Luna Ergonomics in 2008-2009 who while exploring solutions for Indian languages, developed a brilliant new prediction technology that is based on the statistical nature of languages instead of dictionaries. The entirely new usability that was developed around this offered a means to write in all Indian languages on the same phone, needed no printed characters on keypad, was ergonomic to the thumb, was dictionaryless in implementation apart from a host of other advantages. It was one elegant solution that addressed all the industry acknowledged blindspot in one simple usability shift. The new technology developed in India was not only applicable for Indian languages, but also for all other languages of the world. It has so far been developed for all the major 11 languages of India into one integrated platform called Panini Keypad which supports Hindi, Bengali, Telugu, Marathi, Tamil, Gujarati, Kannada, Malayalam, Oriya, Punjabi and Assamese. And the global family of implementations simply called CleverTexting has been developed for 9 major global languages, namely English, Spanish, Portuguese, French, Arabic, Russian, Hebrew, Swahili and Finnish. And is now developed for many other languages of the world including Chinese, Japanese and Korean. The technologies have won many global awards and recognitions and are being actively considered by phone manufacturers.

The technologies are not only applicable for the mobile phone, but also for all other digital interfaces, be it PC1web, STB, IPTV, ATM, touchscreen kiosks, gaming consoles etc.

Texting technologies

The common handheld mobile phone offers only about 12 keys on in its keypad, whereas all languages have many more characters. English has 26 and Indian languages typically have 60 or more characters that form part of the popular usage. Supporting the input of scripts on the phone has been a challenge and many different approaches have been explored for decades. One familiar approach is called multitap where several taps on a key is used to type a character. Other more intelligent approach has included a dictionary on the phone estimating the word from user inputs. These have had their advantages and disadvantages. The Indian language is even more complex to support due to the nature of the language and the above approaches have remained unsuitable. A familiar handicap with the dictionary based system of the past was the inability to support non dictionary words – names of people and places which occur so commonly in the nature of communication done on SMS.

CleverTexting

CleverTexting is a new texting technology that offers a solution with an entirely new usability. In this the phone estimates the limited possible characters that the user could be writing next and shows them on the screen. This allows the user to choose from amongst the predicted characters using a single keypress or directly from the screen in case of a touchscreen device. The predictions of CleverTexting are very accurate because they have been derived from statistical mining of the particular languages in terms of probabilities of letter combinations that actually occurred in large texts called corpora. In 90% of cases, the predictions of CleverTexting turn out

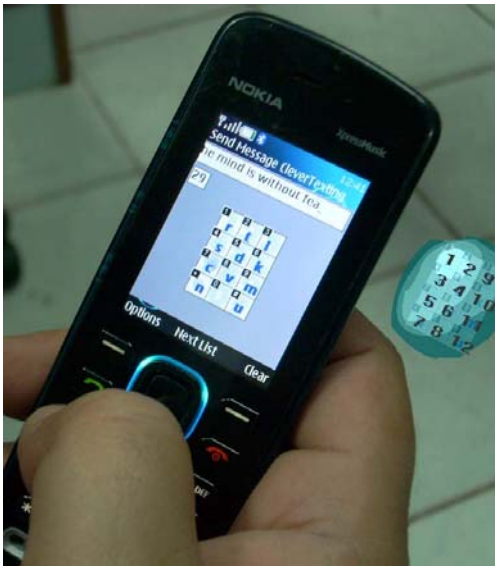
to be accurate irrespective of the language which is the key demonstrated power of the technology.

Fig 1. CleverTexting predicting characters that the user could be writing and showing them on the screen from which the user could choose using the keypad or peck directly on the touchscreen The product has been developed for all Indian languages.

Ergonomic Concerns

When the common phone is held in the right hand, all the keys of the phone are not equally accessible to the texting thumb. The key 1 would be the most accessible and the key # would be the least comfortable. Although the common phone is used by far more number of people in the world than the PC keypad, the phone keypad has not witnessed any redesign based on ergonomic considerations. You will see that the current English keypad on the phone just lays out the characters in their alphabetic order. Its called the ITUT keypad.

Since the characters are dynamically allocated in CleverTexting depending on their conditional probabilities, they are also shown on the screen according to their ergonomic ranks. Hence you would be most often pressing on keys which are most comfortable to the thumb. The character arrangements can be changed when the phone is used on the left hand.



Advantages

The approach of CleverTexting offers several different advantages both for the user as well the phone manufacturers.

Advantages to user

1. Much faster typing in terms of speed.

2. Smallest number of keytaps or keypad interactions. Almost the same number as number of characters one writes. Very little overhead.

3. Single keypress typing, no multitap. Seniors can use.

4. Seamless experience across dictionary and non dictionary words. No mode changes required.

5. Ergonomic to thumb. Pleasure to write long sentences, no blackberry thumb.

6. Easy to learn, operate for all age groups and educational profiles because only two simple rules.

7. Characters on phone keypads are normally tiny, many need glasses to read them. CleverTexting characters are on the screen and large to read.

8. Can operate in darkness (no back lit keypad required)

9. Same usability for all devices. PC, web, IPTV

10. Improves spelling habits. People will write full words due to the convenience.

11. The game like interaction with the phone is engaging and grows addictive as one improves speed.

12. The constant hand eye coordination is good for the development of the brain, to stay alert.

Advantages to the manufacturer

1. No need of printing different language characters on keypad, same phone supports all languages. Printed characters on cheap phones, also get worn out and become unreadable.

2. The ability to support a very large number of languages because support through CleverTexting for micro languages is feasable, can be delivered on schedule and cost effectively. The development is automated. And not a rule based approach. No likelihood of errors, bugs.

3. The isolation between algorithm and data. Same algo different data for a different language. The data could also be downloaded to the phone on demand or included by manufacturer based on geography. Or only included into a SIM by a telecom operator. Can be hot upgraded with newer versions.

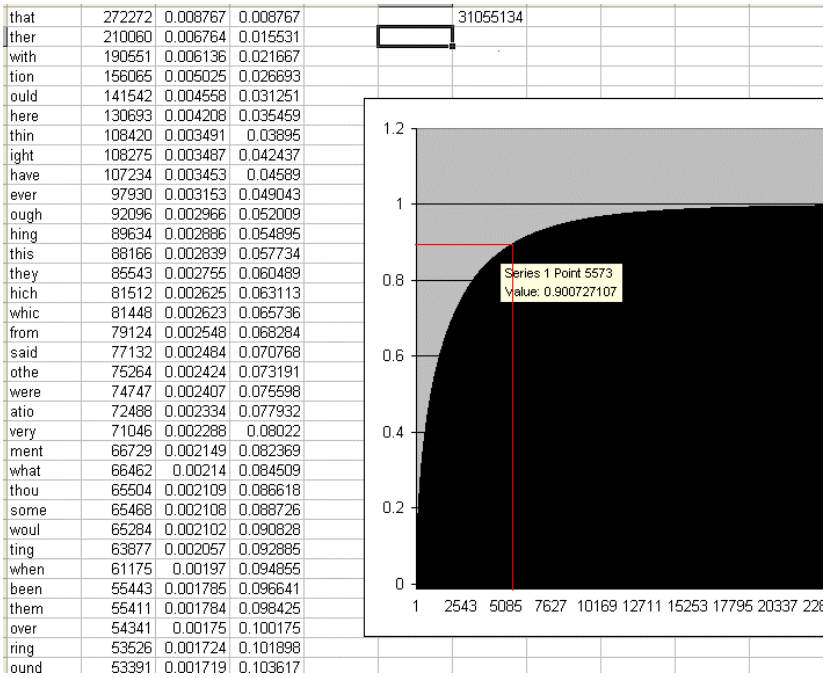
4. The algorithm is lightweight.

5. Same usability for all languages, nothing to teach1market in terms of usability. Learn once, use everywhere.

6. Same usability applicable for touchscreen phones, nothing to teach.

Why CleverTexting works for all languages of the world.

Our languages are highly statistically correlated. In the Figure below it can be seen that in the English language, of the half a million possible four letter combinations, only about 1% make up 90% of all occurrences. The statistical curve is the same for all languages of the world and hence CleverTexting works for all languages of the world. It is the high statistical correlation which has offered great advantage to this strategy over the previous dictionary based approaches.



that	272272	0.008767	0.008767
ther	210060	0.006764	0.015531
with	190551	0.006136	0.021667
tion	156065	0.005025	0.026693
ould	141542	0.004558	0.031251
here	130693	0.004208	0.035459
thin	108420	0.003491	0.03895
ight	108275	0.003487	0.042437
have	107234	0.003453	0.04589
ever	97930	0.003153	0.049043
ough	92096	0.002966	0.052009
hing	89634	0.002886	0.054895
this	88166	0.002839	0.057734
they	85543	0.002755	0.060489
hich	81512	0.002625	0.063113
whic	81448	0.002623	0.065736
from	79124	0.002548	0.068284
said	77132	0.002484	0.070768
othe	75264	0.002424	0.073191
were	74747	0.002407	0.075598
atio	72488	0.002334	0.077932
very	71046	0.002288	0.08022
ment	66729	0.002149	0.082369
what	66462	0.00214	0.084509
thou	65504	0.002109	0.086618
some	65468	0.002108	0.088726
woul	65284	0.002102	0.090828
ting	63877	0.002057	0.092885
when	61175	0.00197	0.094855
been	55443	0.001785	0.096641
them	55411	0.001784	0.098425
over	54341	0.00175	0.100175
ring	53526	0.001724	0.101898
ound	53391	0.001719	0.103617

Fig 2 : Statistical correlation of the English language.

SMS compression

The technologies developed also include support for SMS compression for the first time in the world. This uses a variable bit encoding called static huffman coding which could be obtained from the statistical information of languages because all characters do not occur equally frequently in languages. Frequently occurring characters are encoded in fewer bits and rarely occurring characters are encoded in larger bits. The average number of bits per character works to about 5 bits per character which offers 300% improvement for non latin languages which uses Unicode. And about 150% improvement for latin languages.

Panini Keypad

The Panini Keypad is the brand name of the family of products for Indian languages. Named in the honour of the famous Sanskrit grammarian who lived 2500 years ago. The Panini Keypad family of products offers CleverTexting for the following Indian

languages: Hindi, Bengali, Telugu, Marathi, Tamil, Gujarati, Kannada, Malayalam, Oriya, Punjabi and Assamese as well as a few extra features available to the Indian product. This includes integrated support for all the Indian languages and interconversion via transliteration.

The Panini Keypad is fully developed and has been released to the public domain since Jan 2009. It was the winner of the Judges Choice award at the NOKIA Global Mobile Innovation contest where it was called a Mobile Necessity for Emerging Markets.

Transliteration

The Panini Keypad is an integrated platform supporting all the Indian languages, so it is possible to transliterate between the 11 languages supported. So you can write in Bengali and send in Telugu and recieve a message in Gujarati and read it in Malayalam. The Panini Keypad also includes transliteration to the Roman script for phones overseas with no Indian language support.

The artificial pan indic script called Shiva.

Indian languages although most scientifically derived in the phonemic sense unfortunately use complex scripts today. These complex scripts that require advanced display systems and complex rendering engines do not lend themselves to simple implementation on limited screen capability devices. These are some drawbacks which have resisted easy adoption and support for Indian languages towards every kind of digitisation.

In the statistical work towards development of the Panini Keypad, all the languages of India were revealed in their modern forms, in terms of characters that are in current usage etc. All the Indian languages are orthographically similar and only typographically different. In other words, the word Bharat would have the same spelling in all Indian languages. The only difference being how character vary in their looks. With the above symmetry in place, an all inclusive pan Indic script system that supports all Indian languages, that has been scientifically derived with all digital considerations like segment display systems, vector rendition, OCR, readability and other factors was developed from the drawing board. A major hallmark of the script system is that all the characters are deducable based on simple rules which makes learning very easy and can help literacy. A new script system would not be easy to introduce, so the Shiva script has been unobtrusively included amongst the integrated language support within the Panini Keypad system. With the ubiquitous usage of mobile phone, people would get familiar and more comfortable to such an introduction on another day in the future when such a common script for all Indian languages would be felt necessitated.

The Sanskrit language that used the Brahmi script since the 6th century BC was a simple script that would not have posed challenges to digital implementation. It is only in the 13th century and onwards, that the Devanagari script was used by Sanskrit and other derivative scripts in the regions have followed subsequently. Therefore it would be wrong to suppose there is any sacred association between the Indian languages in their original form and the complex script that we use today. The

Shiva script resembles the original Brahmi script of the past in concept, form and simplicity. No patent application has been filed with respect to the Shiva script.

Building the regional language ecosystem for mobiles

Other impediments in enabling regional language support on phones that need to be ironed out.

1. Many major phone manufacturers have been supporting one or several Indian language fonts on the phone but there is no standardisation in it and the user is not assured of it. There are some phones sold in India which do not have support for any Indian language fonts. India has only 9 scripts and each manufacturer must include all the Indian language fonts on their phones to ensure support is provided for each language.

2. Even if the Indian language font has been provided by the manufacturer, in some cases it has been found to be of poor quality. They do not render correctly for yuktakshars or are too tiny and not readable. Quality must also be ensured for the fonts.

3. All phones in the world support all non latin languages through Unicode, both for SMS as well as for Internet data. Most phones in India also do so, but there is a miniscule number of phones that do not support Unicode encoding and decoding. This standard must be ensured by education of the stake holders for assured interoperations. Its a pleasure to see that even the inexpensive Chinese imported phones also support Hindi with Unicode support.

Applications of CleverTexting for other languages of the world.

The CleverTexting concept is applicable for every language of the world. All the languages of the world analysed by us show a statistical correlation which will lend themselves to efficient statistical predictions. The technologies have already been developed for English, Spanish, Portuguese, French, Arabic, Russian, Hebrew, Swahili, Finnish and are popular downloads all over the world as awareness of this new usability is spreading. The technologies are also being developed for all the other languages of the world including Chinese, Japanese and Korean.

The approach of CleverTexting is very productive because it is not a rule based approach and requires no linguistic support to build the product. The process of building being automated allows for the development of this technology for all the micro languages of the world. No other technology, particularly dictionary based approaches do not allow for this.

Application to other devices

The usability of CleverTexting is not only restricted to the mobile phone but is applicable for all kinds of digital interfaces. It can be used in the PC1web to write in

any Indian language. It can also be used by Set Top Boxes and in IPTV for offering a simple usability to type on the TV from the remote of the TV. It can be used in an ATM because that too is a limited keypad device with the same interface. And it can be used in touchscreen kiosks, vending machines etc.

How the technology can reach users

The technology can reach the user in the following manner.

1. Handset manufacturers implementing this technology on their phones.
2. Telecom operators offering the technology has a subscribed application to compatible phones.
3. Direct to Consumer as a software via Retail Sales and Online selling.
4. Enterprise and E-Governance solutions

Conclusion

The CleverTexting and Panini Keypad products are revolutionary in the way people can type fast on their phones and other digital interfaces. It is an approach which has addressed all the requirements of supporting multiple languages on the same phone into one elegant solution. The technologies are being studied keenly by all stake holders. It is an opportunity for an Indian innovation to define the way people write in India and different countries of the world. The Ergonomist Society of UK hailed CleverTexting as "Thumbs up to a new way of Texting" in their cover story in March 2009, describing it as powerful, promising and full of new possibilities.

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7. http://www.CleverTexting.com

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A usability to type in all regional languages on the PC/web to fill forms in regional languages using the Panini Keypad technology.

Issues & Challenges for Enabling Mobile web in Indian Languages

Swaran Lata , Somnath Chandra , Prashant Verma

Abstract:
India continues to be one of the world's fastest-growing telecommunications market due to a progressive regulatory regime , huge capital outlays for network expansion by operators , reductions in tariffs and cost of handsets. For the India mobile market ,voice services constitute nearly 88 percent of the total revenue. For non-voice or data services which include SMS, Internet browsing and multimedia, year-on –year growth was 33 percent over 2008. Mobile media has increasingly becoming the preferred medium of communication. Accessing internet through mobile is seen as the future, hence enabling Indian languages on the mobile with parallel efforts enhancing the languages content on the web coupled by the development of various standards supporting these initiatives and our participation in such a global platforms is the ultimate long term goal. Interoperability is the key issue so that the dissemination of multilingual news and information can be handled seamlessly across service providers and variety of mobile available in the market. Perceiving the cellular phone to be the agent of change for inclusive growth, the challenge lies in enhancing the variety of the mobile applications and their localization, which in turn will accelerate the growth of mobile business in the country.

1. Mobile Technology Evolution

1.1 Mobile Technologies : 1G to 4G

The mobile technologies ushered a new revolution of communication and information access. It has gone through various evolutionary phases starting from 1G to present 4G and beyond .1G refers to analog cellular technologies and became available in the 1980s. 2G denotes initial digital systems, introducing services such as short messaging and lower speed data. CDMA2000 1xRTT and GSM are the primary 2G technologies, although CDMA2000 1xRTT is sometimes called a 3G technology because it meets the 144 kbps mobile throughput requirement. EDGE, however, also meets this requirement. 2G technologies became available in the 1990s.

The 3G technology for mobile communication started its inception in the year 1998. The 3rd Generation Partnership Project (3GPP) is collaboration between groups of telecommunications associations, to make a globally applicable third generation (3G) mobile phone system specification within the scope of the International Mobile Telecommunications-2000 project of the International Telecommunication Union (ITU). 3GPP specifications are based on evolved Global System for Mobile Communications (GSM) specifications.

The original scope of 3GPP was to produce Technical Specifications and Technical Reports for a 3G Mobile System based on evolved GSM core networks and the radio access technologies that they support (i.e., Universal Terrestrial Radio Access (UTRA) both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes).No technology meets these requirements yet; none is even close. It will require new technologies such as LTE-Advanced (with work already underway) and IEEE 802.16m.

Some have tried to label current versions of WiMAX and LTE as "4G", but this is only accurate to the extent that such designation refers to the general approach or platform that will be enhanced to meet the 4G requirements.

Generation	Requirements	Comments
1G	No official requirements. Analog technology.	Deployed in the 1980s.
2G	No official requirements. Digital Technology.	First digital systems. Deployed in the 1990s. New services such as SMS and low-rate data. Primary technologies include CDMA2000 1xRTT and GSM.
3G	ITU's IMT-2000 required 144 kbps mobile, 384 kbps pedestrian, 2 Mbps indoors	Primary technologies include CDMA2000 EV-DO and UMTS-HSPA. WiMAX now an official 3G technology.
4G	ITU's IMT-Advanced requirements include ability to operate in up to 40 MHz radio channels and with very high spectral efficiency.	No technology meets requirements today. IEEE 802.16m and LTE Advanced being designed to meet requirements.

1.2 Long Term Evolution (LTE) towards 4G

3GPP has completed the specification for Long Term Evolution as part of Release 8. LTE will allow operators to achieve even higher peak throughputs in higher spectrum bandwidth. Work on LTE began in 2004 with an official work item started in 2006 and a completed specification early 2009. Initial deployments will occur in 2010.

Goals of LTE-Advanced

- Flexible and Faster Network Deployment - Heterogeneous Networks
- Better Coverage and Improved Spectral efficiency (Cell Edge and Average) - Robust Interference Management
- Greater Flexibility with Wideband Deployments - Wider Bandwidth by Carrier Aggregation Across Bands
- Ubiquitous & Cost Effective Broadband - Higher Peak User Rate by Higher Order DL and UL MIMO

Technical Features LTE Advanced

- Support of wider bandwidth:

Carrier aggregation, where two or more component carriers, each with a bandwidth up to 20 MHz, are aggregated, is considered for LTE-Advanced in order to support downlink transmission bandwidths larger than 20 MHz, e.g. 100 MHz.

- Spatial multiplexing
  Extension of LTE downlink spatial multiplexing to up to eight layers is considered. For the uplink spatial multiplying to up to four layers is considered.
- Coordinated multiple point transmission and reception

This feature is considered as a tool to improve the coverage of high data rates, the cell-edge throughput and/or to increase system throughput.

- Relaying functionality:

Relaying is considered for LTE-Advanced as a tool to improve e.g. the coverage of high data rates, group mobility, temporary network deployment, the cell-edge throughput and/or to provide coverage in new areas.

2. Localization Of Mobile Applications

Since the user base is spreading fast, a number of companies who have been working in this field may consider developing localized applications to be used by large number of people. Some of these applications may be device based and others will interact through mobile web browser.

1. **Search on mobile**
2. **Calendars**
3. **System Information & events**
4. **User Interfaces**
5. **Text to Speech**
6. **OCR**
7. **Email & SMS in India language**
8. **Dictionaries**
9. **Predictive Input**
10. **Citizen Services**
11. **GPS**
12. **Games**

A mobile-specific syntax for re-designing a Web site for the mobile is not a good idea as it will need training, a different toolset and will also mean that mobile users will be unable to access data that already resides on the Internet.

3. Complexity and Challenges for Indic Languages

There are 22 official recognized Indian languages. The Indian language scripts are mainly stems from ancient Brahmi script and perso-arabic family. The syllable formation possibilities are infinite due to large set of consonant, vowel, vowel signs. Many Conjunct formed are drastically of different look from their consonant counterpart. The conjuncts formation can be either liner or vertical.

- Large linguistic diversity with 22 officially recognized languages and 12 scripts.
- One-language Many Scripts ; Many Languages – One Script

• Specificity for each language and script is unique in nature and cannot be easily replicated , even if they share common characteristics
• Difference in perceptions of usage among various stake holders, e.g. State Governments , Academia and industry
• Some of the languages have coverage across different nations across SAARC countries.
• Involves interdisciplinary research in advanced and sophisticated computer processing involving Artificial Intelligence and Machine Learning in one hand ; linguistic knowledge for incorporating human communication techniques on the other hand.
• Still in research stage in many areas despite huge efforts by academia and scientists in India as well as abroad
•

Complexity:

- What You Speak Is What You Write (WYSIWYW)
- Non-linear in nature
- Script grammar describes transformation rules
- Relatively word-order-free
- Common phonetic based alphabet

4. Challenges In Mobile Web

• **Availability on handsets:** Not all handsets have browsing capabilities. Even if today most of devices sold integrate a browser, this is not the case for handsets from previous generations, which largely have no browser, or a browser not compatible with current standards. However, it is important to note that there are now third-party browsers which are compliant with standards, and freely downloadable. Some of these browsers are able to work on low-end devices, just requiring the support of Java, and are able to cope with low-bandwidth network such GPRS due to compression of content.

• **Access to all handset features:** Web browsers offer for the content author a kind of abstraction layer that ensure that the content or applications will work on all standard-compliant browsers. However, Web technologies, and particularly mobile Web technologies are still evolving technologies. As of today, these technologies do not yet allow a service designer to access and use all the components of the handsets in his application. For instance, there is no standardized APIs to access and use e.g. the GPS, or the camera of the phone from the browser.

• **Usability of Web browser:** mobile browsers available on phones today reproduce exactly the interface of desktop browsers in order to help users coming from the desktop world. For first time users, such interfaces on phones, plus the issue of computer literacy are barriers for accessing services, and require heavy training.

Related to this issue, access to specific services or portals has to be manually configured on the handset.

• **Web and low-reading skills:** Web technology itself is not a barrier, there are no guidelines or methodologies to develop Web content and applications accessible to people with low-reading skills.

• **Web support of lesser-known languages:** The Web architecture has been developed to support all languages, many of these languages are not available yet on the Web.

• **Awareness on Mobile Web Technologies:** While there are now tools, standards and guidelines on how to write Web content and applications for mobile, very few people are aware of this work, and don't know how to deliver services that are usable on mobiles.

• **Support of disconnected mode:** Web technologies still support poorly the disconnected and the off-line modes. While browsers have some very limited caching capabilities which allow a user to access some previously-read web pages when not in range of a network, there is no real support of these modes that would allow the completion of tasks such as form filling, and access a long list of web pages previously load.

• Support and implementation of standards and specifications. Not all mobile browsers implement all of the W3C and other related standard bodies specifications in the same way, or don't implement all features.

5. Issues For Enabling Mobile Web In Indian Langugaes

5.1 Character encoding

In the Mobile technology, the multilingual data handling becomes vital across different layers. Any chosen encoding scheme should consider the following :

• The encoding scheme should support all possible characters, character combinations as per Unicode standard.
• There should be provision to change languages within single message.
• The encoding should be flexible for future Unicode standard.

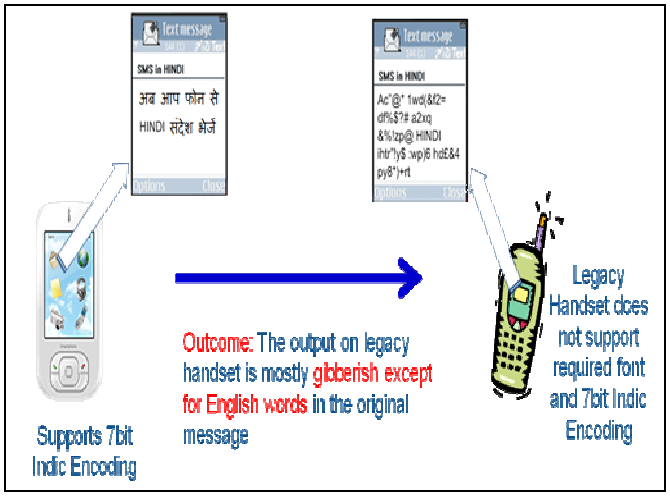
5.2 Bandwidth and Cost

Mobile networks can be slow compared with fixed data connections and often have a measurably higher latency. This can lead to long retrieval times, especially for lengthy content and for content that requires a lot of navigation between pages.

Mobile data transfer often costs money. The fact that mobile devices frequently support only limited types of content means that a user may follow a link and retrieve information that is unusable on their device.

5.3 Backward Compatibility with Legacy Devices

A handset that supports the new 7bit Indic encoding sends an Indic language SMS to a legacy device



5.4 Presentation Issues

Today, Many Web pages are laid out for presentation on desktop size displays, and exploit capabilities of desktop browsing software.Accessing such a Web page on a mobile device often results in a poor or unusable experience. Contributing factors include pages not being laid out as intended. Because of the limited screen size and the limited amount of material that is visible to the user, context and overview are lost.

5.5 Input

Mobile device input is often difficult when compared with use of a desktop device equipped with a keyboard. Mobile devices often have only a very limited keypad, with small keys, and there is frequently no pointing device.One of the difficulties of the mobile Web is that URIs are very difficult to type. Lengthy URIs and those that contain a lot of punctuation are particularly difficult to type correctly.

5.6 Device Limitations

Mobile browsers often do not support scripting or plug-ins, which means that the range of content that they support is limited. In many cases the user has no choice of browser and upgrading it is not possible.

5.7 Illiteracy

As major portion of India is consideration for the illiterate and the semiliterate population. So we just cannot afford to keep this vulnerable section of the population on the other side of the digital divide. In order to reach to the illiterate and semiliterate population, it is essential that the software have audio content, and use symbols and jingles to communicate the message.

5.8 Lack of standardization

Problem of inconsistency and lack of standardization is a very big problem at least for Indic locale. For example, for a simple word 'save', people used to translate in 3-4 ways. So it is making whole desktop 'difficult' for users. Thus, standardization is required towards enabling the mobile devices in Indic languages.

5.9 Fonts

Mobile devices often have few fonts and limited support for font sizes and effects (bold, italic etc.) As a result of this, the use of font size, face or effect, for example while underlining any Hindi statement it will be difficult interpret matras and may not achieve the desired effect.

Comparison between different Indian language support handsets

Handset	Company	Model	Hindi	Tamil	Marathi	Gujarati	Bengali	Kannada	Telugu	Punjabi
Nokia2610	Nokia	2610	Y	Y	Y	Y	Y	Y	Y	Y
Nokia6085	Nokia	6085	Y	N	Y	N	N	N	N	N
Nokia2600	Nokia	2600	Y	N	Y	N	N	N	N	N
Nokia1600	Nokia	1600	Y	Y	Y	Y	Y	N	N	N
Nokia1100	Nokia	1100	Y	N	Y	N	N	N	N	N
Nokia6020	Nokia	6020	Y	N	Y	N	N	N	N	N
Nokia3120	Nokia	3120	Y	N	Y	N	N	N	N	N
Nokia3220	Nokia	3220	Y	N	Y	N	N	N	N	N
SamsungSGH-X210	Samsung	SGH-X210	Y	N	N	N	N	N	N	N
Nokia6610i	Nokia	6610i	Y	N	Y	N	N	N	N	N
Nokia6610	Nokia	6610	Y	N	Y	N	N	N	N	N
MotorolaL6	Motorola	L6	Y	N	Y	N	N	N	N	N
Nokia1108	Nokia	1108	Y	N	Y	N	N	N	N	N
Nokia3100	Nokia	3100	Y	N	Y	N	N	N	N	N
SonyEricssonJ230i	SonyEricsson	J230i	Y	N	N	N	N	N	N	N
LGKG110	LG	KG11	Y	N	Y	N	N	N	N	N

		0								
Yuner H1	Yuner	H1	NA	NA	NA	NA	NA	NA	NA	NA
Nokia1200	Nokia	1200	Y	N	Y	N	N	N	N	N
Nokia1650	Nokia	1650	Y	Y	Y	Y	Y	Y	Y	Y
Nokia5130 XpressMusic	Nokia	5130 XpressMusic	Y	N	Y	N	N	N	N	N
Nokia2600c	Nokia	2600c	Y	Y	Y	Y	Y	Y	Y	Y
Nokia1661	Nokia	1661	Y	N	Y	N	N	N	N	N
Nokia1203	Nokia	1203	Y	N	Y	N	N	N	N	N
Nokia2610	Nokia	2610	Y	Y	Y	Y	Y	Y	Y	Y
Nokia6085	Nokia	6085	Y	N	Y	N	N	N	N	N

6. Text Entry in mobile computing

Mobile computing is on the rise and has spawned new application domains such as wearable computing, two-way paging, and mobile Web and e-mail access. Second, word processors, spreadsheets, personal schedulers, and other traditional desktop applications are increasingly available on mobile platforms. Third, there is a strong demand for the input of text or alphanumeric information that is easily and efficiently entered, recognized, stored, forwarded, or searched, via traditional software techniques.

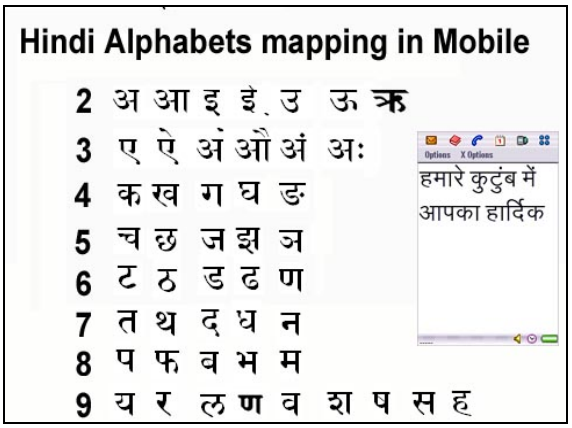
Solutions for Indian languages typing on phones

- Multitapping (Nokia, Samsung)
- Dictionary Mode : T9 and others
- English to Indian language transliteration(Quillpad and others)
- Panini Keypad

6.1 . Issues in Mobile Keypads

Multi-tap issues

- Too many taps per key for each char No way to know which char is on which Key.
- Never support more than one language on the keypad because there is not enough space on the key face to print more characters.



Dictionary Based

- Difficult to learn and operate for the target segments.
- Everyone in this room has a different spelling for मुर्ती ,मुरती, मूर्ति even मुरथी, many permutations. Which is the one to be mapped
- Difficulty in writing non dictionary words
- Dictionary Off, Mode Change etc – difficult to teach, learn and operate.
- Dictionary Off, Mode Change etc – difficult to teach, learn and operate.

Transliteration

- The man who needs to type in Hindi because he doesn't know English does not know one has to write kya for क्या The person who knows kya is for क्या does not need to type in Hindi.

6.2 Panini Keypad

Panini is a new multilingual Keypad system for India supporting 11 languages of India on the Mobile phone. The Panini keypad system when installed on a cell phone allows the user to type conveniently in Hindi, Bengali, Telugu, Marathi, Tamil, Gujarati, Kannada, Malayalam, Oriya, Gurmukhi (Punjabi) and Assamese. It offers statistical predictive texting (Clever Texting) - a breakthrough new technology for ergonomic typing on the mobile for Hindi.

Panini allows one to compose a text message in a regional language of India, and send it to any other phone as a low cost SMS. **Panini Keypad also offers SMS compression which increases the standard payload of a single SMS from 70 characters of Unicode to about 240 characters of Indian language text in a single message for the same cost.** This opens up new possibilities for cost effective Mobile marketing and meaningful Information enabling applications for rural India over the ubiquitous SMS.

7. Issues Of Mobile Messaging In Indic Languages

With the impending explosion in the number of subscribers from rural areas, the need for Indian language SMS is expected to grow manifold for the simple reason that English literacy is extremely low in these areas. In other words, unless Indian

language messaging support is improved significantly, a large number of subscribers will be deprived of the benefits of SMS. At the same time, service providers will not be able to leverage growing customer base in rural areas to further augment revenues accruing from VAS.

Indian language SMS is currently supported by most operators. In almost all cases, the messaging solutions are proprietary and use picture messaging. After the user has entered the text in his/her preferred Indian language, the message is converted into a 72x28 image which is sent as picture message. The receiver must have picture-messaging support to use this service. Note that multiple short messages are needed to transport the picture which means the cost of sending an Indian language is higher compared to English SMS.

7.1 Short Message Service (SMS)

The mobile are important means of communications today. We believe the end-user expects following text based Indian language components from mobile like SMS editing, Browser supporting Indian Languages, Emails etc.
Mobile is required to have more comprehensive text handling capability than editing and encoding the SMS. In all of the above applications the basic text inputting, displaying, fonts and encoding capability has to be provided by mobile handset, even in the case of viewing Indian language websites. This can be achieved by studying the current and future trends of all aspects of 22 Indian languages. There should be complete adaptation of all aspects of languages to mobile environments.

7.2 Currently prevalent 3 SMS encoding schemes

- ISCII based encoding
- 7-bit default alphabets
- UTF-8

The GSM standard supports 7-bits default alphabet and UCS2. For Indian languages, these encodings have their own pros and cons; especially when it comes to number of characters, standard implementation etc.

The 7-bit EA-ISCII is capable of handling all the intricacies of Indian languages but it lacks the flexibility and at present does not support all the Unicode characters. Since EA-ISCII is already approved by Bureau of Indian Standards (BIS); it will be easy to modify it with addition of new Unicode characters.

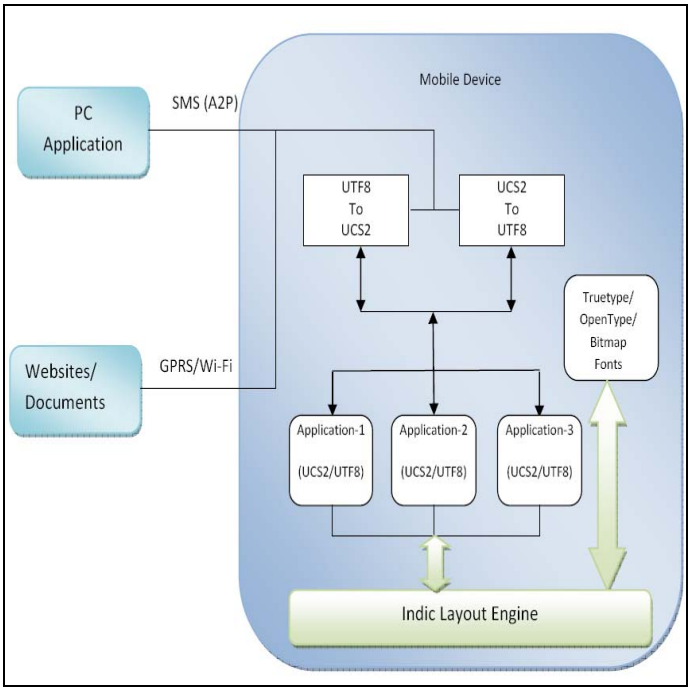
But adopting 7-bit standards to cater growing demands of Indian Languages will not make mobile devices truly localized for Indian languages. We believe for complete localization of mobiles to Indic scripts in accordance with international standards like W3C, Unicode etc we require a little different solution. Following figure shows the generic solution for complete localization of mobiles.

The UTF-8 encoding is more widely used by websites, emails and many open source applications. It is able to represent any character in the Unicode standard, yet is backwards compatible with ASCII. But it requires 3 bytes for encoding.
The UCS2 uses a single code value between 0 and 65,535 for each character, and allows exactly two bytes (one 16-bit word) to represent that value. UCS-2 thereby permits a binary representation of every code point in the Basic Multilingual Plane.

This range covers from U+0000 to U+FFFF which includes all Indic scripts. The UCS2 is the ISO standard mentioned in ISO/IEC-10646. But having UCS2 does not mean the mobile is Unicode compliant. Interestingly, UCS2 does not include the rules and algorithms required to compose the Indic scripts. These rules are given by Unicode. Hence to have complete localization, mobile needs to have both ISO/IEC-10646 and Unicode implementation.

Since all mobiles now a day support UCS2 encoding, it is easy to follow UCS2. It comes with slight disadvantage that only 70 characters/message can be sent. But if we look at overall experience of the end-user; it is preferable to have multiple messages with correct display than to see boxes appearing.

The details of the comparison is placed below at TABLE -I:



The details of the comparison of different encoding schemes are elucidated in Table 1 below.

7.3 Advantages of UTF-8 encoding for SMS

7.3.1 UNICODE view

The UTF-8 encoding is more widely used by websites, emails and many open source applications. It is able to represent any character in the Unicode standard. The advantages of UTF-8 are:

- UTF-8 form preserves ASCII TransparencyUTF-8 is a variable width encoding form, using 8 bits code units , in which high bits of each code unit indicate the part of the code unit sequence to which each byte belong.
- All code points in the Unicode code points would be represented in 3 bytes.
- UTF-8 is the preferred encoding for HTML and similar protocols for Internet.
- UTF is byte serialized
- UTF-8 allows efficient forward parsing
- Self- Synchronizing features :

  -The first byte of UTF-8 code indicates the number of bytes to follow in a multi-byte Sequence

7.3.2 W3C View

According to the W3C view on encoding standards Unicode is a good choice for representing content when served in multiple languages. The amount of bandwidth required to transmit content can vary significantly depending on the character encoding used. Text consisting principally of characters from the Latin alphabet will encode more efficiently in UTF-8, whereas text consisting principally of characters from ideographic scripts will encode more efficiently in UTF-16. When choosing a character encoding, consider the efficiency of the available encodings.

Since the Default Delivery Context specifies use only of UTF-8, all applications should support UTF-8.In terms of internationalization, there are still many network operators which do not support appropriate characters encoding on the signaling channel which would allow all characters of the world to be represented. The GSM specification makes mandatory the support of GSM 7-bit alphabet, but optional the support of UTF-8 and UTF-16 which does allow encoding of all characters.

Parameters	ISCII 7 bit encoding (C-DAC)	3GPP-CEWIT	UTF-8 (UNICODE)
ENCODING PROPERTIES	7 bit encoding	7 bit encoding	8 bit encoding (Used in all internet data exchange format)
Core Mechanism	7 bit data transmission compatible to ASCII	Single Shift Mechanism for Non-Latin Characters & Lock-Shift table Mechanism for Special Characters	As per UNICODE Representation
AVAILABILITY OF ALL CHARACTERS	Not Guaranteed	Not Guaranteed as Representation all Indic Characters for all 22 officially recognized languages and 12 Scripts not yet tested.	Representation of all Indic Languages in UNICODE is complete
Multiple Script – One Language	Not Guaranteed	Not Guaranteed & Tested especially Bidi languages like perso-arabic	Guaranteed as UNICODE is almost the default Text-encoding
CONJUNCT FORMATION	Not Guaranteed	Not Guaranteed	Possible in most of cases as per UNICODE defined mechanism
BANDWIDTH REQUIREMENTS	Less	Less (Can Send Upto 159 characters)	More (Maximum 70 characters per Messaging)
Display	Depends on ISFOC font storage and Bit-map resolution	Not yet tested as per submitted document	If UNICODE is default storage , display is possible in any Indian languages
COMPATIBILITY WITH OTHER INTERNATIONAL STANDARDS -like SMIL of W3C	No	Only 3GPP. Not Guaranteed & tested for other mobile standards like CDMA 1X, IS-95CDMA2000, Docomo, 3.5G and next-generation 4G standard	Most Transparent standard and compatible with all international data exchange formats like IETF , W3C etc , as UNICODE is the basic building block of all standards.
Interoperability	Not Guaranteed	Not Guaranteed and tested	Interoperability is possible with all other data exchange / transmission format
MOBILE-KEYBOARD ENABLEMENT	Proprietary	May be same	May be same

IMPLEMENTATION REQUIREMENTS:			
USER SIDE (Client)	Requires customization	Requires customization	UTF -8 being compatible with UNICODE , does not require much customization both in user side and the server side
SERVER SIDE	Cannot be implemented at Service provider level alone.	Cannot be implemented at Service provider level alone.	
EASE OF USE (Localization)	Proprietary	Not yet tested	Localization of User interface and other applications within the cell-phone like phone book, address book, etc can easily be localised

TABLE 1 Comparison of Different encoding schemes for Indic Messaging schemes

8. Conclusion

For the India mobile market, voice services constitute nearly 88 percent of the total revenue. For non-voice or data services which include SMS, Internet browsing and multimedia, year-on –year growth was 33 percent over 2008. Mobile media has increasingly becoming the preferred medium of communication. There is a strong demand for the input of text or alphanumeric information that is easily and efficiently entered, recognized, stored, forwarded, or searched, via traditional software techniques. The encoding scheme should support all possible characters, character combinations as per Unicode standard. The UTF-8 encoding is more widely used by websites, emails and many open source applications. The various challenges in mobile web is Web browsers offer for the content author a kind of abstraction layer that ensure that the content or applications will work on all standard-compliant browsers, provide guidelines or methodologies to develop Web content and applications accessible to people with low-reading skills. The various Issues for enabling Mobile web in India are character encoding scheme, presentation issues, input issues, illiteracy, bandwidth & cost. In terms of internationalization, there are still many network operators which do not support appropriate characters encoding on the signaling channel which would allow all characters of the world to be represented. In this paper we have tried to highlight some of the major issues towards multilingual enabling of Mobile environment in Indic languages , which need thorough investigation and study. Standardization of mobile media also required to be addressed taking into consideration of specific requirements of each of Indic languages.

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7. www.qualcomm.com/products_services/airlinks/**lteadvanced**.html

The Mobile Web: Key Industry and Technological Trends

Shwetank Dixit

Abstract :

The paper will shed light on key trends for the mobile web in key countries, and then will focus of India specific figures to place India related trends in a global context. The paper will focus on two main parts: Market trends and technology trends in the mobile web space. In the former part, the paper will focus on analyzing usage patterns of the data from usage and download statistics from Opera Mini, which is one of the world's most used mobile browsers, taken over a period of the last one year, which allow us to get an insight into key usage trends regarding mobile web space in India. It will also focus on some demographic data, to give an insight on who are using the mobile web in India and worldwide. The paper will also shed light on the key opportunities and challenges that lie ahead regarding Indian mobile web usage, both from a market perspective and a technical and developer related perspective, and will provide further ideas on how these challenges can be addressed.

Key Words: Mobile web usage, trends, mobile web adoption.

1. Introduction

The mobile web has opened a more channel of communication and access to information, and as such, is of great interest to both network operators and end consumers alike. In India alone, the number of people who have a handset capable of accessing the data services/internet has risen to 127.04 million[1]. This number will only go up, as more and more sophisticated mobile phones enter the market. ARPU (Average Revenue per User) decreased by about 6-9% worldwide for operators in the last quarter of 2009[2]. Providing access to the mobile web, and hence gaining on data revenue, will have to be a priority to compensate for declining voice revenue.

In five years time, more people are likely to connect to the internet through mobile devices than the desktop computers[3]. When given the opportunity, users tend to flee carrier portal sites and like to browser the actual Web on their mobile devices[4]. The opportunity is there to take advantage of this fact, and abandon carrier walled garden in favor of allowing free access to the full web to users on mobile devices, thereby increasing data traffic.

Global mobile data traffic was 0.09 Exabytes per month in 2009, and is expected to increase to 3.6 Exabytes per month by 2014[5]. The mobile web is being used in various quarters, such as Industry operations management, advertising and even higher education[6]. It is imperative to understand the key trends and future possibilities in the area of the mobile web, both from a market as well as technological perspective. This paper will take a look at the key industry and technological trends regarding the mobile web, together with a focus on the Indian market.

2. Market Trends

Opera Software every month releases the 'State of the mobile web' reports[7], which analyzes on a Macro level, usage and handset data from over 50 million users of the Opera Mini mobile browser worldwide. The following market trends are based on the State of the Mobile Web report published by Opera Software for the month of January 2010[8].

2.1 Methodology

All content from Opera Mini users has to first be transcoded through Opera Mini's servers, and then sent to the client's device. Aggregated information is then published by Opera every month as part of the 'State of the Mobile Web' reports. Handset data is based on the number of people who have downloaded Opera Mini for that Month. Hence, these numbers do not reflect users of operator pre-installed versions of Opera Mini.

2.2 Results from the data

In the following few points, we will cover the usage patterns and other points of interest we have noticed while analyzing this data. The number of downloads as well as usage of Opera Mini has increased by more than 100% over the time it was first released. This suggests that more and more people are using the mobile web each year. We delved deeper and analyzed data from the last six months, and saw that usage has increased considerably every month. In January 2010, Opera Mini had about 50 million users, a 7.4% increase from December 2009 and up 149% compared to January 2009. In India, the number of unique users using Opera Mini grow by 236.3% from January 2009 to January 2010.

2.2.1 Handset Usage

There is a clear trend of domination of the market with regards to the mobile web by a particular handset manufacturer, especially in developing countries. In India, in January 2010, the top ten handsets used to download Opera Mini were all from Nokia, the most popular being the 'Nokia 5130 XpressMusic' model. The other markets where in Janurary 2010, the top ten handsets for downloading Opera Mini were all from Nokia, were - Indonesia, Vietnam and China.

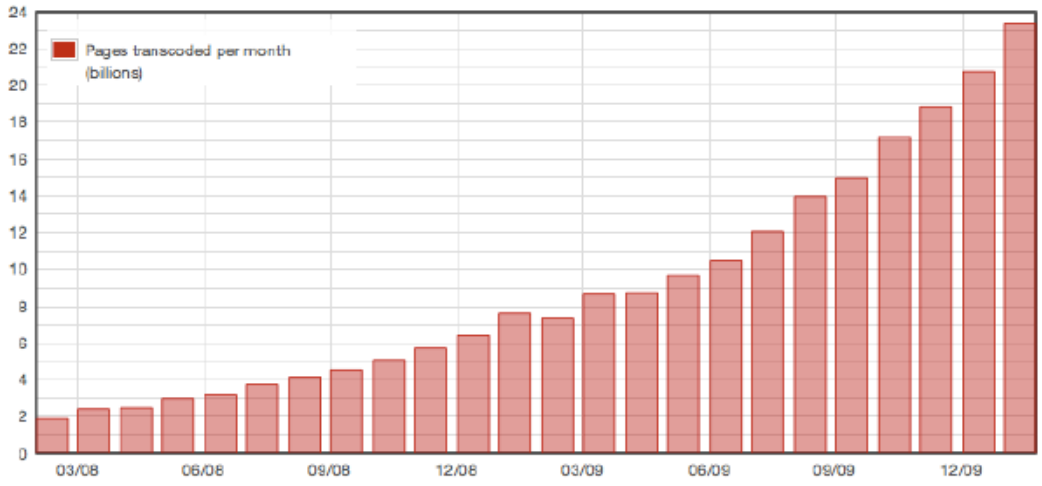
Contrary to that trend is the United States, where out of the top ten handsets, four of them were Blackberrys, followed by two each from Nokia, LG and Samsung. The most popular phone in the US for downloading Opera Mini was the model 'BlackBerry 8330 ("Curve")'.

2.2.2 Mobile Web Usage

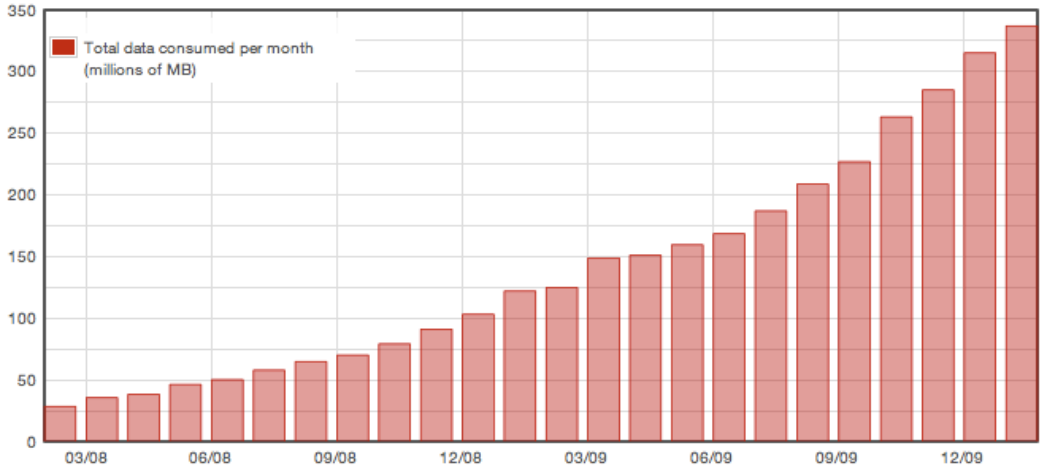
The countries which we found to have the largest traffic use for Opera Mini was Russia, followed by Indonesia, India, Ukraine, China, South Africa, USA, Nigeria, Vietnam and Great Britain in that order. There are certain similarities and certain jarring differences in the usage patterns of these markets, which we will explore further.

2.2.2.1 Pages Transcoded

Page view traffic, or the pages transcoded by the Opera Mini servers, every month for Opera Mini has increased from 7.5 billion pages in January 2009 to 23.3 billion pages in January 2010 which represents an increase of 208%. In India, page view traffic has increased by 225.9% from January 2009 to January 2010, with 6MB of data consumed per user per month, and 344 page views per user per month for January 2010.



2.2.2.2 Data Consumed



In January 2010, Opera Mini users generated over 337 million MB of data for operators worldwide.This is a 7% increase since December 2009 and a 176% increase since January 2009. Data by Opera Mini servers is compressed by up to 90%. If this data were uncompressed, Opera Mini users would have viewed over 3.1 Petabytes of data in January 2010.

2.2.2.3 Top Websites Viewed

In India, for the month of January 2010, the ten most visited websites using Opera Mini were the following (listed in descending order of traffic):

1.google.com
2.orkut.com
3.facebook.com
4.wikipedia.org
5.youtube.com
6.yahoo.com
7.songs.pk
8.zedge.net
9.getjar.com
10.wap.in

Google, a search engine, is the most used website for Indian users of Opera Mini, however, orkut.com and facebook.com are the second and third most used sites, indicating a strong trend towards growth of social networking on the mobile web. Songs.pk and youtube.com indicate an inclination towards general leisure related sites on the rise, with zedge.net, getjar.com and wap.in suggesting that users are also interested in downloading certain mobile related content on their phones.

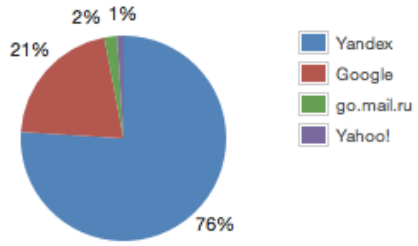
Russia

- Page views that are from search portals: 3.3%
- Average number of search-portal page views per unique user: 14.3

Top search portals (by page views)

Search portal	Total page views
Yandex	2.5%
Google	0.7%
go.mail.ru	0.05%
Yahoo!	0.04%

Search engine market share



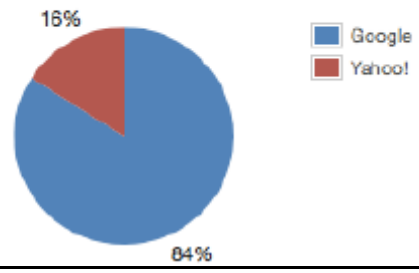
India

- Page views that are from search portals: 22.1%
- Average number of search-portal page views per unique user: 75.8

Top search portals (by page views)

Search portal	Total page views
Google	18.5%
Yahoo!	3.5%

Search engine market share



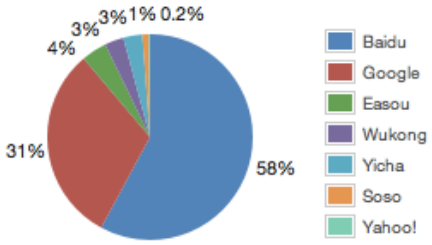
China

- Page views that are from search portals: 13.5%
- Average number of search-portal page views per unique user: 34.5

Top search portals (by page views)

Search portal	Total page views
Baidu	7.8%
Google	4.2%
Easou	0.6%
Wukong	0.4%
Yicha	0.4%
Soso	0.07%
Yahoo!	0.03%

Search engine market share



It is notable that there is an absence of certain categories of sites on this list, such as news sites, as well as transaction based sites like ones related to travel tickets and online shopping.

2.2.2.4 Search Engine Market Share on the Mobile Web

According to our data, search engines are the most used category of websites on the mobile web. It is interesting to note the usage of different search engines in different markets, and the trends it can tell with regards to localization and internationalization. Opera Mini users in Vietnam and India are the biggest users of search portals. In Vietnam, 30.9% of page views are from search portals, and users viewed an average of 63.6 search portal pages per month. In India, 22.1% of page views are from search portals, and users viewed an average of 75.8 search-portal pages per month.

Opera Mini users in Ukraine use search portals the least: 0.8% of page views are from search portals, and users view only an average of 6.1 search-portal pages per month.

In India, Google was the most used search engine with approximately 84% of search

engine usage, followed by Yahoo with approximately 16% usage (All search providers with less than 0.01% of page views have been omitted in the study)

Worldwide, we found that Google was the most used search engine in most markets, except for two notable exceptions. In Russia, we found more people to be using Yandex, with 76% of mobile search engine market share, followed by Google.ru with 21%. In China, Baidu was the most used search engine with 58% market share followed by Google with 31%. This trend suggests that in some markets, where english is not the standard language, there is a greater need to localize and translate content so it is better suited to local audiences.

2.3 Challenges and Opportunities

One of the biggest challenges facing the mobile web is language. On the web, the ability to read and write particularly required. However, there is an opportunity for network operators to increase network speeds for mobile web access, so that content such as audio and video, which does not require the ability to be literate to a great extent, can also be consumed. The ability to consume audio and video properly on the mobile web can be a big force in increase in usage of the mobile web in general, and due to the greater size of audio and video content relative to just text, it can result in greater ARPU for network operators as well. By 2014, 66% of worldwide mobile data traffic per month is expected to come from mobile video[5].

Another challenge is lack of proper localization of sites. Many people may be literate, but not in the language that the site is in. To achieve top market share in certain markets, particularly China and Russia, it is imperative to localize and adapt to the local environment as much as possible. Furthermore, another challenge appears to be websites which are designed keeping only the desktops in mind. Mobile browsers come in all shapes in resolutions, and it is imperative for web developers of today to keep in mind the mobile web while making websites. The W3C Mobile Web Best Practices Guidelines[9] provide a good resource for such information.

Other opportunities in this field include better standards and technologies, which developers can use in the future to make more compelling applications for the mobile web. Platform fragmentation has occurred in today's scenario, where each platform or Operating System (such as Windows Mobile, Android, Symbian, etc) has it's own system through which applications have to be made. The Web is the only viable way through which applications can be be made once so that it has a chance to run across all these platforms.

3. Technological Trends

Upcoming standards and technologies will play a big role in the future of the mobile web. Here we will explore some of these, and how they fit in the context of the mobile web.

3.1 Mobile Widgets

Mobile widgets are mobile applications built on standard web technologies of HTML, CSS and JavaScript, many times using development techniques such as AJAX. Because it uses standard technologies which almost all know by way of web development, they are much easier to develop. Widgets are supported not just on cell phones, but also on some other devices such as certain TVs, cars and personal media players[10]. This gives widgets the ability to be able to run on a number of devices with minor effort required from the developer's side.

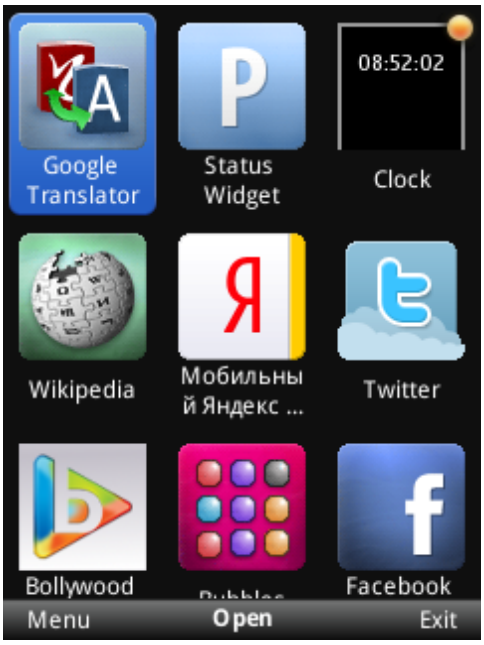


Fig. Opera Widgets Manager on S60 Platform

Widgets running inside a car's dashboard display system

3.1.1 Mobile widgets in the near future

Widgets right now are gaining ground as viable way to make mobile applications, as evidenced by its heavy promotion by certain big network operators and handset manufacturers[11][12]. However, they are still right now somewhat limited in scope, as many device specific features cannot be performed by them natively, which is often a difficulty.

In April 2008, China Mobile, SOFTBANK and Vodafone (and later on Verizon) came together to form the Join Innovation Lab, or JIL[13], which is envisioned to be a platform for mobile widgets. The Open Mobile Terminal Platform also came up with a vision for the future of mobile widgets, called BONDI[14].

Both JIL and BONDI aim to provide a standard set of APIs[15][16] with which developers can make mobile widgets which can take greater advantage of the device's capability. Examples of such capabilities could include connecting to the camera phone, sending and receiving SMS, using the address book, access to external web services etc. Providing such capability will further enhance the utility and value of developing widgets for mobile devices.

Recently, more than twenty four telecom companies announced the "Wholesale Applications Community"[17], a joint effort to offer a central marketplace for mobile applications which would rely on APIs such as JIl and BONDI to provide developers a platform to create applications which work in a cross device and platform way. The alliance represents more than three billion customers worldwide.

3.2 QR and other 2D matrix codes

Matrix codes are increasingly being used as a way to provide electronic boarding passes as well as various tracking applications for inventory control, as well as advertising. The advantage of 2D Matrix barcodes is that more information can be stored in it than 1D barcodes, and it is possible to be encrypted as well as sent easily by mobile phones.

QR code encoding the text 'Sample'

QR codes are a form of 2D matrix barcode which can encode information such as URLs, text, etc in it. Some devices have decoding software which can decode this information and provide the user with the information. An example of QR code use in the industry is by JCPenny, a popular retail chain, which have used QR codes to provide online coupons, which are sent to consumers' mobile devices. This code, when presented at the store, is scanned and the user is provided a discount[18].

The IATA (International Air Transport Association) has selected QR codes, Aztec codes, and Data Matrix, another form of 2D barcodes, as a standard for online flight ticketing information as part of it's BCBP (Bar Coded Boarding Pass) standard[19]. Trinity Mobile reported a 1200% increase in users using its mobile boarding pass services for 2009[20]. An opportunity exists for various online ticketing retailers as well airline companies to grow in the area of electronic boarding passes, thereby reducing ticketing costs in the long run.

3.3 HTML5 and other upcoming trends and technologies

The new version of HTML, called HTML5 [21] has a number of new features which would enable the future of web apps, even on mobile, to be much more easy to develop, and use. Apart from HTML5, other new standards and technologies are also coming up, which should be useful in developing future mobile applications, particularly when used in mobile widgets.

3.3.1 Offline Web Applications and Storage

Besides that, HTML5 supports a mechanism for offline storage of web applications, referred to as 'application cache'[22] or 'app:cache'. With this, developers can specify which files they want available to be viewed offiline, and when the user is not connected to the internet, they can still use those files offline. This is especially useful in the mobile context, where signal strength may vary from one location to another, and may not be present at all in certain places (remote areas, tunnels and subways, etc). Offline Web Applications can play a useful role in this regard.

The W3C Web Storage API[23] provides a way to store user information in a better way for developers, so that there is persistent storage of information using the 'localStorage' property, and temporary storage using the 'sessionStorage' property. This will result in a much better way to store user data on the client side, and could be of much use in mobile web apps and widgets in the future.

3.3.2 Graphics, Multimedia and User Interfaces

HTML5 also includes native support for audio and video, with the <audio>[24] and
<video>[25] tags. Right now, to play audio and video, use of external plug ins are required, which may or may not be present on a device, furthermore, they tend to be resource intensive, which is not good for mobile devices with very limited computing power and battery life. Support for <audio> and <video> tags in mobile browsers will mean that no external plug-ins would be required to run audio and video content. It could be played natively straight from the browser itself.

The canvas tag[26] in html5 allows programmable graphics using just JavaScript, which can allow for easy rendering of charts and graphs, as well as games and other interactive content. Scalable Vector Graphics, or SVG[27], is already being used in the mobile space with the S60 platform having native support for it. SVG(provides vector graphics which can scale to different resolutions without affecting quality of the image. This means you can have the same quality of graphics using SVG on a big screen TV as well as a tiny mobile device.

CSS3[28] is another standard being implemented by makers of browsers. It will help in making better web graphics easily. Features of CSS3 include rounded corners, multi- column text, drop shadows, transitions and transforms, and more. Many mobile browsers already have support for CSS3 media queries[29], with which it can be specified which layout to use for which resolution. For example, a developer can specify a different set of CSS properties for all devices with a certain width and height, and a different set of CSS properties for other devices which support a greater width and height. Since mobile phones all have such a large variety of resolutions, support of media queries in web apps makes it very useful to cater to all of them, and provide the best interface in a easy manner.

3.3.3 Geolocation

Location based services are an exciting area of web applications, especially in the field of mobiles. More and more new web applications are starting to integrate it, including the popular micro-blogging site, Twitter.

W3C Geolocation API[30] is a standard for providing web application developers a way to get accurate information about the user's location using a standard way. Unlike some
of the current ways of determining location right now on the web, the specification for the Geolocation API states that the browser or user-agent must explicitly ask the permission of the user to share his/her location information. This results in much better privacy control than conventional methods. Location information can be used to provide additional services such as location aware suggestions for services and shops, location targeted advertising, turn by turn route navigation, etc.

4. Conclusion

Web usage on mobile devices is increasing at a very fast rate. Data traffic is increasing whereas voice traffic is decreasing, and hence it makes sense to provide access to the mobile web to people to consumers. Certain developed countries have a prevalence towards using smart phones for internet access on mobiles , whereas the developing countries still rely to a great extent on feature phones. Search engines are the most popular category of websites viewed, followed by social networking sites. Sites related to general leisure as well as content downloads have good potential for growth on the mobile web. Mobile Widgets, which are small specialized web applications written in web standards, are gaining momentum, and upcoming APIs could provide greater power and functionality to such widgets. 2D barcode systems are increasingly being used in industry. New and emerging standards like HTML5, Web Storage and Geolocation also provide a potential for more engaging, useful and powerful

web experience on the mobile devices front.

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Real Time Communication Services

Pratiroop Mehta, Mayank Kumar, Vishal Chandra

Abstract:

In the first section the paper introduces mobile communication, challenges of the bootom of the pyramid and need for value innovation. In the second section, the paper details about deploying mobile applications on ground and the major challenges that are faced in mobile communication. The larger objective of the paper is to engage all parties in the Mobile Communication ecosystem to develop a dynamic system of information gathering & delivery for the Indian market while retaining flexibility in the system so that it allows all parties to reach out to other markets where the basic issues and needs are similar to the ones in India. The third section caters to email service. The paper ends with a set of recommendation in the fourth section.

Keywords: Mobile applications, Email, Real Time Communication, Linked Data, Semantic Web, Mind Mapping, Open source, VAS, feedback, market survey, Software as a Service, SaaS, Multi-lingual support

1. Introduction

Mobile communication systems in India have brought the kind of social & economic unification that had previously happened with the introduction of the Indian Railways. Railways catered to the natural human need to travel and socialize, while at the same time allowed students and business persons access to better facilities and larger markets. In the same manner, mobile phones while satisfying a basic human need of communication, has become the primary mover for access to information and a tool for conducting business.

In recent years, the number of mobile connections has far exceeded the number of fixed line phones and internet connections. As has been emphasized in numerous articles and forums, mobile has become the most convenient channel not just for person to person communication, but also machine to person communication. Such a scenario would have been difficult to imagine 15 years back when cost of equipment was the primary reason for lack of internet penetration and internet awareness. Even today internet access at home requires approx Rs. 20,000 as initial investment and Rs. 300 as monthly charge. In sharp contrast a fully featured phone today costs Rs. 5000 and monthly expense on an average is close to Rs. 150. Additionally, the user has an enormous range of mobile devices to choose from based on the features & budgets, making it the gadget of the common man.

Mobile Communication – A Blue Ocean Strategy

It may be interesting to note that, Government policies & industry leaders in telecom addressed the issue of communication in a manner explained much later in the popular management book 'Blue Ocean Strategy' by W Chan Kim & Renee Mauborgne. The book talks about a business strategy that is based on

'looking across Alternative Industries'. For instance, Southwestern Airlines in USA pitted itself against travel by private cars, and created value for the traveler by increasing speed of travel while retaining the convenience of point to point travel and matching the price.

The telecom revolution began with the broad objective of making communication as cheap as sending a postcard. By pitching mobile telephony against postcards, we have improved upon the speed & reliability of communication while matching postcards in cost & convenience. This offers a blueprint to all future entrepreneurs looking to serve the Indian markets.

Fortune at the bottom of the Pyramid

The paper tries to capture the spirit of the book by Dr. C.K. Prahald, Fortune at the Bottom of the Pyramid. As propounded by the book, we choose to consider all citizens in the Bottom of the Pyramid as our clients and assume that all principles of good business must apply when we build mobile applications for them. Quite simply, this means that, we shall bill our clients for the services that we offer and in return we promise to deliver what the client wants. This involves a bottom up innovation and technological development as against building technology before finding application. The challenge therefore lies in identifying the need of our targeted customer, offering services in a package that is best utilized and pricing that is most appropriate.

Value Innovation

What we feel is that often, we fail to grasp the exact nature of the problem that our end user experiences and solve problems at the superficial level. This happens in part because we do not initiate surveys & interact with our 'potential customers' directly, which in turn means that we do not have sufficient data to base our analysis upon.

The focus should therefore be on 'value innovation'. Pure value creation means incremental benefit to the end user that may not be worth an investment from the consumer's point of view. Pure innovation means shooting beyond existing requirements. Value innovation is a comprehensive phrase explaining innovation that creates value for the end user and hence constitutes a sound business. Value innovation involves creativity on all fronts including technology, logistics, supply chain, sales & marketing channel and billing.

2. Deploying Mobile Application

A mobile application deployed on the ground would constitute the following

1. Mobile Device & network
2. Application on mobile
3. Information Bank
4. Market surveys & feedback system to keep the information bank up to date
5. Sales & Marketing
6. Billing & recovery

In the current scenario, mobile device is a part of the open market where manufactures offer devices directly to the customer. However, mobile network,

applications on mobile, sales & marketing & billing is owned and managed by the operators. Information banks could be maintained by the operators or by individual firms. Interestingly, however, there is little work being down on market surveys & developing a customer feedback system in the true sense.

Future challenges in mobile communication

By making mobile devices and mobile network available we have only solved a part of the bigger problem. As we understand, the next set of challenges lies in

A. Information storage
B. creating system for continuous updation of information banks
C. making information delivery cheaper and faster
D. making information available in the format best understood by the user, and
E. Delivering information available when it is most needed, preferably in real time.

This forms the basis of discussion in this paper, where we try to exhibit the importance of **Intelligent Real Time Communication Systems** through specific cases and propose execution strategies for some of the cases. The larger objective of the paper is to engage all parties in the Mobile Communication ecosystem to develop a dynamic system of information gathering & delivery for the Indian market while retaining flexibility in the system so that it allows all parties to reach out to other markets where the basic issues and needs are similar to the ones in India.

A) Information Storage

Linked Data

Linked Data is a concept where data, possibly stored on two or more different databases, can be related and searched. For instance, data on location of polling stations can be linked with data on security threat levels in different areas and presented on a map for the benefit of journalists. In this case, the location of polling booths and threat levels would be stored in two different databases, possibly owned by two different organizations. However, if the data is published in standards prescribed in Linked Data format, the data can be combined to serve information in an easily consumable form.

Linked Data is a part of the Semantic Web (described later in the paper) movement popularized by Tim Berners Lee and is being adopted by private and government organizations around the world for presenting information on the web. Such data sharing begins with the fundamental assumption that it must be left to the people how they wish to use and consume information, since the various permutations and combinations may not interest the authorities owning the data. Individual parties may, however, develop business models around such information for the benefit of everyone.

It may be interesting to note that when users mark their home or office location on Google Maps or similar websites, they are contributing to the Linked Data. The information entered by the user may be combined with other data points to provide relevant information to other people around the world.

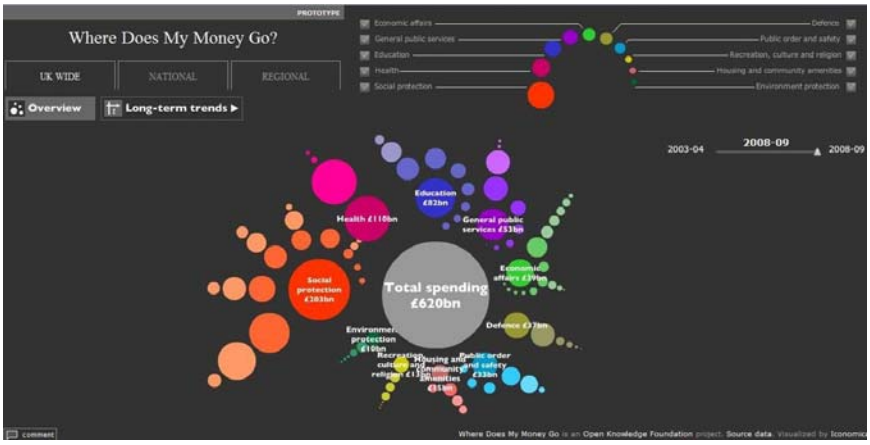


Fig. Power of Linked Data: Screenshot showing the real time spending of UK govt. on various schemes. Ref: www.wheredoesmymoneygo.org

B) Updating of information Banks

Market Surveys & Feedback Loop

There are quite a few firms which offer telecom reports, but most of the conclusions and findings are based on broad subjects. There is very little information on specific subjects, specific problems and specific inefficiencies in the system. As a result, it is left to the user's imagination as to what could be potential business opportunities. In most cases, since the 'feedback loop' is absent, there is practically no chance of validation of business ideas and refinement.

Further, till very recently, the mobile application domain was controlled by the mobile operators. Operators to a great extent relied on the market insights of the application developer which we understand would be limited in absence of the 'feedback loop'. In a recent development, mobile operators have opened Application Stores where developers can place their applications for sale directly to the consumer while the operator helps out with the billing. The onus is now on the developer to understand user requirements and tailor the development accordingly.

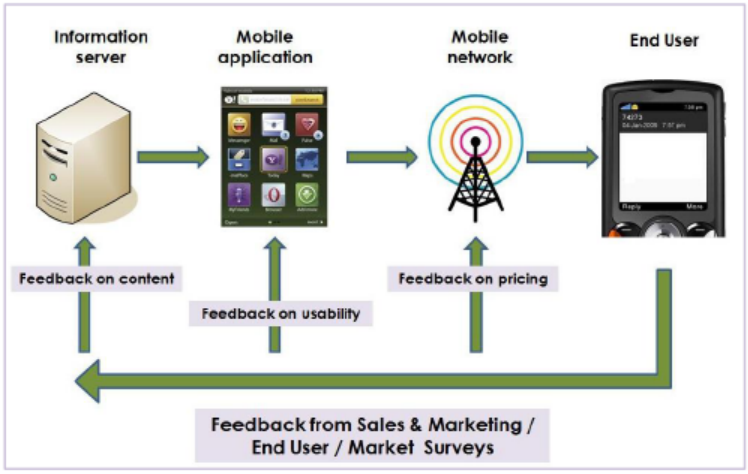
This further emphasizes the importance of 'feedback loops' in the application development environment. Market surveys & advanced analytics based on these feedbacks will assist the developer community in designing products and will also let them focus on development & innovation.

It is important to note that the 'feedback loop' is an essential step towards e governance. The
'feedback loop' once created will serve the larger objective of participation of the public in governance activities. Today, most people even in the developed parts of a city feel left out simply because they firmly believe that their views are not

being heard and will make no difference to the working of the public or private bodies.

In a recent interview, Sam Pitroda, father of India's telecom revolution, has proposed voting via mobile phone. This clearly establishes the fact that mobile can be looked upon as a channel for citizen participation in a democratic setup. Mobile can therefore be used as a tool to gauge the public sentiment or opinion and can influence the functioning of the government. Just like in the case of mobile applications, the feedback loop will help in quicker reaction and hence faster action, leading to a refined product or policy in a shorter period of time.

There is clearly a case where mobile application developers can collaborate with survey agencies, marketing agencies to identify problems and develop solutions accordingly.



C) Faster & Cheaper information delivery

Application development –SaaS for Mobile

Mobile application development is a function of the device & network capabilities. Hence, applications must always be customized given the plethora of mobile form factors (screen sizes, keypads) & mobile operating systems. Apart from making application development a complex task, the associated overheads of application up-gradation, bug fixing, installation / un-installation and user handholding make it almost impossible to have a cost efficient application development ecosystem. In effect, an application deployment strains not just the developer but also the call center and after sales staff.

Mobile ecosystem community can adopt Software as a Service (SaaS) model for all application development. SaaS in the computing world means that the user does not need to purchase and install utility software on every device. Instead the software is hosted on the web, from where a single license can be purchased and used anytime and from any device. For instance, Google Docs is a SaaS version on Office Tools. Google Docs allows users to create & store excel, PowerPoint etc. on the web.

Apart from delivering benefit in terms of cost and accessibility to the end user, what SaaS model also does is, that it allows a firm like Google to continuously

upgrade the software, add or remove features and customize based on user feedback. In the current scenario where software is installed on device, the version of software remains the same state until a new license is purchased, thus stifling the process of continuous innovation.

In addition, SaaS also offers the possibility of passing on the elasticity of cost to the user. For instance, the software developer may offer the software on Pay as you go basis, charging the user for every usage instance rather than a lump sum fee. User is therefore given the power of multiple payment/subscription options.

All these benefits make SaaS the perfect model for mobile application deployment. Application developers can get off the ground quicker, test their services and get user feedback before they evolve a subscription model. This system gives the flexibility of trial and error at little or no cost and hence encourages more people to become a part of the ecosystem.

The biggest benefit of SaaS model can be understood in multi lingual application development. Most phones & browsers are not designed for local language support. A common problem that many developers face is that they are not able to test the translation, transliteration sufficient number of times to announce a failure proof commercial system. A local language SaaS application deployed on the ground will mean a continuous stream of inputs leading up to a refined product.

SaaS deployment however requires data connectivity and browsers on mobile, which is not available on most phones today. However, keeping future potential and benefits of such a deployment in mind, the mobile designs can be adjusted accordingly. As a matter of fact, mobile devices are already moving in the direction of larger screen sizes, better keyboards, touch screen, browser support owing to the fact that such features improve the user experience.

D) Information available in easily understood format

Multi lingual support

A critical factor in service adoption is the ease of use and the learning curve. Needless to say, the learning curve must be smaller and for this reason it is important that information is presented in the user's native language. The challenges associated with developing front end applications and backend system for multi lingual support is being looked into aggressively by firms such as Google. However, it would be easier for local players to work on this subject, primarily for two reasons. Regional firms can grasp the nuances of communication in local language better and hence develop a more comprehensive refined translation/transliteration system. Further these firms will have a better grip of regional aspirations and can develop a business model around such an initiative.

Screenshot of a mobile with Hindi support

Information processing & delivery

As discussed earlier, an important part of application development is the 'feedback loop'. Similarly information banks must keep step with rapid changes in the kind of information that is being consumed and the manner in which it is consumed.

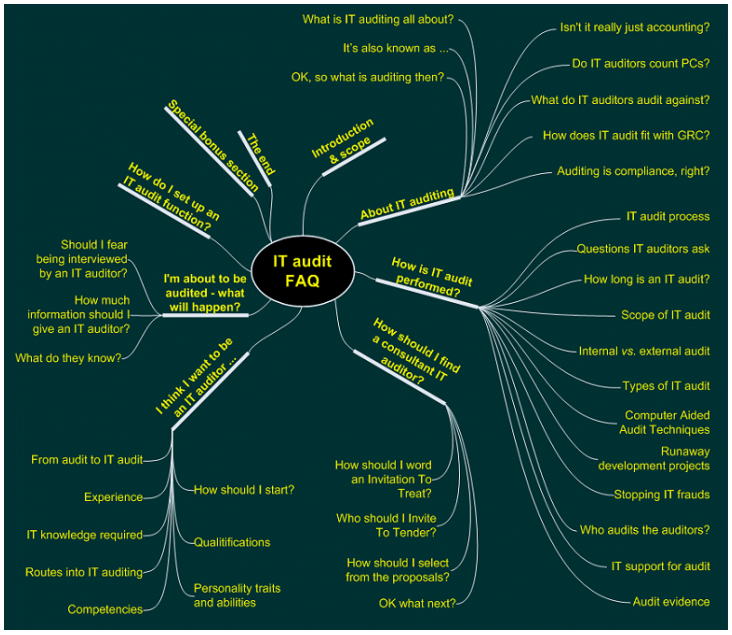
What this essentially means, is that the information gathering system has to be improved so that all possible clients are catered to. For instance, it could be possible that poems in local language are popular. In this case it is important to be able to gather the poems while suitably incentivizing the creator.

What would be an ideal case is where the poet is able to type out the poem in the local language on his mobile phone through a pre installed application, which can be transferred seamlessly to the content (information) bank from where again it can be re distributed via multiple media (website, mobile website, SMS etc) on various subscription schemes suited to the end user across the country on any operator.

Mind Mapping for information presentation

A mind map is an intuitive diagram used to represent ideas or tasks or other items linked to and arranged around a central key word or idea. Mind maps can be used to visualize ideas and use as an aid in study, organization, problem solving, decision making, and writing. Mind maps may also be used as a memory aid. The graphical, non linear manner of information arrangement encourages a brainstorming approach to planning and organizational tasks.

The concept of mind mapping can be re created as a mobile application. This kind of application can be used in schools and colleges for explaining multi dimensional concepts to students or used by business persons for clearing thoughts & framing plans.



Mind Mapping: Screenshot showing the mind mapping diagram for an IT Audit project

E) Intelligent Communication - Semantic web

This is Tim Berners-Lee, the founder of the World Wide Web's vision of the internet: "I have a dream for the Web [in which computers] become capable of analyzing all the data on the Web – the content, links, and transactions between people and computers. A 'Semantic Web', which should make this possible, has yet to emerge, but when it does, the day to day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines. The 'intelligent agents' people have touted for ages will finally materialize."

To give an example, a person looking for some equipment is more likely to go online and search "video camera on rent" rather than "video camera on rent in Meerut". For a person, search engine itself could be a difficult concept to grasp. It is for this reason that all information searches must be context aware.

Hence, the search engine must 'pre understand' keywords such as "Meerut", "less than Rs. 2000","wedding next week". These keywords would be picked up from calendar, emails & other information, that the user has allowed access to the search engine. A search engine such as this one will go a long way in making the user experience better.

Semantic communication

The most logical platform for delivering a semantic search engine is mobile. Mobile being primary mode of communication which is close to the consumer all the time is likely to be used for such a search service.

Add multi lingual & voice search support, and the service will be useful for almost everyone who has access to a mobile phone irrespective of the educational qualification or location.

Further, by bundling search engine with an email account, the users will have a location aware semantic communication experience. The challenges lie in making this kind of communication seamless.

Making information available in real time

An important part of information bank utilization is making information available in real time. We propose utilizing email as a media for information distribution & feedback generation. We firmly believe real time information powered by email can potentially give us the missing pieces in the puzzle which will allow us to design and develop applications that satisfy consumer needs at an appropriate price points while providing sufficient scope for up gradation & improvement at a speed faster than current levels.

3. Email Service – For Real Time Communication

Email has become the primary channel for all business communications across the world. Improved accessibility of internet (wireless or fixed line) has made email the logical alternative to fax & postal services.

Moreover, email has since long moved out of the domain of enterprise communication and made itself a must have for every student, business person and professional for private communication. Email service providers such as Gmail, Hotmail and Yahoo have realized this business opportunity by offering email services for free to the end user and earning revenues through advertisers.

How will Email benefit India?

The problem of low internet penetration in India is well known. Laying down internet infrastructure solves only a part of the problem, since last mile acceptability remains a function of equipment cost, literacy & service cost. Hence, alternative modes of making a citizen, information enabled should be looked into.

Email being almost a like replica of physical mail, can be a medium of change in India. Other than the Indian Railways, postal services have played a big hand in unifying & connecting India. Letters & postcards satisfy a basic need which we can enable at a lower cost through use of technology. Once the importance of email as a medium of fast, reliable & efficient mode is established, we can move on to make email affordable and user friendly. This will naturally require a concerted effort on the part of network operators, government agencies such as TRAI & software firms in India.

It is important that all parties are encouraged to look upon the so called 'less fortunate' citizens of developing nations as 'the next billion consumers'. This

paradigm shift will help entrepreneurs explore business opportunities where none have existed. TRAI can play it's role by setting quality standards and incentivizing every initiative.

Email is a sticky media, as those who use it know. This is primarily the reason why even after so many years it is looked upon as the 'killer' internet application providing terrific opportunities to cross-sell and up-sell. We should take the lead among all developing nations to help all citizens create an email account and instead of pursuing a strategy of subsidy, we can empower everyone as customers with the right to accept or reject policies and services.

Is Email service an innovation?

One could argue that setting up an email service is not a technological challenge and current email providers ride more on brand than innovation. However, what is important to note is the focus of these firms on end user experience. Today, in India there are about 50 million email accounts in a country with 60% literacy rate. This leaves a window of opportunity for email service providers who have their ears to the ground and can match user expectations through technology. Gmail having realized this challenge started Gmail Labs feature where an add on product is delivered approx. every 2 weeks.

Why would anyone promote an Email solution?

While, from consumer perspective email allows quick, easy and generally free mode of communication, email service providers see every new account registration as an opportunity to up sell and cross sell. For instance, registration on Gmail allows users access to seemingly unrelated service such as online payment and related services such as photo sharing, social networking, chat etc.

Additionally, just like phone numbers, email ID becomes an identity which is shared with friends and relatives, making it difficult for users to shift to a new provider. This stickiness is what can be utilized for marketing, education, tele medicine, e governance, commerce and general awareness.

Email for accountability & streamlining

Email is recognized as proof of communication within enterprises. Email is understood to be media for intimation of events, assigning responsibility, reporting and communication with customers & partners. Even government bodies recognize email as a secure way for updating citizens on taxation and related issues.

We can therefore look towards a time when, every citizen by virtue of having an email account can receive public and private notices directly without being dependant on 3rd parties for printing & delivery. This will push all agencies towards being accountable & efficient and at least reduce a sense of uncertainty for the citizen.

Simplicity & affordability of email solution

Email, in India & most developing nations, is difficult to access. Some of the well understood reasons are low internet penetration and high cost of equipments. Some other issues like, infrequent electricity supply cause far greater problems and unstable communication being a small but significant one.

Another problem with email is that it does not work in end users language. Although, established firms may have the resources to customize email services for everyone, the ROI might not make it worthwhile. This opens up an opportunity for local players with better understanding of regional aspirations to evolve a business idea.

The most obvious channel for email communication in India post the wireless telecom revolution is Mobile phone. Interestingly, basic mobile services bring lesser and lesser revenue per user every month. From > Rs. 350 in Jan 2007 it has fallen to < Rs. 200 in Jan 2009. In such a scenario where voice & SMS services do not bring sizeable revenues, mobile operators are looking to sell Value Added Services.

However, to make matters more interesting, mobile number portability (MNP) is being introduced in Indian markets while MVNO services are being discussed. MNP will most likely cause churn away from operators which do not offer the best pricing, as against best services which is the norm in the rest of the world. In such, a scenario email offers a new way to the operator to bind the customer to itself. We can imagine a scenario, where a customer who has moved away from basic services might still continue to use the previous operator's email services.

Email binding, may in turn cause the original principles of operator driven VAS market to change. If today, VAS is offered to the subscriber of a particular operator, VAS would be offered to a particular email provider. This will enable operators to continue revenue streams from older customers while allowing entrepreneurs a far bigger & open platform for developing services. Ideally, the most creative & most innovative (not necessarily in terms of technology) will come out the winner.

4. Recommendations

i) To improve the usability of SMS, TRAI can make it mandatory for all mobile phones sold in India to have regional language support or make regional language support application available for free via TRAI website.

ii) Also, SMS communication remains an expensive proposition, with Rs. 3 being charged for premium SMS. Although premium SMS charges are a major revenue earner for the operators, they also in a way discourage usage for socially relevant and educational services.

iii) TRAI can prepare a list of services that it considers to be of social relevance or necessary for e governance. These services can be made mandatory on all networks and publicized by TRAI and other organizations. Development of

services falling under this list can be incentivized by TRAI.

iv) TRAI should encourage all parties in VAS ecosystem to move to open source systems to bring down development costs.

v) Encourage development of Value Added Services based on SaaS so that the benefits of price elasticity can be transferred to the end user

vi) Enterprises & government bodies should be encouraged to upload information on the web in Linked Data format to allow easy manipulation and use.

vii) TRAI can work with operators to create billing system which can be used by firms who wish to promote VAS services on their own without tying up with operators. This will allow firms to innovate not just on technology front but also encourage them to come out with innovative marketing strategies, while being assured that billing will be done through a standardized and transparent system.

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M4D Applications in Agriculture: Some Developments and Perspectives in India

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Abstract:

In this paper we are looking at Indian projects, which are targeted specific to farmers through their applications and services delivery through mobile phones by customised innovative business processes. These are looking at the basic core needs and demands of the end-users as the adoptable mServices which are affordable and create confidence on them. Some of the initiatives crossed to commercial stage and other are at field testing phase after piloting well. The applications used in their services are of short message service (sms), multi-media service (mms) and voice stream options. These are customised based on subjectivity such as literacy, usage pattern, social acceptance, domain specific and life-style of rural farmers in various states. These practices are nothing but innovative business models, which are adopted based on their per capita. Most of the initiatives are push-based method providing opportunity to fill the knowledge transfer to end users' basic needs. The value added services concentrated on crop advisory issues, market intelligence, micro-finance for rural populations and finally local social networking at rural areas. But this paper look at, how effective are the projects which are specific to agriculture domain providing the information and knowledge services to enhance crop yields and improve productivity over a wide range of crops by taking effective decisions at right time by farmers under different agro climatic zones.

Keywords: Mobiles for development, Agricultural mobile services, Information and communication technology, Mobile applications and services

Introduction

The rural growth usually efficient than the urban growth as agriculture growth is more efficient than manufacturing growth in most cases. If we can see the pattern of effectiveness of poverty reduction impact (Danielson A, 2001) based on the corrective measures taken by governments, donor agencies, and the project implementing organisations (commercial and social). The indirect impacts generally create the long term effect on development mechanisms. With quality information at

rural people fingertips, rural people can make improved decisions, from what crop to plant, to whom to sell it for better profit, and benefiting from health and disease prevention advice. The technology (specially mobiles) is making it to happen since mobiles positioning themselves as a personal entity within each individual it occupy in their pockets along with money, keys etc (Rao and Sonar, 2009). The present mobile phone based projects are targeting the farmer specific applications since rural India depends on agriculture which is about 70 per cent population. This provides an opportunity to research community to study for socio-economic development of rural areas issues. The result oriented mobile based solutions based on farmers' needs and demands is a major challenge for research community (technical, social and field specific) with rural socio-economic constrains. By this study we are looking at how effective are these mobile phone induced projects in providing the user specific localised services to farmers in local language to enhance their crop yields and in turn improve their productivity over a wide range of crops under different agro climatic zones.

The main stakeholders in this process are governments (national and state), business enterprises including multi-nationals and entrepreneurs, NGOs and people's groups got a chance to make rural people's life easier. By analysing the pilots to know about the delivery of user needs as services at affordable cost in their local languages where ever they are. Analysis concentrated especially on the socio-economic aspects of the outcomes arising out of projects implementation rather than looking at immediate profits as returns. Keeping in mind the farmers' interest and benefits, the effectiveness of the outcomes are tried to measure in terms of development perspective. These projects fall under farm expert advice on crops, market intelligence on various produce, crop finance, weather and other information cum knowledge sharing areas. Most of the projects crossed the research and development and field testing stages at various small geographic zones of India. Now they started their commercial operations with other collaborating organisations to deliver the mServices to the rural end users. As high mobile penetration across the country providing an opportunity to provide mServices which are going to fulfill the basic needs and demands of rural populations. The adoption of mobile wireless telephone by people irrespective of cadre, created a huge market for the telecom operators on one end, a chance of opportunity raised to provide mServices to unreached consumers through contactless mode. The new telecom policy by

government of India created a new wave of mobile adoption rate of 10 million per month mainly through wireless telephony segment which contributed for overall diffusion rate.

Mobile ICT intervention for rural areas

Information Technology revolution is unfolding, and has very high visibility. However, its benefits have remained confined primarily to the urban areas. Rural communities have not been able to gain to the same extent from information communication technologies (ICTs). As a means of knowledge transfer to rural communities, Information Technology has had a limited impact. Even the vast potential of the broadcasting network has been tapped only minimally for the extension activities. The World Bank recognises that "making effective use of knowledge in any country requires developing appropriate policies and institutions to promote entrepreneurship and efficient use of knowledge"- (Michael G., 2005). Dahlman C. Utz recognizes that India has made tremendous strides in its economic and social development in the past two decades and is poised to realize even faster growth in the years to come. They note that the time is very opportune for India to make its transition to the knowledge economy.

The rural society happens to be a tradition-bound community in which their traditions, cultures and religion play a strong role in influencing their behaviour. This shows on their adoption of technology, incremental change in work more clearly. The transfer of knowledge and information is the basic need to change traditional society to knowledge society. The need of ICT interventions are felt need of the hour in agriculture as rural areas mostly depend their socio-economic growth with agriculture. Rural India needs a very strong and innovative intervention to take a giant leap forward. "Connecting India", with focus on rural connectivity is one such intervention, which can help, ignites the rural creativity to achieve its potential by integrating them in global market (Abdul Kalam, A.P.J., 2005). The idea of digitally oriented development is as powerful and seductive as the technology upon which it is based. No single technology revolution has changed the lives of current generations in the way that the Internet has and later mobiles. The greatest obstacles to rural development – large distances and inadequate infrastructure – made to obtain by instant access to virtual institutions that provide agricultural, market advice, banking, education, health care, neonatal information and so forth. Most of the

Indian rural villages lack connectivity or accessibility to people, this results the wastage of time and money chasing information and officials. This is effecting on their productivity of activities say on agriculture and related areas. Lack of market information (on commodity prices, various input supplies, etc) leads to loss of income and exploitation of rural entrepreneurs by middlemen. Such exploitation and losses further marginalize small and marginal farmers and village artisans (Misra Satyan, 2005).

Technical and research communities have come-up with new dedicated and customised applications to the specific segments especially rural communities. This created a huge emerging market at bottom of the pyramid (BOP) which created interest even for multi-nationals want to contribute their part in services going to be rendered. Bridging the development divide, mobile phone based projects is providing a platform to test the catalytic growth of rural India. These cabalistic activities are to be sustained with telecom intervention else unreached communities can't able get a chance to come up. The penetration percentages differ between urban and rural, where urban is placed at about 80 percent of subscribers' base as per TRAI annual report. The market trends shows communications will become a basic human right in modern civilization era. There will be a continued push on price and distribution to take costs out. The spread of communication based services to wider demographic area to get benefit more number of people specifically in rural areas. This was created an emerging market but the existing business models have to modify drastically to accommodate the characteristics of lower price based services, affordable handsets with localised content and local language options. India is one of the major emerging markets second after China, wants to push services to all its citizens as a policy. The role of private sector may be crucial because the country has not much achieved success in achieving state-coordinated economic growth. The scope, consumer usage skills and educated middle class are few advantages for the growth of mobile based services in India as shown in Figure-1.

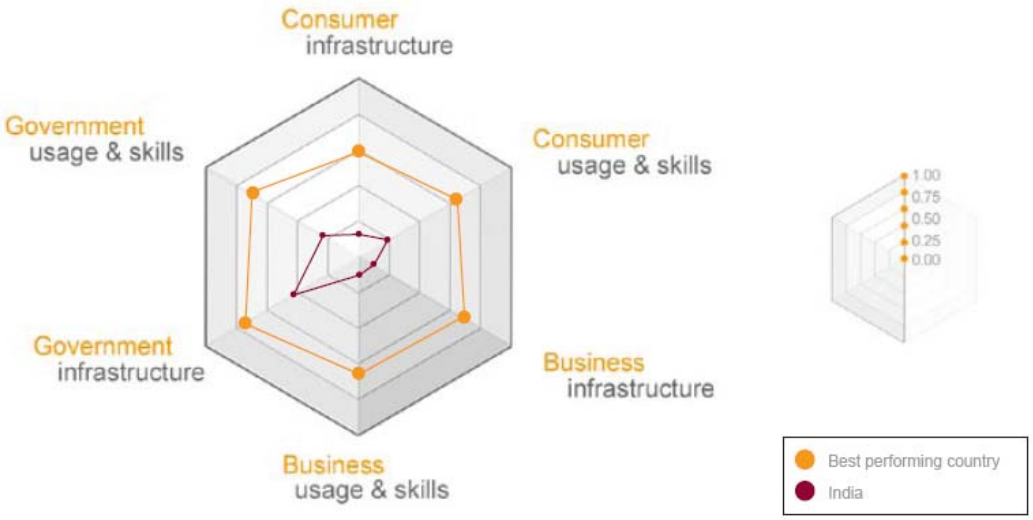

Figure 8: India's connectivity performance status (NSNRS, 2008)

Mobile diffusion in India

Indian telecommunication revolution that too wireless connectivity made it possible to reach to unreachable located consumers through mServices. During the present decade, India has seen an exponential growth in the telecom particularly in wireless. Rural teledensity has just reached the two digit level whereas the urban teledensity is moving towards the three digit level. Mobile- penetrations among the 700 million rural population are put at about 16-18 percent and growing rapidly (TRAI, 2009). The penetration is at least 10 million subscribers every month from September 2008 onwards. Even the masses have access to mobile connectivity, but the potential of the handsets are not yet tapped. This is largely because of the content delivered is often not directly related to their livelihood and environment. Since they need localised news and information directly delivered in their language to meet their daily needs. Only 29% of subscribers are from rural India, which constitutes about nearly 70% of the total population of the country (TRAI-1, 2008). Out of 593731 inhabited villages, the service providers had reported that 407112 villages have already been provided with mobile coverage (TRAI-1, 2008).

By March 2009 about 5.55 lack villages to be covered under public telephone (TRAI-4, 2009). By 2012, India is expected to have 200 million rural telecom connections (with trend shown in Table-1), and rural users will account for more than 60 percent of the total telecom subscriber base at a penetration rate 25 percent according to a report by the Confederation of Indian Industry and Ernst & Young.

Table 3: Telecom subscriber future growth

	2006	2007	2008	2009	2010	2011
Total population (in millions)	1152	1169	1186	1203	1220	1237
Mobile subscribers (in '000)	149,620	233,629	306,533	370,002	419,360	459,828
Mobile subscribers: % change y-o-y	97	56	31	21	13	10
Mobile penetration (in %)	13	20	26	31	34	37

Telecom sector has shown an exponential growth track after 1998 telecom policy introduction in India. Teledensity, which grew (TRAI, 2007) only 1.92% in 50 years (1948-98), increased by 35.06 per cent in just 11 years by March, 2009. Teledensity is interlinked with level of growth; the larger gap between urban and rural can't be sustained for long time. This is clearly seen in Table-2. From September 2008 till July, 2009 the teledensity raised by 10 percent stating the penetration or adoption of telecommunication services by people is very high. The monthly growth rate is high as seen in Figure-2.

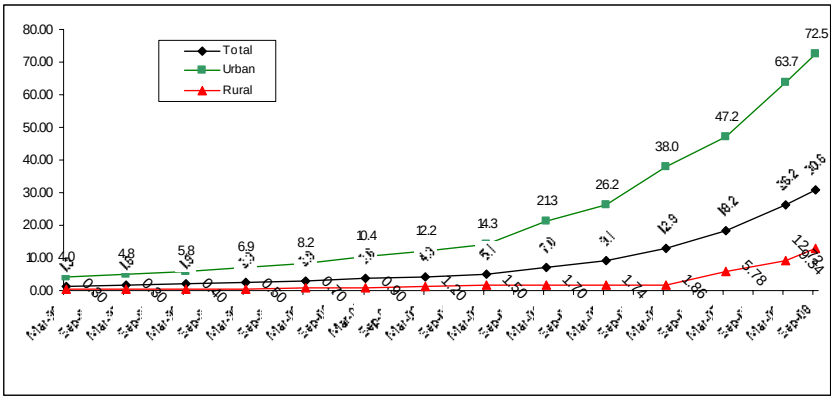

Figure 9: Telecom growth chart

As per AK Raman of Tata Strategic Management Group (TSMG), the fast-rising subscriber base, falling airtime rates, the rural thrust by various telecom players and the prevalence of information asymmetry among a large section of farmers make India an ideal place for the development of customer centric services. But these adoption rates depend on one major thing is, affordability (IKWarton, 2009).

The Mobile Industry, which is one of the most dynamic and growing industry in the world, is no longer just about the delivery of voice over phones. The future of mobile telephony is expected to rely on mobile services (Carlsson et al, 2006) due to saturation in voice. The basic services evolved rapidly. This basic challenge is to understand how and why people adopt or do not adopt mobile services (Carlsson et al, 2006). Perceived ease of use and perceived usefulness predicts attitude toward use of a technology. It includes five concepts: ease of use, usefulness, attitudes towards use, intention to use and actual use (Davis, 1989).

Table 4: Telecom monthly growth rate

Wireless subscription (in million)	**Sep-08**	**Oct-08**	**Nov-08**	**Dec-08**	**Jan-09**	**Feb-09**	**Mar-09**	**Apr-09**	**May-09**	**Jun-09**	**Jul-09**
Month	**10.07**	**10.42**	**10.35**	**10.81**	**15.41**	**13.82**	**15.64**	**11.90**	**11.59**	**12.03**	**14.38**
Total	**315.31**	**325.73**	**336.08**	**346.89**	**362.30**	**376.12**	**391.76**	**403.66**	**415.25**	**427.28**	**441.66**
Teledensity* (in per cent)	**30.64**	**31.50**	**32.34**	**33.23**	**34.50**	**35.65**	**36.98**	**37.94**	**38.88**	**39.86**	**41.08**

* Wireless and Wireline taken together; Wireless subscribers are 98 percent of the total.

Mobile based applications and services for rural India

With quality information at rural people fingertips, and appropriate mServices available in local languages, rural people can make improved decisions, in specific to each individual. Still expanding their vast reach and simplicity of use at affordable cost, mobile devices are now in a position to extend public services to rural people at corner of the country. As a result, there is a growing focus on m-based services implementation by public and private bodies ready to disseminate information as per the needs of the rural people.

The solution for reach, affordability, acceptability, personalised with privacy got ascertained. There are challenges – affordability is a key issue for many potential users. Not everyone can afford handsets; innovative business models adopted by the

firms and handsets at low price tag which work for voice and sms based services. Looking at flexible business model rather than complex and rigid one of the past is need of the day. The thing still missing is the confidence on the system, delivery mechanism through affordable mobile unit, localised content in local language, easy to understand (NSNRS, 2008). The customers of the future change and their demands will also change. It makes sense plan for the change in advance, based on their taste and expected demands. This provides a challenge to the firms providing mServices to fine tune accordingly with changing criteria of the customers. This made to provide a flexible rather than rigid business model to be built in for sustenance of the projects specific to rural segment (NSNRS, 2008).

Figure 10: Customer requirements (NSU Magazine-4)

The mobiles can play a role in the development of certain sectors say, agriculture, micro-commerce, banking, healthcare, education, infotainment, transport and other sectors. Most of the pilots till date supported well that mobiles can play a role to reach these sectors through mServices to rural populations. Tailor made mServices with rural specifics is not an easy task. But this derives better market spread to providers and good benefit to information hungry rural customers that too at affordable cost to them.

The challenge before business enterprises made to re-look into their business strategies to tailor their mServices for rural communities, since it is attributing for their promising future market. The mobile market is evolving into a mass market for rural consumers for their socio-economic development. The consumer reach and capacity for learning and development, which is providing confidence to make decisions on day to day basis. mServices are depending on end user demands and

how the provider able to deliver them is the key for success. Looking at key driver verses customer demands as presented in Table-1. In Indian market mostly the key drivers are: usage cost, consumer need based services, device independent services and finally services must be easy to find, subscribe and use.

Table 5: Five key driver category (NSNGIRS, 2007)

S.No.	Key Driver	Customer demands
01.	**Cost and billing** • Total monthly cost • Device cost • Perceived value • Cost of same network calls • Tariff plans • Billing clarity and accuracy	• I want value for money • I want pricing plans that are relevant, simple and transparent • I want online visibility on how much I have spent • Bills must be accurate and easy to understand
02.	**Network performance and service quality** • Coverage and service availability • Indoor coverage • Call drop rates • Failed events • Call quality	• I want to access services wherever I am • The service must work well everywhere • I want the services I use to be secure • Applications must be easy to use
03.	**Customer service** • After-sales-service (easy to contact) • Quick-to-respond	• I want proactive support • I want different service options matched to my needs • My problems must be solved first • As soon as I subscribe to a service, I want to be able
04.	**Service and device portfolio** • Services that are easy to find, buy and use • Services that match customer needs • Devices and customer premises equipments • Innovative services • Security	• Services must be easy to find, easy to subscribe to and easy to use • I want services that match my needs and preferences • I want a particular device • Services must be cool and work well • I want to combine my own service packages

05.	**Brand** • Reputation for good service • Understanding of customer needs • Trustworthiness and loyalty schemes	• I like respected brands • I want my loyalty to be valued and rewarded • I must be able to trust my CSP • The CSP must be reliable with a good reputation • My needs matter and the CSP must understand this
CSP – Communication Service Provider;		

What we observe now is not just the size of the network (governed by Metcalf's law) that determines its value but it's also the amount of participation of network stakeholders such as customers, employees, competitors and others. Once operators begin to provide profit that goes beyond basic connectivity there will be a cascading effect and a great rush will follow, because it will fundamentally change the business model of all service providers (Andrew Zolli, 2008). The high quality end-user satisfaction is achieved by providing new services faster and do not suffer confusing data. When it came to identify which ICT device can provide best method of delivering public services, mobiles are showing the best potential to stimulate the supply and demand of public services. Mobiles are becoming affordable and the connecting to more and more people is go on increasing and offering excellent interactivity than other ICT devices. This is providing a chance for all application providers to start customer specific services at affordable conditions.

Need of Mobile ICT intervention for Agriculture

Agriculture role in economic development is essential because the majority of the people in developing countries make their living from the land they cultivate. To improve the welfare of the majority of people is by helping to rise, (i) the farmer's productivity goes up by growing food and cash crops, (ii) the prices they receive for those crops produced. Although, it is a necessary condition, raising agricultural output is not by itself sufficient to achieve an increase in rural welfare (Perkins et al, 2007). The rural and often remote nature of the community makes it unbelievably difficult for farmers, in particular those with small holdings. The farmers consciously or unconsciously are adapting to modern living, their expectations being influenced by the urban dynamics, is an observed phenomena. Farmers inadequate information on current and local market prices or timely need-based information (advisory or time tested) which help them decide in harvesting the crops. Reduced crop yields, increased wastage (unwanted and ill-advised inputs), and slowed down market

efficiency, severely impacting farmer's earnings (Misra Satyan, 2005). The implications on the rural people are three-fold such as: loss of income, time and opportunity. Information is critical to the social and economic activities that comprise the development process. Telecommunications, as a means of sharing information, is not simply a connection between people, but a link in the chain of the development process itself (Hudson, 1995).

To bridge the information gap between the farmers and to build productive and competitive market, different ICT interventions providing to make rural and under-developed markets become efficient and productive. Agriculture extension and farmer-outreach programs are facing major challenges (Ramamritham, 2006) – cost-effective outreach, solutions tailored to needs of individual farmers and an image that is farmer-friendly. Mainly mobile technologies have created new channels to communicate with others in a well-located way. Farming is not so linear but requires constant inputs at every stage where new technological inputs provide better crop outputs. It means, crop production depends on weather, agricultural practices and management of pests and diseases at right time to save crops and gain better results. The final produce should provide better marketable price to farmers, where the market intelligence is the key, which was provided regularly for nearby markets in local language. The market dynamics are critical to take a decision by farmer where, when and at what price should the produce sell to gain better margin. The decision is in the hand of farmer only, but the actual market situation is known to him, by transfer of information about market dynamics. Due to the knowledge gain, farmer can able to deal with the middle men or the market forces well for better price for his produce. That means, knowing the market trends, both for inputs and outputs, farmer can make better decisions as he is the master in his own area. How effective are the mobile phone based projects which are specific to agriculture domain providing the information and knowledge services to enhance crop yields and improve productivity over a wide range of crops by taking effective decisions at right time by farmers under different agro climatic zones seen here.

Agro-information services through Mobiles

The internet and mobile networks have the potential to provide agro-information services that are (i) affordable, (ii) relevant (timely and customized), (iii) searchable and (iv) up-to-date (Ramamritham et al, 2004). The mobile phone technology

provides electronic capabilities (battery, processing power, memory) (Helen Nierinck, 2008), reach to customer, privacy, and anytime/anywhere, physical contact-less services (Helen Nierinck, 2008). Keeping these factors and needs of Indian farmers in mind, various applications and services provided by mProjects for dissemination of agricultural information. Operators are developing consumer friendly value added applications which can be accessed by just two-three key strokes. Complicated applications will be discouraged by rural communities. Hence, operators are selling handsets with pre-embedded value added services (VAS) content in the mobile devices. These measures are driving customized applications and services in India. The projects are being taken up at locations which are more favourable to test and implement the technology, applications and services (Rao and Sonar, 2008). The VAS concentrated on crop advisory, market intelligence, micro-finance and finally local social networking at rural areas.

Mobile based projects' overview for rural India

The mobile phone technology provides the electronic capabilities (battery, processing power, memory) (Helen Nierinck, 2008), reach to customer, provides privacy, anytime and anywhere, contact-less services and most preferred user carry personal item (Helen Nierinck, 2008). Keeping these factors and the needs of Indian farmers in mind, various applications and services have been deployed by different projects. The projects considered are providing farmer needs' based mServices through their technological innovative applications combined with creative business plans – aAqua mini (Bahuman and Kirthi, 2007), Fisher Friend (Thomas, 2007), mKrishi (Robert Horvath, 2008), Reuters Market Light (RML) (Amit Mehra, 2007), IFFCO Kisan Sanchar (Awasthi, 2008), Life Tools (NSNRS, 2008) and CERES (Anurag at el, 2008). Development occurs when people are increasingly able to take control of their lives - means the decision power for the development challenged citizens had a chance to come out of bottom of the pyramid (Danielson A, 2001). The mobile based projects for farmers had objectives which benefit farmers and based on development agenda. These objectives suits for markets (input, output) prices, availability status, agricultural extension, social connectivity and finally financial support systems. Here we are looking specific agriculture domain specific projects as listed in Table-4 and their usefulness to farmers in specific but rural development in general.

The company background provide indirectly that elimination of donor agency need, long term project execution, scale up issues and sustainability of projects are well attained. The projects sustain based on their objectives and usefulness for all stakeholders. The basic core needs and demands of the end-users as the adoptable mServices at affordable cost creating confidence on users. The applications used in their services are of short message service (sms), multi-media service (mms) and voice stream options. These are customised based on subjectivity such as literacy, usage pattern, social acceptance, domain specific and life-style of rural farmers in various states. These practices are nothing but innovative business models, which are adopted based on user per capita. Most of the initiatives are push-based method providing opportunity to fill the knowledge transfer to end users' basic needs.

Table 6: Indian pilot projects in Agriculture domain

S. No.	Project Name	Partners (with service option)	Project Stage
1.	**aAqua Mini**	Agrocom (on GSM,CDMA)	Commercial trails
2.	**mKrishi**	TCS-Qualcomm (on GSM)	Commercial trails
3.	**Fisher Friend**	TATA Tele-Qualcomm-MS Swaminathan Foundation+ Astute Systems Technologies (CDMA)	Commercial trails
4.	**Reuters Market Light** (RML)	Reuter-MSAMB-India Post (on GSM, CDMA)	Commercial trails
5.	**IFFCO Kisan Sanchar** (IKSL)	IFFCO-Airtel (on GSM)	Commercial trails
6.	**Life Tools**	Nokia+ Idea+ RML (on GSM)	Commercial trails
7.	**CERES**	CERES+ Reliance (on CDMA)	Commercial trails

The projects become a source of knowledge and information transfer for farmers from agriculture scientists/extension functionaries and markets through mobiles. The critical thing here is the understanding of requisite content or knowledge for farmers' needs. Providing local content in local language through text mode, the literacy challenged farmer is facing the real hurdle to utilise the opportunity for his/her benefit. Understanding the nature of agriculture is fundamental to understanding development is the key.

i. aAqua Mini - offers real-time decision-support tools (aAQUA) to progressive farmers and organizations supporting progressive farming (Bahuman and Kirthi, 2007). The project is working on revenue generating business model. The services provided are broadly to farmers include, localised – remote crop diagnostic solution; audio prompted guide application (in English/Marathi/Hindi); remote crop & land properties based disease diagnostics; micro-weather info (temp, cloud cover, precipitation); SMS enabled register & query mechanism; online poll for registered users; spam, search, rank features; and service is available on GSM and CDMA networks.

Table 7: Projects' company profile

Project Name	Company Name	Location	Type of Company				Sector Type				
			Multinational Corporation	Large national Company	Local SME or National	Non-profit Organisation	Agriculture and/or Food	Research & Development	Mobile Communication	Hardware Manufacturer	Media & Content
aAqua Mini	Agrocom	Indian			x		x	x			
mKrishi	TCS	Indian	x					x			
	Qualcomm	UK	x					x	x		
Fisher Friend	Astute Sys	Indian			x			x			
	TATA Tele	Indian		x					x		
	Qualcomm	UK	x					x	x		
	SF	Indian				x	x				
Reuters Market Light (RML)	Reuters	UK	x								x
	MSAMB	Indian			x		x				
	India Post	Indian			x						x
IFFCO Kisan Sanchar (IKSL)	IFFCO	Indian			x		x				
	Airtel	Indian		x					x		
Life Tools	Nokia	Finland	x						x	x	
	Idea cellular	Indian		x					x		
CERES	CERES	Indian			x			x			
	Reliance Infocom	Indian		x					x		

SME – Small and Medium Enterprise; **SF** – Swaminathan Foundation;

MSAMB – Maharashtra State Agriculture Marketing Board;

ii. Fisher friend – The project is working on private NGO partnership based revenue generating business model in Tamilnadu state at present (Thomas, 2007). It is to test its sustainability with Indian fishing communities. The services provided are broadly to fishing farmers include, weather forecasting; market price; sea wave heights information; fish shoals location information (via satellite scan data); and service is available on CDMA (pre configured handset) networks only, but not on GSM networks.

iii. mKrishi – allows the farmer to make a query in a local language from a mobile phone and receive personalised advice or relevant information on the same in local language (Robert Horvath, 2008). This is the project working on private partnership based revenue generating business model in Maharashtra and Uttar Pradesh states at present. It is testing to test its sustainability with Indian farmers' needs. The services provided are broadly to farmers include, crop disease diagnosis; sensors based remote land & crop property recording (grape, cotton, soybean and potato); micro-weather Information (temp, cloud cover, precipitation) and service is available on CDMA networks only, but not on GSM networks.

iv. Reuters Market Light (RML) - offers Indian farmers up-to-date, local and customised commodity pricing information, news and weather updates (Amit Mehra, 2007). The project is working on public private partnership (PPP) revenue generating business model in Maharashtra and Punjab states. The broad services provided to farmers include, localised - commodity pricing (Onion, Cotton, Soybean, Pulses, Pomegranate et al); weather updates; news (agriculture & general) and service is available on GSM networks only, but not on CDMA networks.

v. IFFCO Kisan Sanchar (IKSL) - would be focusing on communication requirement of rural India through mobile operator Airtel, besides providing agriculture related information to enable villagers take right farming decisions (Awasthi, 2008). The project is working on public-private-NGO partnership based revenue generating business model across major states covering in two stages. The services are broadly to farmers include, telecom products and services of Airtel; free daily voice updates on VAS platform (mandi prices, farming techniques, weather forecasts and fertilizer availability) and dedicated helpline for farmers to answer their queries

vi. Life Tools – having a range of agriculture, education and entertainment services designed especially for the consumers in small towns and rural areas of the emerging markets (Nokia report: 2008). This is the project going to work on private partnership (PP) based revenue generating business model in India. The services provided specific to farmers include, information on seeds, fertilizers, pesticides, weather (temperature, rainfall, wind conditions) and prices in English, Marathi and Hindi language option and prevailing market prices, education service in dual language display option.

vii. CERES - aims to assist farmers by providing exhaustive information covering all areas in timely and customized manner to meet specific local needs to increase the overall productivity of agricultural practices (Anurag at el, 2008). This is the project working on private partnership based revenue generating business model in Gujarat state covering 78 villages in Vadodara district. The services provided specific to farmers include, information on seeds, fertilizers, pesticides, disease and farming input; market prices and weather (micro-climatic, rain/storms, temperature, humidity, precipitation, wind speed) on weekly and monthly basis.

Results and discussion

The projects have similar objectives but their business models are different based on subjective planning and implementation. There are challenges – affordability is the one important for many potential users. The missing issues are the confidence on the system, delivery mechanism through affordable mobile device, localised content in local language and easy to adopt. The major observation is that the project's capabilities to serve the farmers needs, but not through in any single project till date. The combined outcomes are arrived through SW analysis on mKrishi, RML, aAqua mini and eSagu to see how effective these pilots as per farmers needs are.

- The objective of all of the pilots is to provide latest information about crop practices, input and output market information to farmers to gain good price for their produce.
- The strength in providing better back-end crop information system management including crop yields per farmer handled by agri-experts to provide advice.
- The back-end information management supported by automated data collection of weather, crop information, soil analysis details through remote sensory system.

- Expert (Agriculture/Extension official) can contact farmer on his mobile handset at any time to get further crop details as per expected needs.
- Remote operation capability at front-end and automated multi-media based back-end information management system provides farmers better crop management guidance from experts.
- The tools and features providing to expert(s) to study state of the crop are quite advanced and guide farmer(s) critically at needy time on demand at any time.
- EMI with differed payment based (proposed) business model suits best to Indian farmer conditions and situations of rural India.
- Providing market (input and output) information (price and stock) through SMS to farmers timely in local language daily.

The observed features of the projects looked collectively the networked ones can provide an excellent services and applications to farmers at affordable cost. By looking at the above issues, it is inferred that:

- The projects initiators are multinational or major communication companies of India provide stable business with extended reach and penetration across the country.
- Transparency and feedback system mechanisms are to be adopted into the system to enhance pilot's sustainability.
- Add on feature of expert interaction through mobile with back-end information management system can provide any-time any-where service mechanism.
- Network independent operations can give users better service confidence else some parts of the market segments get negative feedback which leads to negative growth.
- By providing consolidated weekly market price trends reports (by email, snail mail or on their mobiles itself) on crops, provide farmers a chance to plan better.
- The growth can expect with signal spread across villages with affordable price tags.
- Network independent hybrid model is the best bet for any project want to deliver the services to rural consumers.

One of the stepping stones to achieve the goals is utilising technology to make services reach the unreached in development process.

Conclusion

The information is a key ingredient for sustainable human development – hence, for further human development access to it is a prerequisite for the needy communities. Once these projects are time tested with common objectives, then they become hope for developing countries. The process has just started but the impact has to be seen. It is looked upon outcomes with farmers' needs perspective rather than in economic sustainability angle. The mobile based projects are offering a method for bridging the gaps between development professionals and rural communities by initiating interaction among them a dialogue, new alliance, inter-personal networks, and cross-sectoral links between organisations and communities. It can articulate bottom up mechanism, sharing domain specific and localised knowledge in local language. The benefits observed through pilot projects include increased efficiency in the use of development resources, less duplication activates, reduced communication costs. More in-depth study of mobile based services can provide better understanding of how effectively and efficiently mobiles can act as a tool for development to solve farmer's needs. These initiatives provide a new hope for rural masses in their socio-economic development, only time will tell.

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GPS/GSM based train tracking system – utilizing mobile networks to support public transportation.

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Abstract :

The paper presents a solution implemented at Sri Lanka, to provide an intelligent train tracking and management system to improve the existing railway transport service. The solution is based on powerful combination of mobile computing, Global System for Mobile Communication (GSM), Global Positioning System (GPS), Geographical Information System (GIS) technologies and software. The in-built GPS module identifies the train location with a highest accuracy and transfers the information to the central system via GSM. The availability of this information allows the Train Controller to take accurate decisions as for the train location. Location data can be further processed to provide visual positioning using maps granting a wholesome view on train location. Positioning data along with train speed helps the administration to identify the possible safety issues and react to them effectively using the communication methods provided by the system. Additionally, the location information can be used to facilitate accurate scheduling with regard to train arrival and departure on each station.

Introduction

Rapid growth in the field of Information and Communication Technology (ICT) is a worldwide phenomenon experienced today. Emergence of wireless and mobile technologies plays a key role in the global ICT boost, unfolding a new era of communication technology. Global private sector was the first to explore the endless opportunities and potential of wireless technologies, by redesigning the business processes with the integration of latest wireless and mobile technologies to have the competitive advantage in the business world. Today, the ability to achieve organization's goals depends purely on the availability, accuracy and reliability of the information.

Governments worldwide have also recognized the high potential in the ICT sector and are using it as a core instrument to facilitate government processes and functions with the goal of uplifting the current standards of living of the society. Governments today are inspired by the concepts like eGovernment and mGoverment where governments are driven by the innovative and intelligent use of ICT as a service provider for government activities and distribution of public information. ICT combined with latest mobile and wireless technologies can be used effectively to streamline government activities and public service delivery process to improve productivity and drastically reduce capital

expenditure, time and effort. Many governments have identified potential areas to be developed via the effective implementation of ICT based solutions that will meet the demands of the future world. The transportation infrastructure is one such area, which can be improved to provide an efficient, dependable and safe service to the general public with the integration of advanced communication technology. Appropriate adoption of technology would assist seamless administration of resources that would positively impact the country's economy.

The railway services in Sri Lanka are rendered by the Sri Lanka railways Department, which is wholly owned by the public sector of the country. The government is seeking methods to improve the efficiency of this service with the main objective of providing a better service to the train commuters. However, the effort of the government is constrained by the lack of funding and inappropriateness of the current solutions. But the development of ICT has revealed many options to uplift the railway service at a lower cost. Accurate train positioning has been a fundamental requirement to improve the efficiency of the service. The current switch based train-tracking system used by Sri Lanka Railways (SLR) supports the train controllers to manage the train operation by providing the train's location. The location data provided by this system lacks in dependability. Furthermore, the maintenance of the system accounts to a large portion of total cost incurred on the railway service. Majority of these systems (especially outside the Colombo Suburban Area) offers low accuracy in terms of indicating the location of a train to the Train Controllers. Installing the systems, which can accurately provide such readings are really expensive and the total cost of ownership is unbearable for SLR. The train safety has been an issue with the increasing number of incidents being reported that has caused death and injury. Majority of deaths on the railway involve third parties with the incursion onto the level crossings. Average train accident would cost millions of Sri Lankan rupees and these can be avoided if there is a mechanism to track the train location and speed and warn the locomotive drivers about possible safety issues. Additionally, the train commuters also face difficulties due to frequent train delays, as the administration is unable to provide accurate schedules based on train's location and speed.

The solution is a comprehensive GPS/GSM based train tracking system, which provides accurate, dependable and timely information to the controller. The in-built GPS module identifies the train location with a highest accuracy and transfers the information to the central system via GSM. The availability of this information allows the Train Controller to take accurate decisions as for the train location. Location data can be further processed to provide visual positioning using maps granting a wholesome view on train location. Positioning data along with train speed helps the administration to identify the possible safety issues and react to them effectively using the communication methods provided by the system. Additionally, the location information can be used to facilitate accurate scheduling with regard to train arrival and departure on each station. This information can also be made available for the commuters to identify any train delay in advance making this service more reliable.

Railway services in Sri Lanka

The Sri Lanka Railways Department provides long distance and intercity express, Colombo commuter, parcel and mail, freight and provision of special

charter trains. This accounts to a provision of services to 105 million passengers and transfer of 1.6 Million metric tonnes of freight per annum. The railways are a vital part of the country's transport infrastructure. As the economy grows, demand for efficient transport services increases, which the rail industry has an important role to play in meeting. The rail industry is making progress in increasing the number of passengers carried, as well as its share of the freight market, and in improving its customer focus and its levels of performance and safety.

Railway Today

In 2008, railway losses amounted to LKR 4,553 million and state bus transport losses amounted to LKR 3,554 million, giving a total of LKR 8,107 million losses on state transport. This is not just a one- time phenomenon, but has been the trend for the last few decades. The total losses from the railway alone since 1999 have been LKR 28,052 million. That means, on average, the railway lost LKR 234 million every month over the past ten years; or, to make it even more graphic, LKR 7.79 million every single day for the last ten years [1]. This depicts the current state of the railways system in Sri Lanka as for the efficiency and general acceptance of the service.

Reliability matters to the railway's customers and to the economy at large. Train delay, a common phenomenon in Sri Lanka is considered to be inevitable and an acceptable scenario. A train delay might wary from 15mins to many hours. There are occasions where this has caused disputes among the commuters and the administration but the problem still remains unresolved. Railways department maintains a fixed schedule on train arrival and departure but does not pre-update based on potential delays. As a result the commuters face many problems and waste time and energy that can be used more productively.

The provision of safe and reliable services is a fundamental requirement of the railway as thousands rely on this service as their prime mode of transportation. The railway accidents accounts to death, injury and a large cost to the government. Most of the accidents are in form of derailments, which occur infrequently but have the potential to result in a large number of casualties. The most significant contributors of these accidents involve track and signaling faults. Lack of communication between the controllers and the drivers might prevent the preliminary precautionary actions being taken to avoid such accidents. Additionally, the danger relies on the fact that there would be no mechanism to identify the potential safety issues as for the unawareness of trains speed and location.

The railways department has set itself several objectives to address this situation through a quantitative improvement of its services. It is planned to increase railway share of passenger transport from percent 5% to 10% and Modal share of freight transport from 2% to 10% by 2010[2]. Additionally, the department has identified the importance of improving the safety and efficiency of the service and has set the following objectives in its strategic plan;

- Improve cleanliness & quality of coachers / stations

- Reduce train delays by 25 % and accidents/ derailment by 50%
- Remove all speed restrictions less than 8 Km Ph
- Establish management structure based on performance evaluation and monitoring process
- Enhance the percentage of efficiency
- Put in place a methodology for utilization of public funds corresponding to specific services to make the present negative contribution in to a positive one

There're several constraints that needs to be addressed in order to achieve these objectives as this might even require complete reengineering of certain technological aspects of the current system. The main constraint of course is the lack of funding. Railways are suffering from historic under-investment stretching back for decades that could be assumed to be so for the foreseeable future as well. However, it's possible to develop effective solution that is economically feasible to the government. This would only be possible with the appropriate introduction of new technological solutions that achieve both performance and cost goals.

Provisions for the future

Setting objectives won't be adequate for the development of the railway service in Sri Lanka. There should be effective and appropriate steps taken with a vision on addressing future demands and expansion. These steps should involve further planning, extensive designing, implementation of solutions and maintaining such systems in order to sustain the service. There are several potential steps that can be taken in order to address most of the aforementioned issues associated with the railway service that in turn would assist the Railways department in achieving its strategic goals.

Improving Safety

The Railway department of Sri Lanka carries about 150 million passengers per annum and the safety of such service can never be taken for granted. Passengers are entitled to expect to travel in safety throughout their journey and the government should be committed to protect the passengers and employers form any safety issue that might rise during the journey. Effective safety planning requires a detailed understanding of key risk areas; the activities or circumstances where the safety risk to passengers, the workforce and the public is greatest. This allows resources and effort to be concentrated where they will have the greatest impact. Following are the main security issues identified in Sri Lanka;

- Infrastructure engineering issues – derailment, signaling, points and crossings
- Public behavior – Assault, objects on line, objects thrown at trains, accidents at level crossings

- Passenger behavior – Struck against fixed objects, falling from train in running

- Workforce issues – maintenance error, control errors

The main safety issues are in the form of accidents that mostly involve third parties other than the passengers and the employers. However, infrastructure and workforce issues accounts to a considerable amount safety threats identified in Sri Lanka. Most of the infrastructure issues are associated with signaling and accident. This can be addressed by developing a communication channel between the train and the control center. The control center should be able to identify the train's location and speed to recognize possible safety threats; such as collision domains, speeding and noncompliance to signals. The control center should also be able to notify the locomotive drivers of the security threat. This will allow the drivers to avoid or at least minimize the harmful consequences. New system-management technology combined with accurate knowledge of train position will give the opportunity to present drivers with advisory speeds as well as safety-critical speeds, aimed at maintaining the flow of traffic by regulating trains in advance of points of conflict so as to avoid or minimize the need to stop trains to await paths. Human intervention at control centers can lead to accidents due to human error or negligence. For an instance if the cross point calculation is done manually it can lead to accidents if an erroneous value is communicated. These problems can only be solved via an automated system, which will handle these tasks and would consequently avoid human error.

Improving Reliability & Availability

The trust on the railway as a reliable service has degraded over the last few decades due to poor provision of services to the general public. This is mainly due to the frequent delays experienced specially in long distance services. A reliable railway is the single most important requirement of passengers. Delays are an unproductive use of people's time, and serious delays might disrupt their travel plans. The initial cause of a delay can be:

- An infrastructure problem for which railway department is responsible (for example, a signaling problem or a speed restriction imposed in response to a track defect);
- An operational problem for which a train operator is responsible (for example, the breakdown of a train); and
- An incident that is largely beyond the railway's control (for example, an accident involving a third party)

The signaling problems and accidents involving third parties can be minimized using a communication channel between the drivers and the control centers. The control center should be informed of the train's current position and speed that should be based on an accurate, dependable source of data. Delays can be minimized with driver advisory speeds, improved platform departure times, backed by predictive routing algorithms and supporting regulation of train movements through junctions, can ensure presentation of trains just in time to utilize a free path, rather than stopping and starting from rest when a path becomes available. None of these solutions will be possible

unless the current tracking system is replaced by a dependable and a more informative system that is capable of providing accurate train position and speeds of the entire network.

The cost of train control should fall rapidly once real-time train location systems that are suitable to the local context is identified and are implemented. It is likely that operations on most regional lines will be controlled from an operations centre, through low-cost wireless technology such as GSM, the future development of which will allow increased capacity for train control systems, regulation, and improved passenger safety services.

Improving Communication and Public Awareness

Lack of information regarding train schedules, delays, and low accuracy of the schedules are to become worse within the context of expansions and would only result in more time spent on the platform, consequently resulting in public dissatisfaction and frustration. There are several constraints identified that would prevent the railways from providing accurate schedules and other information.

- The static nature of the information sources (ex: static web pages and notifications at stations)

- Deficiencies of the current tracking system

General public is made aware of the train schedules using notifications at train stations and via the official web site of the railways department. However, none of these methods will provide accurate data as for the static nature of the web site and the notifications at the station. Additionally, the deficiencies of the current tracking system impose constraints on providing accurate, dependable and timely information to the user. The switched based tracking system used by the railways department is yet to cover the entire network but would cost a considerable amount for expansion and maintenance thus, emphasizes the need of an alternative that would be more accurate and cost effective. This limits effective decision-making due to inaccuracy and would also lead to accidents.

Additional train capacity and better service performance will be the key for success, but the coherent use of technology to deliver information on train status in real time will not only improve utilization, but also offer seamless planning as well as accurate information on availability of passenger services. Further enhancements of such system would even grant passengers capabilities such as text messages informing accurate arrival and departure times and even the seating capacity of the train.

GPS/GSM Based Train Tracking System

We strongly believe that the correct combination of latest information and communication technologies can provide an effective and feasible solution for the requirement of a reliable and accurate train tracking system to improve the efficiency and productivity of Sri Lanka Railways.

The solution we propose encompasses a powerful combination of mobile computing, Global System for Mobile Communication (GSM), Global Positioning System (GPS), Geographical Information System (GIS) technologies and software to provide an intelligent train tracking and management system to improve the existing railway transport service. All these technologies are seamlessly integrated to build a robust, scalable architecture as illustrated in Fig. 1.

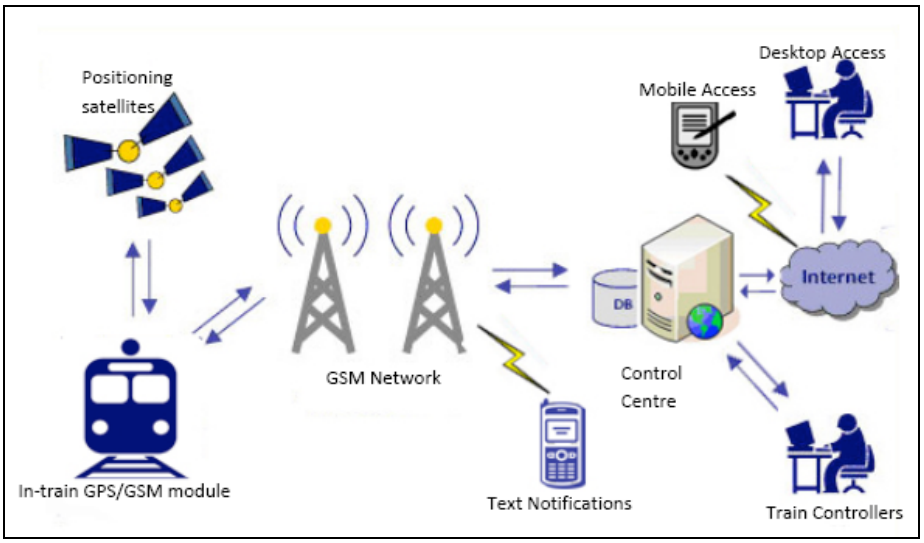

Fig. 1: High Level Architecture

The fundamental process in our system is obtaining train location using GPS technology and transmitting the data via GSM network to the central control unit for data processing and information analysis. Real- time positioning information received by the server is made meaningful and extremely useful for the end user through integration of GIS technology where the end user can better organize and utilize information from a graphical view point.
Our system consists of 3 main modules.

- The portable hardware unit (GPS/GSM train locator unit)
- Central server which handles receiving information from train locators and concurrent user requests
- Graphical User Interface (GUI) to provide services to our stakeholders

The train locator unit planted in the train is designed and implemented, considering the cost factor, size of the module, durability and low power consumption. The power supply unit of the module is a main factor which decides the feasibility of the unit, as it should sustain a seamless supply of electricity at a low voltage for the locator module to function properly. The GPS receiver of the unit is capable of identifying the latitudinal and longitudinal position and ground speed of the specific train by receiving information from the GPS satellites. The position data is periodically sent to the central server through the GSM transmitter of the module. The device is capable of storing data in a buffer at a time of GSM connectivity failure, and can synchronize with the remote server when GSM is back online. The device can also respond to commands and data calls from the remote server as per administrative requirements of the train controllers. We have chosen GSM as the communication medium between the train locator and the central server to improve availability of our system by utilizing the existing GSM network which covers the whole country. The use of GSM over GPRS

significantly improves the feasibility and availability of our system. Despite the high mobile penetration and number of mobile telecom service providers (GSM) covering the island, GPRS usage and the coverage is poor in many rural parts of Sri Lanka. Thus, selection of GSM over GPRS data communication is feasible and enables island wide service provisioning. The competition between the GSM service providers has also lead to high quality GSM services at fair rates.

The central control system includes a server for handling and processing all the position information received from train locators via the GSM network. The server automatically updates the database with latest position, speed and direction information of each train. The server carries out information processing and analyzing in order to cater for different requirements of the users of our system. The main stakeholders of our system are the railway administrators (Railway Department), locomotive drivers and the train commuters. Our main objective is to be instrumental in improving the efficiency and effectiveness of Sri Lanka Railway services by fulfilling the fundamental requirement of reliable and real time information of train positioning for monitoring and administration purposes by the Railway Department.

The end user of our system is offered with an easy to use graphical user interface for information analysis and administration tasks. The web based access and extensible mobile access to our software is designed to be intuitive for the end user to maximize the effectiveness and efficiency of our system. We have incorporated GIS techniques to provide location specific data organized in layers so the end user can better apprehend the information provided by the system. Satellite images providing visual positioning can serve as a very good background when used in conjunction with map data specifying the location. Our system essentially provides functionality for the railway administrator to monitor the progress of a particular train or a group of trains operating in a geographical area. The user can search and locate trains by the train ID, train name, current location or nearest station etc. Information such as train speed, direction can also be given along with real time train positioning data.

The train control and management process includes management of heavy traffic of passenger and freight trains, which operates in complex running patterns on the railway network. The train controller needs to ensure that passenger trains are adhering to the schedules as well to find efficient routes for unscheduled freight trains. Recording the train movements, arrival/departure at railway stations, fuel status, railway track conditions, and passenger information is a tedious task for the train controllers and would be time consuming if done manually. The accuracy of this information is very important to ensure smooth functioning of the railway service as well as to optimize resource planning. For example at a point of a railway-track failure or an accident, train controller should be able to decide on how to utilize existing resources and efficient alternative routes to ensure system availability of the railway service in that region. Thus our train tracking system can be enhanced to automate the train control and management process of the Railway Department in order to improve the efficiency and effectiveness of the railway services provided. Following is a list of facilities that can be offered by our system to automate the train control and management process.

- Automatic record keeping of train operations and events
- Functionality to generate time-distance graph for trains which can be used to control and plan the train movements
- Facility to generate user defined reports and graphs on train movements, arrival-departure at each station, schedule adherence etc.
- Facility to playback the progress of each train and events for review purposes
- Automated schedule regulation
- Forecasting functionality on train arrival-departure at different stations
- Automatic detection of over speeding, non-adherence to traffic regulations, rail-track failures, train delays etc.
- Facility to send alerts/warnings to particular train drivers on possible collisions, derailment through the system
- Automatic rail crossing control

By automating the process of record keeping of train traveling, the load of paper work on the train controller is dramatically reduced. This would also ensure accuracy and integrity of the data eliminating human error when documentation is done manually. A single entry point of data ensures there's no ambiguity of the data recorded in the system. The logged data on arrival-departure time at different stations, number of passengers onboard, freight details, signaling and fuel status at different stations, are instrumental for railway administration when evaluating performance of trains and locomotive drivers. Graphical representation of these data with ability to compare with historical data will be instrumental for the administration to take effective decisions. Various user defined reports on train activities, driver performance, passenger and freight information also support timely and accurate decision making by the administration.

Time-distance graph is vital for the train traffic regulation process. The graph gives the user a wholesome view of the train circulation, railway infrastructure state in different regions and enables the user to detect abnormal conditions and conflicts. The graph is useful for the train operator to identify traffic problems in advance and take precautions to resolve the problems.

Data mining is a method of extracting patterns from data [3]. The use of advance data mining techniques combined with complex algorithms such as neural networks, genetic algorithms and rule induction can be instrumental in identifying hidden patterns from enormous amount of data. Spatial data mining technique combines data mining with GIS to find patterns in spatial data, which could be a powerful tool for applications using geographical information such as our system. With the huge amount of data pertaining to train operations collected daily, process of information analysis using conventional methods would be a difficult task. Hence, the use of spatial data mining techniques would drastically improve the productivity and effectiveness of the train control and

management process carried out through our system.

Facility to playback past activities on the railway, enables the user to review and analyze operational situations in the past. Data mining operations can be used effectively in combination with the playback function to identify sequential patterns of particular activities and their impact on the railway traffic. For example, at an unfortunate incident of a train collision, train controllers can use the playback feature combined with the data mining techniques to analyze and identify the sequence of activities which resulted in that accident. With that knowledge, railway administrators can take necessary precautions and trigger alerting mechanisms to avoid such unfortunate accidents in future, making the railway transportation much safer.

Improving safety and availability of railway transport service requires detection and triggering of alerting mechanisms to avoid possible train collisions and other forms of adverse incidents. Constant monitoring of train location, speed, traffic conditions, rail-track conditions and adherence to traffic regulations helps the train controllers to detect potential collisions and derailments. A proper alerting framework is vital in order to avoid such adverse incidents by alerting the locomotive drivers in advance. Our system facilitates a comprehensive alerting mechanism by enabling the train controllers to send alerts/ notifications to locomotive drivers via GSM connection. The hardware unit planted in the train can be enhanced to prompt the alerts to the driver in graphical and audible forms. A LED display unit and an alarm bell to signal adverse conditions can be integrated with the hardware unit to provide a complete alerting framework. The unit can be further enhanced to support voice communication between train controllers and locomotive drivers in order to provide guidance and important messages to the particular driver. This would also enable locomotive drivers to contact the control unit at a state of emergency. Furthermore the system can be incorporated to significantly improve safety at railway and road intersection points. Over the years, many road accidents have occurred at railway crossings imposing a critical safety threat to both train commuters and passengers in vehicles.

Such accidents are caused mainly by the unreliability of the safety mechanisms such as blocking arms and signal lights used at the crossing point. Thus our system can be extended to improve the reliability of such safety mechanisms by synchronizing the railway crossing control process with the incoming train’s position. We can provide accurate real time information on train position, speed and length of the train to synchronize the functions of rail crossing with the train movements. The productivity of the service can be significantly improved by providing accurate predictions on approaching train at the rail-road crossing and displaying amount of remaining time to clear the crossing from train traffic. Alarm triggers to alert road vehicles approaching too close to the rail-road crossing at a point of train approaching, can also be incorporated to improve the effectiveness of our solution. Thus the system is instrumental in improving safety of both railway passengers and people crossing rail-road cross points.

Integrating an intelligent forecasting mechanism on arrival-departure time at different railway stations can further enhance the efficiency and productivity of our system. Train schedule is inevitably subject to train delays which can occur due to various reasons such as excessive train load, rail track failures, train

traffic, adverse weather conditions etc. A number of operational parameters such as railway traffic, train priority, efficient routes, and railway infrastructure conditions have to be taken into consideration to accurately forecast train arrival time at various stations. Here also data mining with other complex algorithms can be instrumental to provide accurate forecasting on train arrival-departure at stations. The train schedule regulations are automatically updated and stakeholders can be notified.

One of the main purposes of our system is to facilitate accurate public information distribution with regard to railway services and operations. Thus, our system can be incorporated to design and implement innovative Passenger Information Systems (PIS) based on real time information of train positions. LED-Display panels put up at railway stations can display arrival-departure time of each train enabling the public user to make informed decisions on their journeys. Route number, destination of the arriving vehicle and waiting time can be displayed with real time information. With accurate forecasting of train arrival-departure at stations, Railway Department can improve the loyal customer base and also attract new passengers to railway transport service by winning their trust and reducing user uncertainty of using public transport facilities. The user experience can be further enhanced by introducing information Kiosks which can provide information to travelers in an intuitive and interactive manner to make informed decisions on selecting train routes and departure time. The interactive kiosk can be used to obtain travel information such as alternate routes to specified destination, route details on the railway map and latest information on train schedules etc. As a marketing strategy, information regarding the particular city, culture and commercial activities can also be provided to the user through the kiosk. Another extension of the PIS system is delivering real time train information to handheld devices such as mobile phones and PDAs. With the increasing interest on mobile applications, access to latest train schedule information via mobile connection can be influential for improving customer base of the railway service. Easy to use mobile applications can be designed and implemented to enable train commuters to easily subscribe to our service and obtain latest train schedule information via mobile devices. Reliability and customer loyalty of the railway services can be significantly improved by taking such action to improve accurate public information distribution of the current status of railway services.

Conclusion

After seeing many advancements and changes in the location tracking technology, Sri Lanka Railways now has the ability to pin point the location and other attributes of an operational train in an economical accurate manner. Thus it is visible that to keep up with the today's demand for information and to comply with the citizen centric governance, technological advancements is essential for a 3rd world country, as after all the deciding factors of a country's success would be on the how collaborative and duplex the governance framework in terms of seamless information flow of accurate and timely information between governance ecosystem.

Reference

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Research - Case study paper on

Pragathi: Technology based system to support women Self-Help Groups of Andhra Pradesh

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Abstract

The paper was the topic of an academic thesis at masters in design. It talks about the research done to understand the functioning of microfinance based Self-Help Group (SHG) system in Andhra Pradesh and the issues that exist in their account management pattern and the subsequent design of Pragathi, a mobile application to solve those issues. Paper details out the multiple data entry and complicated financial calculations in present system and the impact of it's complexity through extensive study of artefacts, which are used in SHG transactions. It presents the insights on existing system from attending multiple (5) group meetings and discussions with (12) stakeholders across (8) villages. The insights throw light on the need to modify and integrate the system, which might otherwise weaken the overall self-help spirit among village women. The paper discusses about the findings from the study that have informed the design goals for the new technology based system. Paper explains the approach that was followed in designing Pragathi – the new shared mobile based system, which is to help the semiliterate and illiterate members of SHGs to manage their accounts independently. It explains the new design with illustrations over mobile screen through different scenarios which exemplify the periodical SHG meets. It concludes by mentioning the further scope for the Pragathi to support the expanding role of Self-help model in other areas of village/rural development.

Keywords: Self-help groups, micro finance, account management, mobile application

1. Introduction

Poverty cannot be eradicated by just pumping money towards the needy. Microfinance institutes attempt to enhance financial access and explicit participation by poor through self-help groups to thwart the poverty. The concept of microcredit & microfinance was introduced by Sri Mohammad Younus of Grameen Bank (Grameen Info, 2010), Bangladesh in 1980's. To fight the problem of poverty, creating a kind of access to small amounts of collateral free loans to a woman in needy, and resting the responsibility of repaying that loan with the fellow women members in proximity with equal economic status are the novel ideas of this concept (Grameen Info, 2010). The concept and its implementation have attained the world's focus and earned the Nobel peace prize to Sri Mohammad Younus and Grameen Bank in

2006. Successive state Governments of Andhra Pradesh have endorsed this concept and are implementing it in the state rural areas in a suitable form.

Indira Kranthi Patham (IKP, formerly *Velugu*) a state-wide poverty reduction project to enable the rural poor to improve their livelihoods and quality of life through their own organizations (IKP-AP online, 2009) namely self-help groups (SHGs). These are women only groups with limited membership of 10-15 per each. Group members meet periodically (weekly/monthly) to save thrift amounts and access the banking services like loans, insurance etc. IKP is implemented by Society for Elimination of Rural Poverty (SERP), Dept of Rural Development, Government of Andhra Pradesh. As of January, 2009 the time when this topic was chosen for academic thesis by the author, there were 1,01,82,151 members in 8,50,671 SHGs exclusively for women across 22 districts (Hyderabad excluded) of the state. The total savings and corpus of SHG Members were Rs.1962.50 crores and Rs.4210.81 crores respectively. (IKP Progress Rep, January 2009).

Considering the huge task of efficiently monitoring the SHG transactions and to provide transparent services for SHG members, SERP envisaged the development and implementation of an Information & Communication Technology (ICT) solution to automate all the functionalities of SERP and capture all transactions of SHGs and their federations. The scope of this academic thesis was thus visualized based upon this vision.

In order to design an application in social, cultural and financial context of SHGs, it was required to understand the present account management system that exists in these groups. To fulfil this objective, SHG meetings were attended at Kandi village of Sangareddy mandal in Medak district & Korutla, Mududandla villages of Chandampeta mandal in Nalgonda district. And stake-holder discussions were conducted with SHG members and IKP operators at Kotha Kandi, Kalivemula (Medak), Chandampeta (Nalgonda); Bank officials at Sangareddi (Medak), Ramannapeta (Nalgonda); and with officials of SERP; Zero Mass Foundation, a banking correspondent; APMAS, an NGO at Hyderabad. This paper describes the knowledge about SHG system that was gained through these discussions and it presents the patterns and strategies exists in SHG account books which were identified during the field studies. In the process few issues that were unearthed by existing research on SHG account management system are also discussed.

2. Administrative structure of SHGs

SERP has evolved a structure with hierarchy flowing from district level to group level through intermediate organizations. Self Help Group (SHG) or *Swayam Sahayaka Sangham* is the primary unit of structure. Each SHG has membership of 10-15 poor rural married women. Each group has two leaders and both of them are signatories to the bank on behalf of group and will be representing the group in village meetings. Group members have a common account with the bank and rotate some part of saved amount among the group as internal loans.

The intermediate organizations between SHG and SERP are called as federations (*Samakhyalu*). At village level a cluster of 25-30 groups becomes a Village Organization (VO) or *Grama Sangham* or *Grama Samakhya*. VO meetings with 50-60 participation happen on monthly basis. One village can have 2-3 VOs depending upon number of SHGs in the village.

In AP, Mandal is intermediate administrative hierarchy between village and district. *Mandal Samakhya* (MS) supports all VOs functioning in the villages within its jurisdiction. It helps them in terms of auditing, linkage with Govt. departments etc. District level federation is called as *Zilla Samakhya* (ZS) to oversee the program at district level. SERP at state level takes care of overall administration, finance provision and policy issues.

3. SHG growth & saving patterns

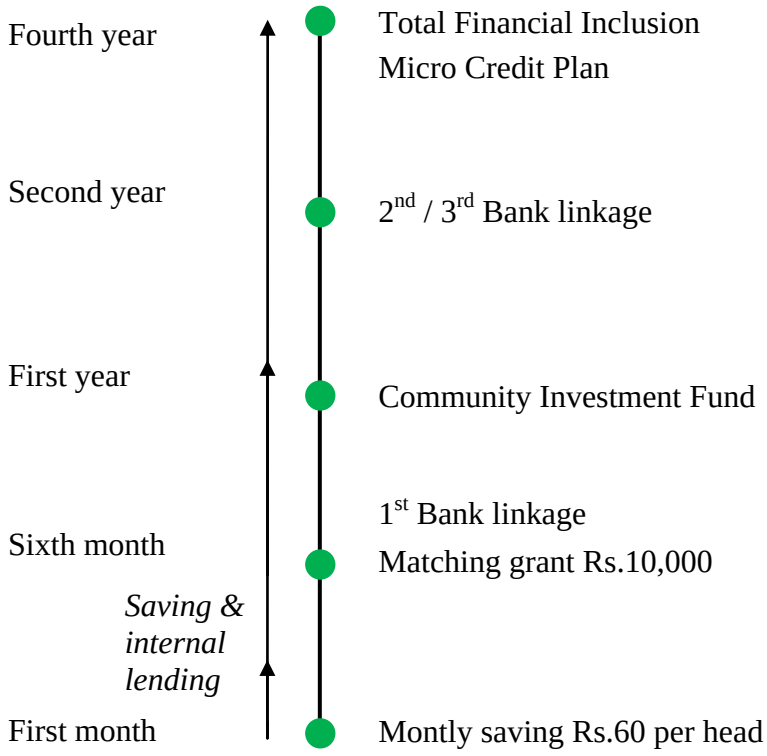


Figure 1: SHG growth pattern

SHG members do the monthly saving in two different ways.

1) They save Rs.30-Rs.100 (differs from group to group) with the group's bank account and
2) Rs.10 with the Village Organization.

Group members avail loans from banks, VOs with different loan conditions among different districts. Amount of loan, interest over it and the time to repay change from loan to loan.
On the whole it can be said that there are three transaction points for SHG members towards loans.

1) One is the SHG itself through internal lending.
2) This is through Bank linkage program, for which to take effect, SHG needs to do disciplined saving for initial 6 months.
3) Third lender is the Village Organization (VO). VO receives money through DRDA (District Rural Development Agency), a Government agency and the groups are expected to spend this money for Community development and hence the loan is called Community Investment Fund.

Other than these saving and loan services, SHG system also provides Insurance (life & general) policies for individuals and groups.

Almost all these transactions, discussions generally happen during Group meetings and VO meetings which take place periodically. Each group has a book keeper who maintains the records and accounts of the group (SHG norms, 2002). She is not a member of the group but should be a literate relative of any senior member. She is paid Rs.100 per month as honorarium for her services.

4. Field study

To understand the different strategies SHGs employ in their functioning; the monthly meetings of following groups which come under diverse conditions were attended.

SHG - A (Actual name is not disclosed), Kandi village, Sangareddy mandal, Medak district. Village located at 70km west of Hyderabad. It is accessible directly through NH - 9 and 4km from mandal head quarters and bank.

SHG - B (Actual name is not disclosed), Korutla village, Chandampeta mandal, Nalgonda district. Village located at 150km east of Hyderabad. Very remote village, 20 km from mandal head quarters. Bank exists in another mandal head quarter at 25 km distance.

4.1 SHG- A, Kandi Village

Figure 2: SHG-A's monthly meeting in session at Kandi village

Number of Members:	12
Founded in:	2002
Number of loans group took:	3
Bank:	State Bank of India, Kandi branch
Meeting frequency:	Once in every week for registering attendance; on 8th or 9th of every month for money collection and disbursement.
Book keeper:	A 17years old college going girl, daughter of II leader.

During the meeting, book keeper records all transactions and discussions in five common account books of the group and in individual pass books of members.

Common books for the group are

1) Minute's book.
2) Savings & Attendance book
3) General ledger
4) Loan ledger
5) Deposits & Payments book

These common group records are crucial to keep track of group's financial health and these books stay with the leader at whose residence, the meetings would generally happen.

Each of these books is further analyzed as artifact study to understand the existing accounting system and the issues with it. Two of such artifact studies are illustrated here.

Artifact study: Graphical representation/illustration to describe the patterns in the usage of a document.

4.1.1 Artifact study, SHG- A

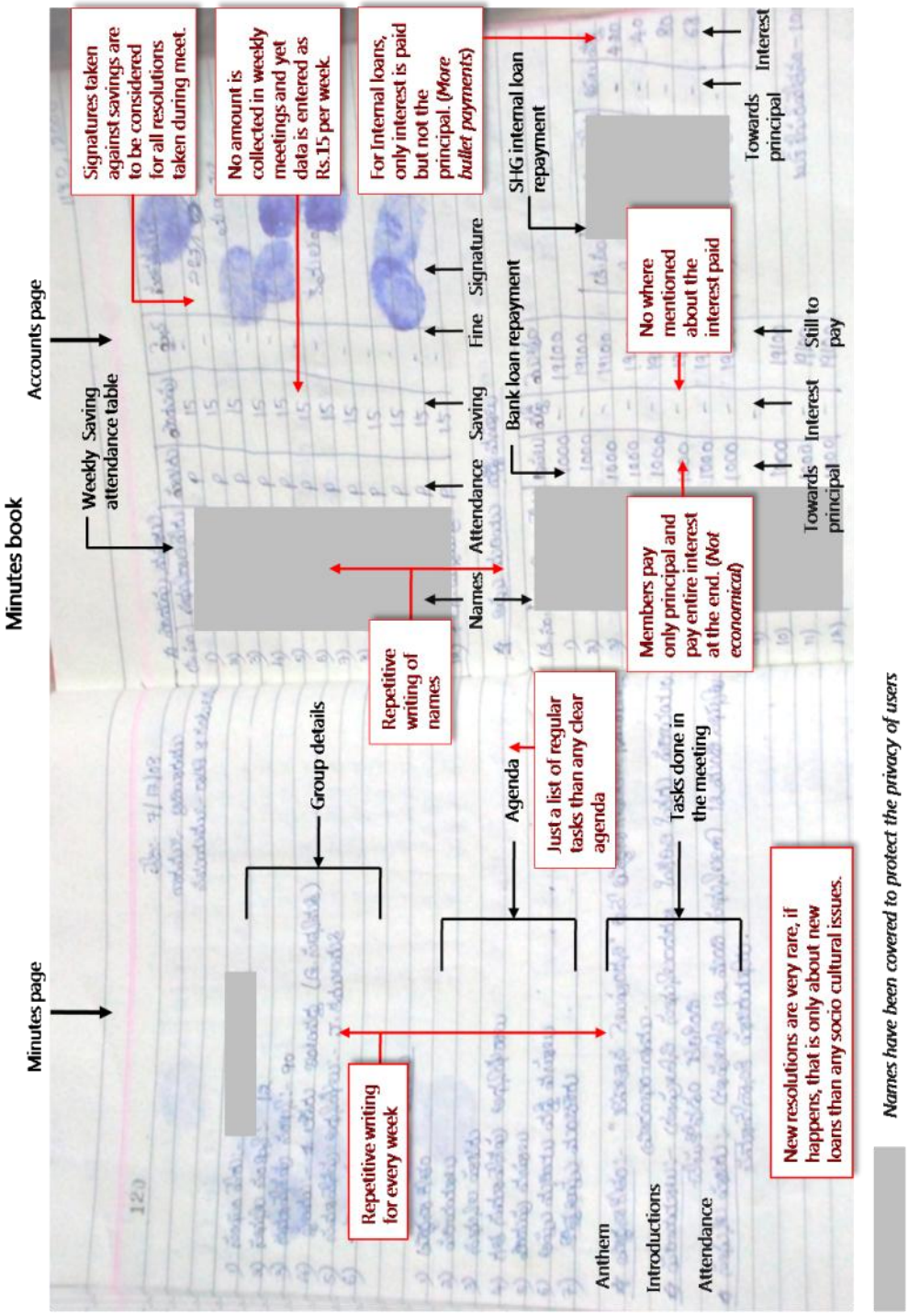


Figure 3: SHG-A's artifact study - Minute's book & its issues

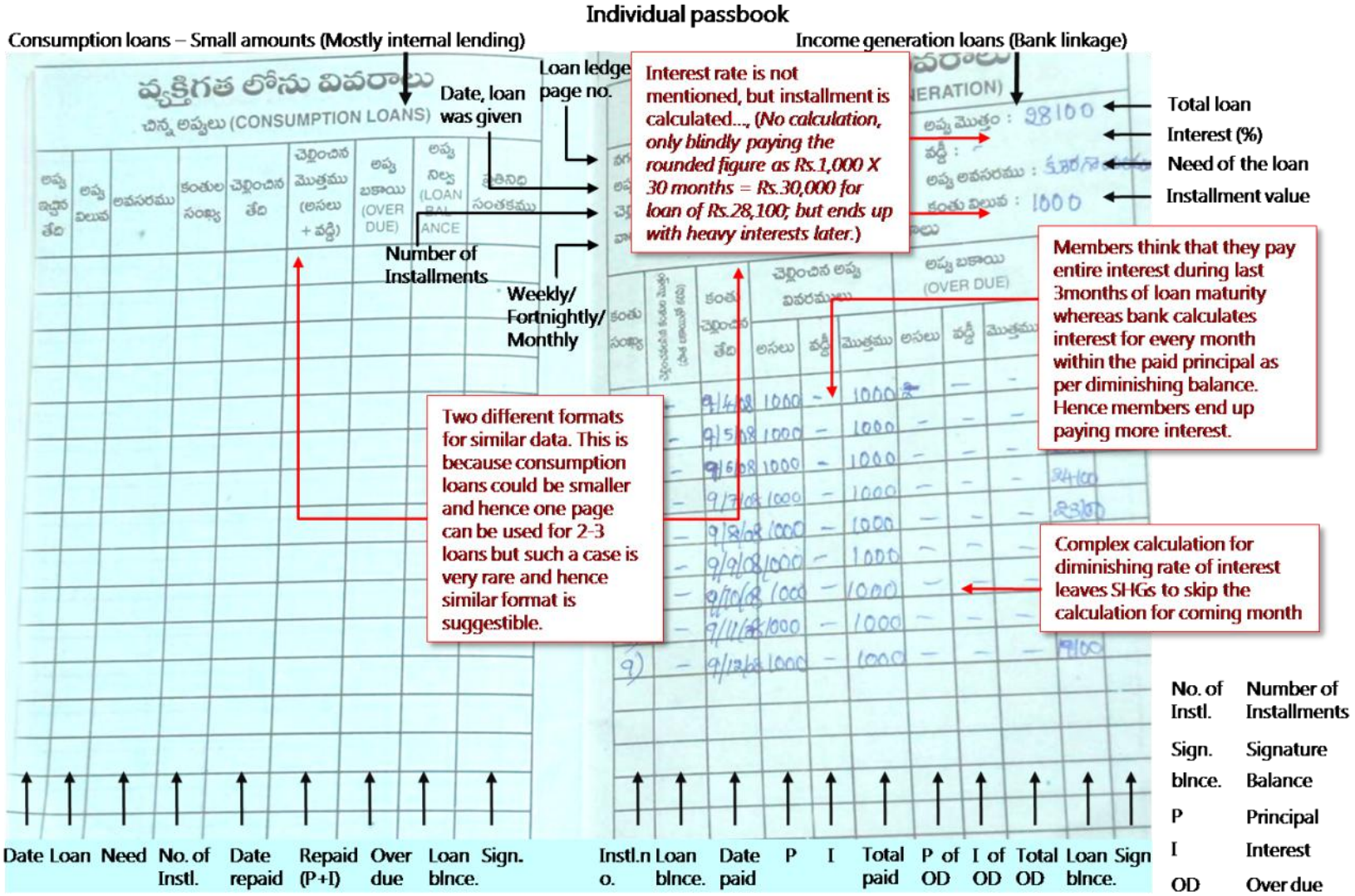


Figure 4: Group A's artifact study – Individual pass book

In SHG system, for a typical bank loan value of EMI for repayment is calculated as per diminishing balance in the principal amount.

Total loan	= Rs.28,100
Interest rate	= 14%
Number of installments	= 30

Equal Monthly Installment for the above loan as per
Bank standard calculations = Rs. 1115.52
(This amount is arrived through Master EMI calculator in MS Excel software)

Artifact study shows that SHG members are paying only Rs.1000 towards repayment and consider that as payment towards the principal amount for the month. Whereas banks calculate interest within this amount. Contextual inquiry (Beyer and Holtzbatt, 1998) with the members revealed that they would pay Rs.1000 (as this is round figure) for 27 installments and then they would calculate the entire interest along with balance principle for the last 3 installments. This would create extra pressure over loans while reaching the maturity date and hence members are forced to pay higher interests at this point, which is not economical. This informs lack of awareness about interest calculation and relative complexity in the system, which is forcing even the prompt paying members to remain as defaulted members at the end of loan's maturity. This observation was mirrored in another research (APMAS Executive summary, 2006) done across the four states Andhra Pradesh, Karnataka, Orissa and Rajasthan.

This study also reveals the duplication of data (attendance, reference page numbers, weekly savings) entry across the account books and many redundant data fields (individual share of interest over internal lending, delayed savings) and there is no documentation for important data like savings towards VO, installment for the coming month, over dues by the members.

4.2 SHG- B, Kandi Village

Figure 5: SHG- B's meeting session at Korutla village

Number of Members:	13
Founded:	2002
Number of loans group took so far:	5
Bank:	Andhra Pradesh Grameena Vikas Bank (APGVB), Deverakonda (Another mandal head quarters), Nalgonda district.
Book keeper:	1st leader's husband

The group members meet once in every month. As members live in close proximity within the village, they have the habit of meeting more frequently whenever the need arises i.e., to discuss about new loans, social actions and available opportunities.

The self-help groups in this district still follow the old record books which are much less detailed than the new one in previous group. This system comprises of

1) Book of resolutions
2) Loan ledger

These are common for the entire group and an individual passbook for every member. This system has more dependency on individual passbooks because group books are not that comprehensive. It is observed that most of the time individual passbooks stay with the leader only. Because of this practice the essence of individual passbook through which financial transparency to be created is partially overlooked.

4.2.1 Artifact study, SHG- B

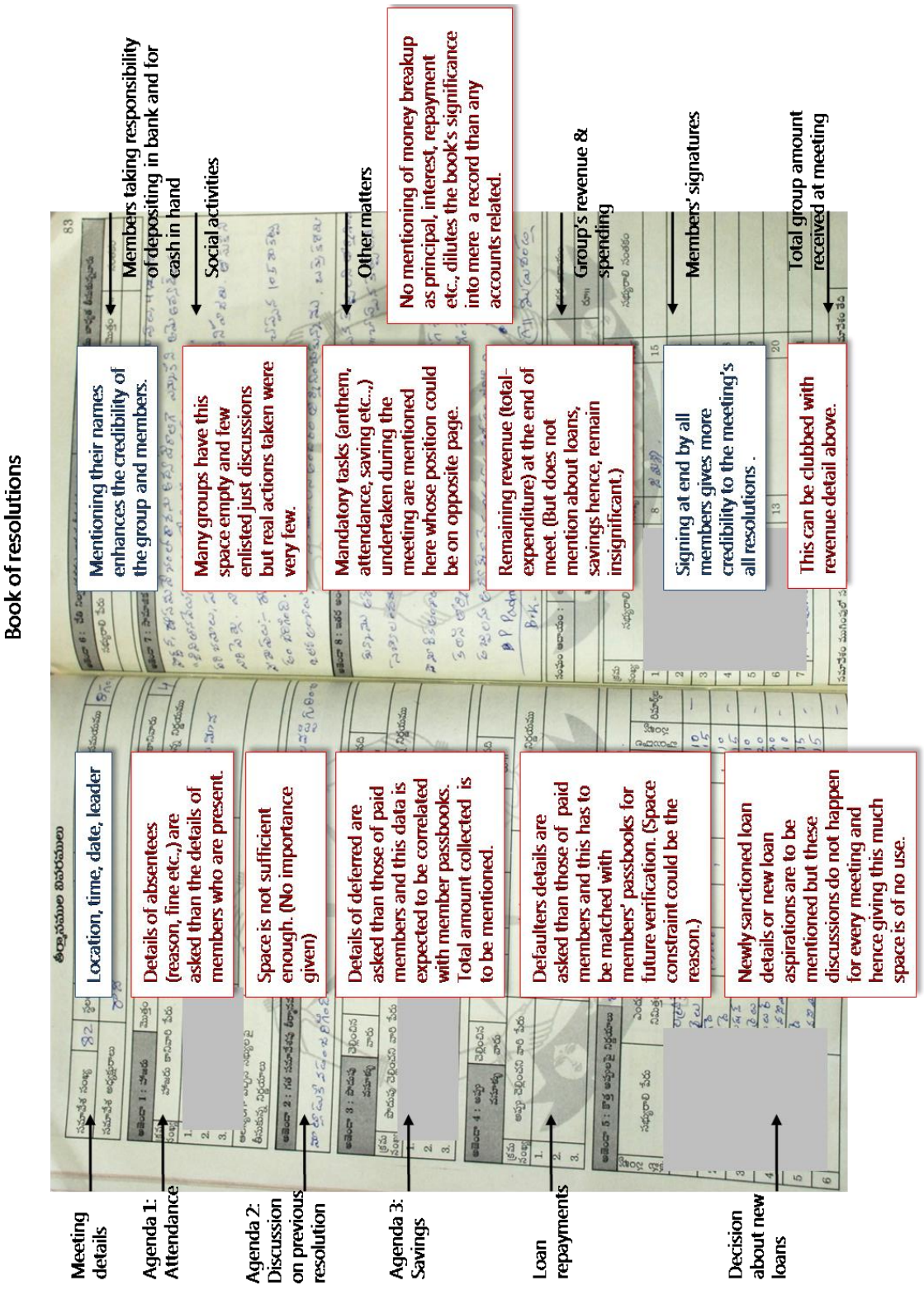


Figure 6: SHG- B's resolutions book

4.3 Common intents in main books of both groups

The following are the common intents in both the groups but mentioned in different formats. Comparison of these intents informed the direction at which redesign has to be moved towards.

SHG - A	SHG - B
Minute's book is the one which is regularly updated.	Resolutions book is the one where all data is regularly entered during meetings.
Meeting details like location, date and presiding leader are regularly entered.	Meeting details include meeting no., location, date and presiding leader.
Group regularly performs the tasks of anthem, attendance etc., and is definitely mentioned in the book.	Attendance is taken compulsorily and may not be the same about anthem but will be mentioned as performed in the book.
Attendance is taken at the beginning of the meeting but there is a practice of doctoring the records as there is no strict policy in practice for absentees.	Details of absentees are to be written in the book along with the reason and the fine to be paid.
Saving details are to be entered but the entered details are not actually correct because of differences in practicing the saving and recording the same.	Details of members who did not save for the month are to be mentioned, but such a case is very rare because saving is the foremost compulsory task of every member and was fulfilled in all cases of this research.
Here there is a scope to update different types of loans in several parameters which helps in understanding the financial health of group.	It is briefly mentioned in this book about defaulters and about total amount collected. But these partial details will not give any scope to understand the status or to plan for next month.
Signatures are along with attendance but not with the declaration of loan repayments. Separate signatures will be taken if there is any new resolution to be passed.	Signatures are taken at the end of meeting to approve all transactions done and resolutions passed.

Table 1: Comparison between different formats of account books

5. Cultural model

As self-help group system under AP state government has a clearly demarked hierarchy, roles played by administrative mechanism have a definitive influence in the way SHGs function. Each of these influential entities pursues SHGs to reach their objectives through various financial and social powers. Members as individuals with their various degrees of commitments towards the collective measures too influence the way their group functions. Cultural model helps in the way to understand these influential patterns.

Cultural model: Graphical representation reporting influences across the players in a domain.

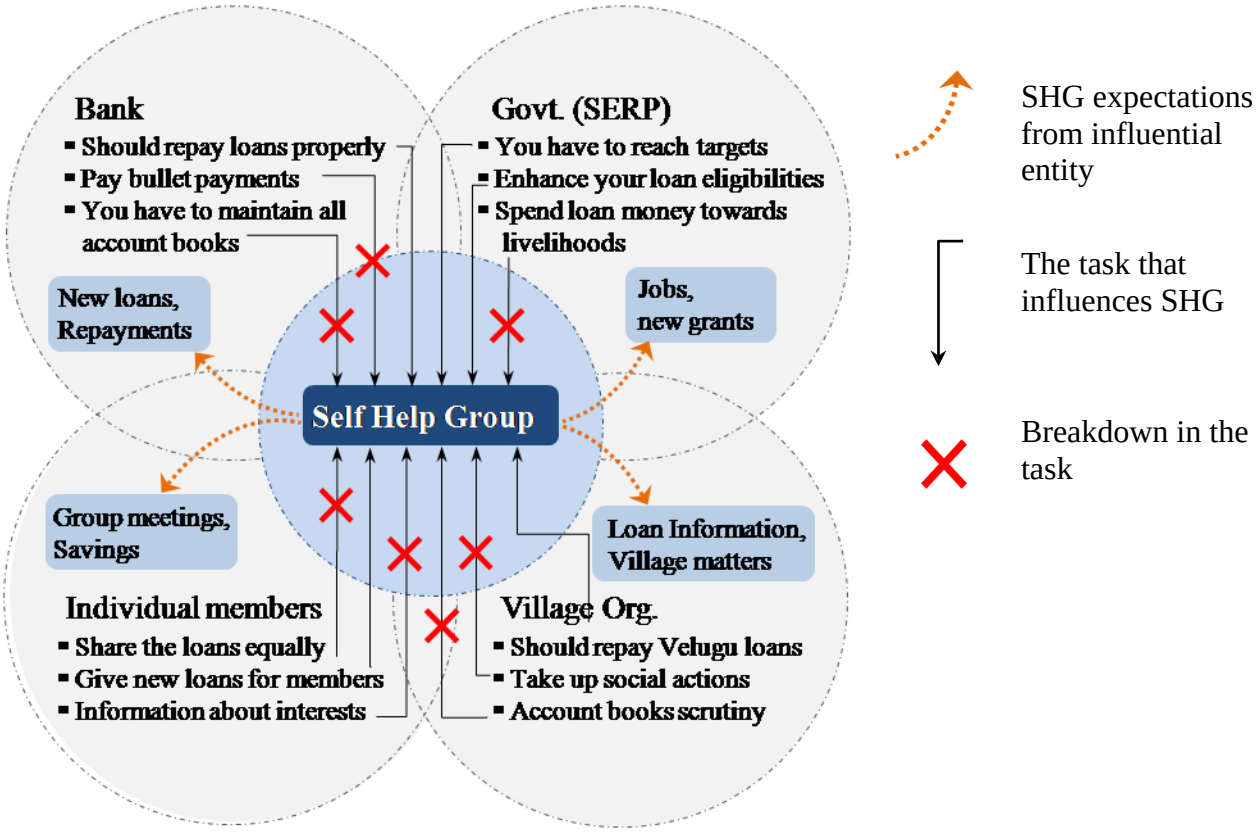


Figure 7: Cultural model

5.1 Insights:

- Quantity took over quality. (Number of groups has crossed 9,00,000 but account management task is still a big hurdle in SHG function)
- Dependence over VO & MS leading to domination over groups.
- Loan information is withheld by SHG leaders.
- SHG members do not have clear idea about interests over saving & loans.
- Expensive repayments.

6. Design goals:

- *Simplifying the account maintenance and reducing dependency on outsiders and thereby enhancing group's freedom.* This can be done by displaying the group financial statistics as
    i) Total group account
    ii) Individual account for members
    iii) Ledger wise visualization for higher authorities

  Digitizing data entry can help in preventing duplicate entry of data and can help in building transparency and trust across the system.

- *Making every member aware of her financial situation.* During the personal discussions with few members of groups, few internal matters within the group were surfaced. Members complained that they have no idea how much interest they are paying and how much in return they are gaining for their savings. The practice of periodical financial statements to be inculcated in SHGs to well inform the members about their status. Financial statement at the start/end of meeting through digitized system would help to reach this objective.

- *Reducing dependency over leaders.* The interdependency within a group for saving and lending money is good but withholding the important information with one or more members would increase the chances of risk, deceive and foul play in group's functioning. Hence it is suggested to make the account information viewable for all members at any point of time. Although no individual alone should be allowed to edit/enter the account information, accessing the same for planning and visualizing personal expenditures should be an objective.
    i) Information opens for all members to view.
    ii) Provision to enter/edit accounts should be made with both members and group leader only during group meetings.

- *Information dissemination regarding available opportunities.* In present system any new information about upcoming loan opportunities would be received by the members through IKP officials. As a future objective towards enhancing the system, it is suggested to send loan information, employment opportunities, market rates and weather information etc., such value added services can also be provided. These can be achieved through periodical alerts to group or members.

- *One of the primary objectives of IKP is to encourage rural women to invest the loan amounts for livelihoods opportunities.* As of now, IKP officials visit each and every group member to identify their economic status and advise them regarding their credit

plans. This is called micro credit plan, and tracking this plan for every member and analyzing their loan expenditure pattern is suggested as a future objective for the project.

7. Parallel product analysis

The available technology options to digitize SHG accountancy system are

1. Handheld device for every group and with a smart card for every member.
2. Laptop for every SHG/VO for recording all transactions during the meetings.
3. Shared mobile per group with extended individual access through network & a finger printer.

The handheld system cannot completely replace the account books as it does not have the screen, to interact over the information displayed. This can be employed as a support system to account books to record and monitor disbursement of loan amounts. Handheld machine cannot prevent multiple entry formats.

AP state government is contemplating to provide laptop for every VO which to be shared across all SHGs within the village. As told during stakeholder meetings with IKP officials one operator would be trained to use the laptop and she has to be present for all SHG meetings that would take place in the village. But this condition increases the dependency of SHGs over the operators and there by multiplies the IKP influence over their functioning.

As the mobile phones have high penetration scope into rural areas with its associated usage as communication device and few government schemes like National Rural Employment Guarantee Act (NREGA) and State Pension Fund are already disbursing their respective payments to beneficiaries through mobile based networks.

8. Pragathi

Pragathi (progressive development in Telugu) is conceived as a shared mobile system (one or more phones per group) to document the SHG transactions and for efficient account management. The system operates over online network with data sharing capabilities across the hierarchy for monitoring the quality of SHG operations.

8.1 Pragathi – System architecture

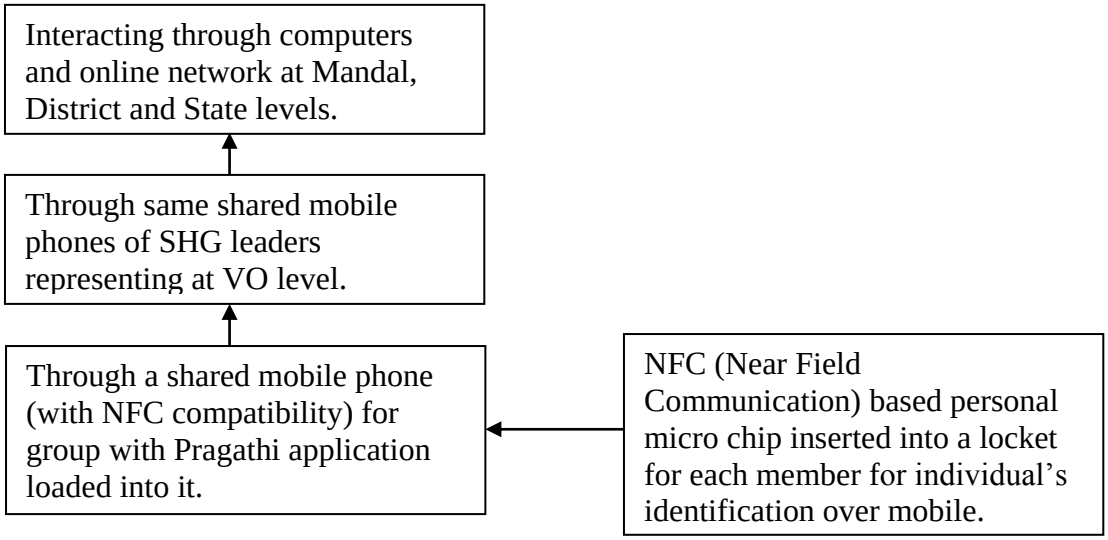


Table 2: Pragathi – System architecture

8.2 Layout options

As the data that to be shown on the mobile screens is critical financial data and the users are semi-literate and illiterate users, the information on the screens should be in context with the users' ability. As per APMAS study; about 41% of SHGs are 'functionally literate' (APMAS, Executive summary, 2006), which means that over half of their members have completed at least primary schooling. Advantageous point could be that even illiterates are easily recognizing numbers and are able to process them for accounts. And hence the interface has to be designed considering these varying abilities.

Several options were done using shapes, colours, symbols, numbers and text as well to represent the financial information. Textual information has to be shown in Telugu, local and official language of Andhra Pradesh. Telugu is not yet compatible to type with mobiles and hence the information to be shown cannot expect the user to type irrespective of literacy status. Users' contribution for inputting has to be limited to numbers. And hence usage of audio bits is also considered to communicate.

Three important stages of the SHG transactions in which significant information process happens by user are considered to apply these options of information design. They are

Process: *After Enrolment / registration*

Pictures + Leaves Symbols + Rows & Columns

Process: *Financial Statement*

Pictures + Leaves Symbols + Rows & Columns

Process: *Loan repayment pattern*

Pictures + Leaves Symbols + Rows & Columns Graphs

8.2.1 *After Enrolment / registration*

This would be the first screen the members would see, whenever the application is accessed over assigned mobile.

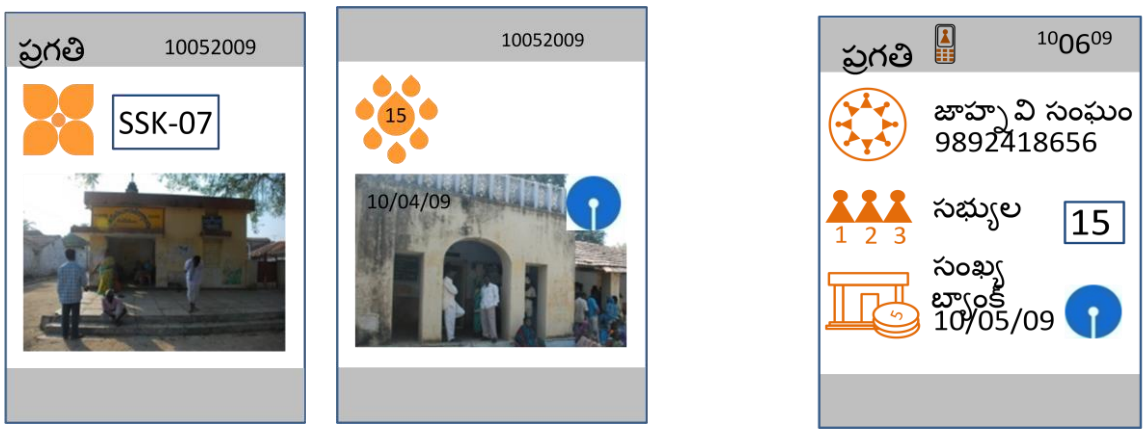


Figure 8: Mobile screen layout options for enrolment/registration

This representation using the pictures of locations related to group's function gives strong confirmation to the users. Group's identity is the through the picture and the code number.

Code number denotes name of the district (first letter), name of the Mandal, village and the group's number in VO. This code number will be entered by IKP official during registration. But this kind of codename for identifying the group may slowly make the groups' names redundant.

Pictures used represent the Village Gram Panchayat office where SHG meetings take place and second one is that of Bank.

In this representation, symbols of functions through which members associate with SHG are extensively used along with text & audio.

For group identity, name of the group and the assigned mobile's number are to be shown because knowing the mobile number is critical for viewing the group's information on another mobile. Bank is to be represented by their Logo, which is easy to remember. Logos of banks are to be uploaded onto application by IKP office.

8.2.2 For financial Statement

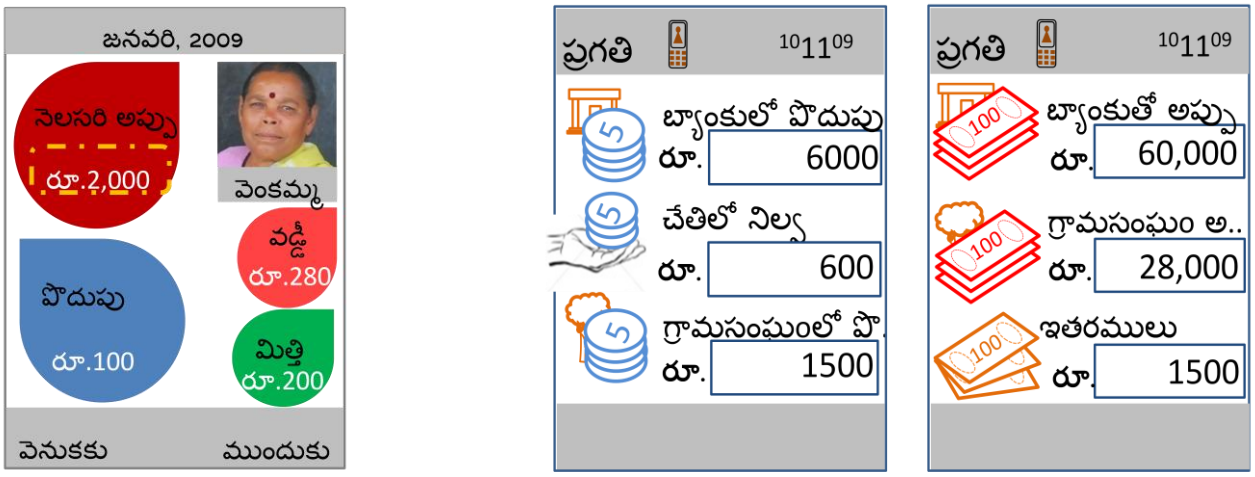


Figure 9: Mobile screen layout options for financial statement

Here these are shown using the colour leaves, with each colour representing the one kind of particular. Dark red is for the monthly installment, lighter red is for interest the member paying for the loan, blue one is for saving for the month etc.

And the orientation of leave denotes whether the money goes from or comes to the respective entity.

This option is to communicate to the users through extensive usage of symbols. And for semi-literates it is always supported by related text. Symbols are designed keeping in view the members arrange money during the meetings.

Savings are represented in coins and with blue colour because members save small thrift amounts. The minor change in the symbol differentiates the particulars between Savings to bank and saving to VO. Similar is the pattern for loans and is abstractly represented by currency notes and with red colour.

The colour coding like blue for savings, red for loans is the clue taken from Bank's practice with passbooks of SHG members.

8.2.3 For loan repayment

Users need to know two important parameters regarding loan repayment. One is loan repayment pattern i.e., the number installments, interest rate etc., and other is present month's repayment and it's affect of next month.

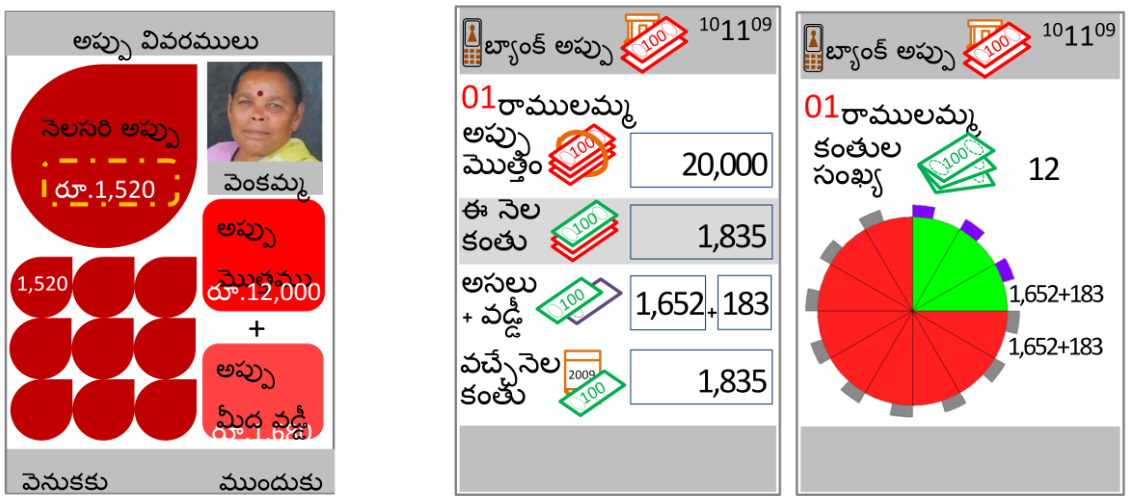


Figure 10: Mobile screen layout options for loan repayment

This option is the continuation of previous page's leaves concept with their orientation outwards denoting repayment.

The particulars related to loan, like installment, interest are in same colour but with light darker/ lighter shades.

Member's identification is through her picture. This option is not yet worked out for representing different types of loans

Here the idea is to focus on present month's payment and interest on first screen and total pattern through a graphic on subsequent one. The calculated user may not go to the next screen at all and can proceed to next process.

As the member enters present month's payment, screen automatically shows the Principal and Interest parts of the amount paid and gives her idea about how much she is supposed to pay for next month.

Symbols vary for different kind of loans within the limits of similar graphical language. Pie chart denotes the number of installments (paid, to be paid, interests) and is inspired from the discussions with members as they were talking about repaying money in terms of fractions of total.

8.2.4 Graphs for comparison

Options for comparison were done considering the metaphors being used in rural environment.

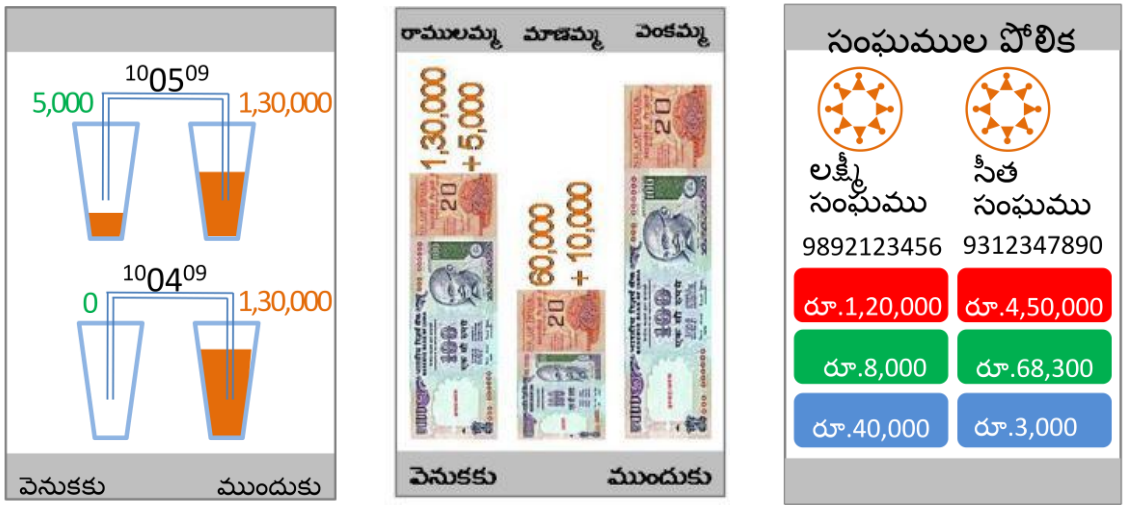


Figure 11: Mobile screen layout options for graphs

Comparison is one of the effective ways of motivating SHG members. It was mentioned by the on field IKP officials as more productive method to get a group in line with others. They have observed this during their initial and later stages of SHG movement. Even during on field interactions when the discussion about bank loans or VO loans came, members compare with another group or village to enhance their stake for the next loan.

The comparison could be between the loans by a member or among members to understand their repayment pattern or between the groups to rate their performance on the basis of loans, savings etc.

One of the ideas was to show money as a fluid which gets transferred from one glass to other to represent loan payment and repayment. But because of space constraint the mobile screen, this option was not found suitable. Actual subject i.e., the difference in fluid levels remained too unrecognizable and showing other parameters of loans on the same symbol was nearly impossible. User might have to scroll through many screens to get a comprehensive understanding of the required data.

As members were seen arranging the money on floor in different columns during their SHG meetings, another option is to directly use currency notes to follow up the similar process on mobile screen. But this option has the limitation of maintaining the actual ratio of the currency note for legitimacy.

All these layouts were printed in mobile screen size and user studies were done with semi-literate users who have migrated to Mumbai from AP for work purpose. These users have been using mobiles from earlier 6-12 months period. These studies were brief with the main objective to understand which format of data visualization, the users are comfortable with.

It was observed that the second option with coloured symbols (icons) for different tasks was chosen over graphs and others for its validity over retention with the users.

Then the symbols used for different tasks were further refined to apply in Pragathi system. The existing metaphors like Blue for Savings, Red for Loans etc., from existing account books are the basis for Pragathi.

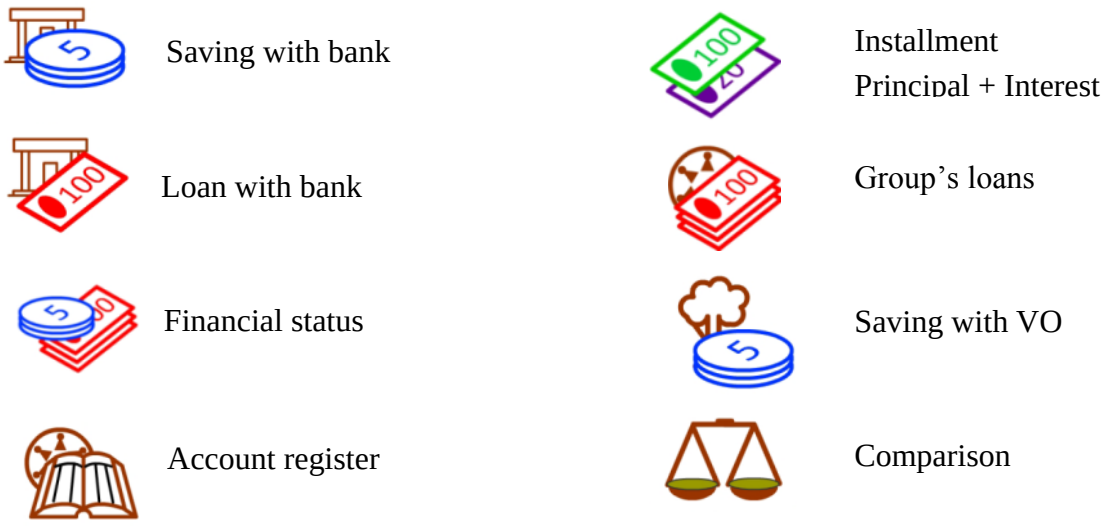


Figure 12: Icons/ Symbols for Pragathi

9. Pragathi – Scenarios & Stages of operation

Considering the complexity of the process, the solution is designed along the screenshots of prototype simulated over 3 scenarios detailing out important stages of SHG operation.

The three scenarios are

1. Enrolling a group and its members into the Pragathi system.
2. Periodical group meeting, in which all major functions would be utilized.
3. Member viewing her account details in a different village.

For the purpose of this research - case study paper, few important screens from these scenarios are illustrated here along with appropriate labels.

Group's details
Assigned mobile no.
Group name & enrolled date
Number of members
Monthly saving per head
Bank account details

First screen showing important details about the group.

Figure 13: Group details screen

Attendance list
Through locket & fingerprint

Name of each member

Savings register shows the particulars of each member and highlights (blinks) the amount to be paid by each member.

Figure 14: Attendance details screen

Financial status
At group level

Savings in bank

Amount in hand

Interest over savings

Savings in VO

Financial status gives an outlook of group's financial reserves & commitments by that month.

Figure 15: Financial status for group

Savings register

Total savings &
Savings in bank

To be paid by each member

Savings register shows the particulars of each member and highlights (blinks) the amount to be paid by each member.

Figure 16: Screen for savings register

Bank loan register

For a member (name & no.)

Total loan value

This month's installment to be paid *(blinks)*

Break up of amount
Principal + Interest

Next month's installment

Application by default goes to the option where the member has to enter the amount for the month and it blinks the amount that is supposed to be paid.

Figure 17: Screen for bank loan register

Loans register

Installments paid for Bank loan, VO loan and SHG loan

Member by member particulars

After all loans repayments, application shows the table of installments paid by members for different loans for confirmation & comparison.

Figure 18: Screen for loans register

Individual financial status

Member's name

Installment to be paid for Bank linkage loan

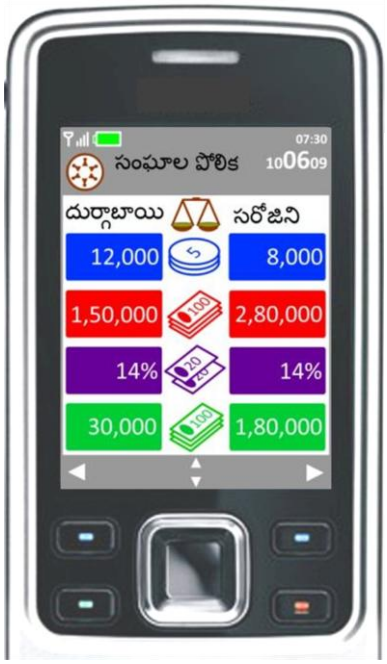
Installment to be paid for VO loan

Installment to be paid for SHG loan

Total installments to be paid for the month

Members can check individual financial information over personal mobiles also even when meeting is off by indentifying through NFC locket.

Figure 19: Individual members financial status



Comparison between two groups

Groups' names

Savings so far

Bank linkage loan

Interest over loan

Loan amount repaid

Application sends timely messages as comparison between groups in terms of savings & loans to further motivate them.

Figure 20: Screen for performance comparison between group

10. Conclusion & Future scope

As the project had the limitations of an academic thesis, complete prototype building and user testing could not be done within the time frame. These aspects of technology support to SHG system can further be researched to surface the opportunities available in this domain. The issues that were identified with SHG functioning and account management system could be applicable to other regions of the country where self-help concept is gaining momentum. Hence these issues need closer attention to address the needs that arise in particular context of the region.

Other areas of research for technology infusion like improving employment opportunities for youth, health care facilities for remote areas, eradicating social deceases by creating socially active communities among rural men & women etc., can mutually benefit the SHG system and the knowledge that is gained can be utilized to further integrate these systems to attain the ultimate goal of rural resurgence.

Acknowledgements

I thank the Prof. Anirudha Joshi, my project guide at Industrial Design Centre, IIT Bombay for helping me to resolve the complexity of project. I am thankful to the SHG members, IKP officials, Bank officers and other Stakeholders who cooperated for the project. I thank the professors and classmates at IDC whose insightful comments helped me during the course of the project. I thank my parents and relatives who participated in brainstorming and review sessions of the project.

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A WWAN Based solution to improve the supply chain management of Fruit Industry by proposed handheld fruit freshness tester.

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Abstract

Fresh fruits and vegetables are a multibillion-dollar international industry, and wider adoption of existing technologies for assessing their quality can increase profitability for growers and processors. Objective neighbourhood differences in access to fresh fruit and vegetables may explain social inequalities in diet. Investigations have focused on variations in cost and availability as barriers to the purchase and consumption of fresh produce; investigations of quality have been neglected.

The Proposed model employs the atom processor/Kit, wireless/mobile network and other components discussed below for solving the problem of unnecessary wastage of fruits due to various reasons.

Use case:

Fresho'meter is an initiative by us to establish a pan-Indian response network in order to increase the quality of fruits and vegetables. It therefore proposes that location information should be transmitted with the emergency to a "Central Authority's Server" (CAS), from which emergency services are dispatched like change of stock or transfer to an area of more sale from an area of lesser sale to avoid wastage.

The Fresho'meter in-stores system must:

- Collect data from the custom stores through sensors, and maintain an up-to-date GPS-fix
- *Automatically direct the central server the information of any store having unhealthy fruits and vegetables*
- *Contact the CAS for stock relocation or replacement.*

In order to perform all these functions, the system must integrate GPS, GSM/GPRS, and ideally an in-band modem which enables data transmission over the voice channel.

2. Introduction

We all agree on the importance of eating more fresh fruits & vegetables, but not enough people are following this important advice. Dietary experts recommend that every person should eat at least five servings of fresh fruits & vegetables every day. Increasing your consumption of fruits and vegetables is one of the easiest changes you can make to increase level of health, lose weight and gain fitness.

The latest food guidelines recommend that adults eat from five to nine servings of fresh fruit & vegetables every day. While that may seem like a lot, it is an important goal to strive for, and a very reachable one.

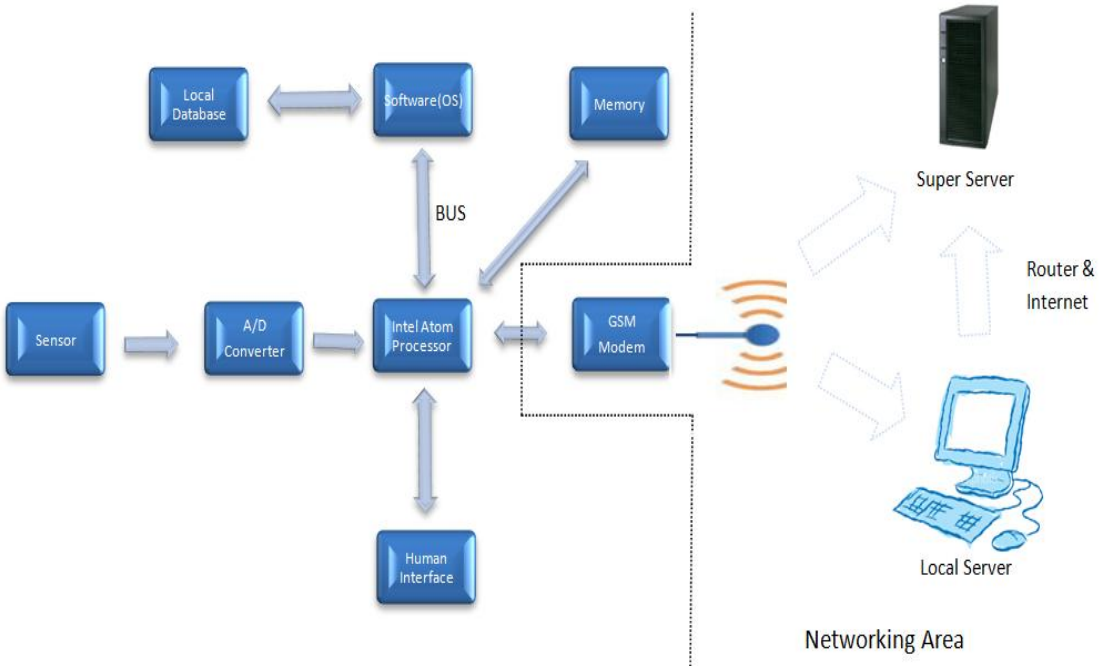
A serving of a fruit or vegetable is equal to:

- 1 medium sized vegetable or fruit (such as an apple, orange or banana)
- 2 small fruits (such as kiwi fruit or plums)
- ½ cup of fresh, frozen or canned fruits or vegetables
- ½ cup of 100% fruit juice
- ¼ cup of dried fruit
- 1 cup of green salad

Quality of fruit and vegetables within the surveyed stores normally seem high. Medium-sized stores, stores in small town and rural areas, and stores in more affluent areas tended to have the highest-quality fresh fruit and vegetables. Stores where food is secondary, stores in urban settings and stores in more deprived areas tend have the lowest-quality fresh produce. Although differences in quality were not always statistically significant, patterns can be consistent for the majority of fruit and vegetable items.

Fruit cultivation in India, quite understandably grows most prolific in the areas of the Himalayas. The Uttar Pradesh hill, particularly the Kumaon hills division, possesses exceptional advantage of early harvest of apple[1], principally due to cultivation of early maturing varieties like Early Shanburry, Fanny and Benoni. The early maturing varieties are harvested 2-3 weeks before the onset of fresh apple from Himachal Pradesh and Jammu and Kashmir and hence, fetch very moneymaking prices. Deciduous fruits, covering pome and stone fruits contribute significantly to the horticulture economy of India. Truly, cultivation of fruits in India does depend upon the success of plantation, harvest, soils and a perfect ambience of brilliant minds.

When we talk of fruit market the effective management of fruit supply chain flashes the mind. As already stated this industry being a global multi-million dollar industry still has been vulnerable to-damage of fruits, disease to people, or substantial loss of capital, because of lack of technological gospels in the area and improper communication between the production areas to the consumption areas. The project paper is an initiative to narrow this gap by building up a bridge between the producer and consumers with the help of **WWAN based solution to improve the supply chain of the fruit industry by the proposed handheld device we call FRESHO'METER.**



Fi g.1: Block Diagram of FRESHO'METER

2. System Design & Specification Details

2.1 Sensors

Figuring out how ripe a particular fruit is quite tricky, and we have always marvelled at those who can tell by flicking their fingers against the skin of a fruit a couple of times[2]. Well, thankfully there is technology to help us now as a new system based on metal oxide sensors could potentially check the safety and quality of foods reliably, quickly and economically, including the ripeness level of a fruit. This is made possible by researchers at the different Institutes for Molecular Biology and Applied Ecology. These sensors are capable of doing so by checking on gas emissions on-line. It is a start to help new housewives get their act together when it comes to picking up the freshest produce for her family. The product design is presented in fig-1.

It works by checking gas emissions on-line– directly in the warehouse for instance, based on the use of metal oxide sensors. Similar to those installed in cars, for example, to close ventilation vents of the car when driving through a tunnel.

If a gas flows over the sensor, at temperatures of 300 to 400°C, it will burn at the point of contact. The subsequent exchange of electrons changes the electrical conductivity. Before the gas reaches these sensors, it has to go through a separation column with polymers. Certain substances are already filtered out here. Initial tests were promising – the system measures the volatile substances just as sensitively as conventional equipment used in food laboratories.

2.2 A/D Converters

Sample and Hold (S/H)

We use polystyrene capacitor based A/D Converter system because of its high insulation resistance and low dielectric absorption.2 A larger value of C decreases (improves) droop rate. If droop current is IDR, then droop rate is:

$$\frac{dVout}{dt} = \frac{IDR}{C}$$

The gate level logical build of the A/D converter can be seen in fig 2 and the corresponding control flow that is used are as specified in the fig 3.

A smaller C decreases (improves) acquisition time.

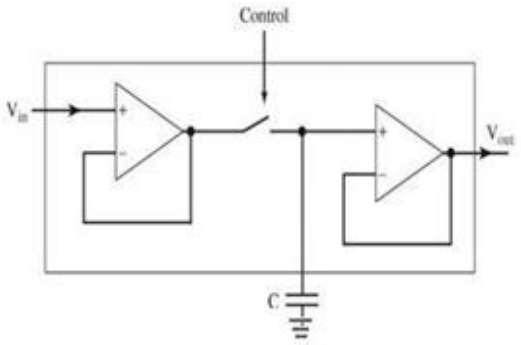


Fig.2: S/H Technique Logic Level

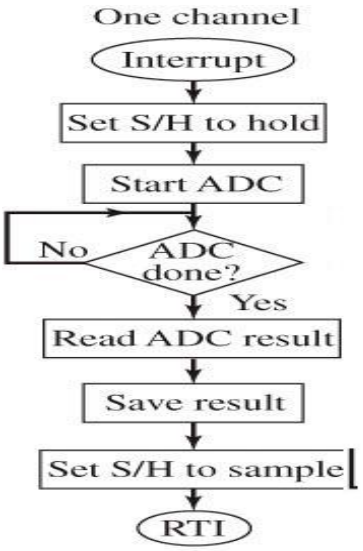


Fig.3: S/H Technique Control Flow

One of our choices, 6812 has built-in ADCs with following features:

- Eight-channel operation.
- 8-bit or 10-bit resolution.
- Successive approximation conversion technique.
- Clock and charge pump to create higher voltages.
- Two operation modes: single sequence of conversions then stop, and continuous conversion.
- Supports multiple conversion of single channel, and one conversion each for group of channels. External VRH, VRL analog high low references.

2.3 Intel Atom Processor

The power packed, high performance Intel atom processor is used as a central controller of the system which drives all the eminent parts of the system viz- the A/D Converter, the Human Interface System, The GSM Modem, Memory both flash as well as the inbuilt RAM. Thus, it can be thought to pose a single CPU tightly coupled together, which could have otherwise required many individual CPUs. Another outstanding space that this atom processor adds to the device is its scalability. This device can be upgraded with any newer technology like incorporation of future-tech functionalities like 3G, since the versatility of this atom processor. It can also help in sustainable accountancy & accuracy of the data in the local memory, server & the CAS.

2.4 Human Interface

Surface-mounted device (SMD) LED panels:
An SMD pixel consists of red, green, and blue diodes mounted on a chipset, which is then mounted on the driver PC board. The individual diodes are smaller than a pinhead and are set very close together. The difference is that the maximum viewing distance is reduced by 25% from the discrete diode screen with the same resolution.

Indoor use generally requires a screen that is based on SMD technology and has a minimum brightness of 600 candelas per square meter. This will usually be more than sufficient for retail applications, but under high ambient-brightness conditions, higher brightness may be required for better visibility.

The viability of the product can be enhanced with the applications developed over android operating system that work in co-ordination with the LED and add a to the real time input stream of the system. This input stream can be prompted with a soft keyboard panel that implement the LED screen toggling and selection operations.

2.5 Memory

The Intel atom processor comes with an inbuilt cache and thus we just need to interface it with only small amount of flash memory that can help the inbuilt Database and can also help to keep the log and other small such things. So a flash memory of 256 Mb will be sufficient to serve the purpose.

This memory can also help to act as a backing store for context switching for the S/H when the device senses the input from the sensor. At other times it can help to store the reference contents of the ADC. This memory can be effectively interfaced with the Intel Atom Processor.

On a later stage in the life cycle of the product, it can also help in storing the data locally that can be downloaded to any local computer system through built in ports in the designed system. This can help in local analysis of the data and can thus promote the overall interest of developing the product.

Another advantage of these flash memories is that they are very cheap and can be upgraded as the system finds the need to do so. The overall cost of the system can be kept relatively quite low.

2.6 Operating System

As already stated, the input stream can function over different applications built in Open-Source Operating systems like “Android or Linux”[4]. The interfacing system software that binds all the eminent parts of the can also be quite generic in the implementation, since the CPU over which these operating system will be planted is The Intel Atom Processor.

As per the demand for the product’s generic behaviour the operating system has to be enabled with memory management, process management & substantial security for the data that is stored in the proposed embedded system or while sending the data to the CAS. Also paging of data has been used to compensate for the small size and low memory negotiation of the device in the network.

2.7 Network considerations.

To build an M2M (machine-to-machine) solution integrating a WWAN (Wireless Wide Area Network, e.g. GSM/GPRS, CDMA or EDGE) communication function will typically opt to add a wireless modem (wireless module) to existing equipment. This approach generally yields dual-processor architecture with a host processor (external microcontroller) and wireless modem (including a processor). The host processor carries out the application execution and interfaces with a set of external peripheral sensors, buses, memory etc., and it communicates with the wireless modem via AT commands.

For long-lasting competitiveness, however, we need to focus on eliminating duplicate components and optimizing software development. Embedding the GSM and application binaries on the same processor requires specialist expertise. In order to avoid this complex integration work and concentrate resources on company-specific we the intellectual property generators, adopt a programmable Wireless CPU (Intel Atom processor) – a microcontroller with integrated WWAN communications capability, onto which the complete software application of the product can be embedded.

The Wireless CPU controls the external peripherals as well as the cellular communication, and it is no longer necessary to use an additional application processor.

With the addition of an M2M-optimised (machine to machine) operating system featuring functionalities such as power management, response to time-critical interrupts, and support for over-the-air upgrades, as well as a set of suitable application development tools, developers have a cost-effective platform that can be programmed relatively easily. Compared to the "black box" approach, this design philosophy aims at creating an inherently wireless solution from the outset.

Previously, each of these functional blocks required its own separate processor, memories and crystal (for clock generation). If we examine this architecture, the following opportunities for cost optimization appear:

- Merging all CPUs into one, shared CPU & can be used by all applications
- Sharing a single FLASH and a single RAM for all software
- Avoiding the interconnection of many multiple physical connectors

A high-performance "Intel Atom-Processor" - unlike a traditional wireless module/wireless modem - can exploit all of the above, using a processor with enough CPU power for all applications and which also includes the GSM radio and communications stack.

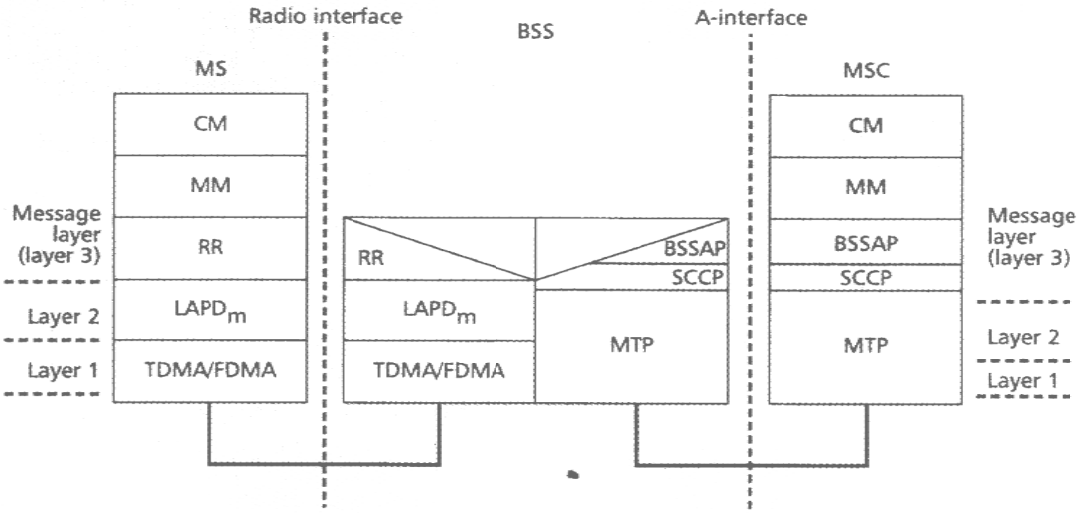


Fig.4: The Architecture of GSM protocol stack

3. Supply Chain Management

Supply chain management uses the supply chain as an organizing concept for identifying domains of business operations where costs can be saved and profits up-scaled. "Value chain analysis" is a part of supply chain management that focuses on identifying where products gain value in the supply chain and how effectively these products (fruits in our case) reach the market to accrue maximum benefit to both the producer and consumer sustainably[3]. The value chain approach has since been adapted by economic sociologists to study power relations in global food (and other) chains and the interactions between the actors in these chains. Their aim is to shed light on the socioeconomic and environmental consequences, such as working conditions, and identify leverage points for improved business practices. Researchers coupled with agriculture and international developments have also used this value chain approach to identify how export-oriented food chains in developing countries affect employment and other development issues. And the development of local value chains is at the heart of movements even in the developed countries like United States. They broadly aim to develop more sustainable, locally oriented food supply chains.

This article aim at developing a device (FRESHO'METER) and through a virtual simulation that can be used to identify innovative interventions throughout the fruit supply chain to create a healthier food environment and improve existing interventions rendered less effective by their lack of consideration of the dynamics of the fruit supply chain. The analysis, provisionally termed consumption-oriented fruit supply chain simulation, follows from established supply chain approaches like value chain analysis, to problem solving in this system.

4. Network Protocol Architecture

The GSM protocol architecture as shown in fig-4 used for the exchange of signal messages for mobility, radio resource, and connection management properties [10]. The protocol layering consists of the physical layer and layer 3. It is to be noted that, it is not the same like OSI layer 3. The GSM layer 3 protocols are used in communication between network resource mobility, code format and cell-related messages in networks. Since the OSI model, some of these functions are actually

provided by the higher layers, the term “message layer” is more appropriate term for layer 3 in GSM.

This message layer protocol is made of three sublayer called as the resource management (RR) implemented over the link between the MS and the BSS, the mobility management (MM), and connection management (CM) sub-layer providing the communication between the MS and MSC. Layer3 also implements the message transport part of the CCITT SS7 on the link between the BSS and the MSC to provide the transport and addressing functionality provided by layer3 of the OSI protocol stack. In GSM, the CM, and MM sub layers, provides the function of the transport, session, and the presentation layer like in OSI model.

The functions of each protocol layer/sublayer are:

4.1 Physical Layer

The physical layer on the radio link is basically used to implement the traffic channels on the landsides formed from TDM slots implemented on 2.048 Mb/s link (E1 trunks). The signalling channels are basically logically multiplexed on an aggregate of the TDM slots.

4.2 Link Layer on the Air Interface

This layer is basically implemented using LAPDm protocol[11][12]. This is used in the data link layer between MS and BSS. This LAPDm uses no flag or frame delimiter and thus no bit stuffing. Instead this work is maintained by the physical layer. LAPDm uses a “Length Indicator” field to distinguish the information field. It basically uses a control field to carry the sequence number like LADP. The types of frame used in the supervisory function are- unnumbered frame, information transfer and control function, numbered information transfer. LAPDm also uses no cyclic bit for redundancy checking. Thus this work is again left at the stake of the block and convolution coding of the physical layer.

4.3 Link layer on the A interface

On the link connecting the BSS to MSC(the A interface), the MTP level 2 of the SS7 protocol is used to provide the OSI layer 2 function as recovery from transmission error through error detection and retransmission.

4.4 Mobile management (MM) sublayer

This layer terminates at MSC and related messages from or to the MS is relayed transparently in the BSS updating the DTAP process.

4.4.1 MM mobility management specific procedure

4.4.1.1. Location updating is a procedure for keeping network informed of where the mobile device is roaming. Location updating will be initiated by the mobile station (CAS) on either detecting new location area by periodically monitoring the location information broadcasted by the network on the broadcast channel, and comparing it to the information that was previously store in CAS (Central Authority Server).

4.4.2 MM common procedures

4.4.2.1 IMSI Attach is used to mark the attach in the VLR on MS power down or power up or subscriber information module (SIM) removed or inserted. Any incoming call is either accepted or rejected but they are handy to say that the IMSI is active in the network.

4.4.2.3. IMSI Detach is just the opposite of the IMSI attach, which is used by the CAS to indicate the inactive status of the network. No response or acknowledgement is returned to the MS by the network on setting the active flag for the IMSI.

4.4.2.3 Authentication is used to let the network verify the identity provided by the user when requested, and to provide a new ciphering key to the CAS.

4.4.2.4 Identification is used by the network to request CAS specific identification parameter to the network, such as users international mobile subscriber or equipment identifiers (IMSI or IMEI).

4.4.3 MM connection related procedure

These are procedure related to establishment and release of the connection between MS and MSC and the entities of the connection management(CM) peers.

This is on a larger part responsible for services to the upper connection management sublayers which can be call control(CC),short message service(SMS), and the call-independent supplementary service(SS) etc.

Each of these services would involve the exchange of multiple messages between the MS and the network before the required MM connection is established and the requesting entity within the CM sublayer is notified.

Thus, GSM essentially is a technology which is self-contained conceptual framework for extending the mobile specific functions of next generation personal and distributed computing with vast applications in supply-chain management & related areas.

5. Sample Simulation of an Apple Supply-Chain Inventory

An excerpt from our simulation of a supply-chain's behaviour is presented here for a random fruit Apple.

Apple[1] was introduced into the country by the British in the Kullu Valley of the Himalayan State of H.P. as far back as 1865, while the colored 'Delicious' cultivars of apple were introduced to Shimla hills of the same State in 1917. The apple cultivar 'Ambri' is considered to be indigenous to Kashmir and had been grown long before Western introductions. Table–I shows the cultivar of apple India.

Table I: Promising Cultivars of Apples in Major Production Regions of India

J&K	H.P.	U.P.
Benoni, Irish Peach, Cox's Orange Pippin, Ambri, White dotted Red, American Apirouge, Red Delicious, Golden Delicious	Tydeman's Early, Mollies Delicious, Starkrimson, Starking Delicious, Red delicious, Richared, Granny-Smith, Red Spur, Top Red, Red Chief, Oregon spur, Golden spur, Michal, Schlomit	Early Shanburry, Chaubattia Princess, Fanny Benoni, Red Delicious, Starking Delicious, Rymer, Buckingham

5.1 Area and Production

Although there has been 5-6 fold increase in apple production during the last 50 years, the productivity level is still very low (5.56 t/ha). Apple cultivation received greater attention by the growers. In H.P, area [6][7][8] under apple increased from 3026 ha in 1960-61 to 78296 ha in 1995-96 with a corresponding increase in yield. J&K covers about 78007 ha under apple with a production of 714834 tons. In the U.P. hills (8 districts) apple occupies about 30 per cent of the area under fruits and contributes 46.9 percent of fruit production. The area covered under apple in U.P. hills is 55200 ha with production of 210000 tons of fruits. In the North-Eastern Hills Region, good quality apple is produced only in the rain-shadow belts of Arunachal Pradesh (5523 ha), and in Nagaland a very small area (64 ha) has been brought under apple cultivation.

About 99 percent of India's apple area falls under the North Western Hills region, covering 6 districts of J&K (Srinagar, Budgam, Pulwama, Anantanag, Baramullah, Kupwara), 6 districts of H.P. (Shimla, Kullu, Sirmour, Mandi, Chamba, Kinnaur) and 8 districts of U.P. (Almora, Nainital, Pithauragarh, Tehri, Pauri, Chamoli, Uttarkashi, Dehradun). In the North-eastern Hills region, good quality apple is grown in a small area in Tawang belt of Kameng district in Arunachal Pradesh. The Tawang area is basically a rainshadow belt and therefore, permits a longer period of sunshine and freedom from heavy rains, making it ideal for apple. Apple is also grown in Sikkim and Nagaland but the production is not a major success.

It is always important to know the production grounds to begin keeping the step stone for simulation of any simulation like supply-chain. Below in table-II, is a list of major production states with their area, production and yield for the production of apple.

Table II: Area, Production and Yield of Apples in India.

States	Apples		
	Area (ha)	**Production (MT)**	**Yield (MT/ ha)**
Arunachal Pradesh	5523	9730	1.76
Himachal Pradesh	78296	276681	9.40
Jammu & Kashmir	78007	714834	11.0
Nagaland	64	109	1.70
Uttar Pradesh	55200	210000	3.95
Total	217099	1211379	5.56

Now with the understanding of the major areas of under production of apple we are ready to analyse the supply-chain for apple industry from on-site production through cold-store warehouses to the everyday dealer and mass supplier in a major city like Bangaluru (Bangalore). On the basis of obtained results we will be in a shape to make

some solid verdicts regarding how this WWAN based technology has the potential to improve the supply-chain management in a pan-Indian market.

5.2 Simulation Model Proposed

Before we actually simulate such a system we also need to make some valuable assumptions

1. Average (source report) per capita consumption of Apples in India is 1.35 KGs.
2. Total population of Bangalore till 01- Feb, 2010 is 62,00,000 approx.
3. There are around 550 cold storages in Karnataka[5][9] out of which 40% are multipurpose,]with an average capacity of nearly 1000 MTonnes. There are nearly 50 mass fruit distributers in Bangalore. These peoples are directly in contact with cold-store warehouses or nearby production areas, in an economic way they influence the demands in the supply-chain management in this system.
4. On the basis of "normalised" values that can be obtained from the Intel processor after detecting the state of the apple inventory at a time the apples can be graded into a range of values of descriptors like

Table III: Conditional Descriptors Distribution.

Sl No.	State	Days	Norm-alised
1.	Unripe	>7	3
2.	Normal	3-7	2
3.	Critical	1-3	1
4.	Waste	0	0

5. Lead time from the various production to the distributers area can be combined to give a distribution table like

Table IV: Lead Time Distribution

Sl No.	Distances (in Km)	Lead time
1.	0-500	1 day
2.	500-1500	2 day
3.	1500-3000	3 day

6. The demand by such mass apple distributers in Bangalore can range from 300-600 KGs/day. This demand can be normalised to map to some value range, and their occurrence in the simulation can be brought about by random number (RAN#) generation.

Table V: Demand distribution & its RAN# and Normalised Value

Sl No.	Demand	RAN#	Normalised to
1.	>300	0-12	0
2.	300-350	13-27	1
3.	350-400	28-43	2
4.	400-450	44-58	3
5.	450-500	59-74	4
6.	500-550	75-88	5
7.	550-600	89-99	6

7. The profit over sale can be monitored as the ultimate result for the test. (1 for existence of such product in the inventory. Profit increases down the line)

Table VI: Profit Distribution

Norm al	Critical	Unripe	Norm-alised	Pro -fit
0	0	0	H	0
0	1	1	G	1
0	0	1	F	2
0	1	0	E	3
1	1	1	D	4
1	0	1	C	5
1	1	0	B	6
1	0	0	A	7

So then it means there is a consumption of nearly 23,000KGs of apple/day in "Bangalore". And an average of nearly 450 KGs is needed by each dealer for sale every day. So, each dealer can make a stock of 5 Metric Tonnes to avoid ordering and receiving of apples for the next 10 days.

5.3 Real life situations and Problems

The normal situations are those under which there is no proper separation between the lots of apple are normal, critical, unripe or waste. So in this supply-chain the waste due to lead time for the product to reach the distributers from the producer cannot be handled. The quantity of critical apples in the received inventory will obviously be greater. The major concentration of the profit distribution in the simulation is around the range of B, C, D, E, F because the fruits

cannot be judged with precision regarding their freshness.

5.4 Proposed Enhanced Supply-chain with FRESHO'METER

This is a situation under which any particular lot will be tested thoroughly of their quality and their life of decay before they are to be sent to the distributers in an area.

The profit distribution lies mainly in the range of A, B, C ,D because the fruits can be electronically tested of their longevity and clearly assessed about their condition at the time of dispatch.

The simulation is run for a sample test of 0-25 days from which value based assertion & statics can be drawn like the average daily profit accrued in both the situation. This simulation need to be run with different set of random numbers as many times as possible to obtain some realistic values. This simulation can be run in an excel sheet about 100-400 times to get the average fruit consumption from 3.36 to theoretical 4.5 x.1 MTns.

Table VII: Simulation & Profit Evaluation under Normal conditions.

Simulation Table- I (Normal Circumstance)								
Step	**State**	**State**	**State**	**Input**	**State**	**State**	**Activity**	**State**
Clock **Day**	**Cycle**	**Day within Cycle**	**Beginning Inventory (.1 MTns)**	**Normali-sed Demand**	**Type of Inventory**	**Profit**	**Lead Time (days)**	**Days until Order Arrives**
0	0	7	-	-	C	5	3	3
1	1	1	50	2	D	4		2
2	1	2	46	4	E	3		1
3	1	3	41	2	B	6		
4	1	4	38	0	C	5		
5	1	5	34	2	D	4		
6	1	6	30	3	D	4		
7	1	7	25	6	E	3	2	2
8	2	1	23	0	E	3		1
9	2	2	45	6	C	5		
10	2	3	40	2	C	5		
11	2	4	34	7	C	5		
12	2	5	29	6	D	4		
13	2	6	26	0	D	4		
14	2	7	23	0	D	4	3	3
15	3	1	18	5	E	3		2
16	3	2	13	1	E	3		1
17	3	3	37	7	B	6		
18	3	4	31	3	C	5		
19	3	5	27	7	C	5		
20	3	6	21	2	D	4		
21	3	7	18	2	D	4	2	2
22	4	1	15	7	E	3		1
23	4	2	41	2	C	5		
24	4	3	38	4	D	4		
25	4	4	34	3	D	4		
TOTAL				84		106		
AVERAGE				3.36		**4.24**		

Conclusion

This random simulation can be considered as a backbone for developing path to build the supply-chain for various fruits & vegetables. This is very clear that the normalised profit increases considerably over the use of technology in this system which is around 20% in our case. The main advantage of implementing this system can be avoiding wastage of the fruit or any general food product which get spoiled due to transportation. We can generate dynamic status reports and thus can make qualitative and quantitative decisions regarding the fruit transport like- we can distribute the critical fruits in an area that falls in between the source and destination to maximize profit margins and at the same time minimize the wastage of fruits which would have been spoiled or reached its critical situation in the supply journey itself. The graph in the end describes how the supply-chain management system can make profit out of this FRESHO'METER by smart management of the fruit product maintaining a CAS for real-time demand estimation and dynamic supply tuning.

Table VIII: Simulation & Profit Evaluation after Product set-up conditions

Simulation Table								
Step	**State**	**State**	**State**	**Input**	**State**	**State**	**Activity**	**State**
Clock Day	**Cycle**	**Day within Cycle**	**Beginning Inventory (.1 MTns)**	**Normali-sed Demand**	**Type of Inventory**	**Profit**	**Lead Time (days)**	**Days until Order Arrives**
0	0	7	-	-	B	6	3	3
1	1	1	50	0	B	6		2
2	1	2		2	C	5		1
3	1	3		4	A	7		
4	1	4		2	B	6		
5	1	5		5	B	6		
6	1	6		4	C	5		
7	1	7		0	C	5	2	2
8	2	1		6	D	4		1
9	2	2		2	B	6		
10	2	3		6	C	5		
11	2	4		3	C	5		
12	2	5		1	D	4		
13	2	6		1	D	4		
14	2	7		4	D	4	3	3
15	3	1		5	E	3		2
16	3	2		0	E	3		1
17	3	3		4	A	7		
18	3	4		2	B	6		
19	3	5		5	C	5		
20	3	6		0	C	5		
21	3	7		7	D	4	2	2
22	4	1		2	D	4		1
23	4	2		3	B	6		
24	4	3		6	C	5		
25	4	4		1	C	5		
TOTAL				85		131		
AVERAGE				3.4		**5.24**		

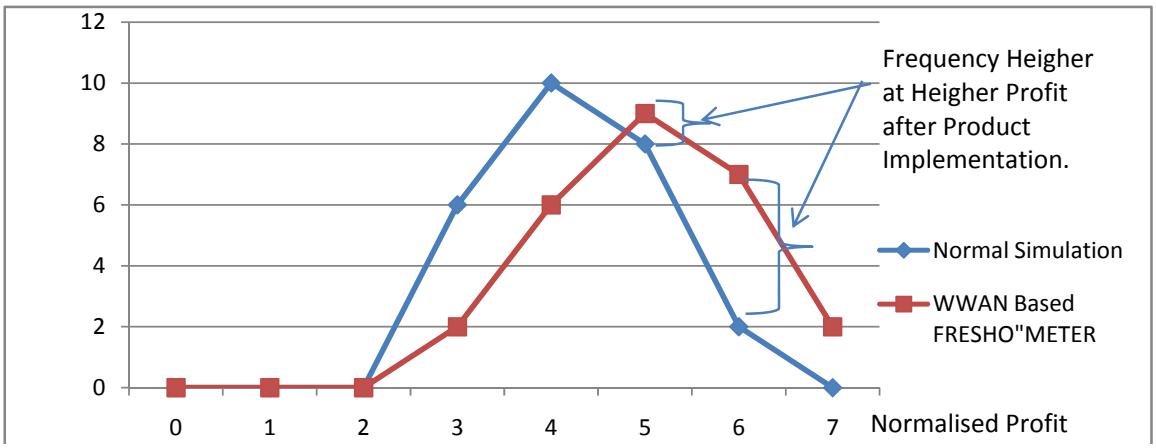


Fig. 5: Simulated Results of improved Supply chain & Hence profits for all the stack holders

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Mobile Applications – A Rural Centric View

Submitted by Alcatel Lucent, India

For TRAI ***National Forum on Mobile Applications for Inclusive Growth and Sustainable Development***

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About Alcatel-Lucent

Alcatel-Lucent is the trusted partner of service providers, enterprises and governments worldwide, provides solutions that deliver voice, data and video communication services to end-users. In December 2008, Alcatel-Lucent announced its strategic transformation to combine the trusted capabilities of the network environment with the creative communications services of the web. A leader in fixed, mobile and converged broadband networking, IP technologies, applications and services, Alcatel-Lucent leverages the unrivalled expertise of Bell Labs, one of the largest innovation powerhouses in the communications industry. The company has operations in more than 130 countries and the most experienced global services organization in the industry.

About Alcatel-Lucent in India

Alcatel-Lucent has been present in India since 1982, and became the first company to manufacture digital switching equipment in the country. Since then, Alcatel-Lucent has been deploying GSM and CDMA infrastructure, 3G, broadband, IP Multimedia Subsystem (IMS), optical and radio transmission, IN platform and applications. Alcatel-Lucent has also been working in enterprise systems and telecom infrastructure projects for railways, defense and aviation. Today, half of India's fixed and CDMA wireless lines are powered by Alcatel-Lucent technology. Alcatel-Lucent has established strategic partnerships in managed services with Reliance communications to manage its pan India wireless network, and with Bharti Airtel to manage and transform its wireline and broadband network. With more than 20 offices and 10,000 employees across sales, customer support, services, software development and R&D, Alcatel Lucent is a major partner in the development of the Indian telecom industry.

Acknowledgement

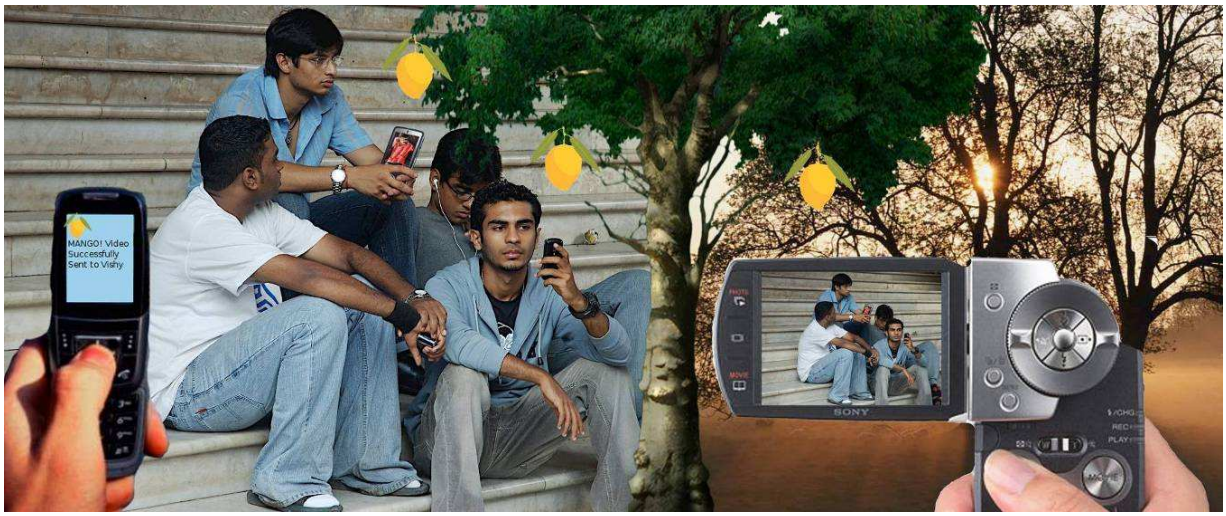
Alcatel-Lucent India takes this opportunity to thank TRAI National Forum for selecting the abstract submitted by us on 10-Feb-2010 and giving us an opportunity to present a full fledged paper on "Mobile applications for inclusive growth and sustainable development"

Telecom services at affordable prices can increase the ability of the rural masses to participate in the market economy which will in turn improve their earnings. Growth of the telecom sector is a critical component of the infrastructure which acts as a catalyst in the entire development process of the country. Telecom connectivity in the rural areas poses a major challenge because of low income and geographical variance across the country.

The telecom revolution unleashed in the last decade is bound to transform the lives of the Indian masses. In spite of adding 10-15 M Mobile subscribers every month there still exists a rural – urban divide. Alcatel Lucent (ALU) along with its research arm Bell Labs is committed to create innovative solutions to bridge this divide.

This paper shares an insight in to the applications like Mango, Mob Sourcing and ground-breaking WiFi based backhaul, VillageNET, which can be used to deliver these applications to India towns and villages where deployment of existing wireless networks are not commercially viable.

Mango: Low-cost, Scalable Solution to Mobile Content

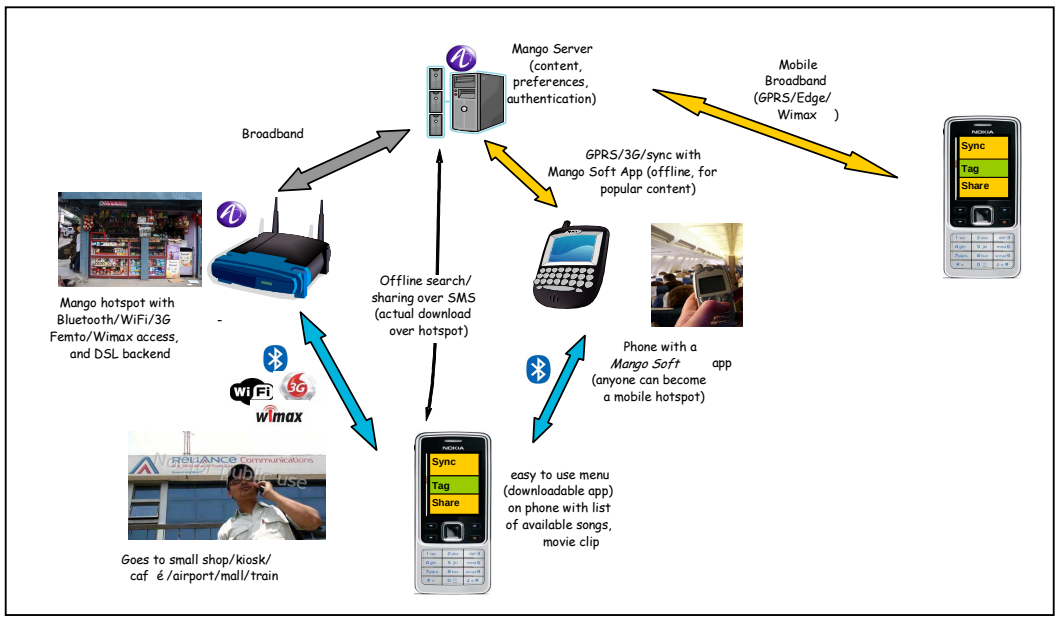


Mango (Mobile Audio-Video-To Go) is an application that enables rich content delivery over Bluetooth to a mobile phone. The basic idea is simple: A user sends an SMS indicating the content s/he would like to download. The required content is then transferred to a nearby Mango device over backhaul (WiMAX, DSL, Microwave or ALU Innovative VillageNET solution), which in turn seamlessly transfers the content to users mobile over Bluetooth, when user comes in the range of Mango hotspot. Similarly, the user generated content can also be uploaded from user mobile to the internet via the Mango hotspot.

The Mango Architecture

The Mango content server collects and stores all mobile content to be downloaded or shared. The Mango hotspot is the base station that caches content at the edge of the network. The hotspot may be an inexpensive access point backhauled with WiMAX, DSL, Microwave or ALU Innovative VillageNET solution. Typical installation locations for Mango hotspots can be small shops, school/college campuses, doctor's offices, railway stations, etc. The Mango hotspot can also be in "soft" mobile form as an application on a mobile device; the mobile device will then act as a store-and-forward relay for content to and from other mobile devices.

Figure below shows the basic Mango architecture:



Services on Mango

Download Personalized Rich Media Content: A user can select content of his choice from a large collection of regional and personalized content; the next time the user is at a Mango hotspot, that content is downloaded to his mobile device. A user can either subscribe to regional content such as news or sports highlights, or a TV serial, where the latest content will be downloaded every time he visits the hotspot. Alternatively, he can view listings of on-demand content, such as latest audio and video songs, movie trailers, etc., and select for download. Notice that the selection of content or subscription changes can also be done sitting in their homes, without going to the Mango hotspot. These listings and the user selection can be updated using **auxiliary low** bandwidth communication interfaces such as SMS or GPRS, since they require minimal data transfers.

Create and Share Personal Content: A user can share their own content such as pictures, audio and video files by uploading it at Mango hotspots. This content is then delivered to the recipients when they visit another Mango hotspot, which in turn uploads data to internet via its backhaul.

Inexpensive Video or Voice Calls: A Mango hotspot can also serve as a "phone booth" to make inexpensive video or voice calls. A user can go to a hotspot and make cheap calls to another user elsewhere. For video calls, he can either use the in-built camera in his phone or could also use a webcam connected to the Mango hotspot.

Soft Mango Hotspot: A user carrying a phone with either wireless connectivity or by frequently visiting Mango hotspots can also act as a virtual mobile Mango hotspot. He can then offer the limited download/upload services listed above to locations where Mango Hotspots are not accessible. The mobile operators need to pay incentives to the users to encourage them to use their handsets as virtual Mango hotspots.

Local advertisements: The Mango network can host a localized yellow-page service, where any user can add advertisements, announcements, offers or reviews about local services such as shops, events, news, etc. These will be listed in the hotspot that he visits and other nearby hotspots. Mango will allow simple creation of text, audio and video yellow page ads which will be displayed at specific hotspots and a simple search/browse interface for users to view these ads.

Mango Apps Store: Rural mass markets users have little awareness of and access to new applications for their mobile devices. Currently the only applications most customers use are those supplied by the operator on the handset or SIM card. New applications can therefore be offered by the Mango hotspot to each user as part of the personalized or localized content for their handsets.

Mango Payment Gateway: Mango hotspots installed in shops can act as secure mobile payment gateways. Thus payments for retail transactions in the shop can be made more convenient by replacing cash with the mobile phone, similar to NFC-based payment systems. Similarly, person-to-person cash transfers can also be enabled with Mango hotspots and their owners acting as intermediary agents.

Content Customization: The owner of a Mango hotspot (who keeps it in his shop/home, etc.) will have access to the content and services listed at his hotspot through a simple interface. This enables him to tailor the content and services at his hotspot according to the needs of the frequent visitors. For example, he could create a few easily accessible packages of locally relevant content. Or offer special calling or money transfer rates during local festivals. We believe that in Indian market with a wide diversity of literacy levels, languages, cultures and interests such customization will play a vital role in both attracting new customers and engaging existing ones.

Conclusion

We find that the Mango solution has the potential to complement and reduce the load on cellular networks by offering a cheaper and more scalable delivery network for rich multimedia content.

Therefore, Mango provides an exciting opportunity to accelerate the uptake of mobile multimedia services in Indian markets.

Mob Sourcing

The mobile handset is clearly the simplest way to reach a large number of users in our country. It also presents a way to reach users in real time, wherever they are. Many mobile phone users have a very limited spending budget, but often have plenty of free time, during which they have access to their mobile phones. They are willing to complete small tasks on their mobile phones in return for small remuneration. For example, idle users may be willing to write local reviews, complete user surveys distributed by consumer businesses, test out new mobile apps on their handsets, respond to queries for local services, etc.

However, any third-party (over-the-top) mobile mob sourcing provider faces several big challenges. A truly scalable mobile service must work on even the most basic handsets owned by lower-end users. At the same time, it must work seamlessly with little installation or usage complexity. Further, reaching these users (making them aware of the service) is another big challenge for any third-party mobile mob sourcing service. Automatically finding their location and presence information is a further hurdle for over-the-top mobile providers. Finally, the service must incur very little network overheads to keep the service profitable.

A Crowd sourcing solution needs to efficiently combine the following goals:

- Reaching a large number of diverse users (especially low-end users), spread over large geographical areas across the country
- Selecting users with a given profile (age, gender, rural vs. urban, spending patterns)
- Either knowing when they are free and where they are located, or allowing them to complete tasks anywhere and anytime using just their mobile phones
- Seamlessly sending them crowd-sourced tasks and collecting the results with low overheads on the mobile network
- Reaching out to users in real-time when necessary
- Making the tasks very simple to install and complete, as well as seamlessly paying the users (even un-banked users) for their work.
- Making it very simple to design new tasks that will work efficiently on diverse mobile platforms
- Have a convenient way to pay users, including un-banked users

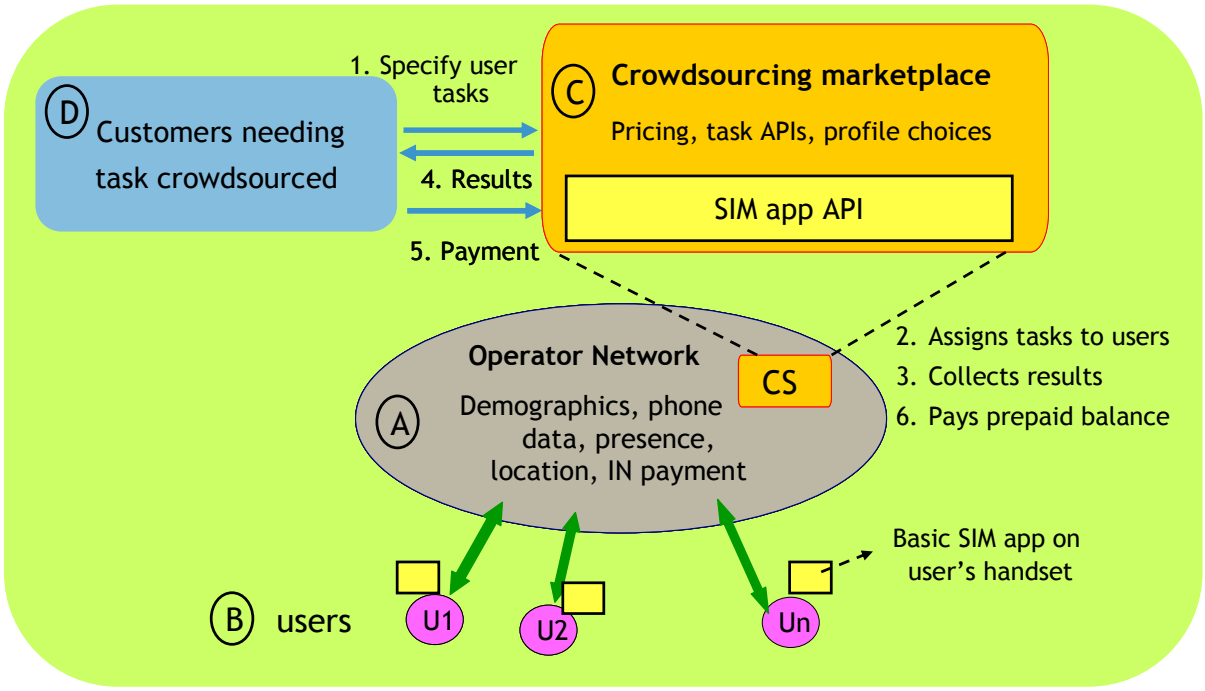
ALU Mob Sourcing is an efficient and easy-to-use mobile crowd-sourcing service for emerging markets. This application allows businesses or individuals to submit tasks and surveys, which are framed out to mobile subscribers to complete over their mobile phones, in return for small payments.

The technology behind the Mob Sourcing application is rather simple. The Mob Sourcing platform sits inside an operator's network, and combines several enablers from the operator's network

such as user demographics, location, presence, preferences, and spending patterns. This allows operators to allocate specifics tasks/surveys to a large number of geographically distributed workers of any specific demographic or profile.
Once the task is completed, the platform uses the operator's payment gateway to make micro-payments to mobile users ("workers" or “task-doers”) in the form of prepaid balance in return for their work.

System Architecture

The following block diagram illustrates ALU Mob Sourcing architecture:



The core entities in this system are:

A. Mobile operator’s network
B. Mobile operator’s subscribers
C. New infrastructure added either to the operator’s network or just above it, for creating a mob sourcing marketplace
D. The customers of the new mob sourcing service

The new mob sourcing marketplace provides the following enablers its customers:

Task specification API: This API allows the customers to specify the task to be crowd sourced in a very simple, high-level manner. This enabler allows the customer to focus on the content of the task rather than the way it is presented to the user, or the way results are collected, etc. The API allows for customization of simple menu-based interfaces, multimedia interfaces such as audio, video, and text to communicate with the users, what medium to send tasks or replies (e.g., SMS, MMS, USSD, GPRS, and IVR), specification of deadlines for completion, ways of collating results of the task, etc. For example, a taxi finder service provided by a business (or the operator) can allow users to specify how soon they want the results, whether to return the 3 best replies, etc.

User profile: This enabler allows the customer to precisely specify what type of users must complete the tasks, and how many. For example, a clothing business may be interested in finding fabric and fashion preferences of smaller town women in the 18-27 age group. Or a consumer company may launch a crowd-judged ad jingle contest among rural users.

Pricing: As an online marketplace, the mob sourcing service will allow the customers to specify how much they are willing to spend on their tasks. Optionally it can allow the customer to specify auction parameters so that users can bid to complete tasks.

Services offered using the Mob sourcing -

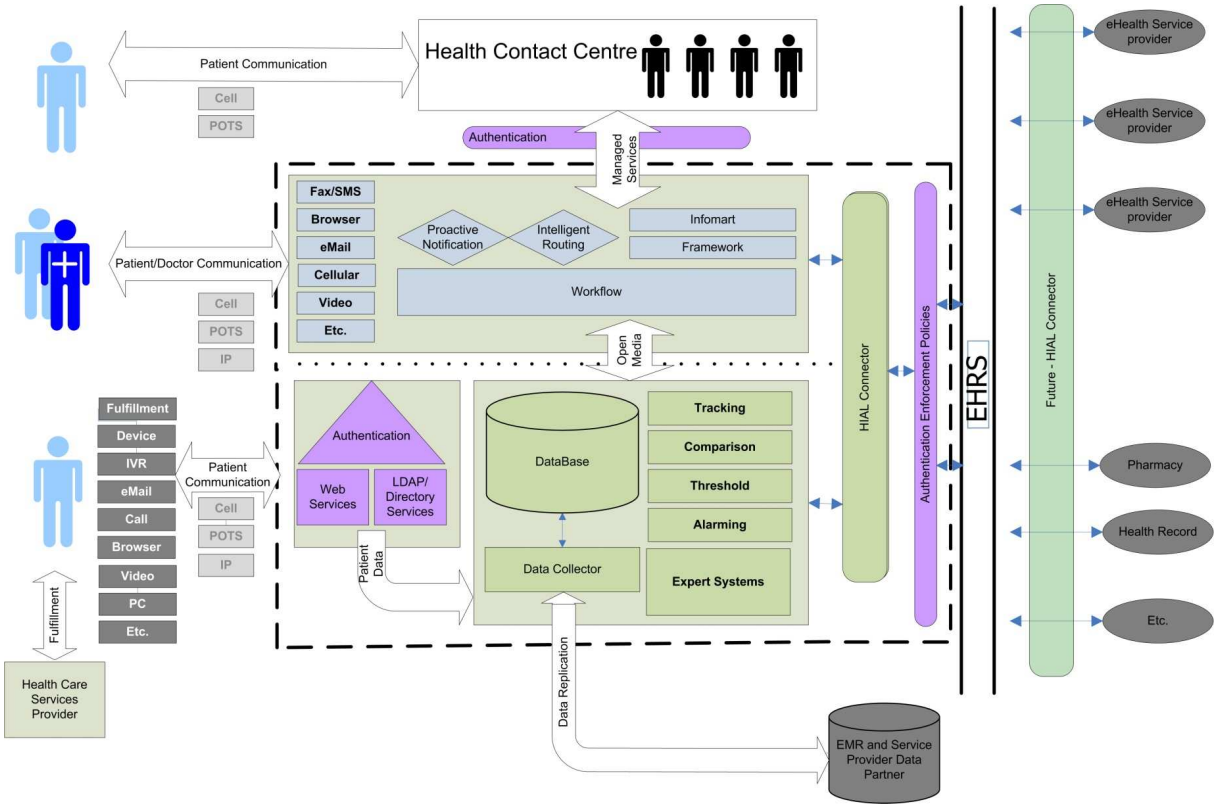
- **Mobile app testing**: A mobile app store can test out newly submitted mobile apps on a variety of mobile phones, and can test localized versions in a variety of languages. Testing for usability can be explicitly carried out by the selected users, while impact of app on the network and the phone can be measured passively by the base mob sourcing SIM app on the phone.
- **Real-time service locator:** Consumers can locate nearby businesses (taxis, plumbers, etc) by sending a query to the mob sourcing system. This query is forwarded to multiple nearby users through their mobile phones who reply with their proposed price; best replies are forwarded to the consumer.
- **Local Information finder:** Someone can query for real-time advice (e.g. on local shopping options or services) or current traffic conditions on a certain route. The mob sourcing system would forward query to phones only in relevant locations, and quickly collect and combine answers and send to requesting party.
- **Rural consumer survey:** Since the mobile network is increasingly reaching rural users, surveying a sizable number of widely distributed rural users can be most cost-effective over mobile phones. Simple audio based APIs for tasks or surveys may work best in many cases.

Conclusion

Mobile Sourcing Solution is expected to be popular with the large middle and lower income segment as well as the young student population in India who have some spare time and are looking forward to earn some money.

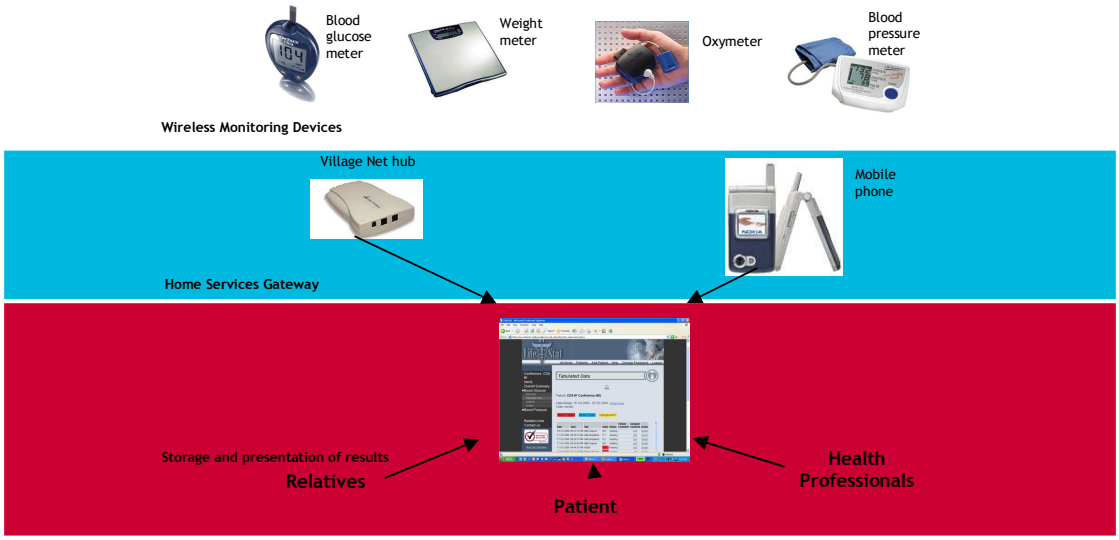
Tele-Medicine

According to the recent National Rural Health Mission report nearly 8% Primary Health Care (PHC) do not have a doctor while nearly 39% were running without a lab technician and about 17.7% without a pharmacist. The PHCs are supposed to be staffed by one medical officer supported by paramedical staff.



ALU Remote Patient Monitoring system is a suit of health monitoring products and applications to provide health facilities to those rural masses that do not have access to PHCs. It is envisioned that ALU Tele-Medicine kit will be installed in PHC which are not adequately staffed. A patient walks into such a PHC where a medical assistant straps the Tele-Medicine devices on. These devices take readings like the blood glucose, blood pressure, etc., as they normally would. The readings are then automatically transmitted to a central server in a city hospital using Bluetooth wireless technology in conjunction with a regular mobile phone. All personal information and health records are stored safely and securely in data storage facility. The doctors in the city hospital are able to view the readings and instruct the medical assistant to take necessary interventions. Tele-Medicine server also provides event or time based alerts to mobile devices.

Key Components



The list of elements entering in the solution is as follows.

On user side:

- Monitoring devices: to capture health information of patients
- Mobile phones: currently supported are Nokia, Blackberry, Windows Mobile
- Home access point: to ensure the conversion of Bluetooth into PSTN/DTMF.

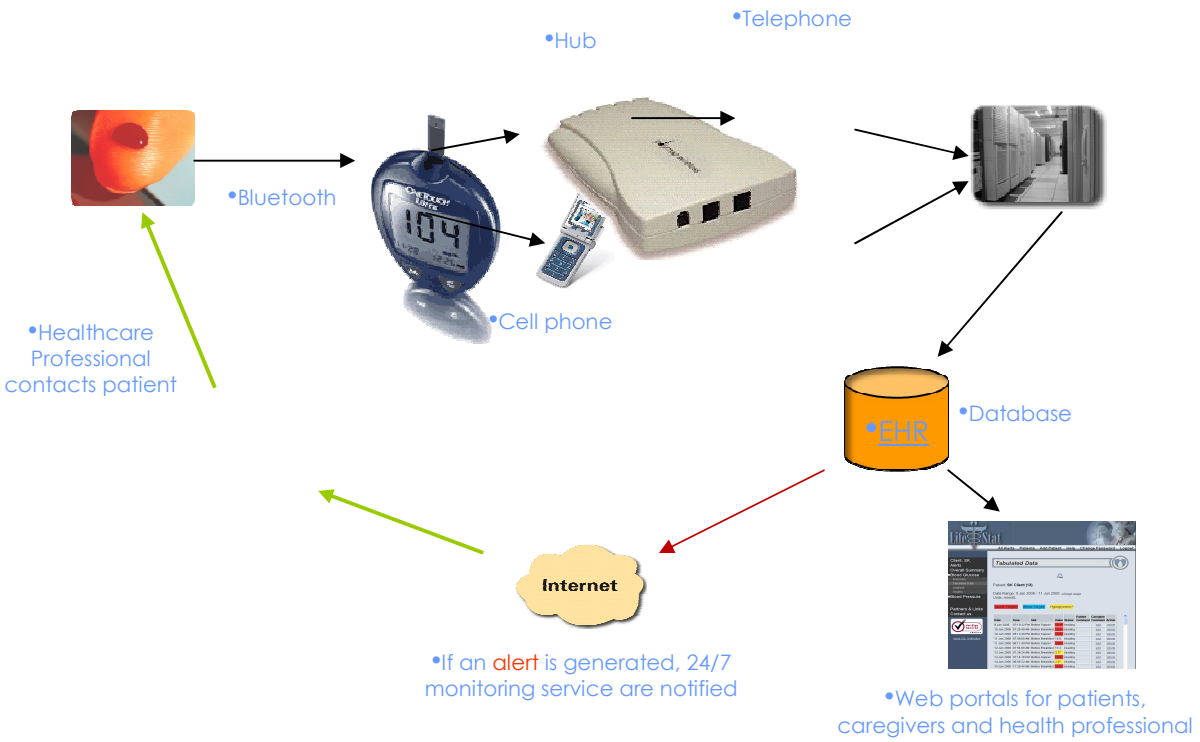
On back-office side:

- ALU server: will host the whole application to capture and store data, expose these thru a portal, trigger alerts if some thresholds are reached, define the medical protocols to be followed by the patient, etc.
- An IVR (ALU) for patient using the solution from home, to complete the call, as the IVR will call back the patient to acknowledge reception of data and ask contextual questions such as, after a glucose check: “was the measure taken before or after a meal?”

On care-giver side:

- Agents (usually nurses) will have a position to access patient data and tools to call back patients or take calls from patients, routed by the system,
- The doctors may follow their patient thru a standard internet access from any personal computer.

Data Flow



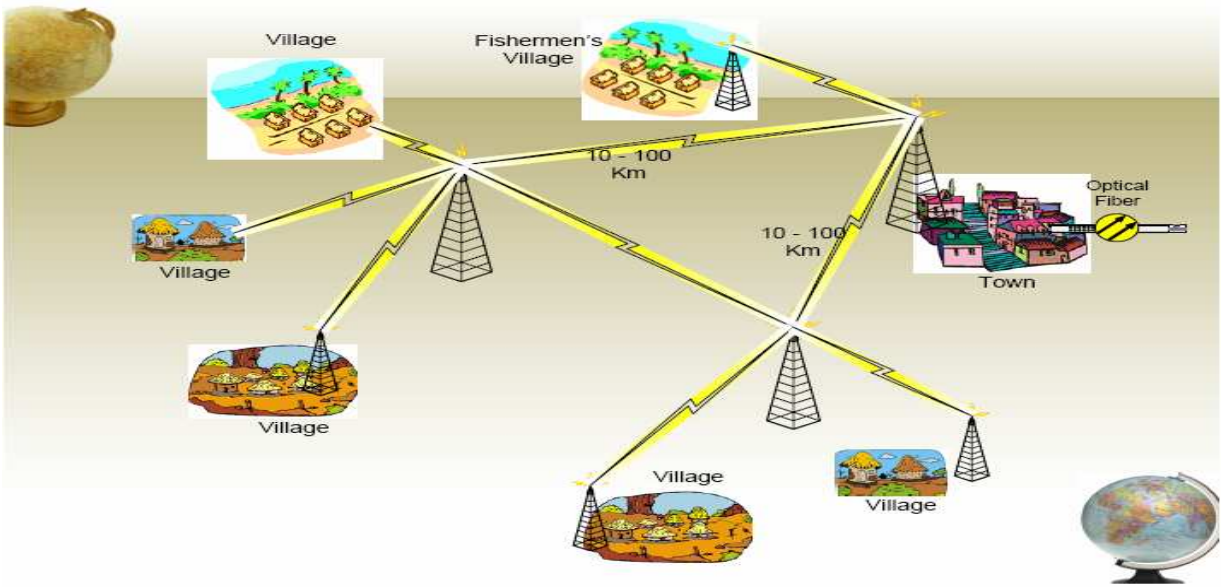
Conclusion

Remote Patient Monitoring capability enables remote health care professionals to take informed health care decisions and timely interventions based on accurate information at a low cost. This solution from, Alcatel-Lucent enables the critical link between "tele" and "care", associating:

- a strong end-to-end technical solution,
- domain credibility brought by medical institutions,
- Alcatel-Lucent business intimacy with telecom service providers.

This eco-system is urgently required to fill the every increasing shortage of qualified medical professionals in rural and remote landscape.

VillageNet: WiFi Based Backhaul



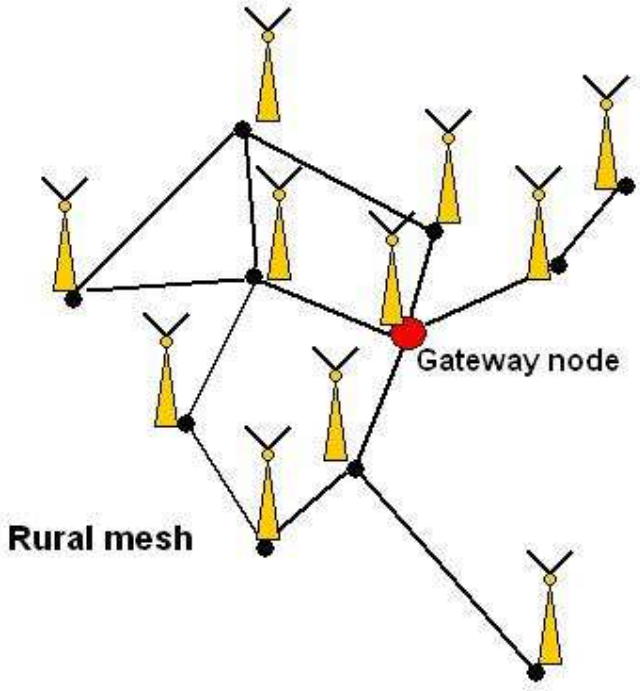
The most important pre-requisite for any ICT applications for rural masses is the availability of data networks in those regions. Traditional approaches in the realm of wireline technologies are either too expensive (laying optical fiber) or technically in-feasible (DSL cannot go longer than 3-4Kms). Wireless data technologies such as cellular 2.5G and 3G, and also WiMAX are also feasible options, but the cost of network is prohibitively expensive.

In India, internet connectivity extended until the level of a taluk headquarters. The problem is to extend Internet connectivity from a taluk headquarters to the nearby villages over a distance of around 10 - 20Kms in an inexpensive manner. VillageNet is a low-cost; WiFi based long distance mesh networking technology designed to provide broadband connectivity between the taluk headquarters and these remote villages.

VillageNet is based on IEEE 802.11 WiFi technology. Given the commoditized nature of this technology, WiFi radios are available at very low-costs (~ USD 50). Using low-cost antennas, and computing equipment, the entire communication equipment at a location can be put together for a few hundred dollars. Also, WiFi is a broadband wireless technology, and link speeds of between 7-12Mbps are achievable. We discuss the details of architecture and benefits of the VillageNET solution from Alcatel-Lucent.

Architecture

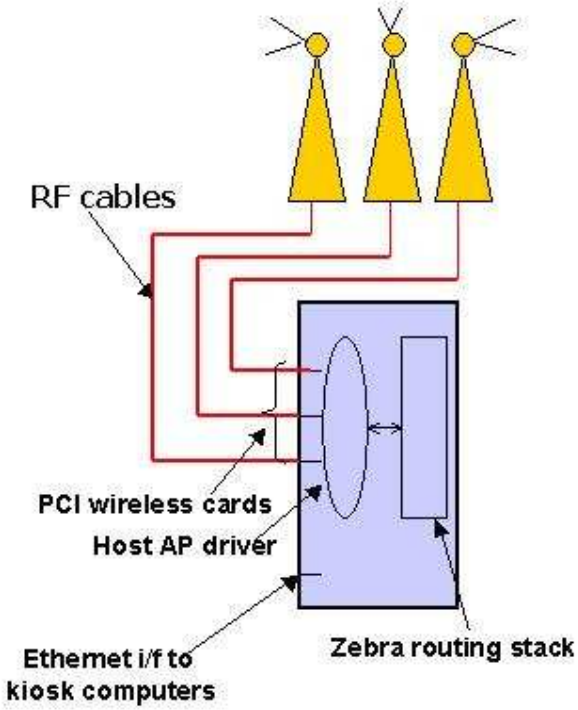
Assuming that that a taluk has a high-bandwidth connection to the Internet, we now describe how the villages surrounding the taluk can be connected using an IEEE 802.11 based long-distance mesh network. Nodes in this mesh network will be the villages and the taluk (termed the *gateway* node), will be the entry and exit point for all traffic in the mesh. As depicted in figure1, nodes would connect to each other through point-to-point wireless links. Some village nodes will connect directly to the taluk, and other nodes will connect to the gateway node (and thus, to the rest of the internet) through one or more hops in the mesh. The distance of a village-village link can be of the order of 10-15 Kms. In order for the signal to traverse this distance, high-gain directional antennas are used at the end-points of a link. The antennas are mounted on towers to establish line of sight.



Directional antenna

Given this network-wide view of a VillageNet network, let us now consider the architecture of a single node in the network. We envisage the communication facilities in a village to initially be a shared resource. A village *kiosk* would house the computing equipment that will be offer the various services of use in the village. The kiosk will also house the *MeshNode* — the 802.11 wireless communication equipment and the protocols running on it. A MeshNode will be an inexpensive Linux-based PC. An 802.11 radio will be associated with each point-point link adjacent on a village node. This radio will be an inexpensive PCI or PCMCIA WiFi card, running open source drivers and routing stacks.

The figure below shows the architecture of the mesh node:



These 802.11 radios will connect to the directional antenna mounted on a tower via RF cables; and an Ethernet interface will route traffic destined for the local node to the kiosk computer.

Conclusion

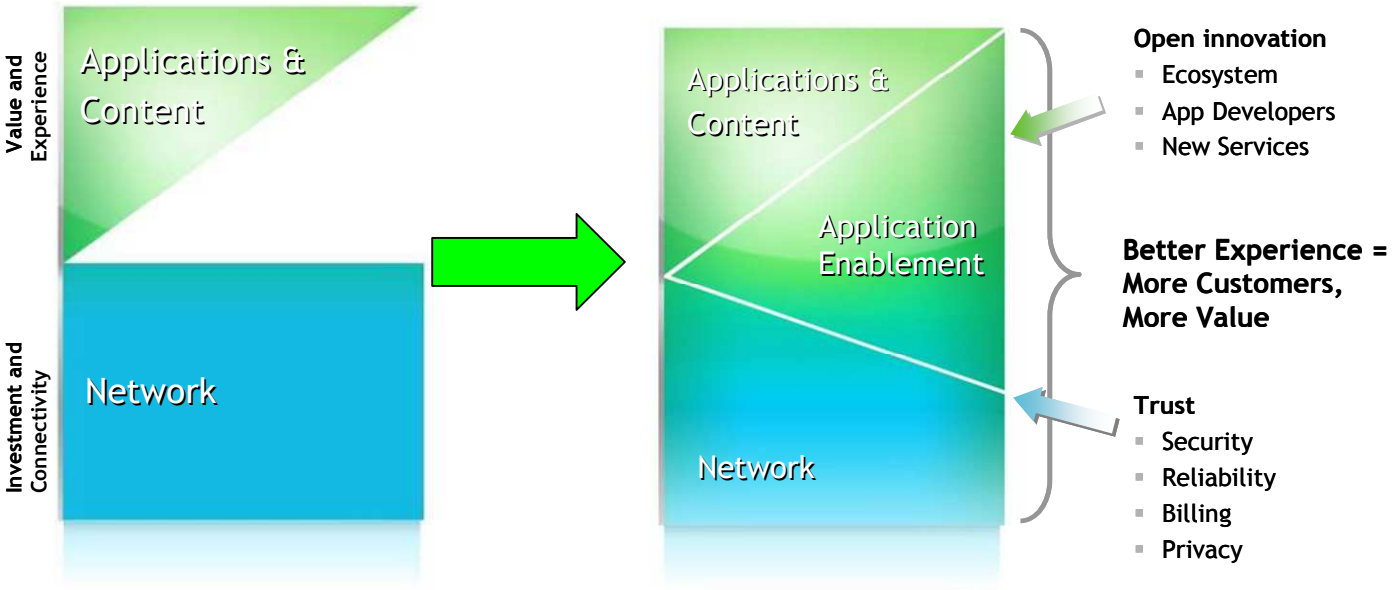
The key benefits of VillageNET solution are:

- Low-cost, high performance mesh architecture to provide broadband access to villages
- Provides a low risk (low-cost) entry point for operators, in rural regions
- Algorithms/architecture applicable in other domains:
  - WiMAX point-point mesh for cellular backhaul
  - Muni WiFi mesh backhaul
- Enable applications such as telemedicine, distance education, weather/crop info, e-governance etc.

Based on our experience, we consider it a very promising low-cost, low-risk approach to provide broadband connectivity to rural areas

Alcatel-Lucent Thought leadership in Applications Enablement

Application enablement is an industry vision and network approach that combines the trusted capabilities of network operators and the speed and innovation of the web to provide end users and enterprises what they demand: a richer and more trusted web experience and beyond. We present you with this vision.

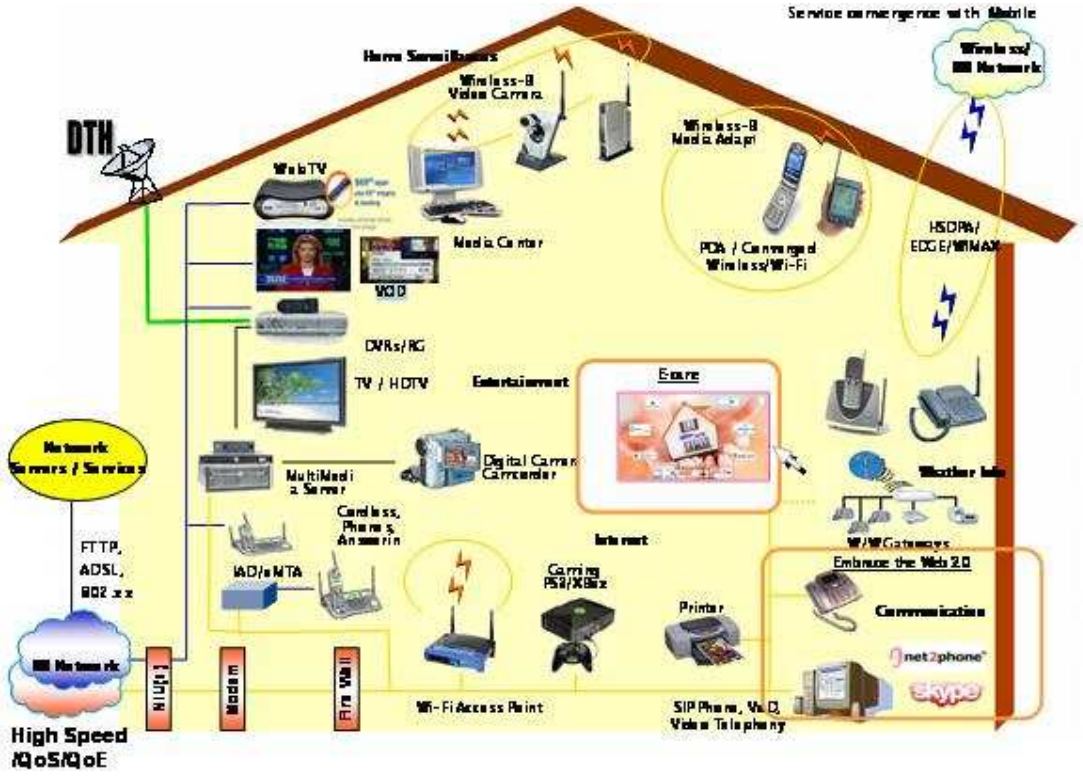


Application enablement is based on the combination of the best of content & network. Application & content providers bring their strong ecosystems of hundreds of thousands of application developers who innovate and develop new services very quickly and the end user benefits.

The end users simply put, want a better experience. What is that experience? Let's look at 3 audiences and identify the drivers of a better experience.

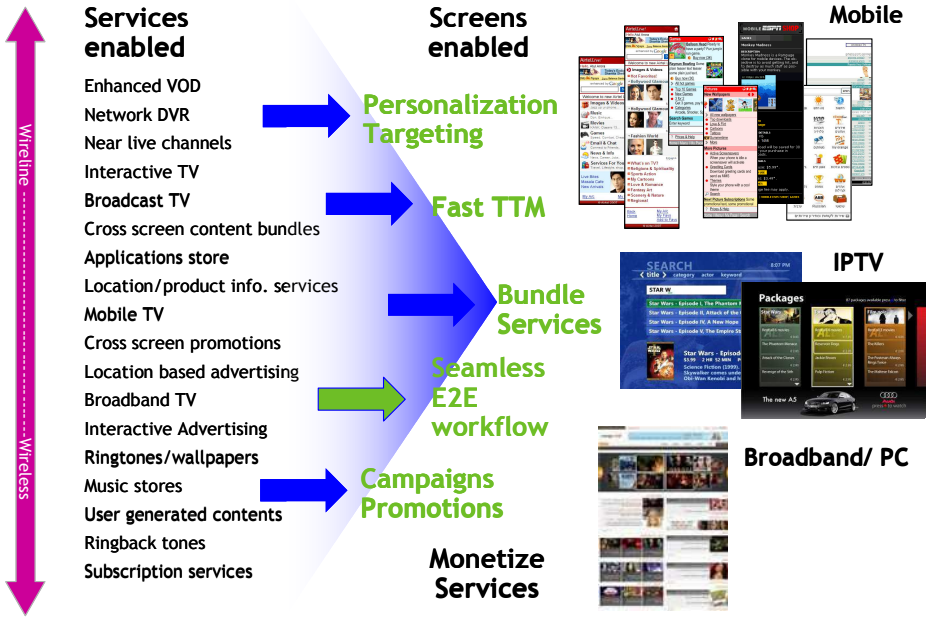
First the Consumer End User: While there are many consumer segments and demographics, from the young generation to the seniors to rural masses, there is one consistency and that is the ability to find, connect, and interact with the people and the brands they love, or the generation in the workforce that wants to connect with Facebook friends, or the senior who just wants to connect with their grand-children that are too far away for physical travel. These end users don't care about technology; they just want the interactions to be intuitive and quality transactions through whatever device they might currently be using. They don't want to try to figure out network settings or capabilities. And they want it in a way that protects them, their information, and their loved ones.

Enterprise End User: The enterprise end users who are also consumer in their home want the best of both worlds. They want the services and capabilities that they get at home, when they are in the office or on the go. The masses who have started to enter the workforce, especially want to "monetize their IT" and drive business results with the Web 2.0 tools they use at home. The enterprise end users also want real time contextual communications. If their Outlook shows 'out of the office', their calls should route to their mobiles. This enhances their availability and productivity with colleagues and customers.



Business/IT Management: The final audiences with unmet needs are the business and IT management people. They manage the network which represents a cost that they need help controlling. They must deliver services to end users wherever they are, in the office, on the road, or at home.

Application and content providers is a space where participants/players run various applications and services, many of which are Web 2.0 centric and targeted at the Digital Youth or the Millennial. This is the generation that grew up with the internet, broadband, mobile phones and the like and wants that particular application to be enabled across multiple screens, Mobile, PC and TV



They are willing to experience the virtual/digital world and transact, search, share, store, and manage the things they care about using technology. These people have also grown up in a world of freeconomics where much of what they consume digitally is free to them, and is sponsored by a third party such as an advertiser. This model would be terrific, if it weren't for the capital intensive networks required to support these capabilities.

Networks on the other hand are capital intensive. To serve a subscriber, you need high speed connectivity – both wired and wireless – everywhere. To build a network with that kind of scale, performance and reliability requires capital. As long as average revenue per user (ARPU) was climbing at a rate that was in line with the investment required to build the network to support the subscriber, things were good. Web 2.0 business models have punctured the equilibrium of this model and we find ourselves in a place where traffic is growing 1000% for some customers, but revenues are only growing at a fraction of that rate.

This is an unstable model as the network and the applications and content space touch at only a small point. This is because the amount of value passed between the two is minimal and can "fit on a dumb pipe". The network provider gets limited monetary compensation for their assets and support, and the application & content providers have restricted access to network capabilities that could strengthen their relationship with the end user – capabilities such as location, presence, QoS, security, etc.

Application and content providers need to, and can, capture more customers with a service that is enabled with key network capabilities and trusted assets. If only there were a way to broaden the "channel" and pass more value between the two areas in a way that was fair to all parties, stability would be achieved, but more importantly the ability to satisfy the end user would be realized and that would grow the pie for everyone.

In summary, application enablement allows network providers to provide a richer web experience on a scale of billions of end users (the actual masses) and millions of enterprises.

Final Conclusion

The combination of technology improvements and new applications will make rural Information & Communication technology (ICT) in India a self sustainable profitable business. Alcatel Lucent is committed to the spread of ICT in rural India and will partner with operators to achieve the ICT targets sets by government of India.

Mobiles, Income and Utility: A Methodological Assessment of m4D

For

National Forum on Mobile Applications for Inclusive Growth and Sustainable Development

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Abstract

Among all information and communication technologies (ICTs), only mobile phones have become ubiquitous even in the poorer nations. "Mobiles for development (m4D)" has hence started to capture the interests of researchers and policymakers. However, empirical evidence of wealth generation has been sparse. This paper, continuing from *Deconstructing ICT4D* (Chaudhuri, 2009), addresses two questions which can help policymakers in assessing m4D projects on the drawing boards. First, why did mobile phones, but not other ICTs, become so ubiquitous? Second, in what ways can the success of mobile applications be calculated? We need to better understand the interplay of technology and social needs in order to maximize the returns from mobile phones.

Keywords: ICT4D, mobile phones, emerging technologies, development

Questions & comments at achaudhuri@iimcal.ac.in

Mobiles, Income and Utility: A Methodological Assessment of m4D

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1 Introduction

Mobile phones represent the single biggest lifestyle transformation for the world population. In developed countries, they have already replaced landlines as the medium of choice for personal communication. In poorer nations, with historically very low levels of wireline penetration, they have emerged as the *de facto* communication channel for most people. In India, for example, out of 509.03 total telephone subscriptions in September 2009, 471.73 were wireless (TRAI, 2010). The adoption of mobile technologies has been unforeseen and phenomenal.[1] So much so, that wireline communication has become relegated to niche usage in established businesses or, in the case of DSL, as backbone for providing Internet service.

Two features of the upsurge in mobile technologies have caught the attention of development researchers and policymakers. The first is the sheer speed of the diffusion, which has made mobile phones ubiquitous. The second is the flexible nature of mobile platforms. They have become the Swiss Army knives of communication technologies, integrating camera functionality, audio-video capabilities, Internet connectivity, and can support a plethora of applications and value added services (VASs). Taken in combination, these two aspects open up possibilities which have not yet been explored by governments, particularly in developing countries.

"Mobiles for development (m4D)" is gaining currency in policy circles of late. It constitutes a sub-domain of the broader field of information and communication technologies for development (ICT4D). The logic is that these newer technologies offer the scope and capacity to resource strapped nations to leapfrog over historically determined socio-economic barriers. One important fact that is often overlooked is that "ICT" is a broad generalization. Computers, the Internet and mobile phones do not have identical technological, financial and social dynamics. More importantly, these dynamics can be different across countries and cultures. In fact, the diffusion of these technologies has followed very different paths across different countries. There is the very real possibility that excessive generalization can hence be misleading, and ICT4D strategies which may be effective in one setting may not be so in another. This is perhaps one of the main reasons why such strategies generally are not scalable or transferable, but instead remain confined to being localized and small scale. This begs the questions as to why the adoption patterns of the technologies are different, and how that understanding can be put to use in development strategies.

Chaudhuri(2009) analyzed ICT4D through a macro lens, speculating on the contributions of ICTs on the national incomes of poorer nations. It concluded ICTs could have a positive impact on economic growth if and only if countries were blessed with a very restrictive set of characteristics such as large internal markets, deep pools of technical capital and, in the case of hardware, good infrastructure. Since most poor countries do not satisfy these conditions, it theorized that the prospects of ICT-driven growth were slim for all but a handful of nations.

One additional key point of Chaudhuri (2009) was that because of the heterogeneity of the technologies collectively branded as ICTs, analyzing them *en masse* is misleading. Taken in conjunction with the low probability of macro returns of ICTs, this means that sectoral analysis of

[1] This paper uses the phrases "mobile technologies" simplistically, though in fact there are competing standards which can be technically incompatible. Broadly speaking, global system for mobiles (GSM) is dominates in most parts of the world, including India and Europe. This is a somewhat older technology, with the new challenger being code division multiple access (CDMA). This has the advantage of being excellent for data transfer, and is understandably popular in countries with sophisticated usage patterns like Korea and Japan. The US is the only market which is evenly split between GSM and CDMA. The point to be noted that even these standards are evolving, and there seems to be some sort of a consolidation happening in the standards. For an excellent discussion, see Gruber (2008).

individual technologies could generate better insight. This current research narrows the focus from ICTs to mobiles, and attempts to lay out our current state of understanding in this field and to pinpoint the gaps in knowledge.

2 Mobiles in the Context of ICTs

In strategizing about using emerging information technologies for country development policies, we have to make assessments at two levels. At the primary level, we have to understand and distinguish between the growth paths of the different technologies which are collectively known as "ICTs". At the secondary level, we have to explore and map the sets of characteristics which generate the path differences to appropriate policy situations. An easy way to appreciate this would be to simply note the financial resources necessary by their respective end-users. Mobile phone handset prices and service charges have suffered precipitous declines around the world, making them affordable to all but the poorest of the poor. That is not so for computers or the Internet. Mobiles, as can be computers, are stand-alone devices, whereas the Internet requires hardware capabilities (computers) as well as communication channels (phone lines, cellular networks or fiber-optic cables). Computers and the Internet require uninterrupted supply of electricity, which is a concern in most developing countries, but is not a factor for the usage of mobile phones as long as their batteries can be recharged periodically.

Fig.1 shows boxplots of worldwide adoption, as percentages of country-populations, of mobile phones, computers and the Internet over time. The overall patterns are clearly different. A few points are immediately apparent. First and most obvious, the speed of adoption of mobiles is clearly the greatest among all the ICTs. Second, the level of penetration is much greater as well, as is apparent from the median values marked in the plots. But the most important insight - from the perspective of development - is the fact that the adoption process appears to have been highly uniform. The plots for computers and the Internet are characterized by having both low mean values and, paradoxically, a host of high outliers. This implies that their distribution in the world is highly skewed. The case for mobiles is just the opposite, with the number of outliers *decreasing* over time.

[Figure 1]

Fig.2 highlights this point very effectively for the case of mobiles and computers. The left panel shows the sharper increase in mobile penetration vis-à-vis computers. The right panel shows the evolution of skewness of the world distributions of the two technologies over time. The skewness for computers has increased, albeit very slightly, from 0.29 to 0.97 from 1988 to 2008. Mobiles, on the other hand, have seen a sharp decrease in skewness in the same period, from 2.27 to 0.08. This is a powerful statement on how inclusive, as a technology, mobile phones have become over the span of a few years.

[Figure 2]

2.1 What Drives Mobile Markets?

In order to understand the evolution of mobile markets, we need to first identify the constituents of the markets. Apart from the service providers and consumer who define the two ends, communication markets (including those for mobiles) are peculiar in being highly regulated. Communication services, even wireline plain old telephone service (POTS), are defined by very high returns to scale from enormous fixed costs and low marginal costs.[2] This is the principal reason why operators are wary of expanding operations into low-income or rural areas which do not have assurances of high

[2] A slightly dated, but otherwise excellent reference is Brock (1998)

returns. Developing countries have historically suffered from poor connectivity partly because of the extreme difficulty in recouping sunk costs in all but the most high-income areas. Fig.3 shows that residential fixed lines appear to have peaked globally and is now on a diminishing trend. More strikingly, this is true even for countries in the lowest income quartile. In this segment, fixed lines are declining rapidly even before touching a respectable peak.

[Figure 3]

It is true that mobile phones services are also very much prone to scale economies. But there are key characteristic differences between landline and mobile technologies. The former has attained technological maturity, and consists essentially of a single product (telephone) for a single service (voice communication).[3] Mobile handsets, as mentioned earlier, can be perceived as platforms, and voice is just one of the functions or services which can be supported by them. Historically the principal problem of wireline markets has been balancing efficiency with monopoly powers of incumbents, while the major regulatory issue in wireless is the allocation of scarce spectrum. Thus, superficially, the operational economics of wireline and mobile markets would otherwise appear to be very different

The above simplified view takes into consideration only the supply side of the market, without explaining the drivers of demand. Why do people sign up for mobile services - voice, data and VASs? In developed markets, mobiles phones have evolved far beyond simple voice communication. That is not the case for the poorer countries in general. This can be logically deduced from two facts. First, hardware availability across countries always permeates down the income scale. This means that applications running on the "typical" phone in a poor country are more limited than those in a developed nation. Second, higher purchasing powers of consumers in richer countries almost certainly means that communication services would generate a lower proportion of total revenues than in poorer nations.

For analyzing the structure of the demand sides of mobile markets, the most logical course of action would be to identify the sources of revenue. It seems logical to presume that the less developed a national communications market, the larger would be the revenue share of basic services in proportion to VASs. IAMR (2008), for example, states that only 9% of operating revenues of Indian companies were generated through VASs in June 2008. At a more granular level, it presents a more striking picture. The single biggest component of this 9% is short messaging service (SMS), which is simply another form of communication, constituting 53%. Leaving aside the 40% generated through ringtone downloads, more than 90% or revenues are generated through communication - voice and text.

A major problem in conducting a bird's-eye analysis of mobile markets globally is the paucity of clean and comparable data from different countries. I use data from ITU (2009) to test the effect of wireline services - or their absence - on the evolution of national mobile markets. Mobile density (per 100 people) is modeled as an additive non-linear function of three sets of factors. The first set consists of price variables describing wireline and wireless services to capture the own- and cross-price elasticities. Computer and Internet penetration are included in the second set, as proxies for an overall "network-externality for information." The final set is constituted by a single variable, wireline teledensity. National incomes and dummies for countries and years are included as controls.

Though cross-country regressions have their pitfalls (See Durlauf, 2001), a number of ideas take shape when glancing at Table 1. Mobile phones display high own- and cross-price elasticities, the former being appropriately negative and the latter positive. Incidentally, they appear to be sensitive to connection charges as well, but the effect is less pronounced for own- and statistically not significant for wireline-charges. Second, even controlling for income, computer and Internet

[3] In the absence of concrete data, there is some ambiguity in this. In the US, AT&T had for a time attempted to promote video calling, but the service had never become popular (See: http://www.corp.att.com/attlabs/reputation/timeline/70picture.html). At present, much of the Internet traffic reaches home-consumers around the world through variants of digital subscriber lines (xDSL). It is possible that this traffic is worth more to service providers than voice-traffic. On the other hand, xDSL lines, though riding on telephone copper, are dedicated for data. A further disclaimer is the general shift of the industry, at least in the developed nations, towards the use of optic fiber for data, effectively bypassing the telephone networks completely.

penetrations have very powerful effects, which lends credence to a hypothesis of information-driven diffusion. The most striking effect is that of wireline density. At low levels of wireline penetration, the effect is highly negative and significant, implying that below a certain inflexion point, the lower the wireline penetration, the higher the mobile penetration. This is the picture which precisely describes developing countries.

[Table 1]

This is the key insight about the popularity of mobile phones in poor nations, relative to other ICTs. They are cheap communication devices first and foremost. Undoubtedly the principal reason behind their unforeseeably rapid adoption in the developing countries is the historically poor state of their wireline communication networks. Landline connections were expensive, unreliable, and almost impossible to get hold of because of the apathetic mindsets of state-owned monopolistic telephone bureaucracies. Thus, the newer, cheap, easy to acquire, handheld talking devices filled a basic need which was simply not being met in the pre-existing setup. Computers - and by extension, the Internet - offer a completely different set of technical capabilities. Talking is a basic characteristic of human nature; computing must primarily fit an occupation. Because of the disproportionately high upfront cost, the purchase of a computer below a certain threshold income level must be regarded primarily as an investment (whose returns have to be positive though not necessarily financial in the immediate sense) and less as an entertainment center. It is easy to see why the average person would rank mobiles above computers and the Internet.

2.2 m4D: Needs Assessment and Impact Evaluation

The ubiquity of mobile phones and their platform-nature have, paradoxically, clouded the issue of their applicability to development. The defining characteristics of handsets- small form factor, low operating cost and power requirements, and of course, mobility - make them suitable for cheap, distributed communication. The emerging and potentially transformational phenomenon of convergence, i.e. the same function over multiple platforms, and the same platform handling multiple applications, adds an additional layer of complexity and potential. Mobile banking, commerce, governance, and distributed health services - all could be on the horizon. There is the even the possibility that once 3G becomes mainstream, people in rural or otherwise remote areas who do not have access to wireline broadband could simply bypass this infrastructural bottleneck and get online with their mobile handsets. Even at present, GSM or CDMA mobile phone could presumably act as general packet radio service (GPRS) or evolution data optimized (EVDO) Internet gateways, or simply as wireless modems to connect computers to when the need arose.

The possible contribution of mobile phones to economic development have at least three dimensions, each of which need to be addressed separately. The first and foremost question is whether they increase income, and if so, by what mechanism? Second, whether or not they increase income, in what ways can they be useful? Third, in what situations should policymakers push it as the platform of choice?

The field of m4D, notwithstanding the excitement and optimism which surround it at present, has to address this fundamental question - do mobile phones generate wealth? From a national income accounting perspective, the answer should be unambiguously affirmative. Whenever someone buys a new handset, makes a voice call, sends an SMS or downloads a ringtone, domestic wealth increases by a multiple of the call charge, texting tariff, or the price of the ringtone. This bean-counter interpretation is of little interest to the policy analyst. By this measure, rolls of toilet paper, produced in high enough volumes, would be just as beneficial to national income. The relevant question is whether mobile phones add value over and above their own value, and through what process. Research which support and explain the catalytic effect of mobile phone at the macro level do not exist. The only two exceptions are Waverman, Meschi and Fuss (2005) and Kathuria, Uppal and Mamta (2009). Apart from the simplistic analyses presented in them, the fact that both were sponsored by Vodafone takes away from their air of objectivity somewhat.

It is not surprising that a possible wealth effect at the macro level has not been captured beyond reasonable doubt. Mobiles are a relatively new technology, and parsing out its impact

from high levels of noise in economic data can be difficult. But the user-level effect, if no less difficult to quantify, is at least easier to justify logically. Mobile phones should be valuable to a user when the information received on it has value. The analysis presented in Section 2.1 suggests that the biggest factor behind the rapid and firm embrace of mobile technologies in developing countries may indeed have been the failure of wireline incumbents - invariably state monopolies - to provide credible service to citizens. The demand for communication services had been there, but had not been met. The hypothesis of demand-driven growth suggests that a mobile can also be considered an "economic device" if and only if a necessary condition is satisfied, viz. when the information received on it has economic value. Note that this is not the same as a lowering of Coasian transaction costs (Coase, 1937), but reaping dividends which would not have been possible in the absence of the relevant information. This can be as simple as a person not getting a business contract or a job interview because he cannot be contacted. The most widely cited report on this is Jensen (2007), who shows how fisherman in Kerala are able to get better bargains for their catch by keeping tabs on the prevailing prices at markets within a reasonable commute radius.

2.3 What Role Policies?

The two preceding sections, taken in conjunction, provide a frame of reference for identifying possible application areas of m4D. The case Jensen (2007) presents is clearly a very special one in which mobile phones are an investment at the personal level, and reduce information asymmetry. It is doubtful whether this condition would hold for most mobile users, and so the phones would not yield direct economic returns. But these two possible scenarios complement each nicely. For the majority of users, mobiles are a recurring cost - they yield non-monetary utility of a high enough order to justify the expense. For the second group, the utility is in either the lowering of transaction costs or is clearly returns on investment. It is this second group that the policymaker should target.

Any policy which causes allotment or redistribution of resources must aim at maximizing social returns from that investment which, in this case, would be possible only if the group or need is correctly identified. The critical question in that case would be how to identify the possible end users. There are two broad approaches to the issue. The first would be to recognize that the mechanism would be one of self-selection, i.e. people would automatically choose to invest in services or applications if the returns justify that. It is to be noted that Jensen's fishermen were not following a policy prescription thought up by a development expert, and were merely maximizing their own benefits in a commonsensical manner.

It is possible to come up with instances where this logic would have a different flavor, viz. for applications which ride on mobile platforms, but would not be easily available otherwise. Consider the case of M-PESA, the highly successful and widely analyzed mbanking program, which is a join venture by Vodafone and Safaricom in Kenya.[4] M-PESA fills a financial vacuum of sending and receiving money in country with a very poor banking infrastructure. Because of the obviously low marginal costs associated with the technologies behind the scheme, the cost to the customers can be kept low. This competes with the previous situation in which banking services had simply not been available for a great many people. What the mobile service on which M-PESA rides did is to enlarge the choice-set of essential services available to people.

3 Conclusion

The success of these [private sector] operations were clearly a function of the perceived needs of the services by the people. There is an important lesson to be learnt here for both private sector application providers and for governments reaching out to people through mobile channels. The prerequisite for the success of such schemes, whether they be for-profit VASs or some aspects of mgovernment, is the existence of unmet demand for a crucial service, or clear calculations that show mobiles would greatly reduce transaction costs. It is interesting to note that the role played by the respective governments in both of the above examples was positive in that it was not actively

[4] www.safaricom.co.ke/index.php?id=745

negative. That would have been the case if, for example, it had arbitrarily shut down mobile operations or had insisted on excruciating bureaucratic minutiae for the mobile operators.

This brings us to the third and final critical questions: should mobiles be used at all as a development policy tool, and if so, when? The key thing would be to try to identify the cases where the generation of *utility* occurs at the level of [groups of] individuals, instead of searching for elusive macro-level *wealth* generation. In other words, the platform (mobile phones) should be subservient to the applications (banking, geo-locating, security notification, etc.) that could be offered on it. Context should always be weighed in for the project calculations.

We can clearly be optimistic about the future of mobiles in developing countries, but have to exercise caution in evaluating plans of using the technology for development purposes without a proper evaluation of its appropriateness as a platform or delivery channel for individual situations. It cannot, for instance, be an easy fit in education when the classroom requirement is a decent-sized monitor and heavy computational muscle. Nor would mgovernment be useful when governance itself is lax and the people ill-equipped to use technical apparatus. The form must fit function, capabilities and requirements.

Figure 1: Worldwide Adoption of ICTs

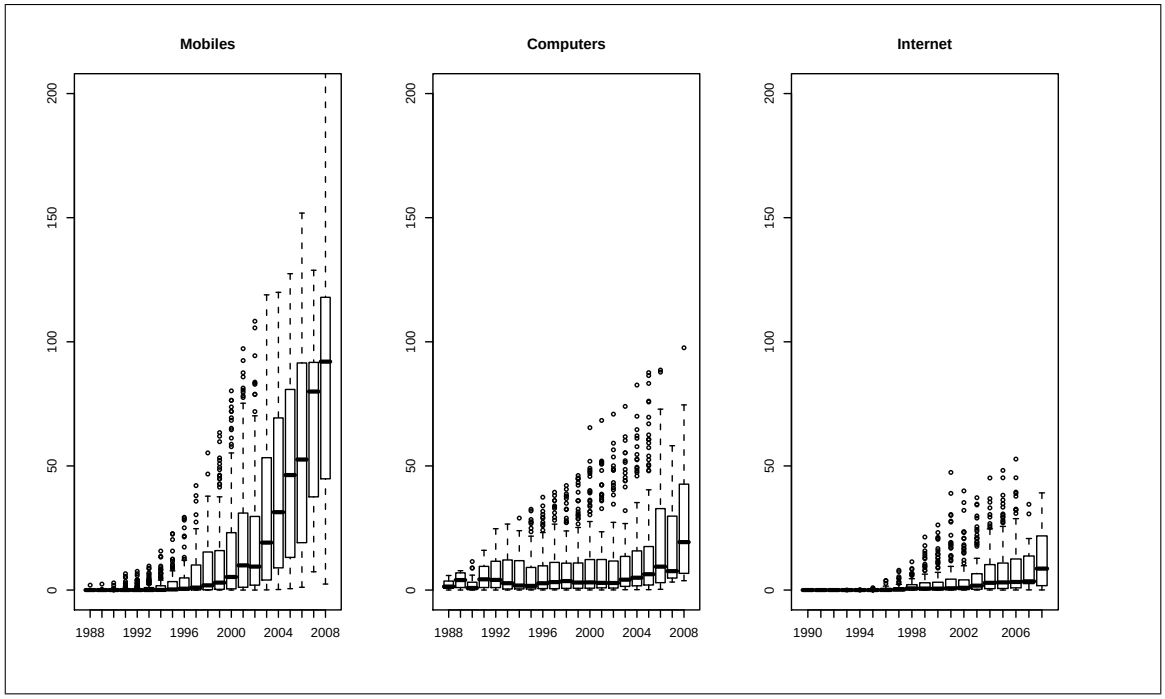

Figure 2: Evolution of Average Penetration and Skewness of Mobiles and Computers

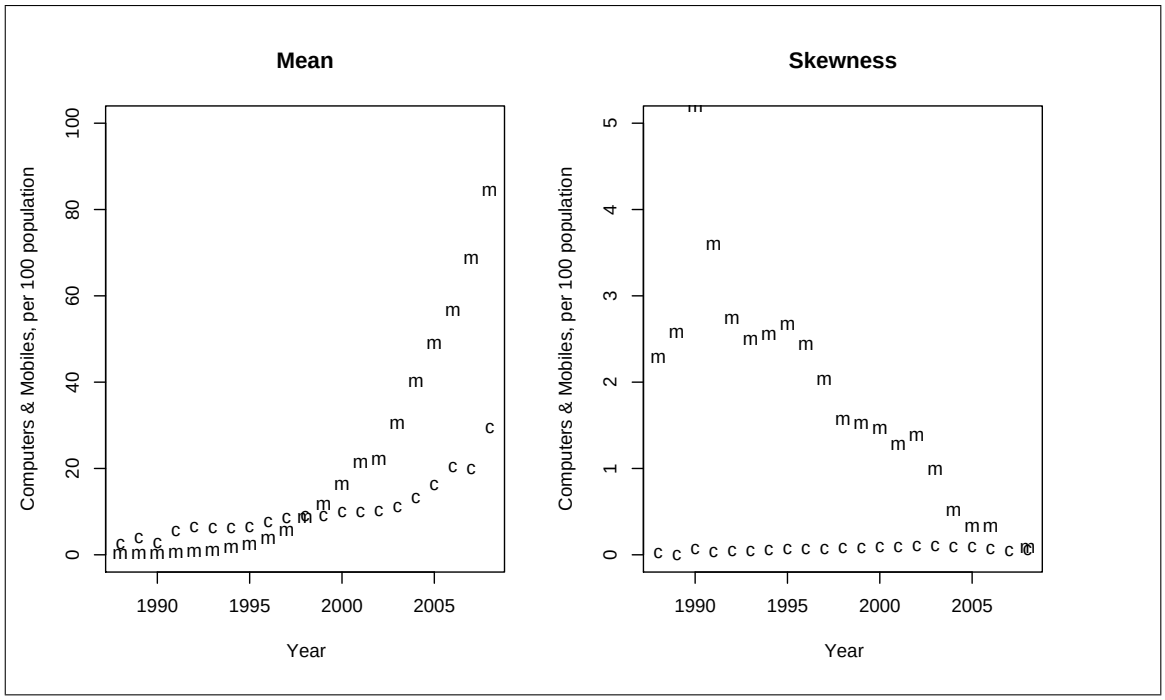

Figure 3: Evolution of Fixed-Line Penetration, by logged Per Capita GDP

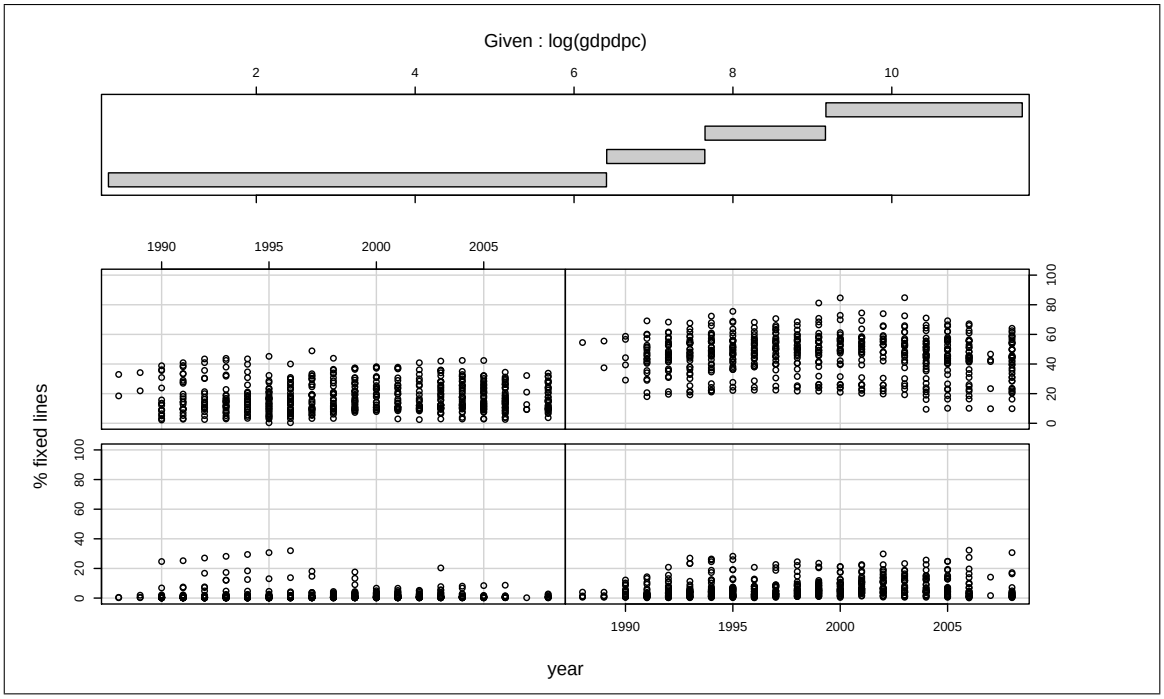

Table 1: Determinants of Mobile Penetration

Variable	Description	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept		220.9910	32.4359	6.81	0.0000
mcon	Mobile: connection charge	-0.0813	0.0210	-3.87	0.0001
mcon^2		0.0002	0.0001	3.23	0.0013
mmonth	Mobile: monthly charge	-0.1125	0.1097	-1.03	0.3054
mmonth^2		0.0015	0.0024	0.63	0.5279
mt3minp	Mobile: 3 min charge at peak time	-9.0762	2.0604	-4.41	0.0000
mt3minp^2		1.7533	0.5533	3.17	0.0016
rtelcon	Residential: connection charge	0.0154	0.0214	0.72	0.4717
rtelcon^2		-0.0000	0.0000	-0.46	0.6487
rtelmonth	Residential: monthly charge	1.3310	0.4194	3.17	0.0016
rtelmonth^2		-0.0550	0.0162	-3.40	0.0007
ft3minp	Residential: 3 min charge at peak time	22.8727	12.8256	1.78	0.0750
ft3minp^2		-19.8043	13.0952	-1.51	0.1310
mainper100	Wireline density	-1.5628	0.3223	-4.85	0.0000
mainper100^2		0.0235	0.0045	5.20	0.0000
finternetper100	Wireline Internet density	1.6764	0.2672	6.27	0.0000
finternetper100^2		-0.0221	0.0058	-3.82	0.0001
compper100	Computer density	1.1573	0.1921	6.02	0.0000
compper100^2		-0.0075	0.0020	-3.75	0.0002
log(gdpdpc)	Per capita GDP in US$, logged	-64.3262	8.2480	-7.80	0.0000
(log(gdpdpc))^2		4.6993	0.5504	8.54	0.0000
year: 1999		2.4129	1.4293	1.69	0.0919
year: 2000		5.1577	1.5601	3.31	0.0010
year: 2001		8.4748	1.6522	5.13	0.0000
year: 2002		9.5150	1.8722	5.08	0.0000

Variable	Description	Estimate	Std. Error	t value	Pr(>|t|)
year: 2003		11.9813	1.9687	6.09	0.0000
year: 2004		14.8864	2.1714	6.86	0.0000
year: 2005		21.4036	2.3883	8.96	0.0000
year: 2006		28.1054	2.8107	10.00	0.0000
year: 2007		30.2548	6.5205	4.64	0.0000
year: 2008		41.2009	4.3739	9.42	0.0000
country: ALB		38.8333	10.0829	3.85	0.0001
country: ARE		1.6437	15.3837	0.11	0.9149
country: ARG		14.6860	11.8965	1.23	0.2175
country: ARM		10.8943	10.0302	1.09	0.2778
country: ATG		36.8851	14.5585	2.53	0.0115
country: AUS		-45.8482	17.0012	-2.70	0.0072
country: AUT		-23.7620	16.9273	-1.40	0.1609
country: AZE		15.7331	9.6446	1.63	0.1034
country: BEL		-20.4747	16.6807	-1.23	0.2201
country: BEN		-10.4269	8.9845	-1.16	0.2463
country: BFA		-14.7732	8.8849	-1.66	0.0969
country: BGD		-16.2934	9.1403	-1.78	0.0752
country: BGR		56.7127	14.1808	4.00	0.0001
country: BHR		9.2607	13.7289	0.67	0.5002
country: BIH		25.9260	11.3314	2.29	0.0225
country: BLZ		2.0950	10.6234	0.20	0.8437
country: BOL		4.4069	9.1636	0.48	0.6308
country: BRA		9.9414	11.3329	0.88	0.3807
country: BRN		2.9485	13.7881	0.21	0.8307
country: BTN		-9.1986	9.3086	-0.99	0.3235
country: BWA		12.8491	12.9343	0.99	0.3209
country: CAF		-21.2547	9.3997	-2.26	0.0241
country: CAN		-90.9487	18.7119	-4.86	0.0000
country: CHE		-83.4489	21.0752	-3.96	0.0001
country: CHL		25.1854	14.0271	1.80	0.0731
country: CIV		-2.0604	8.8324	-0.23	0.8156
country: CMR		-4.2018	9.1587	-0.46	0.6466
country: COL		22.3445	10.5458	2.12	0.0345
country: COM		-16.1864	10.2304	-1.58	0.1141
country: CPV		9.4475	9.7496	0.97	0.3329
country: CRI		-2.9617	11.7949	-0.25	0.8018
country: CUB		-0.3182	12.1125	-0.03	0.9791
country: CYP		-15.9790	15.8799	-1.01	0.3147
country: CZE		25.5896	13.6576	1.87	0.0615
country: DEU		-48.6986	18.3430	-2.65	0.0081
country: DJI		-12.6729	8.7590	-1.45	0.1485
country: DNK		-72.1399	20.0679	-3.59	0.0004
country: DOM		7.5807	10.5214	0.72	0.4715
country: DZA		10.2329	9.9812	1.03	0.3057
country: ECU		22.2771	9.9901	2.23	0.0261
country: EGY		6.7112	9.6465	0.70	0.4869
country: ERI		-27.3201	9.6936	-2.82	0.0050
country: ESP		4.8920	15.8850	0.31	0.7582
country: EST		18.8184	13.2230	1.42	0.1552
country: ETH		-27.7284	9.7443	-2.85	0.0046
country: FIN		-28.8322	17.4601	-1.65	0.0992
country: FJI		8.3696	10.1878	0.82	0.4117
country: FRA		-45.9381	17.6386	-2.60	0.0094
country: FSM		-9.7677	11.2004	-0.87	0.3835

Variable	Description	Estimate	Std. Error	t value	Pr(>|t|)
country: GAB		1.9039	10.6085	0.18	0.8576
country: GBR		-32.2333	17.7935	-1.81	0.0706
country: GEO		3.8002	9.9664	0.38	0.7031
country: GHA		-7.0801	10.2974	-0.69	0.4920
country: GIN		-7.3384	9.2876	-0.79	0.4298
country: GMB		-12.2019	9.7655	-1.25	0.2120
country: GRC		13.6482	16.6557	0.82	0.4129
country: GRD		4.6154	12.4637	0.37	0.7113
country: GUY		16.4680	9.4204	1.75	0.0809
country: HKG		-20.3460	17.4151	-1.17	0.2431
country: HND		5.0247	9.1577	0.55	0.5834
country: HRV		12.0205	14.2564	0.84	0.3995
country: HUN		32.9044	13.3233	2.47	0.0138
country: IDN		-0.8935	8.9302	-0.10	0.9203
country: IND		-10.9661	8.8400	-1.24	0.2153
country: IRL		-25.8051	17.5762	-1.47	0.1426
country: ISL		-55.2461	19.6211	-2.82	0.0050
country: ITA		0.5795	16.6351	0.03	0.9722
country: JOR		21.0570	9.6649	2.18	0.0297
country: JPN		-45.7862	18.7557	-2.44	0.0149
country: KEN		-7.8399	9.2257	-0.85	0.3958
country: KGZ		-3.9192	10.2659	-0.38	0.7028
country: KHM		-12.2475	9.1270	-1.34	0.1801
country: KIR		0.6133	9.5601	0.06	0.9489
country: KOR		-13.1224	15.3615	-0.85	0.3933
country: KWT		-5.1241	14.6944	-0.35	0.7274
country: LAO		-15.1314	10.1073	-1.50	0.1349
country: LBN		-4.1317	12.0298	-0.34	0.7314
country: LKA		-1.8992	9.3411	-0.20	0.8390
country: LSO		-15.3441	11.7232	-1.31	0.1911
country: LTU		51.8039	12.2237	4.24	0.0000
country: LUX		-46.2352	19.6461	-2.35	0.0189
country: LVA		20.0114	12.2419	1.63	0.1026
country: MAC		-1.7968	15.0691	-0.12	0.9051
country: MAR		12.1271	9.2982	1.30	0.1926
country: MDA		21.1768	10.7344	1.97	0.0490
country: MDG		-45.8338	11.1085	-4.13	0.0000
country: MDV		16.9440	9.9745	1.70	0.0899
country: MEX		-4.6959	11.4501	-0.41	0.6819
country: MHL		-5.9051	10.4233	-0.57	0.5712
country: MKD		24.1327	13.3163	1.81	0.0704
country: MLI		-17.3714	11.7013	-1.48	0.1382
country: MLT		-13.6872	15.5737	-0.88	0.3798
country: MNG		6.2235	8.8754	0.70	0.4834
country: MOZ		-8.8310	10.2693	-0.86	0.3902
country: MRT		-7.6823	9.1083	-0.84	0.3993
country: MUS		8.1582	11.8108	0.69	0.4900
country: MWI		-19.6661	9.9386	-1.98	0.0483
country: MYS		7.6221	11.1706	0.68	0.4953
country: NAM		-5.9159	9.7776	-0.61	0.5454
country: NCL		-9.0604	15.8522	-0.57	0.5678
country: NER		-21.6893	9.9436	-2.18	0.0296
country: NGA		-8.9271	11.6357	-0.77	0.4433
country: NIC		-0.8934	10.3562	-0.09	0.9313
country: NLD		-56.3672	18.6745	-3.02	0.0026

Variable	Description	Estimate	Std. Error	t value	Pr(>|t|)
country: NOR		-51.0166	18.2721	-2.79	0.0054
country: NPL		-17.8210	9.0236	-1.97	0.0487
country: NZL		-18.8835	15.6125	-1.21	0.2269
country: OMN		-11.1142	11.8648	-0.94	0.3493
country: PAK		-9.5400	11.5663	-0.82	0.4098
country: PAN		22.6331	11.0064	2.06	0.0402
country: PHL		7.9086	9.1462	0.86	0.3876
country: PNG		-15.5043	16.5195	-0.94	0.3483
country: POL		8.4093	14.3368	0.59	0.5577
country: PRT		28.5384	14.8807	1.92	0.0556
country: PRY		9.5922	9.8229	0.98	0.3292
country: PYF		-13.9276	14.6781	-0.95	0.3431
country: QAT		-21.5547	15.8963	-1.36	0.1756
country: ROM		22.9516	11.2535	2.04	0.0418
country: RUS		11.8628	12.9493	0.92	0.3600
country: RWA		-19.7499	9.4750	-2.08	0.0375
country: SAU		-3.1850	12.3160	-0.26	0.7960
country: SEN		-2.4464	8.7841	-0.28	0.7807
country: SGP		-35.3794	16.9195	-2.09	0.0369
country: SLB		-4.9835	9.2383	-0.54	0.5898
country: SLV		8.9432	10.4647	0.85	0.3931
country: SRB		28.7312	12.3490	2.33	0.0203
country: SUR		28.8992	11.5580	2.50	0.0127
country: SVK		9.7125	12.3026	0.79	0.4301
country: SVN		-6.9074	14.5280	-0.48	0.6346
country: SWE		-61.3519	20.2220	-3.03	0.0025
country: SWZ		-2.5586	9.4067	-0.27	0.7857
country: SYC		20.2569	12.7004	1.59	0.1112
country: SYR		8.2938	9.6695	0.86	0.3914
country: TGO		-11.4798	9.1983	-1.25	0.2125
country: THA		4.2087	11.0461	0.38	0.7033
country: TON		1.4222	10.1276	0.14	0.8884
country: TTO		5.6847	12.5675	0.45	0.6512
country: TUN		21.5957	9.8957	2.18	0.0295
country: TUR		28.1515	13.0519	2.16	0.0314
country: TWN		-3.8674	16.4810	-0.23	0.8146
country: TZA		-6.2422	10.1200	-0.62	0.5376
country: UGA		-22.9742	9.0524	-2.54	0.0114
country: UKR		33.8618	11.1557	3.04	0.0025
country: URY		-1.0100	14.1507	-0.07	0.9431
country: UZB		-23.5095	11.7819	-2.00	0.0464
country: VCT		19.3131	11.2024	1.72	0.0852
country: VEN		8.0268	11.3360	0.71	0.4792
country: VNM		-2.5161	9.0530	-0.28	0.7812
country: VUT		-6.7340	11.9021	-0.57	0.5717
country: WSM		-0.9182	10.6119	-0.09	0.9311
country: YEM		-2.2835	8.9247	-0.26	0.7981
country: ZAF		9.6365	10.4175	0.93	0.3553
country: ZMB		-4.9227	9.0805	-0.54	0.5879
country: ZWE		-4.1389	11.6238	-0.36	0.7219

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Mobile Banking & M–Commerce and Related Issues

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Table of Contents

Chapter-1

Introduction

1.1 'Commerce' is the trading of 'something' of value between two entities. That 'something' may be goods, services, information, money, or anything else the two entities consider to have value. Trading was the main facility in earlier times with barter facility for goods and services. Later, currency was introduced as standardized money to facilitate a wider exchange of goods and services. Today's era is an information era and the world is passing through an Information revolution. One of the profound consequences of the information revolution is its influence on how economic value is created and extracted. Today the information is more easily accessed, absorbed, arranged and is priced in different ways. Markets are expanding from regional to global. Knowledge is replacing land, labour and capital as the key value driver. Intelligent networks and virtual spaces are limiting the need for surface and air travel. With the technological progression particularly in computers and Internet field has led to the birth of electronic commerce (E-commerce) which enabled the business processes to be more simplified, efficient, quick and accurate resulting in improved productivity with higher satisfaction level to the customers. Also, improved processes resulted in reduced cost of production and transaction cost and therefore the profitability of businesses increased manifolds. The emerging wireless and mobile networks have added another dimension of mobility and extended e-commerce to another research and application subject called mobile commerce popularly known as **m-Commerce**.

1.2 M-Commerce is the buying and selling of goods and services through wireless handheld devices such as mobile telephone and

personal digital assistants(PDAs). M-Commerce is a platform where a mobile customer can avail various banking and other related commercial facilities through his mobile phone. M-Commerce is not the transaction itself. It provides services and information, which can trigger a future transaction. The scope of m-Commerce therefore goes beyond the initial one time commercial transaction. The main areas of m-Commerce use are in text messaging or SMS, mobile payment, financial & banking services, logistics, goods/services buy/sell, information services and wireless customer relationship management etc.

Benefits of m-Commerce:

1.3 The benefits of m-Commerce with respect to customers, merchants and banks are as below:

- Ubiquitous Personalized service – anywhere, anytime
- Remote payment for utility bills; insurance premiums; credit card bills; EMIs etc
- Integration with existing payment systems e.g. Credit/debit card payment option
- Promotion of Location based services
- Faster transaction time
- New business opportunities for stakeholders
- Point of Sale(POS) device may not require
- Branding and business opportunities for banks
- Higher volume in banking with less cash transaction
- Penetration into cash dominated category

- Help developing customer loyalty
- Reduction in cost of infrastructure and usages

Types of m-Commerce

1.4 The m-Commerce can be classified broadly in the three main categories:-

M-Payment: through Credit/debit cards:

Mobile phones linked to credit/debit cards can be used to make payments. e.g. M-payment applications like mChek, PayMate, ngpay etc

E-Money:

Cash loaded in the mobile phones. Consumers use this virtual cash as real value for all types of transactions. E.g. Prepaid cash card, recharge voucher amount etc

M-Banking:

Mobile phone used for accessing the bank accounts. All payments are routed through the bank. e.g. Balance query, share trading alert, banking transactions etc.

Applications of m-Commerce:

1.5 Various applications of Mobile Commerce are given the below Table:-

Application	**Example of m-Commerce services offered**
Mobile banking	Mobile Accounting Mobile online stock transaction Mobile banking information Payment for insurance, recharge coupons etc
Mobile information services	Current affairs Tour and travel information Mobile search engines and directories
Mobile shopping	Purchase of goods and services Content purchase & delivery
Mobile ticketing	Sports and cultural events Cinema Tickets
Mobile marketing	Mobile coupons Mobile newsletters
Mobile entertainment	Mobile Gaming Download of music, video and ring tones Location based entertainment services

Drivers of m-Commerce

1.6 There are various factors responsible for the growth of m-Commerce. A few of them are listed below:-

- Changing behavior pattern and expectation of consumers with regard to shopping and brand loyalty

- Businesses are changing the way they do business. Mobile phones are enabling these changes to happen.
- Tremendous growth in mobile telephony.
- Exponential growth of consumer interest and adoption of the Internet and e-commerce.
- Development of real-time transfer of data over 2.5G/high speed internet network. With the introduction of 3G services and with the expected private sector participation, 3G will enable faster data transmission and ubiquitous connectivity.
- The evolution of the handheld devices incorporating Wireless Application Protocols(WAP) and GPRS.
- With the rise in the number of subscribers of database services, the cost of entry into m-Commerce is low for most entrants;
- Because of the benefits of m-Commerce as described above it is attracting players from all economic sectors from technology, finance, retail, media, all anticipating that m-Commerce will help in increasing customer acquisition and retention and generate new revenue opportunities for them.

1.7 By 2010, more than three billion people are expected to own mobile phones in the world. India is the second largest nation in the world in terms of number of mobile subscribers and is growing at the fastest pace in terms of number of mobile subscribers. There are over 545million mobile phones (as on Jan'2009) in India and about 18 million are being added every month. As per the reports available, there are about 149 million(~25%) subscribers registered for the data services(December 2009 figure). However, as compared to number of mobile subscriber base in India, user transactions

through m-Commerce per day are abysmally low (5-10million) and it can be said that presently M-Commerce is in the nascent stage in India. However, it has great potential of expansion of business transaction particularly in non-cash category. If properly harnessed, it can help in facilitating inclusive growth particularly in rural India.

Chapter-2

Mobile Payment Solutions & Technologies

2.1 As mentioned in the first chapter there three broad categories of m-Commerce. Mobile payment is one of the prominent m-Commerce methods which are used actively by majority of the user of m-Commerce. This chapter deals with the various solutions and technologies for mobile payments.

Mobile Payment (m-payment) Solutions

2.2 There are broadly three different models available for m-payment solutions on the basis of payment :

- Bank account/debit card based
- Credit card based
- Telecommunication company billing based

➢ **Bank Account/Debit based m-payment**

2.3 In this model, the bank account/debit card is linked to the mobile phone number of the customer. When the customer makes an m-payment transaction with a merchant, the amount from the bank account of the customer is debited and the value is credited to the merchant account.

➢ **Credit Card based M-Payment**

2.4 In the credit card based model, the credit card number is linked to the mobile phone number of the customer. When the customer makes an m-payment transaction with a merchant, the credit card is charged and the value is credited to the merchant account. Credit card based

solutions have the limitation that it is heavily dependent on the level of penetration of credit cards in the country.

- **Telecommunication Company Billing of M-Payments**

2.5 Customers make payment to merchants using his or her mobile phone and this may be charged to the mobile phone bills of the customer. The customer then settles the bill with the telecommunication company. This model is not available at present in India.

Technologies for Mobile Payments

2.6 The mobile technology landscape provides various possibilities for implementing m-payments. Mobile phone may send or receive information through channels like– SMS, USSD or WAP/GPRS. The choice of the channel influences the way m-payment schemes are implemented. Secondly, the m-payment client application may reside on the phone or else it may reside in the subscriber identity module (SIM). The detail about customer's bank account/credit/debit card is stored inside the phone/SIM. When customer wants to transfer the money to a merchant he accesses the application and enters phone/account number. The application running on his mobile encrypts the details of account-number/credit/debit-card including the amount to be transferred to the merchant. The customer enters MPIN (Mobile PIN) number. The merchant is alerted for confirmation. Once the confirmation is received, the amount is transferred from the customer account to the merchant account. There are other methods like near field communication technique, which is a contactless application. Some of these techniques are described briefly as below:-

- **Short Message Service (SMS)**

2.7 This is a text message service that enables short messages that can be transmitted from a mobile phone. Short messages are stored and forwarded by SMS centers. SMS messages have a separate transmission channel than the voice channel. SMS can be used to provide information about the status of one's account with the bank or can be used to transmit payment instructions from the phone.

- **Unstructured Supplementary Services Delivery (USSD)**

2.8 USSD is a technology unique to GSM. It is a capability built into the GSM standard for support of transmitting information over the signaling channels of the GSM network. USSD provides session-based communication, enabling a variety of applications. USSD is session oriented transaction-oriented technology while SMS is a store-and-forward technology. Turnaround response times for interactive applications are shorter for USSD than SMS.

- **Wireless Application Protocol(WAP)/ General Packet Radio Service (GPRS)**

2.9 GPRS is a packet-switched data service available to GSM users. GPRS enables services such as WAP access, Multimedia Messaging Service (MMS), and Internet communication services such as email and World Wide Web access in mobile phones. With the help of WAP/Internet one can use m-payment from his mobile device.

- **Phone-based Application (J2ME/BREW)**

2.10 The client m-payment application resides on the mobile phone of the customer. This application can be developed in Java (J2ME) for GSM phones and in **B**inary **R**untime **E**nvironment for **W**ireless (BREW) for

CDMA phones. Personalization of the phones can be done over the air (OTA).

Near Field Communication (NFC)

2.11 NFC is the fusion of contactless smartcard (RFID) and a mobile phone. The mobile phone can be used as a contactless card. NFC enabled phones can act as Radio-Frequency Identifier (RFID) tags or readers. This creates opportunity to make innovative applications especially in ticketing and couponing. This technology is becoming increasing popular and is being used in the developed countries being comparatively safe and secure method of mobile payment.

Dual Chip

2.12 Normally, SIM cards are purchased in bulk by telecom service provider and then they customised the SIMs for use before sale. For m-payment application in SIM the application provider writes m-payment application in collaboration with the telecommunications service provider. To avoid this, dual chip phones have two slots one for a SIM card for the purpose of telephony and another for a payment chip card. Financial institutions may prefer this approach as they can exercise full control over the chip and the mobile payment process. But, customers would have to invest in dual chip mobile devices.

Mobile Wallet

2.13 An m-payment application software that resides on the mobile phone with details of the customer (and his or her bank account details or credit card information) which allows the customer to make payments using the mobile phone is called as a mobile wallet. Customers can multi-home with several debit or credit payment instruments in a single wallet. Several implementations of wallets that are company-specific are in use globally.

Comparison of medium of communication in m-Commerce:

2.14 The table below compares SMS, GPRS and USSD that can be used in making transaction, communication or payment advice in m-Commerce.

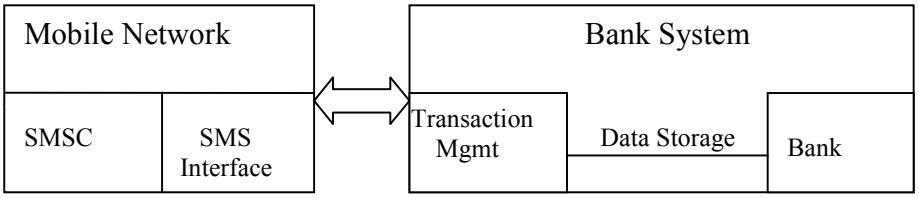
Comparison of medium of communication in m-Commerce Technology					
Sl No	**Elements**	**SMS Based**		**GPRS based**	**USSD based**
		SIM based SMS	**Phone based SMS**		
1	**Data carrier**	SMS	SMS	GPRS	USSD
2	**Data storage**	SIM memory	Phone memory	Not stored	Not stored
3	**Card present/ card not present TXN**	Card present	Card present	Card not present	Card not present
4	**User interface**	Menu based	Menu based	Interactive	Interactive

Network Architecture, and Models m-Commerce

2.15 The m-Commerce implementations models are primarily of two types:-

(a)The Access Model – In this model, the mobile operator is restricted to just the access portion of the service. Here mobile network establishes

relationship with a normal bank with both parties marketing the service. The network provides a 'front-end' to the SMS system that is linked to the bank's system. This interface system is designed to take care of security, transaction routing and the management of the SMS responses back to the customer, based on information supplied by the banking system. This covers the automatic account update whenever a transaction is initiated. The architecture can be simply represented by the following diagram:-



In this model, the banking system comprise of three elements. The transaction module maps the actual transactions, determining the settlements that must be made and generating the transaction confirmation messages that must be sent to the users. The data storage module holds the account balances for all the users including the retailers and other service providers, while the bank module represents the physical cash storage facility and the holder of the banking license.

The Access Model is employed by SMART Money in the Philippines, MTN Bank in South Africa, Safari.com in Kenya and Tanzania as well as Celpay in Zambia and the Democratic Republic of Congo.

(b) The Hybrid Model- This model is the more complex arrangement whereby the network operator has a greater role in the provision of the service. In this model network operator also perform the activities of a banker after taking necessary approval from the Central Bank. His activities can range from including just the transaction management

aspect, right through to the stage where the network operator also holds a banking licence and provides all aspects of the service.

2.16 Of the two approaches, the Hybrid model is more complex as the network operator is required to follow rigorous rules covering issues of liquidity, banking security and anti money laundering. The implementation of the Hybrid model will necessarily involve extensive negotiations with the banking regulator. This model is adopted by GLOBE Telecom in the Philippines. In India presently access model as described above is employed.

Chapter-3

Present scenario in the Developed/Developing world

3.1 M-Commerce applications like m-payment are becoming popular in developed and developing countries due to different reasons. In the developed countries the mobile payment is complementary to the traditional payment systems and is popular due to flexibility, ubiquitous nature and convenience in conducting transactions. It is driven by the industry and is an enabler for wide range of m-Commerce Services viz. m-ticketing, m-retail, m-banking etc. In many developing countries, on the other hand, due to lack of banking facilities in the rural area, lack of alternative solutions, accessibility& affordability issues and limited micro payments, the use of mobile payment is becoming popular due to the reach of mobile phones and their ability to offer m-Commerce services. Mobile money applications are emerging as potent financial tools in rural and remote areas of the globe, allowing people with no bank accounts to get paid, send remittances or settle their bills. Mobile phones are also being used to transfer funds between people. These applications are working in countries like Philippines, Kenya, South Africa, Tanzania etc. M-Commerce experience in some of the developed and developing countries are given below:-

3.2 In Kenya a popular mobile payment service is called **M-Pesa,** which is designed specifically to provide financial Services to people without access to the conventional banking. To avail this service one does not need any bank account, there is no joining fee, no monthly charges and no minimum balance to be maintained. The service provider has the Trust Account which owns the bank account with the real money. In this system the e-money is transferred from one person to other by SMS. M-Pesa is a fast, safe and easy of use mechanism.

3.3 In Philippines, **SMART Money** is the Mobile Banking product offered by SMART Communications which allows customers to transfer funds from their bank accounts to their SMART mobile service account including prepaid recharging. Facilities exist for the customer to deposit cash, withdraw cash, top up the mobile phone prepaid credit levels from that account or other bank accounts, without going near a bank or a SMART office. The service is menu-driven and the customer can perform all necessary actions using the phone alone.

3.4 In Afghanistan, national police is testing a service from the mobile operator to pay for its officers. In this case an Afghan police officer gets his salary in a text message on his mobile phone.

3.5 In South Africa, companies like Wizzit, Fundamo, and MTN Banking are using M-Commerce Services. Wizzit has positioned itself as a virtual bank and has no branches of its own mobile phone subscription. Customers can use their phone to make person to person payments, transfer money, purchase prepaid electricity and buy airtime for prepaid mobile phone.

3.6 In Europe, the European Commission has vision of a mobile Europe, where its citizens freely move among the EU countries, and seamlessly enjoy services coming from the communication, banking, government, and health domain considerable efforts are being made to promote the converged products and services that go beyond the national borders. Currently applications namely 'simpay', 'starmap', 'mobile alliance', 'Mobey Forum' etc are operating m-Commerce services in Europe.

3.7 With the help of European Commission a project called Secure Mobile Payment Service (SEMOPS[1]) is developed for an open, cross-border based secure mobile payment service. SEMOPS takes into account the different requirements of the stakeholders and addresses them in innovative ways. Trust, security and privacy have been tackled in order to comply with visions of mobile Europe. The issues like open architecture, multilingualism, real-time interaction, multiple platform support, user-friendliness, cross-border support, open business model etc have been addressed. It is commercially launched in Hungary, and pilots have been completed in Greece and Italy.

3.8 Mobile payment services have been fairly successful in Asia especially in South Korea, Japan, Philippines and other Asian countries (e.g., Mobile Suica, Edy, Moneta, Octopus, G-Cash). The M-payment in these countries has been penetrated in almost all sectors. South Korea is moving towards NFC based contactless technology.

3.9 In USA, mobile payments were slow to take off initially due to availability of other alternatives. However, it is also moving towards NFC based contactless mobile payments.

3.10 In India, though the M-Commerce is still in its nascent stage with about 5-10 million transactions per day, however, it is picking up fast. The main mobile payment platforms are mChek, ngpay, Obopay, PayMate, ATOM, Oxicash, etc. The Reserve bank of India (RBI) issued guidelines for mobile banking in October, 2008 with the limit on per day transaction as Rs10,000/. This has now increased to Rs 50,000/- per day. This will certainly push the demand of m-Commerce/M-banking. With the introduction of 3G/BWA service in the country many more mobile applications will develop and the eventual movement from

[1] http://www.semops.com/uploadfiles/SEMOPS_Sympotic2004.pdf

2G/2.5G to 3G/4G networks will provide the infrastructure for the companies to move forward with the wireless technology applications.

Chapter-4

Existing frame work for m-Commerce in India

4.1 In India, the M-Commerce is primarily of the nature of M-Banking. For making any transaction a customer has to have his bank account in a bank and he has to register himself with the bank for operating his m-Commerce services. Reserve bank of India(RBI) issued operative guidelines m-Commerce in Oct,2008.

RBI Guidelines on M-Banking

4.2 In the beginning, with the proliferation of mobile phones in various states, some banks started offering information based services like balance enquiry, stop payment instruction of cheques, transactions enquiry, and location of the nearest ATM/branch etc. Acceptance of transfer of funds instruction for credit to beneficiaries of same/or another bank in favor of pre-registered beneficiaries had also commenced in a few banks. Later Reserve Bank of India(RBI) had set up the 'Mobile Payments Forum Of India' (MPFI), a 'Working Group on Mobile Banking' to examine different aspects of M-Banking. The Group had focused on three major areas of M-banking, i.e. (i) technology and security issues, (ii) business issues and (iii) regulatory and supervisory issues. In October,2008 RBI brought out a set of operating guidelines for adoption by banks. These guidelines are under various heading like Regulatory & Supervisory issues, Technical issues, Interoperability etc. Main points in the guidelines are:-

- Only licenses Indian banks having core banking facility were permitted to offer M-banking services, within the country, in Indian Rupees only.

- The M-banking has been restricted only to customers of banks and/or holders of debit/credit cards. The customer has to physically present in the bank and registered himself for M-banking.
- From the security transaction point of view it is mandatory for the banks to follow the guidelines issued by Reserve Bank on "Know Your Customer (KYC)", "Anti Money Laundering (AML)" and Combating the Financing of Terrorism (CFT). Banks have also been mandated to have secure M-banking transactions and they have to ensure confidentiality, integrity, authenticity and non-repudiability of the transaction.
- To ensure inter-operability between banks, and between their mobile banking service providers, banks have been asked to adopt the message formats like ISO 8583, with suitable modification to address specific needs.
- From security point of view, banks are required to ensure proper level of encryption and security at all stages of the transaction processing and to ensure end-to-end encryption of the mobile banking transaction. Validation of transaction should be through a two factor authentication with provision that the mPIN (M-Personal Identification Number) shall be stored in a secure environment.
- To guard against the use of mobile banking in money laundering, frauds etc. The guidelines with respect to network and system security have also been issued for the banks.

M-Commerce Processes

4.3 On implementation of above guidelines following are the M-Commerce Processes:

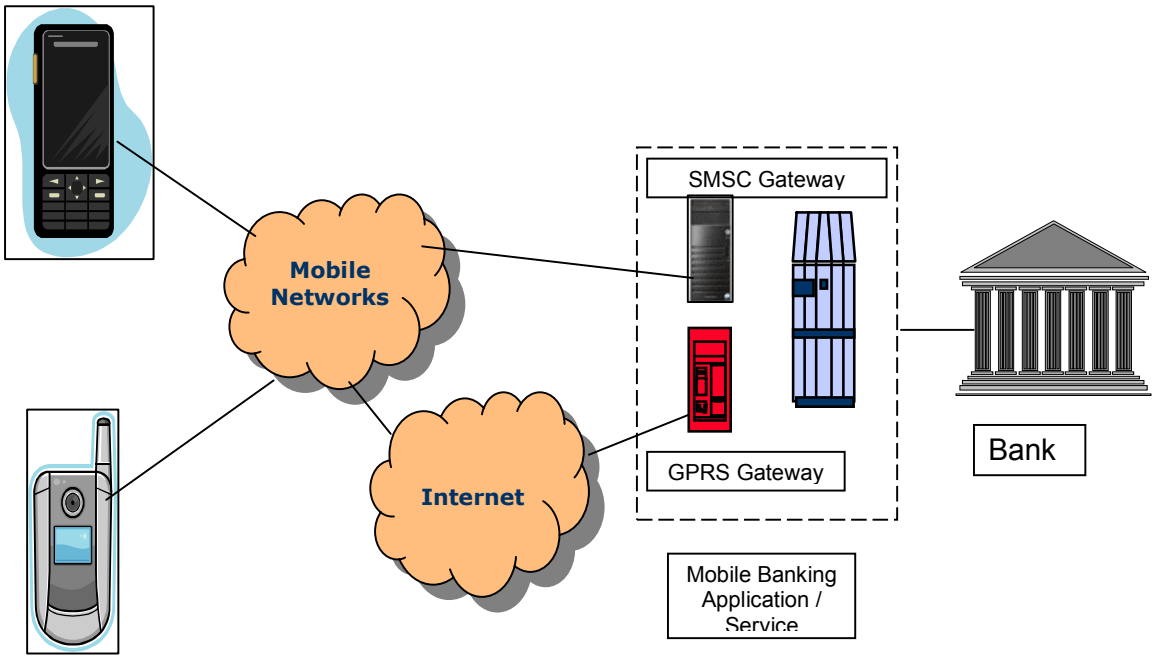
- Customer desiring m-Commerce services registers himself with his bank.
- The application for M-banking is downloaded, wherever required, via either Over the Air (OTA) or from internet on the mobile phone having required features (Java/GPRS).
- M-Commerce application is initiated by password / MPIN generated after downloading the software from the Mobile banking Application Service (MBAS) provider

4.4 Once application is downloaded the following are possible transaction flows in m-Commerce.

Transaction flows in case of m-Commerce

4.5 Possible overall transaction flows for intra-bank and inter-bank transactions are:-

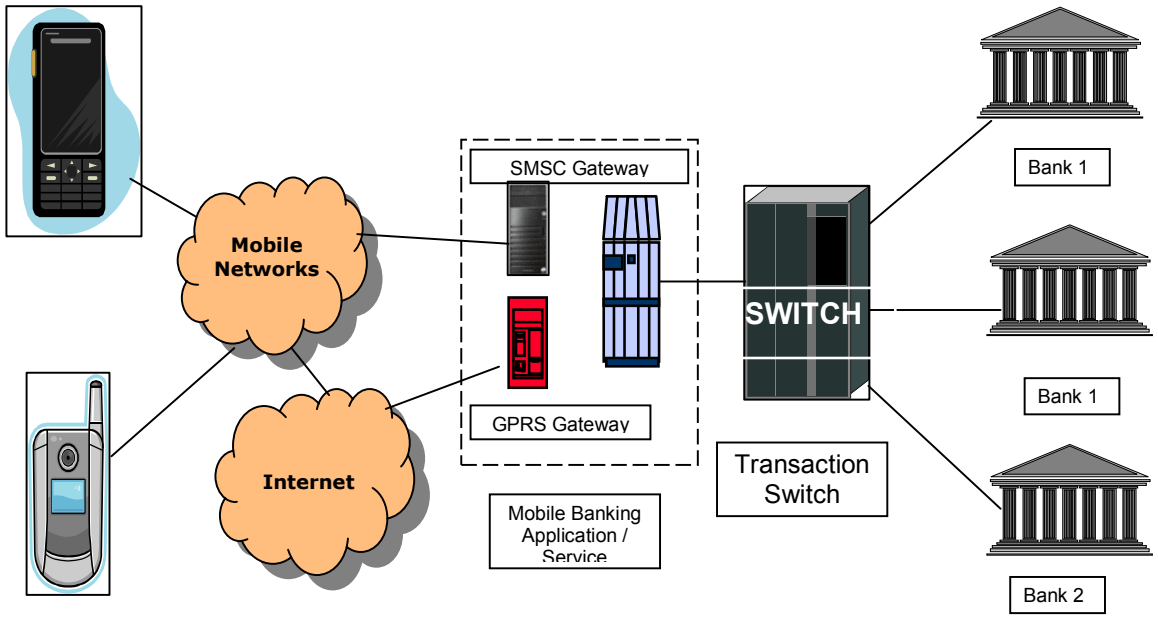
Intra-bank transaction flows[2]:-



[2] Source:-www.mpf.org.in

- Bank connects to Mobile networks via MBAS Provider.
- Sender and Receiver perform a registration at Bank
- MBAS stores card number, or account number and Bank ID
- Sender specifies a recipient Mobile number / account number and initiates a transfer request
- MBAS performs checks and forwards the request to the Bank
- Bank validates the From/ To accounts, performs a fund transfer; responds to the sender and the receiver via MBAS.
- In the intra-bank transaction case service offerings is for bank's customers only and Banks can offer cutomised services. Transaction processing and settlement transactions can be settled by the bank itself.

Inter-Bank transaction flows[3]:-



[3]Source:- www.mpf.org.in

- MBAS connects to the mobile networks, and connects to a Transaction Switch, which in turn connects to Banks
- Same Sender / Receiver Registration process as intra-bank transfer case
- Sender (of Bank 1) specifies a recipient Mobile / account number of other bank (Bank 2) and initiates a transfer request
- Bank 1 validates the 'From' account, performs a debit and returns status to Switch
- Switch sends the credit leg to Bank 2
- Bank 2 validates the credit account, and responds to Switch
- If invalid 'To' account, sends a failure message to Switch
- Bank 1 reverses the debit, sends out a failure message to Sender.
- Service offerings in case of inter-bank transaction case are:-Transfer of funds across banks account and Purchase / payments. In this case Transaction processing and settlement for Intra bank transaction settlement by each bank and in case of Inter bank the settlement reports are generated by the Switch for settlement, by the Settlement Bank / or settlement Agency.

M-banking platforms/services agencies in India

4.6 In India, the M-Commerce/M-banking services are run by many Mobile banking application service providers with their tie-ups with banks and the telecom service providers. Different technologies and types of applications are available from them on the mobile platform; each offering a matrix of advantages and disadvantages, especially when the needs of the disadvantaged segments are taken into consideration. Some of the names of M-Commerce platforms/services in India are mChek, ngpay, PayMate, ITZCash card, Green Money Transfer, ATOM, Obopay, OxiCash etc. From these paltforms like m-check, ngpay, ATOM require

Java enabled handsets & GPRS facility to operate m-Commerce, while platform like PayMate does not require these. Most of the M-banking transactions are between the bank accounts of the customers. Some of the platform like 'Green Money transfer' allows person to person transfer through their bank accounts. Bharat Sanchar Nigam Limited (BSNL) has also plans[4] to launch a mobile banking platform with the help of Department of Post wherein a mobile subscriber will be able to send money orders electronically through SMSs which will be encashable at all post offices in the country.

[4] Business standard, Delhi 21st Feb,2010

Chapter-5

Issues in M-Commerce

5.1 As mentioned in earlier chapters, the present system of Mobile payment in India is through the banks. The main problem is that a large number of people do not have bank accounts particularly in rural and far-flung areas. It may be due to less accessibility and reach of the banks and due to lack of mass awareness for making people to avail banking services.

5.2 Even in the existing framework of m-payment and M-banking, there are technical, regulatory and legal issues which need to be tackled for enabling the adoption of m-Commerce by the masses. There are financial aspects related to payments and micro payments; security aspects related to payment, information transfer within and beyond the access network; privacy aspects related to data security, email, virus, location based privacy, transaction details privacy; consumer protection related to cost control, information disclosure on tariffs and services, protection of minors, appeal for grievances; and others aspects like taxation policies , e-money policies etc.

5.3 The issues in M-Commerce have been categorized in the following broad categories:-

Regulatory Issues:

5.4 There are many regulatory issues as far as banks, telcos and third party processors are concerned.

Issues for Banks :-

- Anti Money laundering and Know Your Customer(KYC) controls,
- Cash payment and cash handling infrastructure,

- Transaction capability,
- Bank account opening and maintenance,
- Tie-up with merchants etc.

Issues for Telecom companies:-

- Anti Money Laundering laws,
- KYC regulations,
- Acceptance of deposits by Telcos,
- Fraud management / reporting, etc.
- Telco Network for using domestic money remittances,
- Transaction monitoring

Issues for Third party payments processors

- Regulatory controls,
- Application hosting and Network infrastructure,
- Transaction capability and monitoring,
- Centralized cross bank settlement mechanism etc.

Technical Issues:-

Lack of Standards:

5.5 With a host of device operating systems and platforms, middleware solutions and networks, make application development for the wireless Internet a formidable task. While WAP has been a very important in the evolution of the wireless Internet and in turn m-Commerce, there are problems/difficulties with the standard, such as the lack of WAP-enabled devices and security issues. The lack of standards gives rise to lot of local and fragmented versions of m-payments offered by different stakeholders. Standards need to address security and privacy concerns of customers as well as interoperability between various

implementations. Standards formation is a process of negotiation between various stakeholders. There is a need to have consensus among the players in terms of m-payments standards setting.

Device constraints

5.6 There are technical issues related to the mobile devices particularly mobile phones. As compared to e-commerce where computers are themselves quite powerful, the mobile phones suffers from some of the following constrains:-

- Less processing power and memory
- Constraint bandwidth
- Short battery life.
- Frequent disconnections
- Tiny screens, poor resolutions
- Privacy Issues like unauthorised access to stored data, especially personal information and transaction history and Locational information that may target direct advertising and could also encroach on privacy rights of people

Security Issues

5.7 Securing m-Commerce is even more difficult than wired transaction. As mentioned above, the device constraints raise the questions as to whether there will be adequate security for users without compromising the ease of use and speed. There are issues in the m-Commerce technologies discussed in chapter-2 like SMSs are prone to spoofing and there are issues related to SMS encryption. However technology manufacturers are developing improved security for applications with authentication and encryption technologies and many claim that the transaction using mobile device is fully secure. But then there are tradeoffs for increased security, namely price and style.

6 There is also an issue related to protection of the infrastructure supporting m-Commerce from the attacks. Protecting of customer's data and financial transactions and ensuring the integrity of billing mechanisms are also some of the important issues.

Content related issues:-

6.1 M-Commerce, like the Internet, is largely a 'pull' mechanism than 'push', therefore a question as to who would be responsible for the transmission of illegal contents may arise. Other related issues in this category can be copyright, trade mark and patent infringement, data protection compliance issues.

6.2 Due to device constraints it may be difficult for customers to retain messages or content that has been sent to them on their phones for a period long enough to have complaints about the deficiency of service/ transaction.

6.3 Another major issue is the revenue sharing agreements between mobile service providers, banks, content providers, aggregators and other service providers like utilities, travel agencies, hotel industry, retailers etc.

Other Issues:-

Payment settlement related issues can be arised in case of following types of settlement**:-**

- Card based settlement
- Bilateral settlement between Banks
- Settlement with Multilateral Settlement Agency
- Settlement with Multilateral Settlement Agency acting as Central User Registry

Ability to suspend, cancel or block transaction – consumer's right to suspend or cancel ongoing transactions like subscriptions to stock quotes. Merchant's right to suspend transactions, if there is breach.

Inclusion of telecom service providers as Business Correspondence(BCs):- Presently telecom service providers are acting as conduit between customers, mobile application service providers and banks. As per the present RBI Guidelines, banks can make Business Correspondence from the entities including from those Section-25 companies that are stand-alone entities or in which NBFCs, banks, telecom companies and other corporate entities or their holding companies do not have equity holdings in excess of 10%. This clause may have preventive effect in active participation of the telecom companies in promotion of m-Commerce in India.

Chapter-6

Way Forward

6.1 For any service to be successful, the customer acceptance is a necessary pre-condition. Customers look for easy to use, secured, ubiquitous and cost efficient m-Commerce services. Trust in the m-Commerce system is an important factor. The banks, application providers and telecom service providers need to work towards building trust amongst the customers. If the most trusted brands in the business can come together to offer m-Commerce services it will have positive impact. A transaction log, including the offer of sale, order for goods, confirmation and payment authorisation etc, can be created and deposited in an unalterable format at a trusted repository from where it can be retrieved, in event of a dispute. This will help developing trust amongst the users.

6.2 The ecosystem in m-Commerce include the customer acquisition setup, distribution and retailer network, application service providers, technology provider and the banks. Major steps can be taken by banks and the mobile service providers to proactively promote the new payment schemes. The telecom service providers have to fulfill the expectations of customers are to have reliable and ubiquitous connectivity on their mobile phones and banks have to seek an easy and simplified m-Commerce experience.

6.3 To make m-Commerce applications successful steps in the following areas may help:-

- A stable legal environment with availability and enforcement of contract laws will build faith in the system among the various players and foster the industry as a whole.

- Government by putting in place consumer protection laws and grievance redressal mechanism will foster consumer trust and faith in Mobile commerce.

- Mobile Terminal/Device Industry may develop and introduce advance functionalities in the device at affordable costs and compatibility in local languages. Content availability in vernacular/local languages will surely attract non-English speaking users thus increasing the number of m-Commerce users.

- The content production can be promoted through government policies in several ways. Reduced duties on electronic and audio video production equipments will bring down the costs of production. This will bring down the costs of content on mobile raising its demand and ultimately pushing up m-Commerce.

- The other way government can influence Content Industry is by ensuring enforceability of intellectual property rights (IPR) and digital rights management (DRM) laws. Content Piracy is a major problem in media, which brings down the profitability of the industry. A profitable industry would attract more developers and thus make more content available, which will bring in tougher competition resulting in a drop in rates.

- Banks can extend their services through aggregators or can enter into direct agreements with mobile companies to form joint ventures for micro credits and other services. Fair revenue sharing mechanisms. A fair revenue sharing mechanism and a viable & sound business model for all the stakeholders shall make m-Commerce attractive for all players.

- Telecom companies, if included, as Business Correspondence will involve them more actively in promotion of m-Commerce services in India. Though RBI has permitted non-bank entities[5] including Mobile service providers(MSP) to issue mobile based prepaid instruments, but MSPs have not shown their interest in it.

- A proper grievance handling mechanism will help address the customer problems and will develop trust in them. Customers who believe the process has not worked fairly for them should be able to request clarification, complain, or otherwise seek redress. Claims could be made directly to the Bank rather than through the Agents, and claims should be dealt with through a well-defined process that specifies roles, responsibilities, and expected timelines.

- Security issues as mentioned in the earlier chapter need to be looked. It is also necessary that the infrastructure supporting m-Commerce is protected from the attacks. Technical protection and isolation of internal systems and of the network itself will be necessary in view of the greater exposure through public networks access. The issues of protecting customer's data and financial transactions and to ensure the integrity of billing mechanisms and certifications services must also be addressed. Firewalls, access control, monitoring and detection systems have little values unless they are configured, maintained and operated properly.

6.4 Presently m-Commerce in India is done through the banks only. For financial inclusion of the masses, which does not have bank accounts, it may be necessary that access to basic Banking services be give to the unbanked & rural population of this country by means of an

[5] http://www.rbi.org.in/scripts/BS_ViewBulletin.aspx?Id=10854

easy to access and an affordable delivery channel i.e. a mobile phone.

6.5 International success of as G-Cash (Globe Telecom) in Philippines and Mpesa (Safaricom) in Kenya proved that mobile phones successfully contributing to financial inclusion to the disadvantaged and weak section of the society which may not have bank account. These services in these countries have clear cut objectives in terms of what they want to offer to the masses.

Conclusion: - It is well recognized that mobile phones have immense potential of conducting financial transactions thus leading the financial growth with lot of convenience and much reduced cost. For inclusive growth, the benefits of m-Commerce should reach to the common man at the remotest locations in the country. For this all stakeholders like Regulators, Govt, MBAS, telecom service providers and mobile device manufactures need to make efforts so that penetration of m-Commerce reaches from high-end to low-end users and from metros to the middle towns and rural areas. Inclusion of non-banking population in financial main stream will benefit all. There is also need to generate awareness about the m-Commerce so that more and more people use it for their benefit.

With the advanced technologies like 3G and BWA expected to come soon, there will be a larger window to innovate service delivery. Performance(QoS) of mobile services with 3G will improve and accessible data plans will be available, it will have positive impact and will result in attracting more customers to the era of new world where cash/paper transaction is replaced by the m-Commerce.

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MOBILE BANKING ECOSYSTEMS IN THE DEVELOPING WORLD: A CRITICAL REVIEW

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ABSTRACT
M-Banking has been touted as revolutionary in the developing world with its capacity to extend financial services access to the formerly unbanked. Extant literature explores the detailed development and implementation of M-Banking applications, and the generalized enabling environment for their successful deployment. However, inclusive accounts combining both these angles that comprehensively assess M-Banking ecosystems are scarce, and this paper seeks to address that. It presents a detailed analysis of four individual M-Banking case studies, representing three different countries and hence regulatory frameworks, to guide evolving M-Banking applications. The case studies as well as the visually representative models are informed by the current literature. In doing so valuable lessons are imparted.

INTRODUCTION
Until recently mobile phones were diffusing more rapidly in developed nations; however this has seen a shift and mobile networks have since been rapidly expanding in low-income and middle-income countries. Affordable mobile handsets, low-value prepaid cards and greater coverage have introduced telephony into the lives of millions of first-time users, and it seems unlikely that this trend will abate anytime soon. Interestingly, there is evidence that suggests that a significant proportion of these mobile phone users in emerging economies around the world are also "unbanked", or lack access to formal financial services. Indeed, it is speculated that there exist more people with mobile connections than with bank accounts across the developing world.

Following in the footsteps of the mobile revolution, innovative ventures have been launched in emerging economies the world over which seek to deliver financial services to the unbanked populations. These services typically include long-distance remittances, micropayments, and micro-transfers in alternative currencies where airtime in a handset can replace or augment cash holdings. The mobile phone platform reduces the cost of delivery of the financial services, both from the provider end - by lowering the costs of building and maintaining a traditional bank branch network, and from the customer end - by lowering the costs of accessing these services. These advantages can accelerate the access to financial services on the back of the mobile infrastructure. This form of banking is defined as Mobile Banking, which is a subset of electronic banking that underlies not only the determinants of the banking business but also the special conditions of mobile commerce.

This paper provides a comprehensive literature review of the mobile banking solutions that exist in the developing world today, not as pilots, but as full-fledged commercially successful systems. It is divided into three major sections. The first section will review the models and theories across streams of literature – drawing primarily from the M-Commerce/M-Banking literature.

The second section will provide four case studies of successfully deployed M-Banking systems in three countries – Kenya, South Africa and the Philippines. The general trend in the developing world M-Banking literature is to either provide a detailed insight into the individual applications, else assess the enabling environment factors. However, this paper attempts to include both angles to present a visually representative model of mobile banking ecosystems. Intuitively, the green and red colors have been chosen to provide at a glance the enabling and the impeding factors in the ecosystem. The models have been informed by the literature. Because of the scope of the paper however, only four M-Banking applications were chosen albeit with care to include as many parameters as possible, thus serving as a guidance for evolving M-Banking applications. For instance, three different countries are represented and not four because it was necessary to compare two different applications in the same working environment of a country. Further, the Philippines is a

middle-income country and has a tight regulatory structure, as opposed to Kenya which is a low-income country and has an uncertain regulatory environment. Ownership has also been differentiated according to the pure network operator ownership, the partnership of a network operator with a bank, and a third-party model [8]. However, what is common across these countries is that all of them have seen massive mobile network growth, while their banking sectors languish in comparison. The former seems a prerequisite for the M-Banking initiatives to emerge, whereas the latter can drive the need in the market.

The case studies are first assessed according to the M-Banking application itself. The type of service, underlying technology, the actual services delivered, the distribution networks (which can client-based or network-based [2]), and their interoperability (which can be either transactional where users can transact with any other user in the environment, or operational where users have the privilege to choose the financial system they want to use irrespective of the network operator) are all assessed and tabulated for a visual representation. This model in turn is informed by the Models and Theories section. Next the enabling environment in which the M-Banking application exists – primarily the telecom, banking and M-Banking sectors, is evaluated, followed by an overview of the regulatory environment. Together, the M-Banking application along with the environment it thrives in forms the M-Banking ecosystem.

Finally, the paper will be concluded with the Discussion and Limitations sections.

MODELS & THEORIES

It is widely predicted that **M**obile **F**inancial **A**pplications would likely constitute one of the most important components of m-commerce [12], although a few contend that the status of its current research is at best *explored* and not *abundant* [6]. MFAs broadly comprise of applications such as *mobile banking and brokerage service, mobile money transfer, and mobile micro-payments* [12]. Mobile payments can be further classified as *machine-interactive* and *goal oriented*, where the former parameter indicates the interactions between people and the medium, and the latter refers to the utilitarian benefits that the service offers [5]. This classification offers insight into the directions that future research can develop in [6]. The network architecture, that characterizes how these mobile payment services will be delivered over the mobile network, adopts two models – *the Access Model*, and *the Hybrid Model* [7]. In the access model the network provides the front-end to the underlying SMS system that is linked to the bank's own system. While the participating bank system handles the back end, the interface system maintains the security measures in place, the transaction routing, and the management of the SMS responses. The hybrid model in contrast has the network operator being more involved in the provision of the services. [7].

However, the paradigm that asserts the two models of mobile banking – the *additive* model and the *transformative* model, are of special interest to this paper [8]. While in the former the mobile phone serves as an additional channel to an existing bank account, in the latter the financial product is linked to the use of the phone and is targeted at the unbanked, who are largely low income people [8]. This paper is concerned with transformational models, or at least those mobile banking applications that have the potential to be transformational, and its visual models are informed by the model described in the aforementioned paper.

M-PESA

M-Pesa was developed by the Vodafone Group with initial support from DFID's *Financial Deepening Challenge Fund*. Indeed, the external challenge fund was critical in relieving the internal competition within Vodafone and redirecting its energies towards a development market proposition with potential long-term value. Initially, launched as a micro-loan repayment service during the pilot phase, it was officially released in 2007 as an innovative person-to-person payment service by Safaricom, Vodafone's country operator [3]. Today, M-Pesa facilitates branchless banking via the mobile phone by offering financial services such as *account balance check, deposits and withdrawals, and money* and *phone credit transfers* [4]. M-Pesa is especially encouraging small businesses and domestic remittance trends through its person-to-person money transfers [3]. In fact, Vodafone has now launched a pilot with Citigroup to explore international remittances from the United Kingdom to Kenya by mobile phone, only reflecting the potential of services like M-Pesa to extend remittance services to millions of people in remote areas [9]. Eventually, M-Pesa aims to serve customers who are *unbanked, unconnected, often semi-literate, and who face routine challenges to their physical and financial security* [3]. The M-Pesa application is depicted in Figure 1.

The mobile telephony market in Kenya has opened up in recent years owing to *progressive government actions on equipment taxes and approval, active competition, and the entry of private sector capital* [11], and despite its inferior telecommunications infrastructure and relatively higher costs of mobile handsets and connections [10], more and more people are adopting and acclimatizing to this technology. In contrast, the banking sector, with its poorly developed infrastructure, has failed to improve its penetration with claims that as much as 90% of Kenyans lack access to formal banking services [8]. Thus, Kenya is at a juncture where more of its citizens have access to mobile phones than access to banking services, thus paving the way for M-Banking solutions. Interestingly, Kenya provides an environment that lacks unambiguous legislative

and regulatory ratifications, and thus rarely impedes the entrance of a new enterprise. However, important areas such as E-Commerce, AML/CFT etc are still at the draft or bill phase and innovators must bear this in mind. A DFID report provides a comprehensive database of information on existing and intended legislation and regulations [8]. Figure 2 has been informed by it.

Safaricom has kept the dialogue channels with the regulators open, and has established a direct relationship with the Central Bank. Although M-Pesa's accounts have been carefully structured so as to avoid constituting a *banking activity* under the Kenyan Banking Act [13] thereby escaping the Central Bank's formal banking regulations, it willingly performed in an audit and continues to provide regular reports to them [1]. Such bilateral engagement with the regulators can ensure that even in an uncertain market enterprises can thrive and yet not exploit its clientele. However, what is of concern in this particular case is that while M-Pesa, along with the Commercial Bank of Africa, undertake the legal liability on behalf of their clients, the fine print in the account holder agreement explicitly states that *Safaricom bears no responsibility or liability for any default or negligence on the part of agents providing M-PESA services* [13]. This is worrying in an environment where no specific rules exist about an agent's ability to accept and deposit cash on behalf of the M-Banking service provider.

WIZZIT & MTN BANKING

Wizzit

WIZZIT was initially planned as a division of the South African Bank of Athens, although currently the WIZZIT brand is actually owned and operated by a separate entity started by independent entrepreneurs. However, the South African Bank of Athens remains legally liable for all WIZZIT accounts, and offers them access to the traditional e-payments system of South Africa [8]. Commercially launched in December 2004, WIZZIT aimed to target low-income customers and provide them with an interest-bearing bank account that was accessible through their mobile phones [18]. The need could easily be recognized in South Africa where an estimated 16 million people are fully unbanked, whereas an estimated 20 million are mobile phone subscribers, most in the low-income segment [15]. Moreover, the cost of activating a Wizzit account is one-third lesser than that of opening a traditional bank account [18]. Currently, clients can use their phones to *make person-to-person payments, transfer money, buy airtime for a prepaid mobile phone subscription, pay bills, and achieve full transactional and informational banking* through their mobile phones [14]. Wizzit account holders also receive interest on balances over USD 682 [18]. It has been found though, that the average WIZZIT clients bought airtime twice as often as they withdrew funds from a branch or ATM, and five times as often as they made a money transfer [15].

While many WIZZIT customers are indeed poor, they do not constitute South Africa's poorest. In a survey conducted with WIZZIT users, early adopters were found to have *more income* and *assets* and were *financially* and *technologically more sophisticated* even amongst the low-income South Africans [18]. However, WIZZIT hires WIZZkids who are agents certified to open bank accounts, and are often previously unemployed youth. These WIZZkids typically reside in the same communities from which potential WIZZIT customers are recruited and can thus, provide the highly valued human-interaction element by educating and training potential clients. The network of WIZZkids also allows WIZZIT to undertake **K**now **Y**our **C**ustomer requirements. This face-to-face contact could to a degree achieve identity checks of potential customers [16]. In fact, WIZZIT employs more stringent KYC checks for account balances that are greater than ZAR 25,000 or transactions that exceed the value of ZAR 5,000 [2].

By May 2007 WIZZIT served 100,000 active users [17]. This is a far cry from the 16 million potential customers that lack access to basic banking services. One of the reasons could be the pricing strategies that WIZZIT employs for its basket of services. In a comparative study conducted across six different branchless banking pioneers, it was found that a client who engages in WIZZIT's range of banking services would spend as much as 3.5% to 6.4% of the poverty line. This is significantly off the 2% threshold that would make the service truly affordable to the poor [18]. However, WIZZIT is a relatively cash-poor start-up and mobile banking is their primary business. It is possible that to hedge the losses incurred among the low usage clients, WIZZIT levies higher service fees across various transactions. The WIZZIT application is summarized in Figure 3.

MTN Banking

In 2005 MTN, one of the largest mobile operators in South Africa, acquired a customized technology solution offered by Fundamo and entered into a 50-50 joint venture with the Standard Bank to open the MTN Banking company that offered the Mobile Money service. It offers a bundle of a new debit card-based account with the traditional m-banking features. This includes a complete suite of services – *domestic money transfers, bill payments, prepaid airtime purchases, mini statements and balance enquiries* [14]. The joint venture is a step forward in the Standard Bank's agenda to fulfill the government's requirement of ensuring that banking services are made accessible to the historically disadvantaged [19]. Also, the joint ownership automatically enables the product to operate under the existing license of the Standard Bank. Thus, the Standard Bank assumes responsibility of adhering to the Central Bank's

requirements [20]. Customers who register with MTN Banking are therefore, automatically assigned a bank account at the Standard Bank, although these are capped in terms of the total monthly transaction volume and the maximum account balance [15].

The starter packs are distributed through MTN and Standard Bank distribution points and can be collected on showing a valid South African ID document. The Mobile Money solution complies with the Central Bank's as well as the **F**inancial **I**ntelligence **C**entre **A**ct's (which is the anti-money laundering legislation in South Africa) regulations, thereby simplifying its rollout and deployment for both MTN as well as the Standard Bank [22]. However, similar to WIZZIT's KYC procedures, Mobile Money accounts with higher balance limits will undergo proportionate KYC scrutiny in compliance [14].

Interestingly, MTN Banking brings in the concept of *Operational Interoperability*. By leveraging its brand and distribution channel, it seeks to compete with other South African banks. Effectively, this signifies that Mobile Money will provide its users with access to all the banks in the market, as well as the option to be banked by them in accordance with their own propositions. Indeed, it is speculated that this feature, combined with the ability to transfer cash to other banked customers, indicates the beginning of unqualified interoperability [14]. This is summarized in Figure 4.

Enabling Environment

South Africa boasts of one of the largest telecommunications market in the world [21]. With the opening up of the market to competitors South Africa boasts of 20 million mobile phone subscribers [15]. But the government is planning to deregulate the telecom sector further, and impress more stringent Universal Service policies [25]. Predictably this should reverse the slowing down of the penetration numbers, as some evidence suggests [8]. The banking sector, conversely, has failed to maintain its uptake and an estimated 16 million people (48%) have little or no access to banking services [15] despite the emphasis on universal banking. It however is relatively stable, especially after the banking crises the country faced in the 90s [24].

Indeed, more than a quarter of unbanked adults in South Africa already use or have access to a cell phone. Evidently, there is a need in the market to provide more inclusive financial services to the disadvantaged that M-Banking services seek to fulfill. The South African policy environment has been defined as more *certain*, although it is less open to new enterprises [8]. Figure 5 provides data regarding the regulatory environment currently prevailing in South Africa.

MTN Banking can be treated as marginally more successful than WIZZIT possibly because it capitalizes upon MTN's vast mobile network. Their M-Banking co-existence, along with Celpay, is proof that closely regulated markets may not necessarily deter branchless banking initiatives as long as the providers and regulators acknowledge the difference between small and large valued transactions, and regulate accordingly. For instance, proof of residence to open M-Banking accounts is no longer required in South Africa as long as transaction limits are maintained. Further, no clear regulations exist regarding agents' handling of cash on behalf of the providers in South Africa as well. But since the WIZZkids network comprises of WIZZIT employees, it indicates that any mishandling or indiscretion on their part would in fact render WIZZIT liable.

GLOBE G-CASH

GLOBE Telecom launched its G-Cash product in the Philippines in October 2004. G-Cash is essentially an SMS-based technology application that provides mobile money remittance and payment service; it also supports a wide basket of services as *cash deposits, cash withdrawals, transfer of credit to the prepaid account, transfer of airtime credit, cashless purchases, direct credits from employers' payrolls, and bill payments* [7]. Philippines's telecom market is extremely mature with mobile phone penetration rates exceeding 50% [17] and mobile access rates of 95% [13] due to the low cost mobile phones available in the market, the competitive pricing of SMS messages, the limited penetration of landlines, and the new government policies that have rendered the market open for the telecommunications sector. The country also has a well-developed m-commerce environment that took off in 2000. Between GLOBE Telecom and SMART communications, they share and control almost the entire telecom as well as m-commerce sector in the Philippines. The enabling environment is summarized in Figure 7.

Philippines has a history of being blacklisted by the **F**inancial **A**ction **T**ask **F**orce for failure to comply with their prescribed AML/CFT regulations. Eventually, they were cleared but not without tightening their AML/CFT enforcement. These regulations are mandated by the **B**angko **S**entral ng **P**ilipinas, which is the central bank, although the Philippines provides a cohesive environment wherein GLOBE can work with the BSP and the **A**nti-**M**oney **L**aundering **C**ouncil to control cash in and cash out, and the amounts transferred [13]. Currently, GLOBE's G-Cash is regulated as a **M**oney **S**ervice **B**usiness, or a non-bank financial institution, and has to observe account and transaction limits [13].

The cash float is retained at GLOBE's usual business bank though, although the bank maintains no knowledge of G-Cash's clientele transactions [7]. The closed system ensures that G-Cash clients stay on their unique systems, which

permits basic KYC techniques [13]. GLOBE does not support transactions between users who are not on the GLOBE network, although this is waived for overseas Filipinos. An acceptable local ID is required for any transaction to comply with the requirements of the BSP. It has been predicted that many of the 700,000 airtime loading retailers nationwide would soon be able to exclusively provide G-cash to clients [23]. The vast distribution network makes the service accessible, especially for users from remote islands who prefer interacting with familiar merchants to avail of the offered services. The GLOBE G-Cash application is depicted in Figure 6.

However, estimates claim that the majority of the approximately 750 rural banks require an I.T. upgrade to participate in GLOBE's M-Banking enterprise [16]. Here the **R**ural **B**ankers **A**ssociation of the **P**hilippines **M**icroenterprise **A**ccess to **B**anking **S**ervices banks have a critical role to play. Essentially, the RBAP-MABS is the bridge between the rural banks, GLOBE and BSP. It also undertakes the responsibility of providing technical assistance and compliance knowledge to these banks that offer the **T**ext-**A**-**P**ayment – a microloan repayment service. In fact as this service gains momentum, the strong relationship between GLOBE and RBAP-MABS is touted as one of the reasons for why rural banks are slowly but surely beginning to realize the potential to serve rural clients [23].

DISCUSSION

The purpose of this paper is to identify lessons from successful m-banking models in developing countries around the world – by surveying the application itself and the enabling environment it is deployed in. This paper was especially concerned with *transformational* m-banking models that target underserved populations, thus possessing the capacity to bank hitherto unbanked populations. However, the literature perpetrates an optimistic and simplistic classification of these "banking services". Traditionally, m-banking in developing countries services its clients with micropayment and money transfer prospects, whereas other critical banking services such as loan approval and savings accrual have not yet evolved. From the case studies we see that Wizzit account holders receive interest on balances over USD 682 – a princely saving that conflicts with Wizzit's transformational outreach, and is therefore a less popular service. M-Pesa and G-Cash have successfully initiated international remittances – a service that is especially valuable for countries that boast of a huge overseas labour market, as both Kenya and the Philippines do. M-Pesa users also use the service to store money to avoid the inconvenient and dangerous travel to the commercial banks [4]. Indeed, it has been observed that the incapacity to transfer funds from sender to receiver is a prime impediment to robust economic activity [3] and enabling this can be valuable in a poorly developed and risky environment.

Interestingly, the case studies show that M-Banking ventures have flourished in both environments – in Kenya's open yet highly uncertain market, and in the Philippines' and South Africa's tightly regulated markets [8]. However, in both cases the providers established a working relationship with the regulators to achieve a common regulatory understanding. Therefore, while M-Pesa escapes the Central Bank's regulations on paper because it is not classified as a *banking activity*, it did undergo an audit to establish its safety and reliability. Similarly, South Africa was able to do away with the stringent address verification stipulation for smaller accounts, and the Philippines engaged in constant dialogue to arrive at a satisfactory solution and be removed from the FATF blacklist.

However, the issue of the agents and their capacity to handle the funds on the behalf of the providers is still ambiguous at best. While telecom giants can leverage their vast distribution network (as is the case with MTN Banking and GLOBE G-Cash) to offer their m-banking services, providers will often renounce responsibility if there is any indiscretion or mishandling of funds by these agents (as M-Pesa's contract states). This can be extremely worrying, although no clear data exists on these indiscretions if at all they have taken place. On the other hand researchers observe that agents should not be prohibited from deposit taking or withdrawals at all, in order for the M-Banking service to be truly transformational [8]. This seems viable, but some regulation must be in order. For instance, G-Cash agents in the Philippines must undergo a one-day training process in order to be certified agents. This is deemed as detrimental, as the training sessions are not geographically accessible [13]. But if this could be rectified, it might be a beginning to providing a balanced solution to the agent problem. Another option is training and maintaining in-house employees who can double up as agents, as is the case with WIZZkids.

Finally, m-banking applications need to offer low-cost services to be truly transformational. It is often challenging for an organization to direct their energies to a development market proposition that may only reap long-term returns, however an external challenge fund can go a long way in resolving this conflict as we saw in the M-Pesa case study. Studies have also warned regulators against price caps at an early stage of market development to avoid losing out on specialized companies such as WIZZIT [18]. Being cash-poor start-ups, they certainly need all the boost that they can get to extend transformative services. Certainly, it is important to recognize that transformational branchless banking models must be subject to a *rational, proportionate, and risk-based regulatory framework* to fully realize their potential [1].

LIMITATIONS

Of course, the biggest limitation of this paper is that it derives its conclusions from the literature and not empirical studies. This can have an effect on the conclusions drawn because M-Banking services are still in their early stages of deployment in many countries, although rapidly growing. Another severe limitation of this paper is that it fails to account for user-adoption in the mobile banking ecosystem. Indeed, an inclusive M-Banking ecosystem should not only comprise of the M-Banking application, and the environment it is deployed in, but also how the users have adopted it. This is evidently crucial to its success and must be borne in mind for future research, given that extant literature does not adequately concentrate on user-adoption cases.

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APPENDIX
FIGURES

MODEL	**Mobile Network Operator**	Safaricom.
	Hybrid	
	Third-Party	
SERVICES	**Mobile Banking**	
	Mobile Money Transfer	Domestic remittances, Making deposits and withdrawal, Transfer money or airtime credit to other users.
	Mobile Micro-payments	Prepaid airtime purchases, Bill payments.
TECHNOLOGY	**Network Based**	
	Client Based	SIM-Toolkit.
	Security	Two-factor authorization. Application resides on SIM.
DISTRIBUTION NETWORK	**Airtime Dealers**	Approach Safaricom's airtime dealers.
	Banks	Approach participating banks.
	ATMs/POS	Participating ATMs.
	Internet	
	Agents/Retail Outlet	Accredited agents. Participating outlets for bill payments.
INTEROPERABILITY	**Transactional**	M-Pesa users can transfer money to non-Safaricom users.
	Operational	

Figure 1. M-Pesa Application

EXISTING INFRASTRUCTURE	**Telecom**	**Penetration**	2.5 million users with 49% penetration rate.
		Strategy	Lower the costs of mobile handsets and connections [10].
		Environment	Progressive government actions on equipment taxes and approval, competition, and the infusion of private sector capital has facilitated the success of the telecom sector. Rural areas don't suffer from the lack of infrastructure, but the affordability of services to the local population [11].
	Banking	**Penetration**	90% adults unbanked.
		Strategy	Aim to formally regulate the banking sector and enhance the efficiency in service delivery [26].
		Environment	Weak financial system makes banking system vulnerable to risks & endangers financial stability [27].
	M-Banking	**Penetration**	
		Strategy	
		Environment	
LEGAL & POLICY ENVIRONMENT	**E-Money**	**E-Signatures**	Not legally recognized. Bill is pending.
		E-Money Regulations	No specific regulations.
	Agents	**Cash-In/Cash-Out**	No specific rules.
	Account Protection	**AML-CFT**	Apply only to banks. M-Pesa is not formally regulated but has a no-objection letter from the

			Central Bank of Kenya.
		KYC	Not formally regulated. Agents undertake identity checks.
	Consumer Protection	Legal Liability	Commercial Bank of Africa.
		Protection Codes	No explicit protection codes exist.
	Market Players	Competition Authority	Old Act provides limited jurisdiction.

Figure 2. M-Pesa Environment

MODEL	Mobile Network Operator	
	Hybrid	
	Third-Party	Owned and operated by a separate entity.
SERVICES	Mobile Banking	Interest accrual.
	Mobile Money Transfer	Domestic remittances. Making deposits and withdrawal, Transfer money or airtime credit to other users.
	Mobile Micro-payments	Prepaid airtime purchases, Bill payments.
TECHNOLOGY	Network Based	USSD2
	Client Based	
	Security	Two-factor authorization provided by the phone and PIN. USSD messages not stored on mobile phone. But prone to attacks [28].
DISTRIBUTION NETWORK	Airtime Dealers	Ppurchase airtime from these dealers.
	Banks	Approach Bank of Athens, Postbank or ABSA branch.
	ATMs/POS	Operate Maestro debit card at ATMs and POS terminals across the country.
	Internet	
	Agents/Retail Outlet	WIZZkids
INTEROPERABILITY	Transactional	WIZZIT offers a technical solution to any mobile phone owner.
	Operational	

Figure 3. WIZZIT

MODEL	Mobile Network Operator	
	Hybrid	Joint venture by MTN and Standard Bank.
	Third-Party	
SERVICES	Mobile Banking	
	Mobile Money Transfer	Domestic remittances.
	Mobile Micro-payments	Prepaid airtime purchases, Bill payments.
TECHNOLOGY	Network Based	
	Client Based	SIM-Toolkit with USSD as the underlying bearer [2].
	Security	SIM based application, two-factor authorization.

DISTRIBUTION NETWORK	**Airtime Dealers**	Approach any MTN dealer.
	Banks	Approach Standard Bank.
	ATMs/POS	Operate their MasterCard debit card at ATMs and POS terminals nationwide.
	Internet	Internet access.
	Agents/Retail Outlet	Approach participating agents.
INTEROPERABILITY	**Transactional**	Allows its users to transfer cash between accounts of any bank. But MTN Banking users have to be on the MTN network.
	Operational	Mobile Money will provide its users with access to all of the banks in the market.

Figure 4. MTN Banking

EXISTING INFRASTRUCTURE	**Telecom**	**Penetration**	20 million mobile phone subscribers.
		Strategy	Government proposes to deregulate the telecommunication sector [26].
		Environment	One of the largest telecom markets in the world. Biased government policies.
	Banking	**Penetration**	48% or 16 million people are unbanked.
		Strategy	Aim at one-stop relationship banking, with an emphasis on universal banking.
		Environment	Stable and open.
	M-Banking	**Penetration**	WIZZIT and MTN Banking were laucnhed in the same timeline. Encouraging uptake but not rapid.
		Strategy	Develop a central infrastructure that facilitates the *authentication, instruction, financial transaction processing and fulfillment of transaction to merchant or retailer* [30].
		Environment	Certain market, but tightly regulated.
LEGAL & POLICY ENVIRONMENT	**E-Money**	**E-Signatures**	E-Signatures are recognized by law in South Africa [8].
		E-Money Regulations	E-Money guidance exists in South Africa [8].
	Agents	**Cash-In/Cash-Out**	No specific rules.
	Account Protection	**AML-CFT**	Central Bank's and FICA's regulations are well-covered. Fundamo's solution is in compliance.
		KYC	Central Bank's regulations are well covered. Small accounts are exempt from address verification.
	Consumer Protection	**Legal Liability**	Standard Bank/ South African Bank of Athens.
		Protection Codes	Banking Industry Codes of Conduct and Ombuds process cover consumer protection in e-banking [8].
	Market Players	**Competition Authority**	Competent competition authority exists.

Figure 5. WIZZIT/MTN Banking Environment

MODEL	**Mobile Network Operator**	GLOBE Telecom.
	Hybrid	
	Third- Party	

SERVICES	**Mobile Banking**	
	Mobile Money Transfer	International and domestic remittances, Cash transfers, Cash Withdrawals, credit from employer's payroll.
	Mobile Micro-payments	Cashless purchases, Bill payments, TAP
TECHNOLOGY	**Network Based**	Native SMS
	Client Based	SIM-Toolkit
	Security	Two-Factor authorization. SIM-based application when SIM-Toolkit is utilized [2].
DISTRIBUTION NETWORK	**Airtime Dealers**	Approach any GLOBE dealer.
	Banks	Approach participating banks.
	ATMs/POS	
	Internet	Internet access
	Agents/Retail Outlet	Over 3500 accredited agents countrywide [8].
INTEROPERABILITY	**Transactional**	Transactions between Globe and non-Globe clients allowed only for overseas Filipinos.
	Operational	

Figure 6. GLOBE G-Cash

EXISTING INFRASTRUCTURE	**Telecom**	**Penetration**	50% mobile penetration rate. 95% mobile access rate.
		Strategy	Texting Capital of the world. Low-cost SMSs.
		Environment	Limited penetration of landlines. Partial government policies.
	Banking	**Penetration**	80% of the population is unbanked.
		Strategy	RBAP-MABS helping to extend services to rural banks.
		Environment	Inferior quality of the core banking systems.
	M-Banking	**Penetration**	SMART had released its m-payment service in the same timeline with immediate and rapid uptake.
		Strategy	Catering for small transaction sizes, but high transaction volume.
		Environment	BSP partnered with SMART, and allowed GLOBE to dictate certain regulatory terms.
LEGAL & POLICY ENVIRONMENT	**E-Money**	**E-Signatures**	The Philippines Electronic Commerce Act of 2000 recognizes e-signatures.
		E-Money Regulations	Regulated by BSP but almost non-existent as transaction sizes are small [8].
	Agents	**Cash-In/Cash-Out**	Not clear. Money Transfer agents receive cash from clients.
	Account Protection	**AML/CFT**	G-Cash is compliant as per the FATF.
		KYC	Circular 471 allows agents to conduct KYC checks [13].
	Consumer Protection	**Legal Liability**	GLOBE Telecom.
		Protection Codes	Circular no. 542 covers consumer protection issues [20].
	Market Players	**Competition Authority**	Competent competition authority exists as part of the Philippine Constitution drafted in 1987 [29]

Figure 7. Globe G-Cash Environment

FINAL PAPER

Proposed Title: Mobile banking & m-Commerce and related issues.

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Through this paper we would like to present the current scenario in Developed/Developing countries so as to highlight the reasons that have enabled these nations to pioneer or successfully extend m-banking & m-commerce services to its citizens. This paper also depicts the existing regulatory mechanism in the Indian context and suggests changes that will act as enablers. This includes the detailed study of RBI guidelines and its role in the m-banking ecosystem. We have studied countries like Kenya, South Africa, Japan, USA to understand the reasons behind their success of m-banking & m-commerce. We have explored the possibility of partnering with other agencies like Post Offices which are present in 89% of the rural areas and companies like BillDesk that can play an important role by becoming a third party in the eco-system of m-commerce. We have also studied the likely impact of Union Budget 2010-11 on banking sector & hence on m-commerce.

Introduction

According to the World Bank it is estimated that an extra 10 phone per 100 people in a typical developing country boosts GDP growth by 0.8% points[1]. In India the total wireless subscription as on 31st December 2009 has touched 525.15 million, with the addition of 19.1 million subscribers in same month. Our wireless tele-density stands at 44.73[2]. The total broadband subscriber base too has increased from 7.57 million in November-09 to 7.83 million in December-09, there by showing a growth of 3.56%. This shows that the basic infrastructure required for the uptake of m-commerce & e-commerce has gradually been built. But at the same time we have over five lakh un-banked villages in our country[3]. In an attempt to extend banking services in villages, banks have been trying to establish branches in gram panchayats. For example SBI had earlier entered into a Memorandum of Understanding with the Orissa Government to provide banking outposts in all 6,234 gram panchayats to facilitate Electronic Benefit Transfer of National Rural Employment Guarantee payments and other social security benefits throughout the state paving the way for financial inclusion of disadvantaged and low income groups[4].

On the mobile operator's side the picture is not rosy with average revenue per minute (ARPM) declining rapidly at 5%-6% quarter-on-quarter in 2009. Voice ARPM has declined from 75-85 paisa in the first quarter of FY08 to 45-55 paisa in the second quarter of FY10.The share of rural areas in additions of new subscribers too has increased from 25.6 % in Sept 08 to 29.8% in Sept 09[5]**.** This factor is responsible for further bringing down the ARPU.

Potential of m-commerce in India: It is estimated that out of the 321 million wage earners, all carry mobile phones, but only 40 percent are involved in the banking activities of the country[6]. 41% of the total population in India, 40% of urban population and 61% of rural population is unbanked[7]. According to financial services and research firm Celent claims, in 2010, nearly 35 per cent households registered for online banking will use mobile banking too. This will increase the mobile banking user base to 2 per cent from last year's 0.2 per cent. These facts present a great potential for mobile operators to increase their VAS revenues through mobile banking in the mobile-connected but unbanked pockets of our country. The banks too have an opportunity to extend their reach to the unbanked population through the mobile operator at a much lower cost. Once this population is served by m-banking the same service can be extended to m-commerce. The potential of m-commerce can also be understood by various examples of m-commerce deployment around the world with varied economic stature.

Present scenario in Developed/Developing counties

The pioneering step of offering m-commerce was taken by NTT DOCOMO in Japan when it offered its subscribers the service of "mobile wallet" in 2004.But, the most successful example

of mobile money is M-PESA, launched in Kenya by Safaricom of Kenya. It has about 7mn users out of population of 38mn & 18.3mn mobile handsets. The income of Kenyan households using M-PESA have increased by 5-30% since they started mobile banking. Similarly, there are many more examples of success of m-commerce around the world.

1. MTN launched Farmer's friend, phone-based agricultural-information service in Uganda
2. Google & the Grameen Foundation's "Application laboratory", or AppLab
3. China Mobile service, Nong Xin Tong, providing the same services has reached over 50mn users. It also runs a website 12582.com.
4. TradeNet launched in Ghana in 2005
5. CellBazar in Bangladesh
6. Wizzit in South Africa
7. Celpay in Zambia
8. Gcash & Smart money in Phillipines

There are more facts that are revealed after study of success stories of various countries of m-commerce. Mobile commerce means something different to each country and to each mobile network operator. There is no universal approach to the product, its deployment and its use even within a country. The uptake for mobile commerce solutions is expected to be more aggressive in lesser developed economies in near future. Some markets are dominated by the mobile operator, while others will be dominated by the banks. Still others will have a mix. The reasons for success of m-commerce in Japan & USA are:

1. Acceptability of technology
2. Minimal constraints from Regulatory
3. Same regulatory authority for IT & telecom in Japan
4. High teledensity & per capita income
5. High revenue share given to the VAS providers.

Reasons for success of M-PESA in Kenya are:

1. The unusually high cost of money transfer
2. The unusually high market share of Safaricom(80%), the main mobile operator

3. The regulator's decision to allow the scheme to proceed, even without formal regulatory approval

4. The post-election violence in the country in early 2008

Existing framework for m-banking in India

Practically, India has implemented m-banking services only and no other m-commerce service is implemented in India. Following are the guidelines given by RBI in December, 2009[8]:

1. Transaction limit: Banks are now permitted to offer this service to their customers subject to a daily cap of Rs 50,000/- per customer for both funds transfer and transactions involving purchase of goods/services. Presently, such transactions are subject to separate caps of Rs 5000/- and Rs 10000/ -respectively.

2. Technology and Security Standard: Transactions up to Rs 1000/- can be facilitated by banks without end-to-end encryption. The risk aspects involved in such transactions may be addressed by the banks through adequate security measures.

3. Remittance of funds for disbursement in cash:

In order to facilitate the use of mobile phones for remittance of cash, banks are permitted to provide fund transfer services which facilitate transfer of funds from the accounts of their customers for delivery in cash to the recipients. The disbursal of funds to recipients of such services can be facilitated at ATMs or through any agent(s) appointed by the bank as business correspondents. Such fund transfer service shall be provided by banks subject to the following conditions:-

1. The maximum value of such transfers shall be Rs 5000/- per transaction.

2. Banks may place suitable cap on the velocity of such transactions, subject to a maximum value of Rs 25,000/- per month, per customer.

3. The disbursal of funds at the agent/ATM shall be permitted only after identification of the recipient. In this connection, attention of banks is drawn to the provisions of the Notification dated November 12, 2009, issued by Government of India, under Prevention of Money Laundering Act, 2002, as amended from time to time.

4. Banks may carry out proper due diligence of the persons before appointing them as authorized agents for such services.

5. Banks shall be responsible as principals for all the acts of omission or commission of their agents.

Technical & Regulatory issues in m-Banking:

Some of the issues which RBI suggested mobile service providers & TRAI to examine are[9]

1. Facilitation of mobile banking requires tie-ups with individual service providers for enabling such services. Banks face difficulties in entering into such partnerships.
2. MSPs do not open up channels for facilitating mobile banking services by banks- Opening up USSD (Unstructured Supplementary Services Data) channel for mobile banking and enabling the accessing of mobile banking facilities through all GPRS connections.

Present volume of e-commerce transactions in India[9]

The total amount of e-commerce in India:

1. **ECS (Electronic Clearing Service)**

   The volume of ECS (Debit) transactions increased from 75,202 thousand to 1,60,055 thousand during this period.

2. **NEFT (National Electronic Fund Transfer)**

   The aggregate value of transactions increased to Rs.2,51,956 crore during 2008-09

3. **RTGS (Real Time Gross Settlement)**

   The daily average volume of transactions is 90,000 for about Rs.1,200 billion of which 82,000 transactions for about Rs.980 billion pertained to customer transactions as at end of August 2009.

Study of government initiative as mentioned in Union Budget & Economic Survey[10]

The Government is also committed to GDP growth which is evidenced in its Union Budget 2010-2011. For overall growth it is also required that banking sector financial inclusion along with growth in telecom sector may bring more benefits to society at large.

Financial inclusion is seen as a major factor for overall economic growth as it indicates inclusion of those who have been deprived of banking system. The barriers evidenced in financial inclusion are – awareness of banking system, financial literacy & spread of

knowledge of banking system among the citizens especially at rural areas and partly at urban and semi-urban area.

The financial inclusion which may contribute to overall GDP growth can be achieved partly with the help of m-banking coupled with m-commerce.

According to RBI guidelines, "mobile banking transactions" is undertaking banking transactions using mobile phones by bank customers that involve credit/debit to their accounts.[11]

Related to Banks:

a) Banking Licenses: RBI is considering giving some additional banking licenses to private sector players. Non Banking Financial Companies could also be considered, if they meet the RBI's eligibility criteria. The commitment to growth in banking sector along with allowing mobile banking will help to achieve the objective.

b) Public Sector Bank Capitalization: Rs.16,500 crore provided to ensure that the Public Sector Banks are able to attain a minimum 8 per cent Tier-I capital by March 31, 2011.

c) Recapitalization of Regional Rural Banks (RRB): Government to provide further capital to strengthen the RRBs so that they have adequate capital base to support increased lending to the rural economy.

Related to Financial Inclusion:

a) Appropriate Banking facilities to be provided to habitations having population in excess of 2000 by March, 2012.

b) Insurance and other services to be provided using the Business Correspondent model. By this arrangement, it is proposed to cover 60,000 habitations.

c) Augmentation of Rs.100 crore each for the Financial Inclusion Fund (FIF) and the Financial Inclusion Technology Fund, which shall be contributed by Government of India, RBI and NABARD.

Rural Development:

a) Rs. 66,100 crore provided for Rural Development.

b) Allocation for Mahatma Gandhi National Rural Employment Guarantee Scheme stepped up to Rs.40,100 crore in 2010-11.

c) An amount of Rs.48,000 crore allocated for rural infrastructure programme under Bharat Nirman.

Other relevant Scheme:

a) A new initiative, "Swavalamban" will be available for persons who join New Pension Scheme (NPS), with a minimum contribution of Rs.1,000 and a maximum contribution of Rs.12,000 per annum during the financial year 2010-11, wherein Government will contribute Rs.1,000 per year to each NPS account opened in the year 2010-11.

b) Allocation of Rs.100 crore made for this initiative. Rs 1,900 crore allocated to the Unique Identification Authority of India (UIDAI) for 2010-11. UIDAI will be able to meet its commitments of issuing the first set of UID numbers in the coming year.

c) . A Technology Advisory Group for Unique Projects (TAGUP) to be set up to look into various technological and systemic issues for effective tax administration and financial governance.

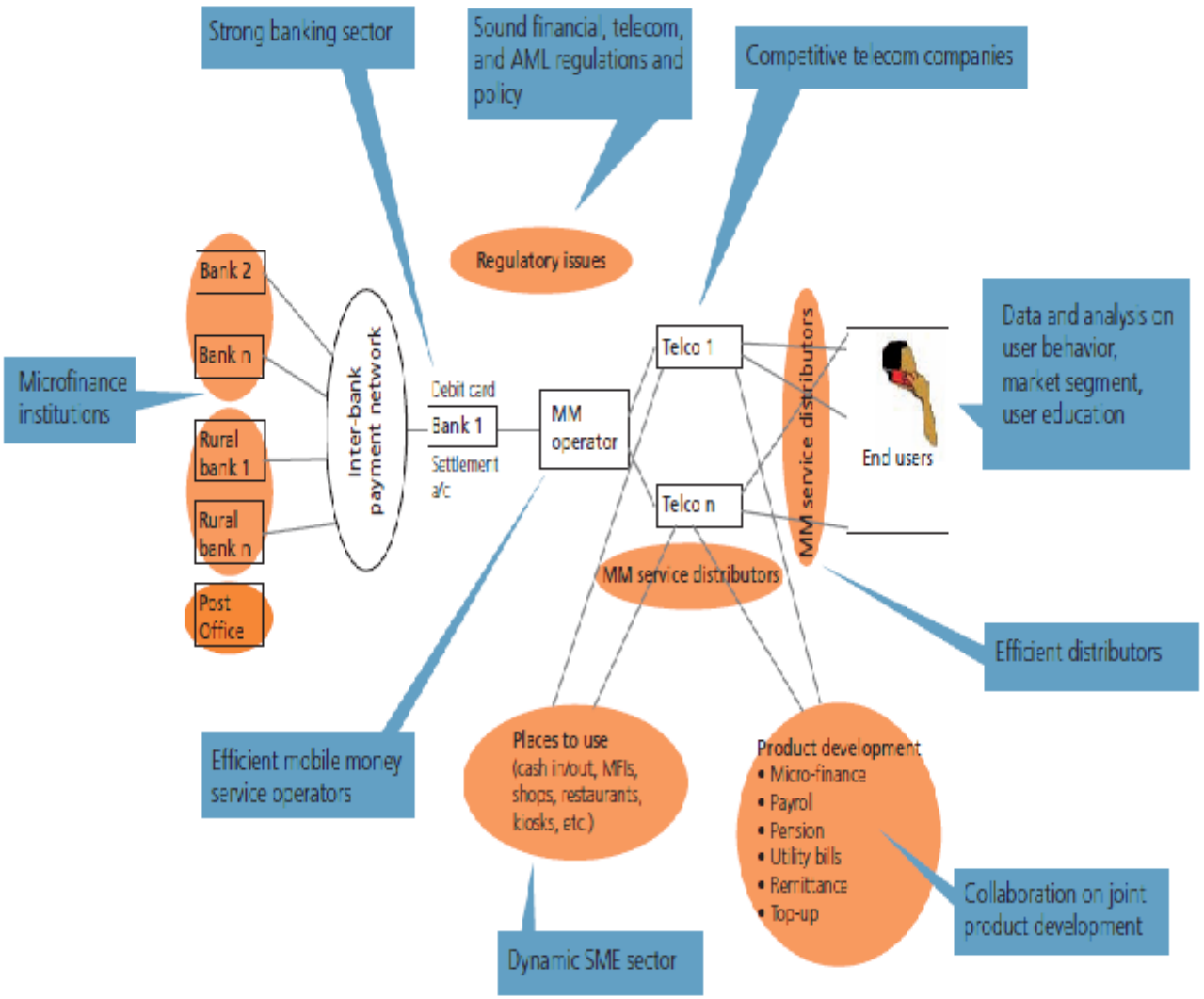
To make these initiatives deliver, certain changes are recommended

Stage 1 services – Financial literacy based – can be provided by bank along with telecom operators. The VAS provider may help them building financial literacy. This can be typically enhanced and channelized through various primary schools teachers at rural and remote levels. Even NGOs can act as financial literacy intermediary (Allowing companies under Section 25 of the Companies Act to work in these areas or even as BC.) In the days to come like Computer literacy acted as a major force, mobile literacy may act as replacement. Further to it overall literacy and education through mobile is helpful. Once this stage is achieved, a base can be created for subsequent development. VAS providers & telecom operators may sell their services to earn their pie and banks and other financial intermediaries will have to wait till subsequent stages implementation. As per the RBI initiatives it has already undertaken a project titled "Project Financial Literacy" which may be in line with above.[12]

Stage 2 – **Information based services** like balance enquiry etc.

Stage 3 Services – Savings based – The money saved is money earned. Special efforts will have to be made to initiate and enhance savings base at these areas. The savings at bank level can be enhanced through mobile operators where operators can act as agents and banks will be the recipient of deposits. There are various schemes which help rural population to earn minimum wages, through self employment, or other means, the money earned / generated at these areas can be channelized to banks through intermediaries. E.g.: Pigmy Deposit – A daily savings scheme at your doorsteps. Banks may also use the services of Business Correspondent appointed in compliance with RBI guidelines, for extending this facility to their customers.[11]

The process implies in the following diagram as



Source: IFC

Citizens – Money collecting agent having mobile handset and license to act as intermediary – Bank branch – banks – Money may come in the economy

A basic saving account with bank is a necessity which would lead to safety of funds, security for future along with earning interest on it on daily basis. (www.rbi.org.in notification dated 04th March 2010 & 19th February 2010)

If such unbanked population is covered by telecom operators along with licensed intermediaries (Business correspondents) vide RBI guideline January 2006, then the proportion of unbanked population will be reduced since such population can be covered through mobile operators along with licensed intermediaries. The normal route of channelizing the savings along with constant financial literacy will lead to offering more banking products to citizens which may be in the form of Fixed Deposits, Recurring Deposits and other schemes which will increase the liquidity base for banks, increase savings at poor level, they will earn interest on the same and it will ensure the future for them. The telecom operators and VAS providers will be facilitators which may have to design their business model. (Ref: August 2008: Banks can engage companies registered under Section 25 of the Companies Act, 1956, as Business Correspondents (BCs) provided in such Section 25 Companies NBFCs, banks, telecom companies and other corporate entities or their holding companies do not have equity holdings in excess of 10 %.)

Stage 4 Other Services leading to Savings – At a later stage a few more schemes can be offered which are;

- Mutual Fund
- Insurance
- New Pension Scheme which is an excellent opportunity

However, only those banks who have implemented core banking solutions would be permitted to provide mobile banking services[11].This may limit the penetration of m-banking & m-commerce since all the banks that have rural presence may not have core banking solution.

Stage 5 Remittances – It carries more risk as compared to above models. For this existing RBI guidelines are sufficient. Over a period of time growth in micro finance is also expected.

For e.g.: State Bank of India has gone ahead with above and has plans for the same. Bank has designed and implemented SBI Tiny Card savings bank accounts based on smart card based technology, operated with fingerprint identification. The process works through POS comprising of a mobile phone, fingerprint scanner & printer. The technology will support opening and operation of Saving, Recurring Deposits products and remittance products.

Stage 6- Offering of Credit and loans and advances against their deposits and / or offering other banking products to this citizens.

Mobile – banking alliance – If the banks partner with mobile operators then it will help them to penetrate at rural areas. If mobile operators tie up with banks for mobile payments then for banks mobile operators can act as intermediaries for collecting the savings and other banking transactions. Point of sale terminals, biometrics and smart cards can be offered subsequently.

Even though on different savings scheme as mentioned above the nominal rate of return is same for all citizens, rural unbanked population is likely to gain advantage since the tax rate will be nil and inflation rate may be lower to the exclusive advantage to rural citizens.

Information Security is most critical to the business of mobile banking services and its underlying operations[11].

Banks offering mobile banking service must ensure that customers having mobile phones of any network operator is in a position to avail of the service. The visionary objective may be total financial inclusion irrespective of banks and mobile operators (like interbank transactions shall also be permitted).

Existing framework for m-commerce in India

From the literature available it is clear that only concerns involving m-banking has been addressed by the banking regulator, the RBI. For other areas like digital rights Management, copyright issues, invasion of subscriber privacy, unfair trade practices etc have not been debated or researched on.

To understand the role & scope of the various sector regulators we need to first understand the scope of m-commerce and e-commerce.

M-commerce has been defined as "any transaction with a monetary value that is conducted via a mobile telecommunication network"[13]. In a very broad sense m-commerce includes all services that can be initiated over mobile devices such as voice telephony, SMS-based services, internet access on mobile, payments for goods and services through mobile, services over local radio systems like Wi-Fi, Bluetooth, NFC etc[13].

Electronic- commerce signifies an "anytime access" to business processes, however the access to computer networks is stationary. The services are not completely independent of the geographic location of the user[13] and most importantly the user has to possess certain basic operating knowledge of computers & the internet.

M-Commerce signifies an "anytime and anywhere access" to business processes. The access takes place using mobile communication networks, making availment of these services independent of the geographic location of the user [Hohenberg and Rufera, 2004].

The key difference between the two is that for m-commerce the user neither needs knowledge about internet/PC nor does he need to be an expert with his handset. The user can still avail the services just by following the guidance provided through an Interactive Voice Response (IVR) system. So, the mobile operator or the mobile payment platform provider should not treated merely as a conduit like is the case with the internet. The RBI guidelines on mobile banking provide specific instructions for banks[14]. We feel there is a need for such guidelines for telecom operators, mobile payments gateway providers and any other members in the value

chain. During the period 1997-2002 when incumbents had different interconnection agreements with different mobile operators the TRAI intervened and issued a reference interconnect agreement.

Since the value chain for m-commerce is much unorganized here too we feel the TRAI should intervene and provide a reference VAS agreement to be signed between the various members of the value chain and the telecom operator.

Post 3G auction when the m-commerce will find more acceptance among the users it may be used for other purposes like content download, banking, advertising etc. These services fall outside the scope of regulation of the TRAI. And so in the event of a dispute co-ordination among the various ministries and the sector regulators will be required. Moreover some services may involve the approval of more than two ministries (e.g.: for offering movie download service we may require approval of I&B ministry and telecom). For overcoming similar problems in wireless installations the DoT under the purview of WPC has constituted Standing Advisory Committee on Frequency Allocation (SACFA). The SACFA has members from DD, AIR, WPC, ISRO, Defense etc. Each of these members issue a No-Objection Certificate for the particular installation after which the installation can be commissioned.

In the convergence of device & services there is scope of unfair trade practices hence the need for involvement of MRTPC or Competition Commission of India.

The Ministries /Regulatory bodies that will play key roles in m-commerce are[15]:

- Ministry of Information and Broadcasting (content),
- Ministry of Communication & Information Technology
- Reserve Bank of India (Finance),
- Telecom Regulatory Authority of India (carriage),
- Advertising Council of India (advertisements),
- Securities and Exchange Board of India (capital markets),
- Competition Commission of India

We suggest that Advisory Committee on m-commerce should be constituted under the chairmanship of TRAI comprising of representatives of each of the above mentioned bodies. This committee will approve various m-commerce services that the service providers wish to provide.

Initiatives from Indian mobile operators/banks

1. MTS India, the Mobile services brand of Sistema Shyam Tele Services Limited (SSTL) roped in UTIBA the global supplier of mobile financial transaction platforms, to offer electronic top-up option on prepaid recharge and range of m-Commerce value added services to its CDMA Mobile subscribers across India[16].
2. State Bank of India in association with GE Capital has launched mShop to enable its customers shop from over 100 merchants across the country, using their mobile phones[17].
3. A pilot project on m-commerce is started by collaboration of Nokia, Yes Bank & Obopay in Pune. As per our observation, people have shown a lot of interest in these services. Their major concerns are how easy it is to operate & what are their transactions secure.

Key Concerns

1. Issue of ownership of customers
2. Security Concerns
3. High Transfer Charges
4. Changes in revenue sharing model between the VAS provider/bank and the telecom operator.

Recommendations

1. As suggested earlier, an Advisory Committee for M-Commerce should be set up
2. Guiding principles from TRAI for telecom
3. Security involving UID should be implemented fast
4. The concept of Virtual SIM card should be explored & adapted to the Indian market.

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Short Messaging Service (SMS) Based Diseases Surveillance System under Integrated Disease Surveillance Project (IDSP) in Andhra Pradesh India (A Case Study)

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Key Words: Short Messaging Service (SMS), mHealth, State Disease Surveillance Projects; Cost Effective; Disease Outbreak Response.

There is mounting interest in the field of mHealth - the provision of health-related services via mobile communications - which has the potential to extend benefits to the masses. This can be traced to the evolution of several interrelated trends. In many parts of the world, epidemics and a shortage in the health care workforce continue to present grave challenges for health care systems. Yet in these same places, the explosive growth of mobile communications over the past decade offers a new hope for the promotion of quality healthcare. Among those who had previously been left behind by the 'digital divide,' billions now have access to mobile phones.[1, 2]

Public health surveillance is a crucial component of public health programs. Policymakers and health providers at the global, national and community level need accurate and timely data in order to gauge the effectiveness of existing policies and programs as well as to shape new ones. Surveillance systems in developed and developing countries suffer from a number of common constraints, including lack of human and material resources in addition to weak infrastructure. However, these constraints are more pronounced in developing countries, which bear the greatest burden of disease and where new pathogens are more likely to emerge, old ones to reemerge, and drug-resistant strains to propagate.[3-7] Weaknesses in these countries' surveillance systems thus substantially impair capacity to understand, detect, and respond to infectious disease threats.[3] In the developing world, collecting field information is particularly important since many segments of the population are rarely able to visit a hospital, even in the case of severe illness. This information should ideally be updated and accessible on a real-time basis. But heavy burden on the health care system and its demand on scarce health care resources create a vicious cycle compromising surveillance systems of these developing countries.[3, 6]

In many nations paper-based surveys must be submitted in person and manually entered into a central health database. Recent evidence from small scale pilots in developing countries have shown that the data collection process can be more efficient and reliable if conducted via mobile phones rather than in the previous paper based format [8]. There is a growing body of evidence that demonstrates the potential of mobile communications to radically improve healthcare services—even in some of the most remote and resource-poor environments. There are a number of mHealth initiatives in public health currently being piloted and used. Among these mHealth initiatives, Short Messaging Services (SMS) stands out as being the most advantageous in terms of its cost-effectiveness, scalability, convenience, broad reach, and widespread popularity in the developing world.[1] SMS alerts have proven particularly effective in targeting hard-to-reach populations and rural areas where the absence of clinics, lack of healthcare workers, and limited access to health-related information all too often prevent people from making informed decisions about their health. These initiatives are closing the information gap that currently exists for patient data in the developing world, enabling public officials to gauge the effectiveness of healthcare programs, allocate resources more efficiently, and adjust programs and policies accordingly.[1]

Considering the mounting evidence supporting the use of mHealth in overcoming operational challenges, the Indian state of Andhra Pradesh moved forward in utilizing such innovative technology by designing and using a SMS based surveillance system. This SMS based surveillance system is an attempt to capitalize on the exponential growth in numbers as well as reach of the mobile phones in the state to overcome operational challenges being faced by the IDSP. The SMS based surveillance system for IDSP in Andhra Pradesh is designed locally at the state level by a collaboration of Directorate of Health Services, Andhra Pradesh and the National Informatics Center (NIC) – Andhra Pradesh State Cell. Monitoring and evaluation technical support for the project is provided by the Public Health Foundation of India (PHFI), Indian Institute of Public Health (IIPH) - Hyderabad. The system uses simple alpha-numeric codes to collect information of the prescribed IDSP formats from the reporting units across the state to a central server at the state capital. For security of the confidential information being transmitted, the system identifies every reporting unit with a unique identification number and the SMS are accepted only from registered mobile numbers. The system sends out automatic alerts to registered mobile numbers of concerned officials whenever the frequency of particular events cross pre-set threshold levels.

In August 2008, Andhra Pradesh's IDSP unit started a SMS based surveillance system as a pilot in 6 of its 23 districts. Health workers in 3832 hospitals and health centers (known as 'reporting units' in the surveillance system), across these 6 pilot districts began using this system to send IDSP reports. Informal review of the system showed some promising results like: 1) improved reporting from the hard to reach areas, 2) automatic acknowledgements to the health care workers sending reports, 3) generation of automatic alerts to the concerned officials, 4) reduced burden on the health system in terms of man-days saved from paper based reporting and 5) a decrease in spending on stationery and postage of manual reports. As a result of the promising results from the pilot of the system, the state IDSP program rolled out the SMS surveillance system to about 16,000 reporting units in the IDSP across all 23 districts in the state.

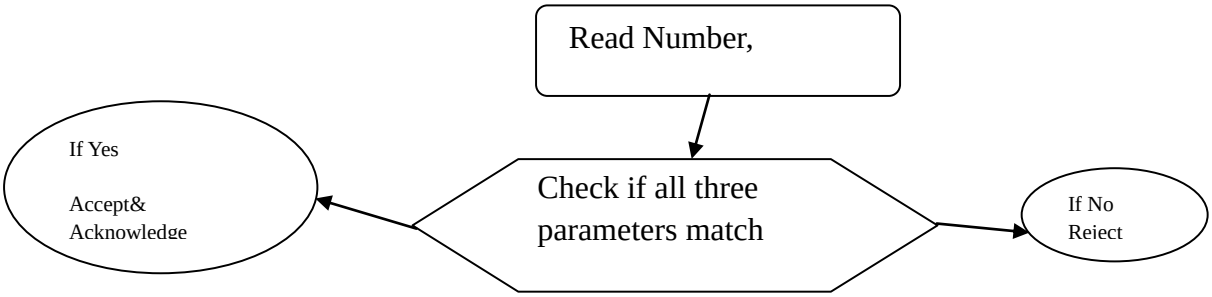
In the conventional paper based surveillance system the reporting was done manually or semi-automatically. i.e. entirely by post or in person to the district level surveillance unit. From the district centre the data used to be consolidated and sent to the State level surveillance unit by email or by fax. Usually the information about the health events used to take a few weeks of time to travel from the field level to the State level.

In the mhealth surveillance system, the field level health workers were given a messaging template, or midlet is stored in the jvm enabled mobiles of the users to capture the data with menu driven interfaces and convert into an SMS. The SMS thus created is sent a central gateway, which intern gets processed and State level and subsequently, the national level disease surveillance servers gets updated. SMS based Alerts and an early warning gets generated automatically to the registered stakeholders, responsible for taking timely remedial measures. The consolidated reports get generated at various administrative action point levels on the web.

The mobile technology uses wireless networks as it provides the much needed mobility besides connectivity to the information sources. However, the mobile devices make users vulnerable , someone who knows how to can eves drop and overhear the verbal communication two mobile

users. To ensure security of the content being transmitted, a separate light weight security mechanism has been adopted in the system to secure the content. However, the data being communicated through the mobiles is statistical aggregate information about health events which can be sought by the public under RTI act. As this is public domain information, top level security is not required. However, the source of information has to be authentic. To ensure the authenticity, mobile number and registration number based authentication scheme has been adopted. In this schema the mobile number and the reporting person/unit identity form a unique combination. So from reporting unit 'a' if person with id 'nnn' is responsible for sending S form information, then, if the mobile number of person 'nnn' from the reporting unit 'a' is 'mmm' then following authentication mechanism takes place. System checks if the mobile 'mmm' is registered. If yes, then it will check the associated person id and responsible form type and permits the user to update data accordingly. So that from any other mobile, the data related to reporting unit 'a' cannot be sent to system. Similarly, the person id 'nnn' cannot use any other mobile number. He may change the device, but the mobile phone number and the registered person id and the admissible form type should match to accept the data. If there is any change in any of these parameters, the SMS shall not be accepted. So others even if they are aware of any authentic person or reporting unit id they will not be able to send the data, as their mobile numbers shall be different from mmm. In case any registered users loses his/her mobile then they have to communicate immediately, so that till registration of a new number , or release of old number by the telephone service provider the old number bearing mobile can be debarred from communicating and reporting data to the IDSP project.

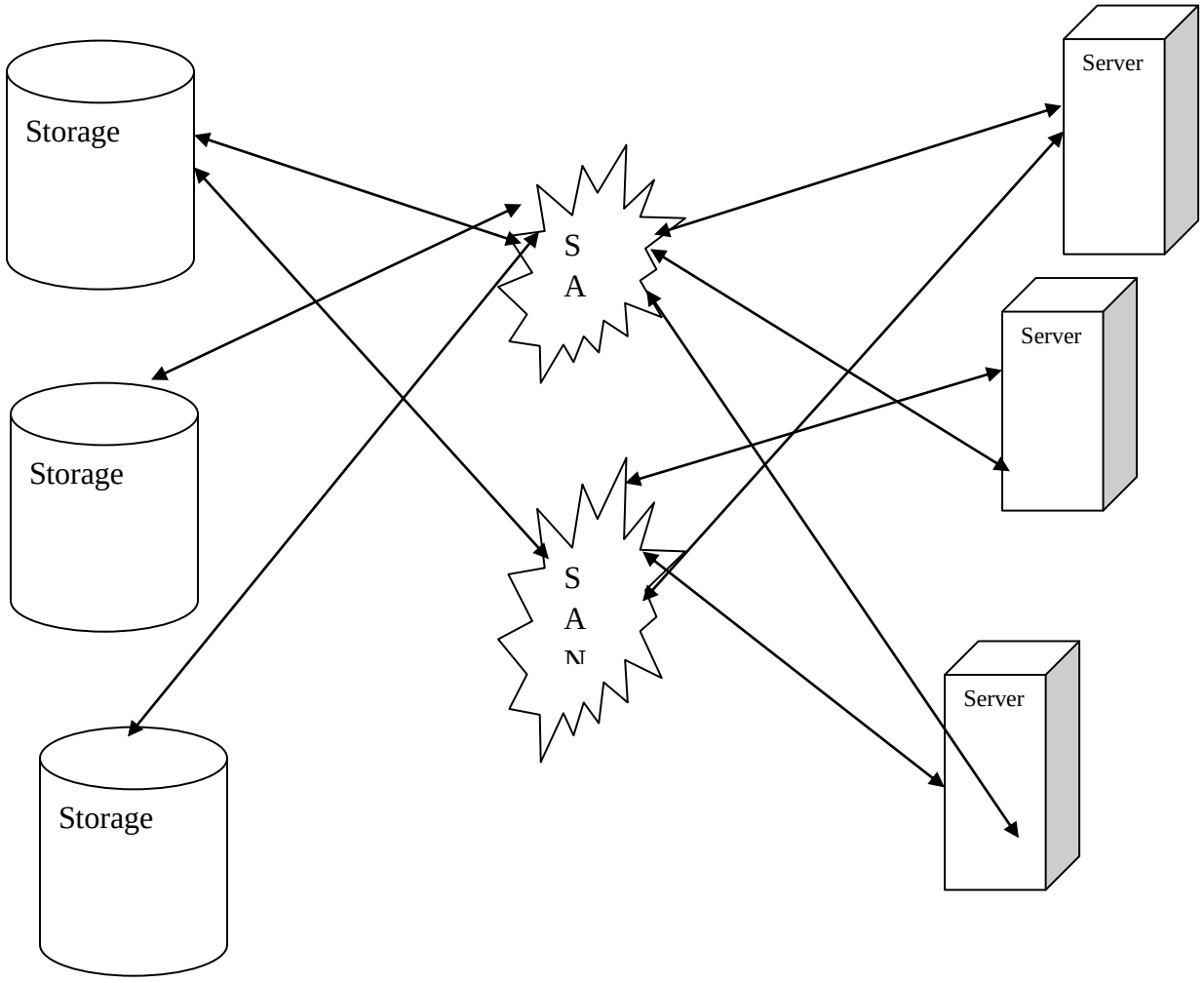
After accepting the data, an acknowledgement message shall be sent back to the user, with brief summary of the data. The user can re-transmit the data in the absence of acknowledgement from the system within half-an-hour time.



A storage area network has been used as data communication and storage platform, which has dynamically interconnected the gateways, application servers and the mass online storage devices. So that the data being sent through the mobiles by the users gets stored directly in to the SAN environment at the state level. This server architecture has topology flexibility reliability high availability besides fault tolerance. This has increased overall storage utilization rate and ensured online back-ups remotely.

The analytical processing and reporting applications are being serviced by the internet applications servers, the data through the mobiles is coming from the gateway server, the information is being stored in the RDBMS server. The data being reported by field level health workers is mission critical in nature. Because if any the values in a location of cluster of locations increases a threshold value then epidemic alerts are to be raised automatically to the important stakeholders. So the server architecture should ensure safe storage of the entire data being reported and also ensure timely alerts by retrieving the data instantaneously.

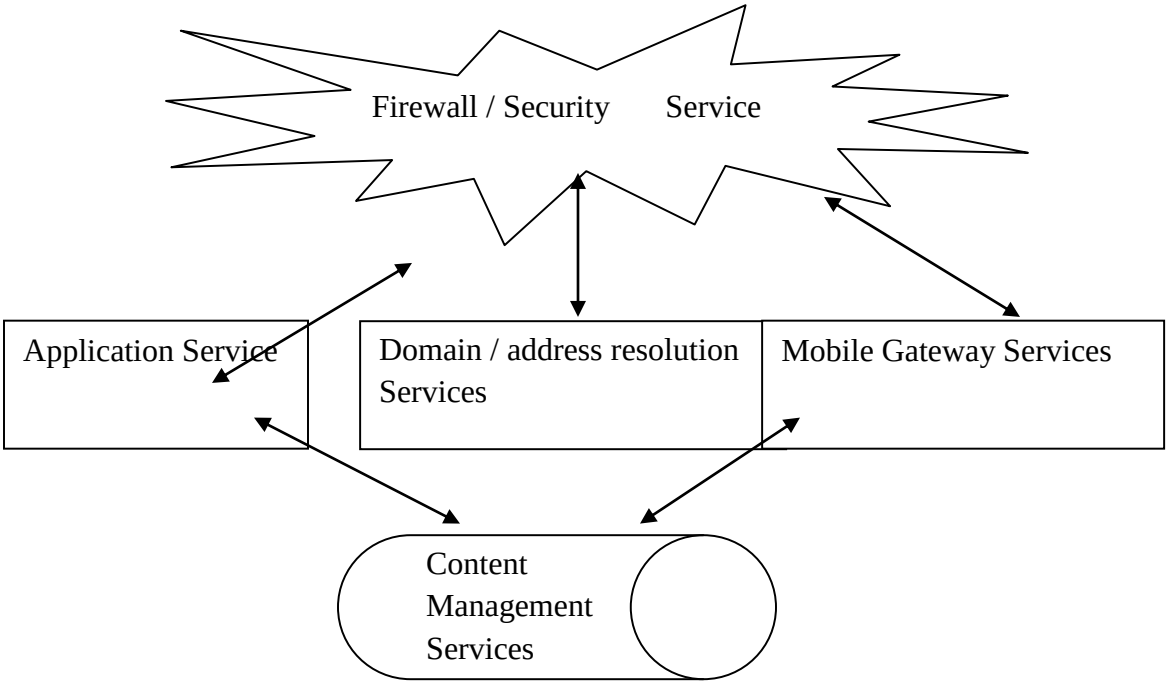
Earlier, NIC has used Small computer system interface (SCSI) bus to connect server-storage in a LAN environment, which used to impose bandwidth limitations to service clients and maintain data availability, besides limitations on the rapid growth of storage space and associated scalability of storage space. It also used to provide serious limitations on dynamic allocation of more space to the online servers. Keeping these limitations in view, for the IDSP m-health application a scalable high available and fault tolerant SAN server architecture was adopted as shown in the figure here.



Fault Tolerant Scalable Storage Architecture of the mHealth System

Error Detection and Correcting Componenet of the mHealth System: Error detection and correction and very essential in the mhealth system. As the data is the disease surveillance system is sensitive in nature. So users are registered and the messages are entertained from authentic sources as indicated above. Subsequently, the pattern of the data is cross checked with the standard template. If it matches, then the message is checked if it has special characters and morbidity is less than mortality or if the disease codes are outside the accepted range. Subsequently, the data is checked for the duplicate records. Finally the data is checked for its currency, ie., whether it is latest and current. Only current data is accepted and stored in the database with the time-stamp of the gateway. In this way the errors are prevented and avoided. The advertisements and any special messages also get filtered automatically in this process.

Services Component Architecture of the mHealth System:



m-Health Services Component Architecture

m-Helath is based on the Services Component Architecture, which has the ability to seamlessly work with various communication constructs including one way asynchronous call return and notification, It also has the ability to bind the legacy components and services accessed normally by the web services, EJB, JMS, JCA, RMI, CORBA and others. It has also the ability to declare the quality of the service requirements such as security, transactions and the usage of reliable messaging. The data in SCA can be presented as service Data objects. The service data objects facilitate communication between various service providing components or sub-systems.

The main system comprises of a security service component, security filtered service data objects enter the system and gets routed based on the address resolution and domain services. Subsequently the web application services and mobile gate way services are the two other important components of the m-health system. Both these services are serviced by the Content Management services. Which shall keep the geographical, demographical, health historical, and other information from other systems besides the content being received from the field level health units.

Cluster based surveillance model : Mobiles do not have persistence reliable connection throughout the day. Devices get disconnected due to drop in signal strength or if the battery is fully discharged. So the data sent by the mobile devices has to be processed in real-time basis. For generating early warnings the information from a cluster of units to be taken into consideration instead of any single unit. Because the disease may occur in a cluster of villages and rapidly grow and cross the threshold values. Based on the field level inputs, such health events are to be detected well before they cross threshold values and early warnings are to be issued.

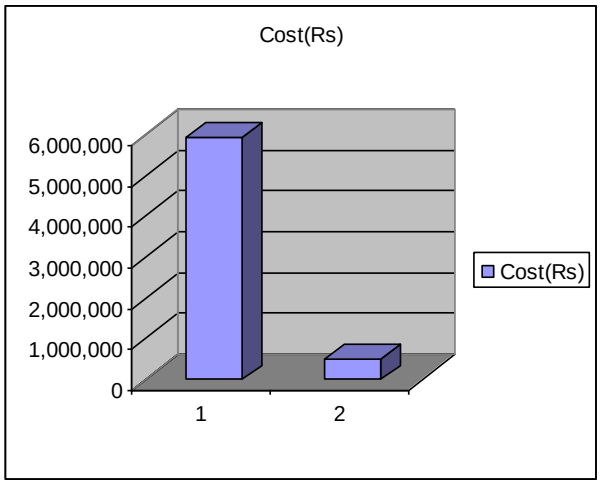
For this purpose a dynamic cluster based approach in surveillance is being adopted. In this approach, the data received from each reporting unit is first checked weather it has crossed threshold value at the individual reporting unit level. If yes warning shall be generated. If not then the data received from the units forming the potential disease outbreak cluster shall be compared. If the data aggregated at the cluster level if crosses the threshold value then outbreak alerts shall be generated.

Cluster C = I (u1,u2,u3,....un)

Where C is the Cluster value. I is integration function of the data reporting from units u1, u2,u3, and so on. Where the Cluster C is presumed to have u1 to un i.e., n units. The aggregation at cluster level is key to the early detection in this model. The cluster gets formed dynamically. To form the cluster the historical health demographic information shall be taken into consideration besides the geographical information, roadways, and the water / air moving corridors.

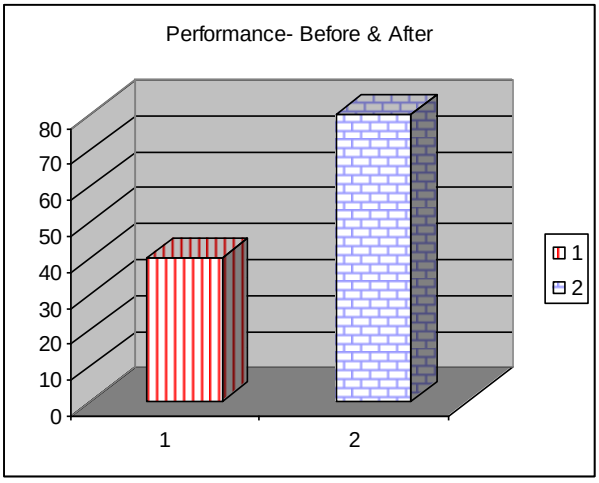
In the process, cluster gets formed dynamically by the system. For example, Cw is the cluster formed by geographically contiguous villages, related to water borne diseases. The common element in the villages or reporting units forming the Cw cluster is geographical contiguity and a common water body or source serving those villages. Ct is a cluster formed by the cluster of contiguous villages connected by a road, or rail or any other transport network. Similarly, other clusters can be formed dynamically and aggregated data at cluster level reported a fresh from field gets compared and clusters level and if the cluster level if data crosses thresh hold value much before individual reporting levels then also automatically alerts and early warnings gets generated.

Such a early warning at cluster level is impossible in any system other than SMS based disease surveillance system. With this cluster based approach, health events can be detected much early, before they reach epidemic proportions and early warnings shall be generated automatically to the field level stakeholders.



As NIC Data Centre Services were availed i.e., the available public ITC infrastructure was re-used for the implementation of the mHealth system. The operation cost in the earlier system minimum per annum used to be Rs. 59.28,000/- (Rupees Fifty Nine Lakhs Twenty Eight Thousand Only per annum in Andhra Pradesh. The SMS system has reduced the cost of operation to only Rs. 5, 00,000/- i.e., rupees five lakhs only per annum the overall savings in the cost is depicted below:

As a result of the implementation, average reporting performance has improved from 40% to 80% in most of the districts in Andhra Pradesh for P form reporting of IDSP data. The system is developed using Open source technologies using Service Component Arhitecture and is fault tolerant, service provider independent, technology and hardware and devices vendor independent. However, it has Unicode compatible so can be used in any Indian languages, and easily scalable and replicable across the country. AP model can be scalable to build a cost effective round the clock disease surveillance and alerting system for the country.



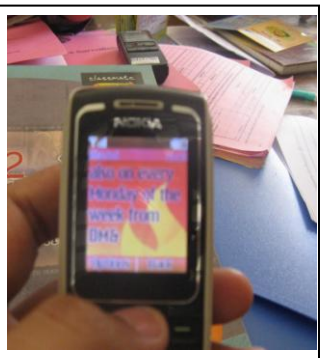
This unique SMS surveillance system in Andhra Pradesh has proved beneficial in a variety of ways. For example, the local healthcare workforce learned how to detect the early warning signs as well as educate the public. Moreover, the system also allowed tracking of Andhra Pradesh's health care resources for H1N1 detection and treatment in real time.

In a joint review of the IDSP program in 13 Indian states, representatives from Central Surveillance Unit at the National Center for Disease Control, Ministry of Health and Family Welfare, Government of India; The World Bank; World Health Organization, India country office, and Center for Disease Control and Prevention (CDC), acknowledged the successful deployment of the system in Andhra Pradesh. The team of reviewers recommended immediate external evaluation of the system to prepare a plan for scaling up of the system. A systemic evaluation of this SMS based surveillance system was undertaken with the goal of assessing its

impact on the IDSP's efficiency and effectiveness in Andhra Pradesh. The evaluation is being conducted by a team of field epidemiology and surveillance experts from the PHFI's, IIPH–Hyderabad.

The evaluation was conducted in five of the twenty three districts of the state. A sample size of five districts out of the total twenty three districts was decided for the evaluation. The basic strategy for district selection was stratification based on performance in the SMS based reporting and the repeated usage of Probability Proportional to Size (PPS) sampling. The state of Andhra Pradesh is divided into three regions viz. Telangana(T), Rayalseema (R) or Coastal Andhra (A). In these five districts the evaluation teams went to a total of thirty Primary Health Centers (PHC) and thirty Sub-Centers (SC) that are part of the reporting network in the state. For the selected five districts, the PHC were again selected using a probability proportional to size sampling, with probabilities being proportional to the number of sub centers in each PHC. The Sub-Centers in the PHCs were selected randomly from the list of SCs at the PHC.

The preliminary evaluation results have shown 50% increase in regular reporting from the hard to reach reporting sites. Hard to reach areas were defined as reporting sites where the travel time to the site from the district headquarters is more than three hours. The health workers surveyed, reported that they were receiving reminders through the SMS based surveillance system and that these reminders have led to an improvement in the reporting frequency. The system also acknowledged receipt of SMS reports in proper format. Many health workers opined that the immediate acknowledgement of report encouraged them to send regular reports. The system also generates automatic alerts based on thresholds set for number of cases reported for various diseases. The threshold levels are set based on the definitions of outbreaks given in the IDSP manuals and are unique to a disease. The outbreaks of diseases are defined in time, place and person and the system recognizes the number of reports of a particular disease, in a pre-defined period of time from registered phone numbers of reporting sites from a pre-defined geographical region to send out automatic alerts to all concerned personnel in the system responsible for responding to the event. Theses alerts have led to a significant decrease in the response time to disease outbreaks in the state. Alerts to multiple stakeholders have also led to better inter-sectoral coordination in responding to disease outbreaks in the state.

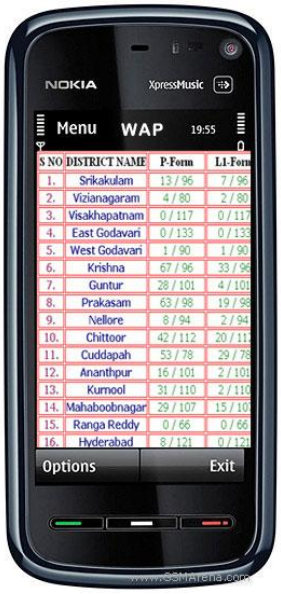


Mobile phone of a health worker showing a reminder from the SMS surveillance System

Interactive state map with complete disease surveillance reports

The evaluation has shown that there is significant decrease in time taken to report every week in SMS based surveillance system as compared to the paper based reporting system. The system has also led to a significant reduction in the money spent on travel and stationary in the conventional paper based reporting system.

Mobile phones in this system have also made availability of real time data from the field easily accessible on the hand sets in user-friendly mode. District and state level managers are accessing real time reports from the field through their mobile handsets and making timely decisions. This has led to significant increase in the number of situations in which the managers have taken some preemptive measures to prevent outbreaks or control spread of outbreaks.



District wise disease surveillance reports on mobile phone

This mobile phone based system is also allows connection of community with the system. Alerts and summary reports are being sent to Panchayat Raj Initiative (PRI) members and in leading to grater community ownership and participation in disease prevention and control at the village level.

Most of the population in the country do not have connectivity to a reliable power grid i.e., electricity. The land line connectivity and internet are distant dreams for them. For inclusive growth participation of these vulnerable sections of society is important. Health is a vital sector of human development. Proper health is pre-requisite for any inclusive growth, or else the population, especially the vulnerable sections of the society end-up spending significant amount of their earnings for health care. This case study documents how in Andhra Pradesh, India, Short Message Service (SMS) technology is successfully being utilized to create a disease surveillance system which is adept for timely and adequate response to disease outbreaks in a cost effective way and keep the communities healthy. With ever increasing mobile phone subscribers in the rural areas mHealth systems like the one described in this paper provide immense opportunities for keeping communities healthy and leading to inclusive growth in the country.

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