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THE RELATIONSHIP BETWEEN MOBILE AND STATIONARY eGOVERNMENT APPLICATIONS AND ENVIRONMENTS: A REVIEW

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MeRC Working Paper No. 17

August 2006

McMaster University

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[1] This research was supported through a grant from the Social Sciences and Humanities Research Council of Canada

ABSTRACT

Mobile government applications are becoming more ubiquitous as wireless networks expand and new technologies and applications are applied to government-related functionalities. This paper compares stationary and mobile applications in government, and develops a model that emphasizes the transition to eGovernment, based on an infrastructure that has much in common with the support of content for both types of applications. The four functionalities of eGovernment (G2E, G2C, G2G, and G2B) are described in this context, and characteristics and issues with mGovernment solutions are outlined in some detail. Finally, a comparison of a variety of applications in both mobile and stationary environments concludes that there is no real pattern in their suitability for mobile adaptation. However, it is quite clear that mobile solutions are most likely to offer the most significant benefits for G2E and G2C functionalities.

KEYWORDS

mobile eGovernment, maturity models, eGovernment functionalities, eGovernment transformation, mGovernment applications

TABLE OF CONTENTS

INTRODUCTION

The driving forces behind the adoption of digital government (eGovernment) are clear from one of its definitions (WorldBank, 2005) as "the use by government agencies of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses, and other arms of government. These technologies can serve a variety of different ends: better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions." mGovernment (mobile government) is a subset of eGovernment that is oriented towards mobile environments and users. Related technologies include mobile and/or wireless technologies like cellular/mobile phones, laptops, and PDAs (personal digital assistants) linking to wireless networks (local area networks, cellphone networks, satellites, etc.). mGovernment can help to make public information and government services available "anytime, anywhere" to citizens, government employees, and officials.

Mobile applications may be adaptations and enhancements of stationary eGovernment applications, or they may be novel applications with no precedent in stationary environments (Scholl, 2005b). With these distinctions in mind, it is possible to classify eGovernment applications into three categories: applications that are primarily suitable for environments that are stationary, primarily suitable for mobile only, or suitable for both stationary and mobile. The thrust and scope of mobile government applications are clearly complementary to stationary

applications, with a focus on particular application areas where mobile technologies provide considerable advantages over landline technologies, improving both efficiency and effectiveness.

The objectives of this paper are to characterize and contrast mobile and stationary eGovernment applications and to identify areas in which mobile applications are likely to be readily adopted, and where they can make significant contributions. The paper addresses first the eGovernment transformation process, including maturity models that show the progress of transformation and how mobile applications develop naturally from existing eGovernment implementations. Next, the four functionalities of eGovernment are described, followed by a description of the characteristics of mGovernment solutions. Then issues with mGovernment are discussed, followed by descriptions of the four functionalities as they relate to mobile solutions. Finally, based on the discussion in the paper, a framework is used to evaluate the likelihood that mGovernment solutions are suitable for a range of potential applications.

eGOVERNMENT TRANSFORMATION

The Internet has had a transformative effect on how citizens and businesses interact with government. Maturity models are useful in understanding how these transformations evolve over time. A maturity model of eGovernment by Gartner Research includes four phases: presence, interaction, transaction, and transformation. In their model, there are four organizational components that support the evolution in capability from one phase to the next. These supporting components are strategy/policy, people, process, and technology. West (West, 2004a) also suggests that there are four stages in the transformation towards eGovernment

functionality. The process begins with the billboard stage, which basically displays static information on the Web. This is followed by the partial service delivery stage, where there is online access to a limited amount of information stored in databases at separate government agencies, and the ability to perform certain online transactions. This in turn evolves into the portal stage. In this stage, users may access a wide variety of government services and functionalities through a common Web portal, including online transactions. Finally, West suggests that the fourth stage involves "interactive democracy with public outreach and accountability enhancing features."

At this time, most advanced eGovernment operations at the federal, provincial/state, and municipal levels in industrialized nations tend to be at the third stage, utilizing a common Web portal for access to government services. From the customer (citizen and business) point of view, this stage improves access to government services, and savings should begin to accrue through online interactions that reduce demand for front office support. A key difference between planning for a mobile portal and planning for other internal support services is that eventually the portal will evolve to support both the internal organization and external citizens and customers (Clarke III & Flaherty, 2003).

Although a common access portal makes government services more convenient to citizens and businesses, additional savings can be realized in the long run from integration and/or interoperability of internal services and operations through back office transformation, and the support of common databases among government agencies. This integration will reduce inefficiencies due to the isolated information silos that have developed ever since government

agencies began using information and communication technologies. This will take much longer than the development of the third stage transformation to online portal access (Schwartz, 2004), which does less to improve government efficiency than to improve citizen and business access to government services. Significant business process changes are typically involved in such integration projects, and Scholl (Scholl, 2005a) reported in a survey that the highest levels of importance to such projects were attributed to (ranging from highest to lowest): stakeholder involvement, executive level commitment, new challenges in record keeping, workflow analysis, and cultural/change readiness assessments. Another survey by Reddick (Reddick, 2005) of municipal implementations in the province of Ontario, Canada showed some progress in internal system process change due to eGovernment. In the survey, in response to the question "How has eGovernment changed your local government?", 47% indicated that business processes were being re-engineered, and 44% responded that business processes were more efficient. 39% indicated that the role of staff had changed, 30% suggested that there were reduced time demands on staff and 20% that administrative costs had been reduced.

Scholl (Scholl, 2005b) has proposed a three phase model that reflects the general evolution and growth of mGovernment. His model can be visualized as an offshoot of the third phase of West's eGovernment transformation model described above. In his model, mGovernment applications are based on existing eGovernment infrastructures, but with an adaptation to the back-office infrastructures necessary to support mobile applications. In the first phase of Scholl's model, processes and applications are represented or reproduced by means of mobile technology, including web-based information publishing, web-enabled transactions based on existing backend systems, and unifying portals designed specifically for mobile access. In the

second phase, changes to process and underlying structure occur, with movement towards more service functionality, integration, and interoperation of applications and databases in the back office infrastructure. This requires changes to the underlying processes and structures, along technical, organizational, informational, and social lines. In the third phase the basic integration and interoperation of core processes and internal applications and databases, along with completely new uses and applications, have grown to the point that mobile applications have become the preferred mode of delivery for specific services. As a result new organizational structures and social networks emerge within which the new technology uses are arranged and embedded.

Scholl (Scholl, 2005b) has suggested six classifications for mGovernment applications – three as adaptation of stationary applications – enhanced or reorganized workflows, extensions of existing workflows, and workflows that are unsuitable for mobile adaptation. He also suggests three classes of novel applications – created or organized novel workflows, extensions of novel workflows, and novel workflows that are not suitable for mobile applications. The early stages of mGovernment are likely to involve adaptations of existing workflows, such as field inspections of buildings. The later stages of mGovernment will begin to bring in novel applications, as the mobile infrastructure begins to create new opportunities. An example is the use of GPS (Global Positioning System) to make current information on transit schedules available to consumers.

A success factor model for mGovernment, that classified success factors into six main groups, was developed by Sandy and McMillan (Sandy & McMillan, 2005). The groups were: cost

(including ROI and cost benefits), business reengineering to facilitate mGovernment operations, education (in wireless literacy), acceptance by employees and citizens, security and data integrity, and consistent access and suitable interfaces across the user community. These were validated in two case studies in mG2E environments. An infrastructure that supports the identification and generation of appropriate and adaptable service bundles that are tailored to individual mobile users is necessary (Davy, Mahon, Doolin, Jennings, & Foghlu, 2005). These service bundles can simplify the life of mobile users by presenting context-sensitive services, make service selection decisions based on user preferences, discover relevant services automatically, and dynamically adapt services to the user's current context.

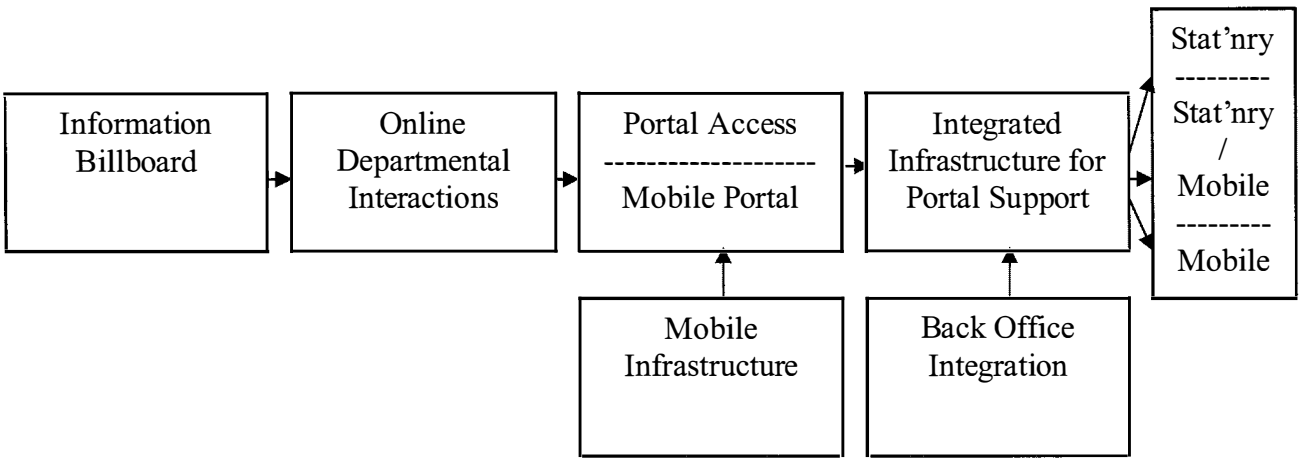

Figure 1. Transition Towards eGovernment and mGovernment

Figure 1 is based on the foregoing discussion of maturity and framework models. It depicts the evolutionary path that is likely to be followed as eGovernment grows from a starting position of simple stationary Internet applications such as information billboards, to online wired interactions with citizens and businesses, to stationary and mobile portal access for both wired and mobile interactions (requiring a suitable mobile infrastructure to be installed). Finally, more

efficient internal operations will eventually evolve out of an integrated back office infrastructure to support both stationary and mobile portals. Ultimately, novel applications suitable only for mobile users will share an integrated or interoperable common content infrastructure that can support stationary and/or mobile applications, as appropriate, with necessary accommodations (e.g. bandwidth and physical limitations on display size) for information presentation to mobile end users.

The main point suggested here is that mobile functionalities are not likely to evolve independently of stationary eGovernment applications, since both environments require access to the same back office content infrastructure. Mobile applications also require additional network infrastructure and specific technical and support services. There are common problems associated with integration and management of the back office infrastructure in an efficient manner, and their complementary nature should lead to efficiencies through joint management and operation.

FUNCTIONALITIES OF eGOVERNMENT

To be able to contrast stationary and mobile eGovernment applications, it is important to consider the four different, but sometimes overlapping, classes of eGovernment functionalities (U.S., 2005); they differ in their end-users, focus, and impact:

1. *Government-to-Employee (G2E)*, sometimes referred to as Internal Effectiveness and Efficiency (IEE), for streamlining internal government operations and increasing staff

productivity. G2E initiatives can bring commercial best practices to key government operations, particularly supply chain management, human capital management, financial management and document workflow. They support government employees in accessing and changing personnel records, processing travel requests, or performing routine e-mails and work assignments, both internal and external to the fixed office environment.

2. *Government-to-Citizen (G2C)* provides citizen access to information and services, and to permit online citizen transactions such as paying taxes, fees, or fines, processing applications, and obtaining licenses and permits. Also included in this category is online democracy, where citizens can communicate with government representatives, collaborate on committees, or vote during elections (Schaupp & Carter, 2005).

3. *Government-to-Government (G2G)* can support close collaboration and electronic transactions among government agencies, and among government levels and across national boundaries. For example, Interpol collaborates with police agencies among different countries to receive and analyze potentially illegal material and activities on the Internet related to child exploitation, and makes referrals to appropriate law enforcement agencies (Anonymous, 2005) for investigation. Another example is the use of G2G links for collaboration in public policy deliberations and decision-making (Karacapilidis, Loukis, & Dimopoulos, 2005). In G2G, the key lines of business include economic development, recreation and natural resources, public safety, law enforcement, disaster response management, and grants or loans (Sulaiman, 2003).

4. *Government-to-Business (G2B)* supports government interactions with business partners and business constituents. This classification includes business transactions such as filing export licenses, procuring supplies and equipment for government agencies, obtaining business licenses, as well as on-line bidding for government contracts. eProcurement by government agencies has a high potential, since governments are the largest single purchaser of products and services in most countries. G2B has a strong intersection and similarity with business-to-business (B2B) applications, and can demonstrate substantial efficiency improvements in government, through collaborative sourcing among government and other non-profit institutions. For G2B, the focus should be to reduce the paperwork burden on business by adopting processes that enable data collection data once for multiple uses, and streamlining redundant data by using the language of eBusiness (XML) for regulation, economic development, trade, permits/licenses, grants/loans, asset management (Tilsner, 2005).

Most published research on eGovernment is more focused on the G2C and G2B forms (Lee, Tan, & Trimi, 2005; Melitski, Holzer, Kim, Kim, & Rho, 2005; Reddick, 2004; West, 2004a), with less being said about applications in the G2G and G2E categories. However, from among the four classifications, mG2E (mobile G2E) and mG2C (mobile G2C) are categories where there is likely to be more potential for mobile applications. The following section will address mobile government applications in general, and then focus more specifically on each of the functional categories in terms of mobile applicability.

CHARACTERISTICS OF mGOVERNMENT SOLUTIONS

Mobile applications differ significantly from stationary wireline applications in the characteristics they bring to eGovernment, with key design factors that include mobility, location-sensitivity, time-critical applications, and personal identity that are normally associated with mobile devices. Mobile/wireless and wireline applications serve a complementary purpose in eGovernment. In some cases, based on both functionality and business model characteristics, stationary applications are a better choice than mobile but in other cases, the reverse is true. And there are some situations where both can work in a complementary manner. Issues such as accessibility, security (encryption and authentication), mobile privacy and identity management, user-centric mechanisms allowing controlled release of personal information, continuity, and availability also provide certain contrasts between stationary and mobile solutions.

Adoption decisions involve complex strategies if wireless devices are to be utilized efficiently, with value added to all the engaged parties: government, citizens and/or business, with a reasonable return on investment. More efficient operation of government and increased value of government services to citizens and/or businesses should be the deciding factors.

A major new driving force for the implementation of mGovernment at the municipal level is the growth of community-based Wi-Fi networks. These have encouraged the development of high bandwidth wireless networks across entire metropolitan areas (Schmidt & Townsend, 2003). These networks usually support citizen access but are particularly supportive of municipal mGovernment services such as utilities, fire, ambulance, police, and municipal inspection services. In addition, they can support Internet connectivity from locations external to buildings. Wi-Fi networks often operate in frequency bands that do not penetrate through major

structural barriers, requiring internal access points to supplement network access in shielded areas. There is currently a great deal of debate about whether citizen access to these networks should be free, as their implementations continue to expand (Nobel, 2006).

Content transmitted by technological solutions in the mobile wireless world can be mobile (but not wirelessly connected for synchronization with wireline content), wireless (but not mobile), or both mobile and wirelessly connected. Mobile applications may need to be integrated through their modes of voice and data, where voice messages could be preserved in both voice and text formats for further uses. In addition, text-to-voice and voice-to-text conversions may add to mobile applications.

Mobile communications and Internet technologies should enable access to eGovernment services any time and anywhere. For maximum effectiveness, such projects should focus on open platforms, supporting usability, interoperability, and scalability, thus facilitating service deployment and access. An additional important consideration is attractive business models satisfying service providers, public authorities, and citizens. In order to broaden high quality citizen access, mobile services need to (Tilsner, 2005): address specific users needs, feature a high level of usability and user friendliness, be easy to configure and deploy, be cost-efficient to the public, and affordable to service users, exploit opportunities to increase competitiveness of local economic agents.

In a user acceptance study of mG2C, Carroll (Carroll, 2005), found that: participants

were discriminating in the selection of devices, functions and media that were applied for different activities; convenience is important to users; and technology must be quick and easy to use, available when needed, and not intrusive. She also found that participants were unwilling to invest effort into performing complex or lengthy tasks, and that they were often multitasking while mobile, and paid limited attention to their devices. Participants wanted to limit incoming information to meet local, real-time needs and the physical limitations of mobile technologies will limit their applicability to more complex public sector services until such time as mobile technology interfaces have improved significantly. Privacy and security were major concerns if transactions involved private information, and Internet access was limited by users to narrowly targeted information.

A major conclusion from Carroll's study (Carroll, 2005) is that there is a diversity of practice among mobile application users, and that the choice of device, media, and application tends to depend on age group, educational background or gender, according to purposes of use, activities, contexts, preferences, and other attributes. As a consequence, Carroll proposed the concept of portfolios of technologies to support this variety. This can provide an empirically-based foundation for developing mGovernment services to meet the diverse needs of citizens. Understanding the variety and combinations of resources within these portfolios is crucial for designers, in identifying the technology forms, functions, purposes and applications that will meet the real needs of citizens and that will evolve to meet changing and future requirements.

ISSUES WITH mGOVERNMENT APPLICATIONS

There are issues that can present barriers to the adoption of both stationary and mobile eGovernment solutions. Ebrahim and Irani (Ebrahim & Irani, 2005) break these down into: IT infrastructure, security and privacy, IT skills, organizational barriers, and operational costs. There is also difficulty in quantifying return on investment, unless the focus is on cost containment, but there are many intangibles in eGovernment adoption that can present difficulties for a management that must justify solutions based on cost containment alone. Governmental focus when transforming services is typically on cost containment and service, and the effectiveness of service requires measures of service to the different stakeholders affected, including citizens, businesses, employees, and other government agencies.

Given the physical constraints in the mGovernment environment, good interface design is difficult to achieve. Mobile devices are typically smaller than their desktop counterparts, have less processing power, and communicate in low bandwidth environments. Mobile applications must be carefully designed to account for these limitations. An even greater challenge to designing successful mobile applications and their interfaces, is dealing with context (Tarasewich, 2003). People can now conceivably be anywhere at anytime and use a mobile application, unlike the typical eGovernment application, where a physical Internet connection is required. With mobile applications, context has a less predictable influence on the design and use of computer systems, since environments are changing constantly, as are user activities.

Back office systems often depend on existing systems that have developed over time as silos with overlapping and inefficient services. Interoperability and/or integration of these systems is a major challenge that may take significant time and investment to overcome. In the meantime,

portals provide a common user interface link to back office systems, regardless of their lack of actual integration. Other major issues that affect digital government implementations include the stage of maturity of the government agency (Ghasemzadeh & Sahafi, 2003) in terms of development of digital government, business process redesign, usability and adoptability, and the election life cycle.

Integration and interoperability are approaches to solving back office efficiency problems for digital government. Technical barriers to integration include (Lam, 2005): lack of architecture interoperability, incompatible data standards, incompatible technical standards, different security models, and inflexibility of legacy systems. Interoperability has been noted as a major concern in eHealth applications (Brailer, 2005). Web services approaches are one solution to interoperability, where software is available over the network, using a standardized XML (eXtensible Markup Language) messaging system, and where XML is used to encode all communications to a web service. Because all communication is in XML, web services are not tied to any one operating system or programming language. Middleware is another approach to support mobile applications, making the devices aware of the context in which they are being used in order to enable applications to adapt to heterogeneity of hosts and networks, as well as variations in the user's environment (Capra, Blair, Mascolo, Emmerich, & Grace, 2002). User context includes, but is not limited to: location, with varying accuracy depending on the positioning system used; relative location, such as proximity to printers and databases; device characteristics, such as processing power and input devices; physical environment, such as noise level and bandwidth; user activity, such as driving a car or sitting in a lecture theatre.

Developing a strategy for information and transaction services for nomadic mGovernment users pose a number of serious technological, organizational, social, and managerial challenges (Scholl, 2005b). Organizational and technical hurdles occur when combining, integrating, and interoperating traditional stationary/fixed network-based applications with mobile services. Technological issues include sudden loss of connectivity, fluctuation of bandwidth, battery power loss, rapid changes in location, varying device capability, asynchronicity of task initiation and outcome, data and context sharing (Capra et al., 2002). Organizational problems result when combining, integrating, and interoperating traditional stationary/fixed network-based applications with mobile services. In general, when integrating and interoperating mobile applications with backend systems, serious performance, integrity, and security issues may result (Capra et al., 2002). Because voice is so widely used in mobile environments, integrating voice, text, and data in mobile applications is a potential source of value to such systems (Scholl, 2005b). Implementing mobile applications may also create social and organizational tensions due to abrupt changes in workplace relationships (Scholl, 2005b).

Lam's taxonomy of barriers to eGovernment integration (Lam, 2005) includes strategy, technology, policy, and organization. Using this taxonomy, Table 1 summarizes some of the issues in mGovernment, based on the literature from mobile applications in government and business. Also indicated in the table are some possible solutions. Note that these solutions often result in side issues that must be resolved. For example, fat clients may solve loss of connectivity issues, but they result in additional privacy and security issues that must be resolved. The use of authentication systems that cover all classes of eGovernment functionality (including mobile and stationary applications) is gaining wide acceptance (Lee et al., 2005).

Table 1. Issues and Potential Solutions for mGovernment Applications

Classification	Issue	Potential Solutions
Technical	Loss of connectivity; bandwidth fluctuations; rapid changes in location; asynchronicity of task initiation and outcome	Fat client (mG2E and mG2B)
	Varying device capability	Thin client, content adaptability (mG2C)
	Integration & interoperability	Standardization; Web services; middleware; portal solutions; single sign-on
	Scalability	Fast implementation and integration of new services
	Usability	End-user involvement; simplified interface; limited service offerings
	Context awareness	GPS, dynamically adaptable middleware
Policy	Trust – integrity, security, privacy	Data encryption, user authentication, user consent
	Quality of service; accessibility	Service measures; evaluation of user classes to be served; planned migration to specific user classes
	Personal identity	User authentication and consent
Organizational	Abrupt changes in workplace and field relationships	Change management; employee education & training (mG2E)
	Agency readiness	Education; appointment of a champion; improved management, technical expertise
	Different readiness levels	Careful selection of initial organization to achieve maximum visibility and impact
	Data ownership and responsibility	Re-organization and/or divestment
Strategy	Cost containment	Selective/phased incremental approach; long term internal integration
	Planning	Setting realistic milestones
	Funding – investment; maintenance and operating costs	Government subsidies; fee revenues
	Interactive democracy	Security and authentication
	Timing – election life cycle	Project planning and completion within election life cycle

MOBILE FUNCTIONALITIES AND APPLICATIONS

In order to evaluate the suitability of potential applications for mGovernment environments, it is important to understand the characteristics of each of the four functional classes (mG2E, mG2C, mG2B, and mG2G), and to review a few existing applications that have worked well in these environments.

mG2E Solutions

Frameworks devised for evaluating mobile business applications for employees (Zheng & Yuan, 2006) can be adapted to mG2E solutions because of the similarities between these environments. Supporting mobility through electronic solutions is having a growing impact on work by enabling employees and managers to carry devices that assist them to stay in constant communication with their organizations. This may involve using voice or data messages, paging, direct communication by telephone or teleconferencing, and database or document information access, storage, and retrieval. Characteristically, mobile environments may fall into four classifications (Solaiman et al., 2001): same place, same time; same place, different time; different place, same time; and different place, different time. Mobile solutions involving "same time" are synchronous in nature, such as mG2E emergency service communications (fire, ambulance, police) involving not just access to online databases, but communications to other mobile users. mG2E asynchronous communications are "different time" such as healthcare (e.g. home healthcare support of visiting nurses (Archer, 2005)), building and restaurant inspections, asset management, and smart metering, typically rely on access to databases for downloading or uploading relevant data.

mG2E solutions are similar to mobile business applications in that a government agency can specify the type of end user devices that will be supported for its employees. This allows a tailored approach to optimizing the performance of mobile systems. Thus, to overcome problems such as loss of connectivity in so-called "dead zones", it is possible to run wireless devices in a fat client mode in which downloaded software supports the application while the device does not have wireless access. Data accumulated during dead zone periods can then be uploaded or fresh data can be downloaded when the device can again access its home site wirelessly. This differs from the approach that is required for mG2C applications, since these must cater to a wide class of citizen devices and capabilities, usually relying on thin client technology such as text or multi-media messaging. The result is that applications are often developed to support the lowest common denominator of device, such as cell phones that typically have limited display space and communication bandwidth.

mG2C Solutions

In an annual global review of eGovernment in 2004, West (West, 2004b) reported that many nations are offering new online services, some of which involve mobile technologies. For example, Norway offers its citizens extensive information regarding how to communicate with government officials via text messaging on mobile phones, and Taiwan provides Web pages that are compatible with handheld PDA devices. Users of a mobile portal in Dubai are able to take advantage of a variety of services including online flight booking, hotel search, visa information prayer timings service, and live quote information from the Dubai Financial Market (Telecomworldwire, 2005).

Text messaging has also become an ingrained tool for some government authorities (Pape, 2006). This includes its use for casting votes by cell phone to decide on a local ballot measure in Switzerland (with potential use for nation-wide voting), in Ukraine for an opinion poll on whether Russian should be the country's official second language, in Thailand, 25 million voters received a text reminder to vote in a national election, in the Netherlands to find information that led to the location of four lost children and the capture of criminal suspects. Instant messaging, a faster, keyboard-oriented method of texting, is also catching on for cell phones and PDAs that are equipped with small keyboards. These features suggest that government communications are evolving along with general advancement in society.

Service composition that incorporates personalization and context awareness can simplify the life of mobile users. This may include presenting potential services to users according to context. For example, a person outside a government office may be reminded that his/her licence renewal date is near and the licence needs to be renewed, or a visually-impaired person attempting to read a timetable at a bus stop may be alerted to the availability of an audio time-table service. Advanced context sensitive services such as this require collaboration between service discovery, composition, personalization, context awareness and adaptation functional components (Davy et al., 2005).

Chen and Dimitrova (Chen & Dimitrova, 2006) develop a model with three dimensions for online civic engagement (government information access, service transactions, and contributing to government policy-making processes), including a number of variables, including political activism, civic involvement, perceived benefits and difficulties, information channels, and demographic characteristics. They suggest that political activism is related positively to

accessing government policy information and contributing to policy-making processes. One component of civic engagement is the concept of interactive democracy. To be implemented successfully, this requires a large commitment to authentication and security, as well as privacy protection for citizens. Given strong commitments in these areas, mobile applications are likely to play a significant role in interactive democracy.

mG2G Solutions

There are a variety of G2G applications (Lee et al., 2005) being used in a number of nations. These include online portals for grant applications, interchange of data between administrations and networking of public administrative units, coordinating purchase needs of public sector procurement officers, information sharing and linkages for financial institutions, interdepartmental e-mail delivery, and emergency disaster response services. Of all these, only the latter two (interdepartmental e-mail and disaster response services) appear to support natural adaptation for mobile applications through the anytime, anywhere paradigm.

mG2B Solutions

eGovernment solutions that can be classified as G2B include federal asset sales, delivery of standardized notifications to government agencies, portal access to integrated government information and services, and integrated online procurement (Lee et al., 2005). The most promising of these solutions for mobile adaptation are mobile portal access to integrated government information and services, and online purchasing through existing procurement contracts. Both support the anytime, anywhere paradigm.

EVALUATING THE POTENTIAL OF mGOVERNMENT APPLICATIONS

In determining the applicability of mobile solutions in government, it is worthwhile to evaluate mobility designs using five criteria: mobility requirements of the user, place, time, process, and identity (Roggenkamp, 2004) (Zhang, Yuan, & Archer, 2002). An example is a citizen (user) needing to apply for a visa (process) at an airport (place) for immediate delivery (time). The (process) associated with this requires a federal government infrastructure that can respond to such demands by the citizen. In this case, it is clear that this might involve a mobile application, but this would at least have to complemented by a stationary application since hardcopy identification would be required (perhaps this will change in the future) and a hardcopy notification would need to be generated.

In Table 2, a number of real and potential applications are evaluated according to Roggenkamp's five criteria. In addition, whether information or transactional data are being accessed determine the nature of the mobile device required. For example, informational access is usually feasible with a cellphone, whereas it is difficult to retrieve or store data (transactional) on a server using a cellphone. This typically requires a PDA or tablet with virtual or real keyboard entry and a moderately large display screen.

In the table, those applications that are suited to a mobile environment, not surprisingly, have Mobility checked off in each case. However, not all mobile applications are location sensitive; those that are not may also be suitable for stationary applications. Applications suitable for mobile environments are not necessarily time critical. Most, but not all, rely on personal identity. In the table, Y(S) indicates that the application could be mobile and/or stationary.

The table does not indicate any particular patterns that point to the suitability for mGovernment applications. This indicates that each potential application must be evaluated on its merits. Some are clearly suited for mobile applications (e.g. emergency services and disaster response) while others are suited to both mobile and stationary applications (e.g. re-ordering supplies and asset management). Others typically fit the stationary environment, including paying federal income tax and vehicle registration, although mobile reminders could play a role.

FUTURE TRENDS

The discussion in this paper has been directed to a comparison of stationary and mobile eGovernment applications, based on the current state of eGovernment implementations. It is very clear that there is a path to mobile applications that is based on the evolution of stationary infrastructure and common content towards the parallel development of mobile services. The services that are most suitable for mGovernment have been found to be mG2E and mG2C, but services in mG2G and mG2B may develop more in the future. In terms of future trends, it is likely that mGovernment applications will track closely with technological developments, including wireless bandwidth, network ubiquity, and more inexpensive and reliable handheld devices with increased functionality. For mG2C applications, the widespread adoption of mobile technology for other purposes must proceed in parallel, because citizens are unlikely to acquire wireless technology strictly to communicate with government. mG2E applications are already in widespread existence for emergency services, but the availability of ubiquitous high bandwidth wireless networks will revolutionize and improve the capability of these services (with significant implications for mG2G and mG2B). Although the analysis of existing eGovernment applications did not reveal patterns that suggest the superiority of mobile

applications, more research is needed in this area to develop a framework with the appropriate factors that will help in identifying suitable mobile applications.

Table 2. Suitability of Mobile Government Applications

Application	Time Critical	Loc'n Sens've	Mobility	Person Identity	Info. / Trans.	Class	Gov't Level	Mobile Appl'n?
Pay parking fee	Y	Y	Y	N	Trans.	G2C	Muni.	Y
Pay federal income tax	N	N	N	Y	Trans.	G2C	Fed.	N
Building inspection	N	Y	Y	Y	Trans.	G2E	Muni.	Y
Emergency services	Y	Y	Y	Y	Info. & Trans.	G2E	Muni.	Y
Disaster response	Y	Y	Y	Y	Info. & Trans.	All	All	Y
Border crossing traffic report	Y	N	Y	N	Info.	G2C	Fed.	Y
Renew drivers license	N	N	N	Y	Trans.	G2C	State/ Prov.	N
Vehicle registration	N	N	N	Y	Trans.	G2G, G2C	State/ Prov.	N
Asset management	N	Y	Y	Y	Trans.	G2E	All	Y
Pay local business tax	N	N	N	Y	Trans.	G2B	Muni.	N
Re-order supplies	Y	Y	Y	Y	Trans.	G2B	All	Y
Criminal record access & sharing	Y	N	Y	Y	Info.	G2G	State/ Prov.	Y

CONCLUSIONS

This review has discussed a variety of frameworks that have been proposed for stationary and mobile forms of eGovernment. It does not appear to be possible nor desirable to differentiate between these two forms of eGovernment, because they share a common content and technical infrastructure, with the majority of their differences lying in the networks that support them, the form of delivery of services to end-users, and the functionalities of each that invite their use for specific applications. While the two most promising areas for mGovernment applications are mG2E and mG2C, this could change in the future as technology evolves and innovative new ideas are applied to address a wider range of situations.

REFERENCES

Anonymous. (2005). *Law enforcement agencies on three continents to fight child exploitation*: Canadian Press Newswire.

Archer, N. (2005, July). *Mobile eHealth: Making the case.* Paper presented at the First European Mobile Government Conference, Brighton, England.

Brailer, D. J. (2005). Interoperability: The key to the future health care system. *Health Affairs - From The Field, W5,* W520 - W522.

Capra, L., Blair, G. S., Mascolo, C., Emmerich, W., & Grace, P. (2002). Exploiting reflection in mobile computing middleware. *Mobile Computing and Communications Review, 6*(4), 34-44.

Carroll, J. (2005). *Risky business: Will citizens accept M-government in the long term?* Paper presented at the First European Mobile Government Conference, Brighton, England.

Chen, Y.-C., & Dimitrova, D. V. (2006). Electronic government and online engagement: Citizen interaction with government via Web portals. *International Journal of Electronic Government Research, 2*(1), 54-76.

Clarke III, I., & Flaherty, T. B. (2003). Mobile portals: The development of m-commerce gateways. In B. M. a. T. Strader (Ed.), *Mobile Commerce: Technology, Theory, and Applications* (pp. Chapter 10). Hershey, Pennsylvania, U.S.A.: Idea Group Inc.

Davy, A., Mahon, F., Doolin, K., Jennings, B., & Foghlu, M. O. (2005). *Secure mobile services infrastructures for mGovernment: Personalised, context-aware composition of pervasive mobile services.* Paper presented at the First European Mobile Government Conference, Brighton, England.

Ebrahim, Z., & Irani, Z. (2005). E-government adoption: Architecture and barriers. *Business Process Management Journal, 11*(5), 589-611.

Ghasemzadeh, F., & Sahafi, L. (2003). *eCommerce adoption: A two dimensional maturity model.* Paper presented at the Fourth World Congress on the Management of Electronic Business, Hamilton, Canada.

Karacapilidis, N., Loukis, E., & Dimopoulos, S. (2005). Computer-supported G2G collaboration for public policy and decision-making. *Journal of Enterprise Information Management, 18*(5), 602-624.

Lam, W. (2005). Barriers to e-government integration. *Journal of Enterprise Information Management, 18*(5), 511-530.

Lee, S. M., Tan, X., & Trimi, S. (2005). Current practices of leading e-government countries. *Communications of the ACM, 48*(10), 99-104.

Melitski, J., Holzer, M., Kim, S.-T., Kim, C.-G., & Rho, S.-Y. (2005). Digital government worldwide: An e-government assessment of municipal Web sites. *International Journal of Electronic Government Research, 1*(1), 1-19.

Nobel, C. (2006). *Municipal Wi-Fi catches on in U.S. cities.* Retrieved February 2, 2006, from http://www.eweek.com/article2/0,1895,1917896,00.asp

Pape, E. (2006, February 6). The mobile phone rings: You're fired! *Newsweek International Edition,* 1.

Reddick, C. G. (2004). Empirical models of e-government growth in local governments. *E-Service Journal, 3*(2), 59-86.

Reddick, C. G. (2005). Citizen-initiated contacts with Ontario local e-government: Administrators' responses to contacts. *International Journal of Electronic Government Research, 1*(4), 45-62.

Roggenkamp, K. (2004). *Development modules to unleash the potential of mobile government.* Retrieved November 30, 2005, from http://topics.developmentgateway.org/egovernment/rc/ItemDetail.do~403277

Sandy, G., & McMillan, S. (2005). *A success factors model for M-government.* Paper presented at the First European Mobile Government Conference, Brighton, England.

Schaupp, L. C., & Carter, L. (2005). E-voting: From apathy to adoption. *Journal of Enterprise Information Management, 18*(5), 586-601.

Schmidt, T., & Townsend, A. (2003). Why wi-fi wants to be free. *Communications of the ACM, 46*(5), 47-53.

Scholl, H. J. (2005a). E-Government induced business process change (BPC): An empirical study of current practices. *International Journal of Electronic Government Research, 1*(2), 27-49.

Scholl, H. J. (2005b). *The mobility paradigm in government theory and practice: A strategic framework.* Paper presented at the Euro mGov 2005, Brighton, England.

Schwartz, K. D. (2004, October 1). Straight talk. *Government Executive, 36,* 47.

Solaiman, B., Cauvin, J. M., Puentes, J., Le Guillou, C., Brunet, G., Debon, R., et al. (2001). *Enabling technology for telemedicine and telehealth.* Paper presented at the 23rd Annual EMBS International Conference, Istanbul, Turkey.

Sulaiman, I. F. (2003). *Why are some E-government programs more successful than others?* Retrieved Jan. 3, 2006, from http://pdf.dec.org/pdf_docs/PNACW063.pdf

Tarasewich, P. (2003). Designing mobile commerce applications. *Communications of the ACM, 46*(12), 57-60.

Telecomworldwire. (2005). *Mobile portal launched by Dubai eGovernment*. Retrieved February 1, 2006, from http://proquest.umi.com/pqdweb?index=6&did=899878961&SrchMode=1&sid=1&Fmt=3&VInst=PROD&VType=PQD&RQT=309&VName=PQD&TS=1138827327&clientId=22605

Tilsner, D. (2005). *Use-Me.Gov: Usability-drive open platform for mobile government*. Retrieved December 2, 2005, from http://europa.eu.int/information_society/activities/egovernment_research/projects/egovernment_projects/index_en.htm#usemegov

U.S., D. o. L. (2005). *U.S. Department of Labor Strategic Plan*. Washington D.C.: U.S. Department of Labor.

West, D. M. (2004a). E-Government and the transformation of service delivery and citizen attitudes. *Public Administration Review, 64*(1), 15-27.

West, D. M. (2004b). *Global e-government, 2004*. Retrieved February 1, 2006, from http://www.insidepolitics.org/egovt04int.html

WorldBank. (2005). *A definition of E*Government*. Retrieved November 30, 2005, from http://www1.worldbank.org/publicsector/egov/definition.htm

Zhang, J. J., Yuan, Y., & Archer, N. (2002). Driving forces for m-commerce success. *Journal of Internet Commerce, 1*(3), 81-105.

Zheng, W., & Yuan, Y. (2006). Identifying the differences between stationary office support and mobile work support: A conceptual framework. *International Journal of Mobile Communications, (to appear)*.

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