DELIVERING MOBILE GOVERNMENT SERVICES THROUGH CLOUD COMPUTING

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Abstract

With the implementation of Internet into mobile devices the ubiquitous connectivity has become a reality. The affordance of mobile technology can be exploited to make e-government more pervasive and equitable. The advances of mobile technology have empowered citizens with means to access information and use e-government services from anyplace and anytime. M-government stands for the use of mobile technologies within the government administration to deliver public services to citizens and companies.

Main subject of this paper is analysis of potentials and benefits that mobile technologies can bring to e-government services. We analyze the need and possibilities for implementing m-government services. We provide a model for implementing mobile government services through cloud computing infrastructure.

We present a generic framework to encourage e-government practitioners to be easily involved in the design and development process to generate more m-government services, document

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good practices, and derive more strategies to improve the engagement in a ubiquitous approach through mobile devices.

Keywords: mobile services, mobile technology, e-government, cloud computing

Introduction

The emergence of Information and Communications Technology (ICT) has provided means for faster and better communication, efficient storage, retrieval and processing of data and exchange and utilization of information to its users, be they individuals, groups, businesses, organizations or governments. With growing computerization and increasing internet connectivity. Governments around the world have engaged in the process of developing a wide range of (e-government) services by using web-based internet applications. These technological advances have tended to occur at a much slower rate in less-developed countries. Governments are aiming to meet the rising expectations of citizens for better, more comprehensive services using innovative information technologies and various service delivery channels. Mobile internet and related technology are among the most advanced delivery channels that are leading to a new era of mobile government. It is no longer a matter of whether or not e-government professionals, should acquire necessary skills to prepare for the new move towards mGovernment, it is a matter of how fast they can acquire the skills to meet the growing services demands of multiple stakeholders (e.g., the public, private and public companies).

Main subject of this paper is analysis of potentials and benefits that mobile technologies can bring to e-government services. We analyze the need and possibilities for implementing m-government services. We provide a model for implementing mobile government services through cloud computing infrastructure.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources, (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (National Institute of Standards and Technology (NIST), 2009).

Cloud computing available service models are:

1) Infrastructure as a Service (IaaS). IaaS provides the consumer with the capability to provision processing, storage, networks, and other fundamental computing resources, and allows the

consumer to deploy and run arbitrary software, which can include operating systems and applications.

2) Platform as a Service (PaaS). PaaS provides the consumer with the capability to deploy consumer-created or acquired applications, which are produced using programming languages and tools supported by the provider, onto the cloud infrastructure.

3) Software as a Service (SaaS). SaaS provides the consumer with the capability to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices, through a thin client interface, such as a web browser (e.g., web-based email).

In this paper, we present a generic framework to encourage e-government practitioners to be easily involved in the design and development process to generate more m-government services, document good practices, and derive more strategies to improve the engagement in a ubiquitous approach through mobile devices.

Our framework suggests that much remains to be done for current mGovernment applications to be able to serve governments with effective tools of administration. Instead, it suggests that adoption of mobile technologies primarily serves external parties to governmental institutions such as citizens and other businesses but has not yet resulted in significant improvements in effectiveness or efficiency for governmental agencies or units.

We argue that it is important to understand the impact of mobile technologies on government administration as this may have implications for the success of well-planned, integrated, and widely adopted mGovernment applications.

We argue that the inherent characteristics of governmental administrations will likely endure, at least in the short run, but there will likely be various efficiency gains in terms of speed, improved services, and possibly cost savings.

Having introduced mobile technologies and their utilization in the governmental sector, the remainder of this paper is organized as follows. In the next section we provide impact that mobile technology has on governments. We then review e-government services and we discuss their application in the cloud computing environment. We next present a model of a mobile e-government service for citizens.

We close the paper with a discussion of key observations and implications for future research.

Mobile technologies and services

Mobile technologies are handheld IT artifacts that encompass hardware (devices), software (interface, applications), and communication (network services) (Jarvenpaa, Lang, 2005). There are estimated to be 1.5 billion mobile phones in the world today (Prensky, 2005). Mobile devices enable information access in its contexts as well as synchronous and asynchronous communication with other participants (Hwang, Tsai, 2011).

Mobile technologies

Mobile technologies can be classified by the type of networks which use these technologies. Purpose of using mobile technologies highly depends of their range and speed. By the range of network coverage, all networks can be classified into several types: PAN (personal area network), LAN (local area network), MAN (metropolitan area network) and WAN (wide area network).

Wireless PAN (WPAN) is a network with the smallest coverage. Its coverage is less than 10 meters and it is used for data interchange between two devices. The most widespread technologies which use WPAN are Bluetooth and ZigBee.

Bluetooth is a universal radio interface in the 2.45 GHz frequency band that enables portable electronic devices to connect and communicate wirelessly via short-range, ad hoc networks. Each unit can simultaneously communicate with up to seven other units per piconet. Moreover, each unit can simultaneously belong to several piconets (Haartsen, 1998).

ZigBee is a specification for wireless personal area networks (WPANs) operating at 868 MHz, 902-928 MHz, and 2.4 GHz. A WPAN is a personal area network (a network for interconnecting an individual's devices) in which the device connections are wireless. Using ZigBee, devices in a WPAN can communicate at speeds of up to 250 Kbps while physically separated by distances of up to 50 meters in typical circumstances and greater distances in an ideal environment. ZigBee is based on the 802.15 specification approved by the Institute of Electrical and Electronics Engineers Standards Association (IEEE-SA).

Wireless LAN (WLAN) is a network which connects two or more devices which are located at small distances away from each other. WLAN networks are usually used at homes or offices. Typical example of a technology which uses WLAN is WiFi.

WiFi is the popular name for the wireless Ethernet 802.11b/g/n standard for WLANs. WiFi LANs operate using unlicensed spectrum in the 2.4 GHz band. Typically, WLANs are deployed in a distributed way. A number of corporate business and university campuses have deployed such contiguous WLANs. Still, the WLAN technology was not designed to support high-speed hand-off associated with users moving between base station coverage areas (i.e., the problem addressed by mobile systems) (Lehr, McKnight, 2003).

Wireless MAN (WMAN) is a network larger than WLAN but smaller than PAN and usually it covers a city or larger territory. An example of a technology which uses this network is WiMAX.

WiMAX is based on the IEEE 802.16 standard. The main features of this standard are frequencies less than 11 GHz, separated into several frequency bands, high data rates (higher than 10 Mbps) and a large coverage area (~ 20 km). (Nuyami, 2007).

WAN represents a system of connected LAN networks, situated in a large geographical area. The largest WAN network is the Internet.

Mobile services

Mobile services are organized into several categories, which are: voice services, data services, messaging services and video services. Mobile network providers provide these services to their customers via GSM or 3G networks.

Voice services are the main services of mobile networks. Using these services, customers are able to make calls to other customers as well as to use additional voice services, such as: call waiting, call back, call forwarding, call barring, voice mail etc.

Data services include data transmission using mobile networks. Data services are becoming increasingly popular thanks to smart phones. A large number of applications designed for smart phone platforms (Android, iOS, Windows Phone etc.) are using data services. A user of mobile application can choose which connection he/she is going to use. The user is usually able to choose between mobile network data connection and WiFi.

Mobile data services include GPRS, UMTS, HSPA or HSPA+ technologies.

Messaging services include sending text or multimedia messages to other mobile customers.

SMS (Short Message Service) represents a communication protocol which permits the exchange of short text messages up to 160 characters between mobile devices. SMS is globally accepted service.

MMS (Multimedia Message Service) is an extension of messaging services. This service enables sending rich content, such as images or audio files, to other customers.

Video services are specific for third generation mobile networks. They enable video calling. By using the video calling service, one customer can see and hear the other customer at the real time. Both customers must have appropriate equipment (3G video phones with embedded front camera and with video calling support).

E-government services

There are twelve services for citizens and eight services for enterprises.

Citizen services include tax registration, job searching, social revenues, issuing personal documents, vehicle registration, application for building permits, police registration, public libraries, issuing birth, death and marriage certificates, services related to higher education, online change of residential address and health-care services.

Enterprise services include following services: social revenues for employed, company tax registration, VAT registration, registration of a new enterprise, delivering data to statistical organizations, customs declarations, environment-related permissions and electronic public procurements.

In the following text, the most important services which are implemented in Serbia will be described.

Tax registration

Tax registration services include services for both citizens and enterprises. In Serbia, it is possible to submit a tax registration application online since March 2012. It is also possible to view a report related to taxpayer's liabilities. Several other services, such as issuing an electronic certificate of all paid debts, electronic application for taxes for total revenue of citizens, online payment of taxes, as well as online office business are planned to be introduced (Internet 4).

Job searching

National Employment Service provides online services to employers in Serbia. An employer can fill out an online application form to announce a new available job position. Unemployed person is able to browse a catalog of available job positions but currently it is not possibly to apply for a position online (Internet 3).

Issuing personal documents

Few municipalities in Serbia offer a possibility of making an appointment for issuing a national ID card or passport for citizens. A citizen can log into the E-government portal by using an electronic certificate and make an appointment by choosing date, time and desired police station where he/she can submit a request for a new document. In the desire time, the citizen needs to go to the chosen police station and he/she needs to present required documentation. This service is convenient because it eliminates all the queues in front of police stations. This service is also implemented as mobile service, so citizens can submit a request for an appointment via SMS (Internet 5).

Issuing birth, death and marriage certificates

A service for issuing birth, death and marriage certificates is available by some municipalities. Currently, this service is not centralized nor integrated with the E-government portal. If a citizen needs to order a certificate, he/she needs to fill out a form at a website of local municipality. The implementation of the service is dependent of a municipality.

Using cloud computing for implementation of e-government services

E-government services need to be available for a large number of citizens. Because of a large number of requests, a scalable and reliable infrastructure is needed. Cloud computing is convenient approach because it is a high-scalable infrastructure which can responds to a large number of requests.

Recently, the U.S. federal cloud computing initiative was published, which is a service oriented approach, whereby common infrastructure information and solutions can be shared across the U.S. government (National Institute of Standards and Technology (NIST), 2009).

Cloud computing has the capability to evolve beyond meeting the business needs of e-Government agencies and towards providing to numerous identified e-Citizens related shortages.

Model for introducing m-government services through cloud computing

M-government services through cloud computing infrastructure permits integration of smart phone applications as well as traditional mobile network services (SMS, MMS etc.) with the e-government portal. Cloud computing infrastructure is used because it provides high scalability. There is a large amount of data in databases of e-government services and this is the main reason why the cloud infrastructure is used.

The main benefit of providing mobile e-government services to citizens is making e-government services available to all citizens. In Serbia, the number of mobile customers are greater than the total number of inhabitants (Internet 1). Also, the number of citizens who own a smart phone is increasing. Mobile services are not yet available for major e-government services (Internet 2). Proposed model for developing m-government services should permit access to e-government services using different mobile services.

Figure 1 shows the proposed infrastructure of mobile e-government services. The infrastructure is based on cloud computing model. E-government portal and web service for integration with mobile devices are installed on virtual machines in the cloud computing infrastructure. Web service integrates mobile applications with e-government portal. The e-government portal with its databases is the main part of the whole e-government system. The e-government portal integrates its databases with databases of each government ministry, government agency as well as with databases of local authorities.

All major mobile services are supported. It means that a citizen can use m-government services via specialized mobile application, SMS or voice call. In the first case, a citizen needs to install a mobile application onto his/her smartphone. All major mobile platforms will be supported. Separate applications for Android, iOS, Windows Phone operation systems will be developed. In the second case, a citizen needs to send a SMS with particular contents to a mobile number determined by the E-government portal. The web service sends back a response to the citizen. Finally, a citizen can use mobile voice services for particular m-government service. The citizen needs to dial a particular number. An IVR (interactive voice response) system answers the call.

The citizen can choose an option by pressing a keypad digit and he/she can hear the response.

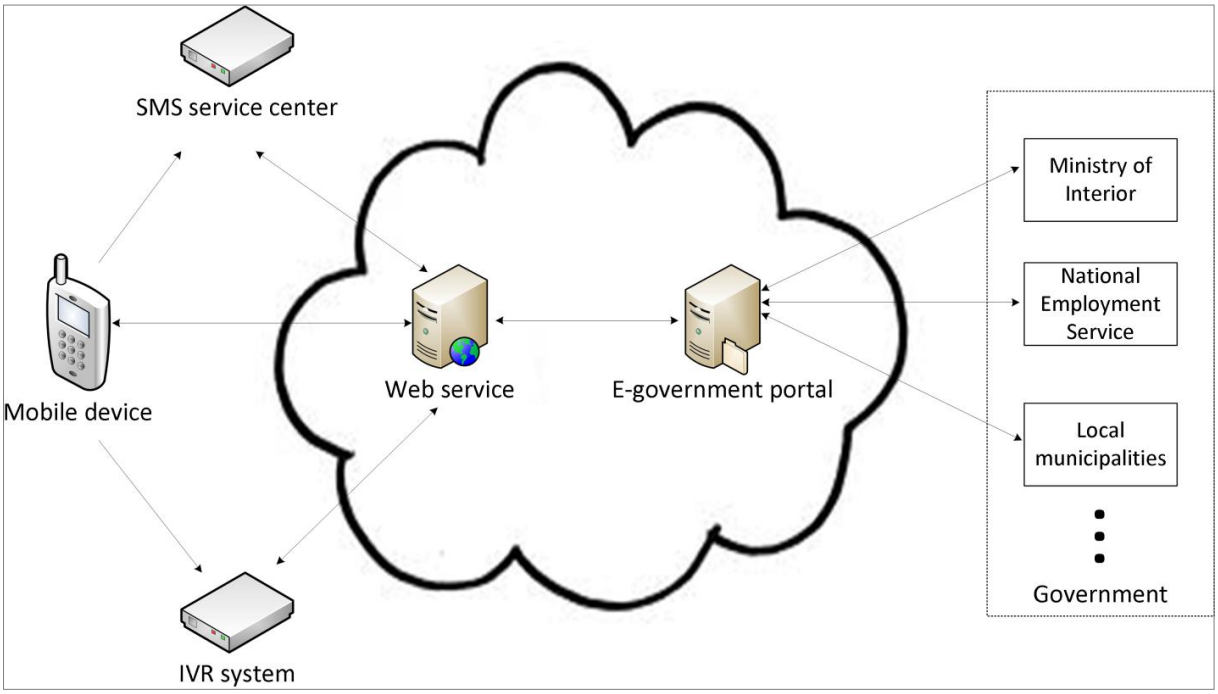

Figure 1 The model of the infrastructure for cloud-based mobile e-government services

Mobile services will be implemented for all e-government services. In the first phase of introducing the system, citizen services will be introduced and the services for enterprises will be introduced in the next phase.

Representative example of a mobile service for e-government is ordering birth certificates. For instance, a citizen wants to order his/her birth certificate. The citizen needs to open a mobile application and to select an option for ordering a birth certificate. It is important that the citizen use his/her own mobile phone which is registered for using m-government services. The device sends a request to a web service which integrates the e-government system components. This web service forwards the request to the E-government portal which sends the request to the central birth register of the Republic of Serbia. The central register checks whether the birth record exists and if it is the case, it sends the request to according local municipality where the birth certificate was issued. The local authority sends back the response directly to the E-government portal, which forwards it to the web service. Finally, the user gets the information that the birth certificate is successfully ordered and that it will be delivered to the address of the citizen. Mentioned phases of the example are shown in the Figure 2.

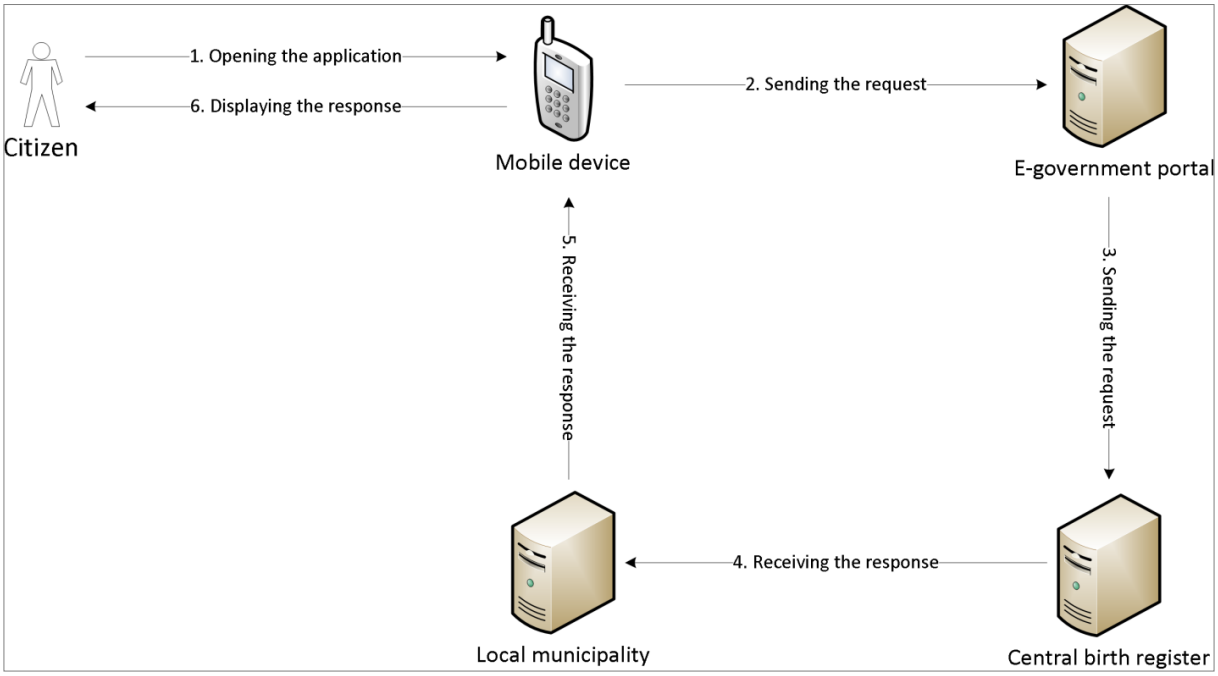

Figure 2 Service for ordering a birth certificate

Conclusion

In this paper, we presented all main concepts of mobile technologies. We also presented e-government services and we explained how they are implemented using cloud computing concept. We developed a model for e-government mobile services in the cloud computing environment. In the future, the e-government portal needs some improvements regarding the integration of system components.

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