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# *Adaptive Mobile- Government Framework*

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## ABSTRACT

*This paper proposes a new framework for adapting the content of Mobil-government services with respect of four contexts; personal, device, connectivity and location contexts. The paper also highlights the main guidelines that help improving Mobile -government content, and the provision of governmental services in terms of place and time flexibility, for achieving the appropriate level of services flexibility, to fit the wide variety of mobile and wireless technologies.*

**Key Words:** *Mobile -government, Content Design, Content Adaptation, User Context,* E-government.

## 1. INTRODUCTION

Mobil-government is a new phenomenon that emerged from recent proliferation of mobile devices and wireless technologies. Governments around the world have the responsibility to efficiently and effectively facilitate services delivery to the public. Therefore, many governments have engaged in the process of developing a wide range of electronic governmental services, which called electronic government (E-government), through the use of Information and Communication Technologies (ICTs).[1] While many predicted that E-government is the most effective solution for providing governmental services, there have been significant developments in mobile and wireless technologies which were considered the main factors for expanding the mobile usage habit among different communities and escalating the number of mobile Internet subscribers. Currently, many governments started to adopt mobile usage habits as well as the wireless technologies to meet the rising expectations of the public for better services.[4].

Mobile-government (M-government) extends E-government benefits by releasing the latest edge of technologies from its minimal requirement which is a personal computer (PC) to wireless technology. M-government is considered as a supplementary approach to deliver governmental services through different transmission channels and technologies anytime and anywhere. As shown in Figure 1, M-government is a subset of E-government [16]. For example, in [3], the authors define E-government as "the use of information and communication technologies (ICTs) to improve the activities of public sector organizations" and they described M-government as E-government with those ICTs that are limited to mobile and wireless technologies such as cellular phones and PDAs (Personal Digital Assistants) connected to wireless Local Area Networks (LANs).

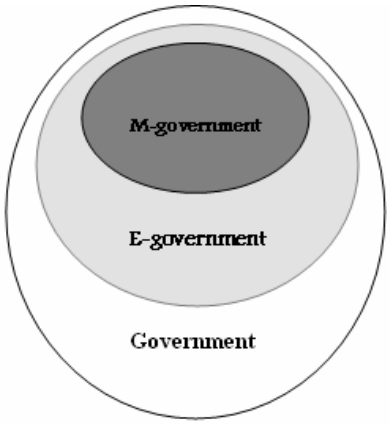


**Figure 1**: M-government As Part of E-government

When relocating the services that are provided by an E-government platform to services provided by M-government platform, many issues and problems will emerge One of the most important challenges we focus on is the designing and the adaptation of the content, which is provided to users through M-

government informational and operational functions, in order to fit the different capabilities and limitations of mobile devices and wireless technologies and to support the mobility of the user.

## 2 RELATED WORK

Designing the content of M-government services is a remarkable research area. In [3], the authors proposed a framework to understand mobile technologies and their implications for M-government applications as shown in Figure 2.

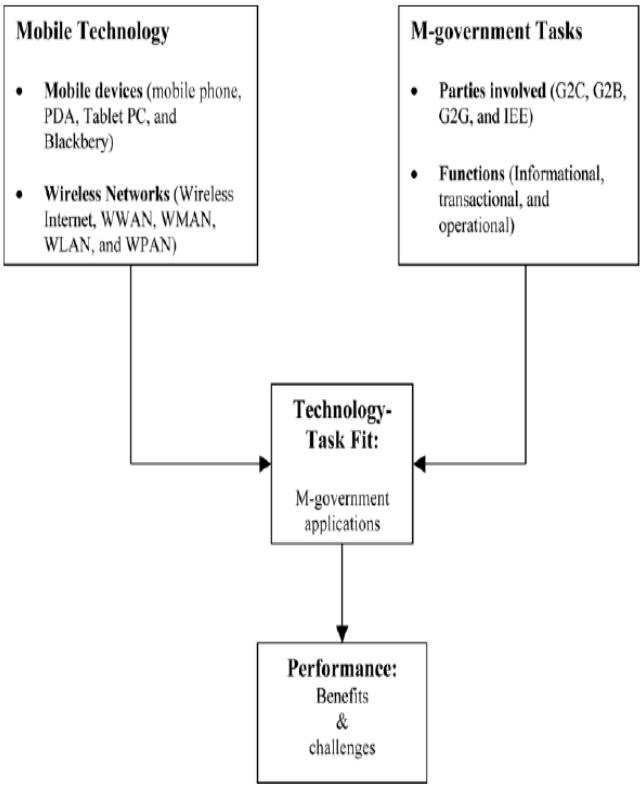


**Figure 2:** A Framework for Understanding M-government [3]

According to the framework the authors analyzed M-government applications and evaluated the mobile technologies (MTs) that are used in M-government. They have also categorized E-government services that can be provided through these technologies. Furthermore, the authors discussed the benefits and challenges of M-government in order to measure the degree of fit between MTs and government tasks and services performed through them.

In [9], the authors discussed some technical and policy consideration related to M-government. One of the important issues that was described in this paper is the content and presentation management. The authors suggested some useful guidelines to handle this issue such as: utilizing Content Management Systems (CMS) to add a formal structure to the content and to adopt enterprise-wide web and content design standards, using the Extensible Markup Language (XML), Extensible Style sheet Language (XSL), and employing Simple Object Access Protocol (SOAP) technology.

Another interesting research in M-government adaptation is presented in [1]. The authors examined location awareness and personalization techniques to ensure the importance in delivering the right service to the right users. The authors also proposed *a* logical architecture for governmental location based services which improved the creation of Intelligent M-government Services that match the best option of a service to the targeted user. The architecture includes four main components, they are: content server, application server, gateway and mobile location center.

In [8], the author proposed a systematic approach that allocates more M-government applications services from a user centric view by examining possible user needs within a set of possibilities and requirements such as the user role, processes of government organization and the context of use. The author discussed the three dimensions of mobility which are spatial, temporal, and contextual mobility. Further more, assessed the service mobility of M-government applications. In addition, the author describe three main stages to meet the user needs such as, examining the user readiness to use a certain technological innovation, followed by the determination of the user willingness to do so, and collecting user requirement to be considered while defining new M-government applications.

## 3. M-GOVERNMNET

To understand what M-government stands for, we are going to describe two fundamental terms: *"mobile"* and *"Government"*. We prefer

to begin with defining the government since it is the base for the new applications that emerged recently, such as E-government and M-government. A government is the dynamic assortment of goals, structures, services, and functions by which a community is ruled [7]. Government has a responsibility to enhance the provision of it's services by utilizing different means and communication channels in order to improve the quality of the public service delivery.

The second term *"mobile"* is a key aspect that differentiates M-government from E-government and any other developments in the governmental sector that use new technologies [4]. It refers to two main components; first, the mobility of users that can acquire the public services anytime, anywhere and while they are moving; second, the mobility of technologies that are utilized in M-government such as mobile and handheld wireless devices.

In this work we define M-government as the flexible provision of public services through mobile and wireless technologies to support users anytime and anywhere.

## 3.1 FROM E-GOVERNMENT TO M-GOVERNMENT

In the past few years we have observed a rapid evolution of wireless technologies and a widespread of internet-enabled mobile devices. In the mid of 2005, the number of cellular phones per person, were more three times than PCs, and most of sophisticated phones have the processing power of a mid-1990s PC, and it is increasing [2]. In 2006 about one billion people, worldwide, purchased a new handset [5]. As a result, the number of mobile users increased rapidly and nowadays they are estimated to be 2 billion users.

Beside, the advancements in wireless technologies play a major role in escalating the number worldwide mobile Internet subscribers who have a wireless access to various online recourses through mobile devices as shown in Figure 3 [11].

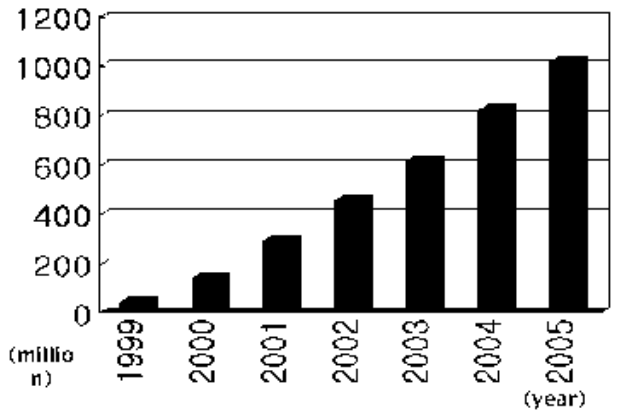


**Figure 3:** The Number of Mobile Internet Subscribers [11]

Such indicators revealed the importance of moving from E-government to M-government and they can be considered as the driving forces toward the adoption of M-government.

## 3.2 M-GOVERNMENT FUNCTIONS

In [6], the authors classified the M-government practices into three classifications which are: informational, transactional and operational functions.

Informational functions are one way transmission of information from government to the user. These functions provide governmental information via publishing and broadcasting. It can also send alerts and notifications to the user through SMS or e-mails. Transactional functions are two way transmissions of information from government to the user and vice versa. This class of functions allows the user to interact with the M-government system, such as online procurement and payments. Operational functions aim to handle the internal governmental operations. It enable government employees to access some important information from remote locations through their mobile devices.

However, in this work we are focusing on the content of the informational and operational functions and how this content must be personalized and adapted to meet the user preferences, location and technologies.

## 3.3 TECHNOLOGIES USED IN M-GOVERNMENT

### 3.3.1 MOBILE DEVICES

Devices that can be used in M-government must attain two key requirements which are: the ability to deliver the governmental services and the ability to support the user mobility. According to these requirements, mobile devices can be the best technologies that can be used in M-government.

Generally, mobile devices can be any device that is small, autonomous, and unobtrusive enough to accompany us in every moment of our every-day life [10]. Mobile devices can be categorized into main three categories as following:

- Personal Digital Assistant (PDA): PDAs are small handheld devices which have some of the personal computers capabilities as well as telephone capabilities. PDAs offer many interesting functionalities such as: organizing personal schedules, multimedia support, recognizing text and voice input and they offer the user the ability to connect the Internet to check an e-mail or to search the web. PDAs have 64 Mb of memory size, 8 hours power capacity and 240x 320 pixel screen resolution as typical parameters. These devices run on two important operating systems which are Windows-mobile from Microsoft and Symbian operating system [9].

- Cellular Phones: In the last few years, cellular phones scattered all over the world. Cellular phones range from devices with limited functionalities that are used for voice and short text message communications to advanced devices, third generation phones (3G), that enable the user to connect to the Internet to send or check e-mails and to open small web pages. However, cell phones have 10 hours power capacity and up to 800x480 pixel screen resolution. For that, the flexibility of these devices is less than the flexibility of PDAs[9].

- Smartphones: SmartPhones are hybrid devices that take some abilities from PDAs and other abilities from cellular phones. Smartphones can be used for text and voice communication, e-mail, web access and media or video player. These devices have 10 hours power capacity, up to 800x480 pixel screen resolution and they run on different operating systems such as: Symbian, Palm, Blackberry and Windows Mobile.

### 3.3.2 WIRELESS TECHNOLOGIES

Regardless of the mobile device capabilities, no mobile device can deliver any service if it does not have an access to online sources of information. Therefore, we will list some of the important wireless communication technologies that are used to allow mobile devices to connect to the Internet in M-government environment and they can be categorized into wireless telecommunication technologies and wireless local and personal area networking.

The following list describes some of the main wireless telecommunication technologies such as WAP, GSM, GPRS/EDGE, UMTS and IrDa.

- Wireless Application Protocol (WAP): WAP is a protocol that was designed to allow the users to browse the Internet from their mobile device rather than browsing the Internet from a desktop computer. Moreover, this protocol can view the information that is written by Wireless Markup Language (WML).

- Global System for Mobile Communication (GSM) [13]: GSM is a widespread standard that is used for the digital cellular phone communication. GSM has a 9.6 Kbps data transfer rate. Moreover, it offers many advantages to the cellular phone users such as enhancing the quality of voice and offering the short message service (SMS) which is an inexpensive way that allow the users to communicate with each other. In addition, GSM offers the Multimedia Message System (MMS)**:** that is descendant of SMS which is used to enable the users to send and receive one or more multimedia messages such as digital photos, graphics, video clips and sounds through mobile devices

- General Packet Radio Service (GPRS)/ Enhanced Data Rates for Global Evolution (EDGE) [12]: GPRS is a technology that allows a ubiquitous mobile data service which

has a higher data transfer rate than GSM, approximately between 30 and 80 Kbps. GPRS as the name indicates depends on the packet switched approach in transferring the data and it is the most commonly used and available wireless technology. It offers the user the ability to browse the Internet and check e-mail on the move.

- Universal Mobile Telecommunications System (UMTS): UMTS is communication technology that based on GSM and was first proposed in Europe. The high data transfer rate of UMTS, which is 2 Mbps, makes this technology suitable for transferring large amounts of data, movie downloads and video conferencing. As GPRS, UMTS depends on the packet switched approach in transferring the data but it is more expensive than GPRS.

IrDA, Bluetooth and 802.11 are the most familiar wireless local and personal area networking technologies [14]

- Infrared Data Association (IrDa) Protocols: A set of protocols that are designed to exchange data in small areas, not more than 2 meters, and with a transmission speed of 16Mbps through the ordinary infrared specification and 100Mbps through ultra infrared specification [14].

- Bluetooth Technology: Bluetooth is a wireless technology that use radio frequency to connect different devices with each other within a limited area, maximum 100 meters. Bluetooth makes it possible to send and receive signals between mobile devices, computers and other devices and thereby simplify communication and synchronization between devices.

- 802.11 (802.11 a/b/g) [15]: Is the formal name of the wireless fidelity protocol (Wi-Fi) which is a collection of standards that has been developed by the IEEE LAN/MAN Standards Committee and it is used for wireless local area networks. The 802.11 standard has evolved over time to provide higher data rates. The first version 802.11a provided 2 Mbps while the second version, called 802.11b, provided 11 Mbps. The most recent version of this technology (802.11g) provides 54 Mbps.

# 4. PROPOSED FRAMEWORK

As we have mentioned previously, M-government informational functions can provide end users with online published information and can send alerts and notifications to users while operational functions enable government employees to access any needed information from remote locations. In the following sections, we introduce our adaptive M-government framework and highlight some useful guidelines that must be applied in order to design information content, which is provided by the M-government platform, displayed efficiently and effectively.

## 4.1 ADAPTING CONTENT PRESENTATION

Content adaptation is a key part in the process of designing M-government applications. In other words, we have to adapt the content presentation to meet the user preferences and the different capabilities and limitations of mobile devices and wireless technologies that are used by different users. Thus, to adapt the presentation of the M-government content we have to take into consideration four main contexts which are: personal context, mobile device context, connectivity context and location context (Figure 4).

Personal context includes any information that is used to describe the user personal matters such as name, gender, date of birth and his service and content preferences

The device context is any information that is used to characterize the user mobile device. It is a crucial issue to specify the user device capabilities in M-government application because they can have a big impact on what content is appropriate and meaningful to be delivered to the user. Some of parameters that characterize mobile devices are the main factors that will be used to characterize this context such as device type and device screen resolution.

Nowadays mobile devices can be connected to Internet through different wireless technologies.

Each of them has different data transfer rate. As a result, we have to specify the type of wireless technology that will be used by the user to connect his device to the Internet and this is called the connectivity context.

Users with mobile devices may need some kind of information related to their location such as the nearest hospital, police station or any other information. Therefore, the location context will include any information that describes the user location.

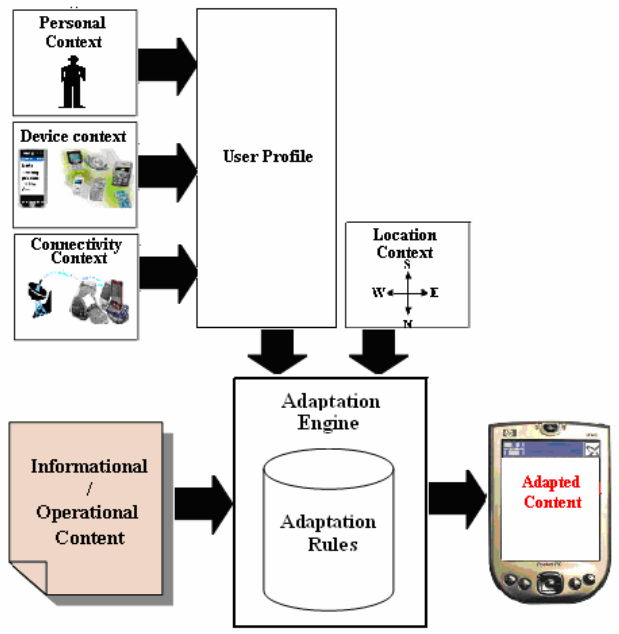


**Figure 4**: Adaptive M-government Content Framework

As shown in Figure 4, our adaptive model takes into account several factors from four context categories as discussed previously. The values of factors that are almost stable will be saved at the user profile and they will be used as inputs on the adaptation engine. None of the location context factors will be included in the user profile since all of their values regularly change. Finally, the adaptation engine specifies which presentation type is most appropriate to the user according to predefined set of rules. As a result, each user can receive an adaptive content that meet his preferences and is compatible with his mobile device and wireless technology. The following list describes some good examples that clarify how the framework can perform in different scenarios:

- By analyzing the user profile based on the date of birth and user gender from the personal context, governmental health clinics can distribute personalized announcement to women older than 45 years to have a screening mammogram at the end of this month.

- A policeman can search a suspect criminal photo from his mobile device that is wirelessly connected to a remote database. According to our adaptive model the system will check the policeman profile to determine the user device type. If the device type equal to PDA, the image will be displayed to him in a resolution less than 240x320 pixels while if his device type is a cell phone the image should be less than 120x160 pixels.

- Some government services aim to develop public awareness about a specific issue, such as the negative impact of smoking. The content can be displayed as animation with different resolution to fit the user device screen. Moreover, according to the wireless connection that is used, the content can be displayed as text, audio or animation. For instance, if the user is connecting the internet through GPRS, he can receive animated content while if he was using WAP that have a lower data transfer rates he can not receive animated content because it will take a long time to be downloaded on his device.

Based on the previous model, the expected dialog between the user and the system is shown in Figure 5.

## 4.2 MOBILE DEVICE OPTIMIZED CONTENT

In order to facilitate the effective presentation of the governmental websites through mobile devices and wireless technologies we propose the following guidelines:

1. Reduce the number of the graphical content in the interfaces because it will increase the time that are needed to download the content and it will take a large space of the small mobile devices' screens.

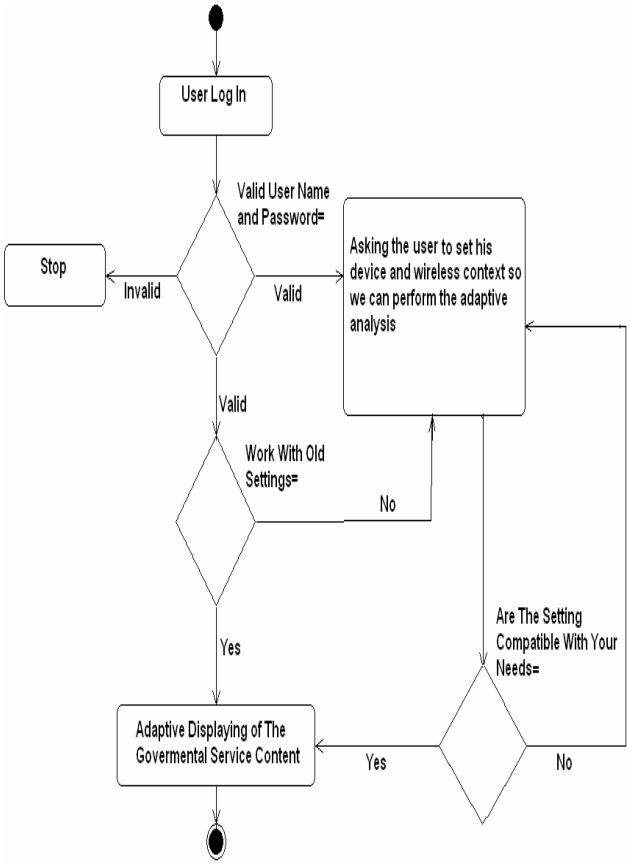


**Figure 5**: User and System Dialog

2. Governmental services provided in a specific web interface must be presented to the user as a menu of hyperlinks to minimize the user need to scroll the content horizontally as much as possible.

3. It is also important to rank the available public services provided to the user according to his priority by analyzing his previous interactions with the system.

## 5. CONCLUSIONS

This paper proposed a framework that improves the provision of M-government services by delivering personalized and adapted service content to the appropriate user efficiently and effectively. The framework considers different factors that characterize four contexts which are: the personal, device, connectivity and location contexts. The possible values for each factor will influence the content presentation type. We found that the same content must be found in different presentation types and in more than one resolution for graphical content, to fit different mobile devices and wireless technologies. Finally the paper introduced some important design guidelines that facilitate the presentation of the governmental websites through mobile devices and wireless technologies.

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**الدكتور مصطفى ياسين**
**عميد كلية تقنية المعلومات المحترم**

**تحية طيبة وبعد ،،،**

**ارجو التكرم بالموافقة على سفري لحضور المؤتمر الدولي للتنمية الادارية ، والذي اشارك فيه بورقة بحثية *عن الحكومة الالكترونية وتحولها الى استخدام الاجهزة النقالة فى توزيع خدماتها الالكترونية .***

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مرفق :-

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