M-Governance:
A Framework for Indian Urban Local Bodies

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Abstract: *The basic and universal corner stones of good governance are quality of service, quick response mechanisms and above all accountable and transparent process mechanism. The first generation e-governance initiatives resulted in computerization of the legacy systems/practices in government with limited ability to internalize the advances in information and communication technologies (ICT). The paradigm shift from e-governance to m-governance (which leverages the convergence of mobile and communication technologies) results in radical differences in the key processes of creating, maintenance and usage of knowledge, creation of secure mobile transaction & delivery system, establishment of the appropriate infrastructural support for multi-mode direct citizen interface and delivery mechanisms. The primary characteristic of these m-governance solutions should be that of "capturing skill levels required to offer faster, cost-effective and scalable solutions at the door steps of the citizen through mobile and embedded technologies rather than mere computerization at the offices of urban local bodies". Information and communication technology is merely an enabler for good mobile-governance.*

Keywords: M-Government framework, Urban Local Bodies, mobile computing, ontology citizen identity**.**

1. Introduction

The term "e-Government" may be defined as "the use by public bodies of information and communication technologies (ICTs) to deliver information and/or services to citizens, external organizations, elected representatives and other stakeholders in such a way as to complement, replace or improve existing delivery systems" (O'Donnell, 2003). We would like to define the term "m-Government", or mobile-Government, as extending the concept of government further to the delivery of information and/or government services to the doorstep of the citizens in a personalized way.

This paper presents a conceptual framework for mobile-governance in urban local bodies (ULBs) in the Indian context, along with a set of applications on mobile devices to facilitate the delivery of some of these services. The proposed framework and applications have been conceptualized to demonstrate the capabilities of indigenously developed mobile devices and applications in bridging the digital divide in an evolving economy.

Urban local bodies in India are the primary delivery mechanism for providing services to urban citizens in the areas of public health, education, tax collection, services & utilities like power, water, telecommunications, sanitation, solid waste disposal, land development, transportation, housing development and many other essential services. The typical urban local body consists of a council of elected members assisted by government bureaucrats. While the elected officials provide the political

interface to the citizens, the bureaucrats handle the delivery mechanisms of the policies articulated by the elected civic bodies.

Most urban local bodies in India have a poor understanding of and access to the enormous potential that information and communication technologies hold in improving the functioning of these organizations. Many cities such as Bangalore have evolved unique public-Private Partnership models in which the urban local bodies, the citizens and enlightened corporate entities are working together to look at governance issues more holistically. The Bangalore Agenda Task Force (BATF), which started off as a unique experiment in private public partnership in urban governance, has been successful in bringing together the various stake-holders consisting of municipal service providers, the city government, domain experts, non-government organizations and the citizens on a common platform to discuss urban development issues and evolve common governance guidelines. (BATF, 2005). In a non-ICT enabled urban local body the key processes adopted while serving the community are (i) making & administering policy, (ii) implementing policy for the welfare of citizens and society, (iii) controlling the activities, (iv) organizing for achieving the above. Some of the ULB's initiatives in e-governance are like registration & Issuance of birth and death certificates, payment of property tax, Octroi, water bills, public health & sanitation etc., (Nagarapalika, 2004, Jadhav, S. 2003).

ICT-enabled ULBs, while administering the policies for the good of the society to deliver quality services with the help of technology, focus on (i) creating, maintaining and using knowledge in decision making, (ii) creating secure systems, (iii) establishing direct citizen interface and service delivery mechanisms, and (iv) providing the required ICT infrastructural support. (Sundar, D. K., Garg, S. 2003). A high level representation for the overall governance system for an integrated policy making model should have enhanced social dialogue, multi-criteria decision making, standardized and simplified processing, using ICT to make these fragmented steps into a coherent, homogenous system (Peristeras, V., et al., 2003).

2. M-Governance Frame Work:

The broad framework for mobile-governance involves the citizen by giving the freedom and flexibility of accessing and interacting with the urban local body in multiple convenient and personalized ways. The framework discussed to creating e-chains to enable e-governance through embedded technologies (Sundar, D. K., Garg, S. 2003) is adopted and modified in the m-governance context for ULBs. These requirements are addressed through a flexible architecture of multi-mode delivery in the proposed framework given in figure 1.

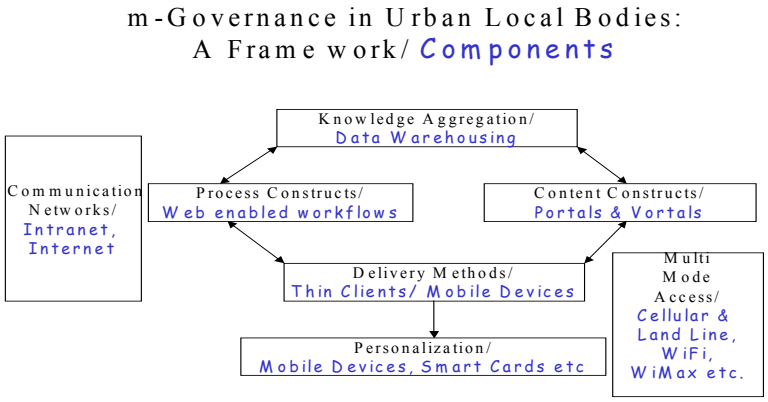

Figure 1

It can be seen, broadly, by the citizen as (i) work flows/ activities that happen with in the urban local body, and (ii) his/her interaction(s) with the urban local body. The main components of it are service delivery mechanisms (both information and material requirements), which should address the highly personalized needs of individual citizens. These components, broadly, are Process constructs/web enabled workflows, Content constructs/portals, Delivery mechanisms: Thin/Thick clients, Personalization: Smart card/PDA, facilitated by multi mode access: WLL, Wi-Fi, Blue-tooth etc.

There are several options available for selection of appropriate technologies for the different components of m-governance, in terms of hardware and software to facilitate the m-governance initiatives. The components, in brief, are communication networks, computing platforms (in-house use, i.e., servers, desktops, handheld – mobile devices, besides user kiosks), software (infrastructure -web servers, databases; and applications).

The key issues that need attention while selecting the different components for the mobile-governance framework are:

- Protocols and services based on open standards, rather than proprietary, closed standards
- Vendor independence for the avoidance of vendor or proprietary format lock-in
- Rapid prototyping and deployment capability
- Security and authentication procedures for safe-guarding of critical data and ensuring the privacy of information
- Scalability and high availability

Several critical technologies are used in this architectural framework:

- The Semantic Web for web-based services
- Knowledge management and sharing through Ontologies
- Mobile Devices for access at the doorstep
- Security and Authentication

The next generation of the worldwide web is expected to move towards the "Semantic Web", which helps define a common framework for sharing and reuse of data across applications, enterprises and community boundaries. So far the Web has developed most rapidly as a medium of exchange documents for people rather than as a medium of exchange for data and information that can be processed automatically. The Semantic Web will bring structure to the meaningful content of Web pages, creating an environment where software agents roaming from page to page can readily carry out sophisticated tasks for users (Berners-Lee, et al., 2001), To explore the potential of associating web content with explicit meaning, rather than rely on natural language processing to extract this meaning from existing documents, this approach requires authors to describe documents using a knowledge representation language (Heflin, Jeff, 2001).

An important aspect of the architectural mobile-governance framework is the capture of existing knowledge about processes and work-flows and its mapping into an abstraction that can be translated into a set of services. Formal representation of knowledge is based on conceptualisation that is an abstract, simplified view of the objects, entities and relationships that define a particular domain of knowledge. Ontology is an explicit specification of this conceptualisation. It formally defines a common set of terms that are used to describe and represent a domain (Gruber, T. R., 1993).

Automated tools to power advanced services such as more accurate web search; intelligent software agents and knowledge management can use ontologies. Ontologies have traditionally been used in AI and expert systems for the representation of knowledge. But these can also be applied to a diverse range of applications that require sharing of information. Some of the common reasons for developing Ontologies are (Noy, N. F., 2000):

- To share common understanding of the structure of information among people or software agents
- To enable reuse of domain knowledge
- To make domain assumptions explicit
- To separate domain knowledge from the operational knowledge
- To analyze domain knowledge

The World Wide Web Consortium has published detailed recommendations for Resource Description Framework (RDF) and OWL (Web Ontology Language) whereby RDFs are used to represent information and to exchange knowledge on the web and OWL is used to publish and share sets of terms, called ontologies, supporting advanced web search, software agents and knowledge management (McGuinness, D. L., 2004). Since our m-governance architecture is inherently web-based, the use of the semantic web and ontologies is appropriate for the development of our applications and services. It will also enable us to share these knowledge bases across different urban local bodies with minimum customisation.

In the context of urban local bodies, automated sharing of information across various software agents would improve the cross-functional service delivery mechanism. An Ontology for Citizen Identity would be useful across the entire range of potential applications in a citizen-centric semantic web of services. This ontology should cover the classification of citizens based on various sub-classes such as personal identity describing demographic information about each citizen, location of property, and employment status for civic benefits and entitlements. Management of the Citizen's digital identity in the context of e-Government services has been covered in (Grandi, F., et al, 2004).

3. The proposed architecture of the m-governance framework in ULBs

The proposed solution architecture, to facilitate the m-governance framework given in Figure 1, follows a hub and spoke mechanism, where hub is the urban local body and spokes are field level applications, and the "rim" is the citizen interface. This high level architecture is depicted in Figure 2 below:

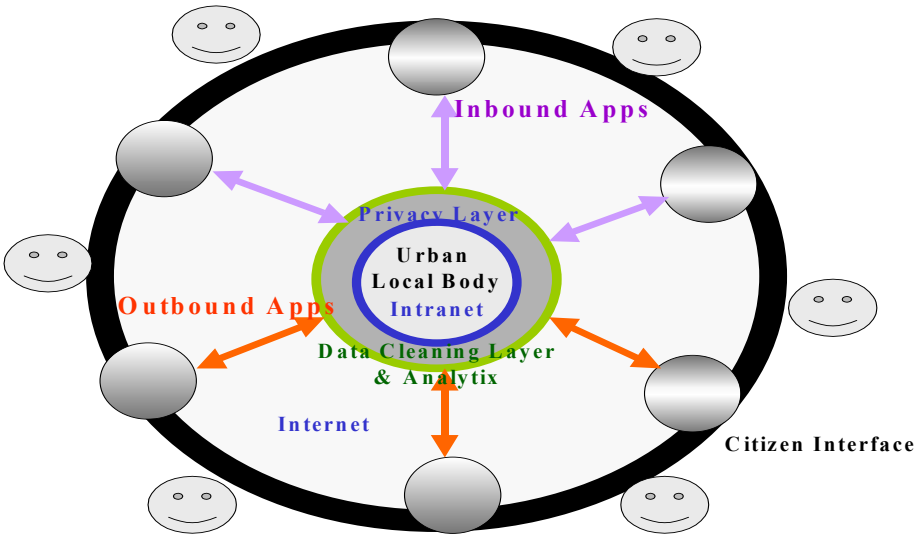

Figure 2

3.1 Hub residing at the office of an Urban Local Body implements standards-based open honeycomb architecture to create an "intranet" with an integrated transaction processing capability across all the functional areas, where additional office automation applications can be added and obsolete applications

can be deleted. It will have various filters, as "sit-on" applications, such as phonetics-based tools to avoid duplication and ambiguity of identities in transaction data, and authentication and encryption techniques to ensure privacy and security of data/transactions.

3.2 Spokes contain essentially applications on mobile and embedded devices that connect the "hub" based services such as accounting, costing, payments and receipts, stores management, assets management, various records related to citizen services/utilities maintenance and updating) with "inbound" and "out bound" activities (procurement, field work monitoring, utilities/services billing etc, field force automation, tracking the utilization of movable assets etc.,).

3.3 Rim facilitates the Citizen interface with the "hub" and "spokes". It consists of customers (citizens) mobile access devices, application portals, kiosks, collection centres and field force automation mechanisms.

4. Solution Description:

The solution advocated by the authors is given in the following two sections. Section 4.1 gives a brief overview of the applications that are hosted on these devices and section 4.2 describes the mobile devices that are used in deploying the proposed software solutions.

4.1 Typical Applications for ULBs

The ULB provides several services to its citizens for which there are usage charges to be paid, like:

- Property Registration
- Utilities like Electricity, Water and Gas
- Urban Transport
- Solid-waste Management

Field level transaction enabling applications (clients) for the above mentioned services are being developed on indigenously developed mobile devices Simputer and wireless tablet (Figures 3 & 4) and optimising and route/capacity selection applications (server) for solid-waste collection and disposal trucks are designed and developed using "travelling sales men with defined time-windows" algorithm(s). A two stage approach was taken while solving this optimisation problem, using LIFO implicit enumeration to get an initial weak-efficient solution, in the first stage and a heuristic approach to get an improved solution in the second stage (Sundar &Ravikumar, 1998).

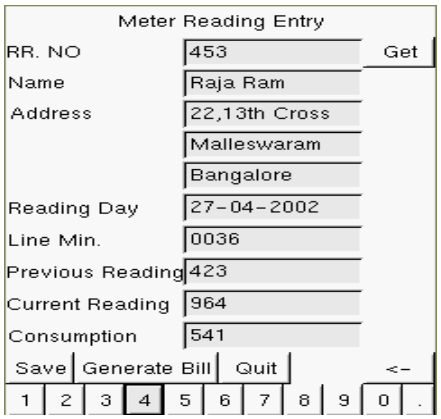

Figure 3: A Utilities Billing Client on the Simputer

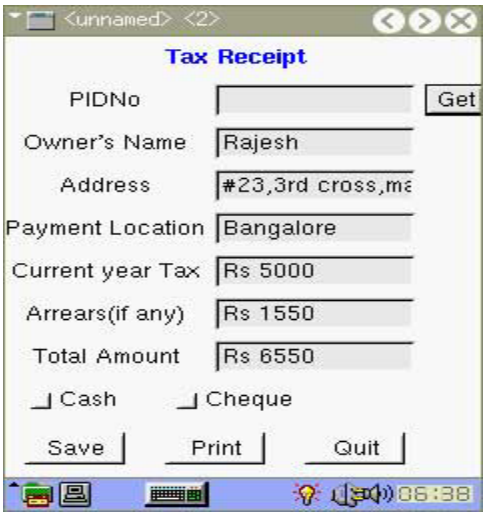

Figure 4: Citizen's Municipal Taxes on the Simputer

4.2. Mobile Devices for last-mile access

To facilitate the deployment of m-governance services at the doorstep of the citizens, the rim-and-spokes architecture has the flexibility to incorporate a diverse range of mobile access technologies such as PDAs and wireless tablets. The "Simputer", a low-cost mobile device, and the "Sarva", a wireless tablet are being used in prototyping the above solution architecture. Both these mobile devices have multiple connectivity options, local language interfaces, Text-to-Speech capability, and use the open-source GNU/Linux operating environment.

It is essential to point out certain cultural attributes that have traditionally functioned as "entry barriers" to the widespread acceptance of computing solutions in India. Some of these entry barriers are:

- Low levels of literacy in the community
- Lack of knowledge of English, the language in which most commercial software is available
- Cost of computing
- Inadequate power

These are some the attributes that have created a "digital divide" which needs to be bridged. The Simputer and Sarva mobile computing devices, which have been developed by one of the authors, have several technological features that specifically address these issues to lower the entry barrier and bridge the digital divide. These devices have the capability to accept input and display data in several local languages, thereby enabling the applications to offer information in the language of choice of the user. Currently, support is available for Hindi, Kannada and Tamil and several other language interfaces will also be available in the near future. In addition, these mobile devices have a built-in text-to-speech engine to enable applications to provide voice feedback for dynamically entered text. The TTS engine is capable of handling speech synthesis in several Indian languages. Iconic interfaces with multi-lingual text-to-speech capability go a long way in making computing facilities available to the common man. We have developed the text-to-speech engine and voice databases specifically targeted to the embedded environment of our mobile devices.

These mobile devices incorporate an embedded smart-card reader to enable smart cards to be used for security, authentication and device personalization. Smart cards enable such devices to be shared amongst a local community of users and bring down the total cost of ownership. Such devices could be community owned and an individually owned smart card would be used to store a citizen's demographic and personal data used to access information on the servers.

The Sarva is a wireless tablet that incorporates several other advanced features such as an embedded GPS receiver and a GPRS modem. While the GPRS modem is used for wireless data connectivity through the cellular network, GPS is used for location-based services such as tracking and logistics management, mobile asset tracking and in-vehicle navigation. In the context of urban local bodies, a GPS-enabled wireless tablet is planned to be used for mapping of assets such as subterranean electricity transmission lines, water pipes and telephone cables, solid-waste management and planning of roads and housing developments. These would also be useful in emergency services such as ambulances, fire and floods.

5. Conclusions

Mobile-government can usher in a approach to delivery of government services to the doorstep of the citizens. In the context or urban local bodies, the use of advanced tools such as the semantic web and ontologies for information sharing will enable the service providers us to incrementally add services quite easily. The semantic web enables the service provider to deploy software agents for seamless sharing of information across the spectrum of applications and providing the citizen a personalized view of her service requirements. The deployment of indigenously developed, web-enabled, mobile devices such as the Simputer and the Sarva wireless tablet make it possible to offer cost effectively, services at the doorstep of the common citizen. The availability of multi-lingual text-to-speech and local language interfaces has enabled us to lower the barriers to acceptance of these devices.

The proposed framework for mobile-governance in urban local bodies is replicable and captures the required skill levels through the technology to deliver quick and quality services at the doorsteps of the citizens by minimizing the transaction costs. The initial prototypes of the hardware and software are now being deployed in controlled pilot environments and have the potential to be scalable and cost-effective, and replicable in other countries with similar levels of development.

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