

Design Methodology for Mobile Information Systems

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INTRODUCTION

Mobile information systems (MISs) are having a major impact on businesses and individuals. No longer confined to the office or home, people can use devices that they carry with them, along with wireless communication networks, to access the systems and data that they need. In many cases MISs do not just replace traditional wired information systems or even provide similar functionality. Instead, they are planned, designed, and implemented with the unique characteristics of wireless communication and mobile client use in mind. These unique characteristics feature the need for specific design and development methodologies for MISs. Design methods allow considering systems independently of the existing information technologies, and thus enable the development of lasting solutions. Among the characteristics that a MIS design method needs to consider, we cite: unrestricted mobility of persons, scarcity of mobile devices' power-source, and frequent disconnections of these devices.

The field of MISs is the result of the convergence of high-speed wireless networks and personal mobile devices. The aim of MISs is to provide the ability to compute, communicate, and collaborate anywhere, anytime. Wireless technologies for communication are the link between mobile clients and other system components. Mobile client devices include various types, for example, mobile phones, personal digital assistants, and laptops. Samples of MIS applications are mobile commerce (Andreou et al., 2002), inventory systems in which stock clerks use special-purpose mobile devices to check inventory, police systems that allow officers to access criminal databases from laptops in their patrol cars, and tracking information systems with which truck drivers can check information on their loads, destinations, and revenues using mobile phones. MISs can be used in different domains and target different categories of people.

In this article, we report on the rationale of having a method for designing and developing mobile information systems. This method includes a conceptual model, a set of requirements, and different steps for developing the system. The development of a method for MISs is an appropriate response to the need of professionals in the field of MISs.

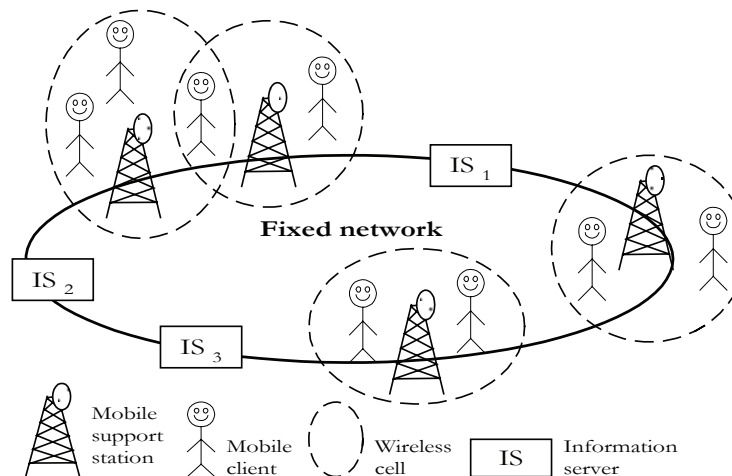
Indeed, this need is motivated by the increased demand that is emerging from multiple bodies: wireless service providers, wireless equipment manufacturers, companies developing applications over wireless systems, and businesses for which MISs are offered. Besides all these bodies, high-speed wireless data services are emerging (e.g., GPRS, UMTS), requiring some sort of new expertise. A design and development method for MISs should support professionals in their work.

MOBILE COMPUTING MODEL

The general mobile computing model in a wireless environment consists of two distinct sets of entities (Figure 1): mobile clients (MCs) and fixed hosts. Some of the fixed hosts, called mobile support stations (MSSs), are enhanced with wireless interfaces. An MSS can communicate with the MCs within its radio coverage area called wireless cell. An MC can communicate with a fixed host/server via an MSS over a wireless channel. The wireless channel is logically separated into two sub-channels: an uplink channel and a downlink channel. The uplink channel is used by MCs to submit queries to the server via an MSS, whereas the downlink channel is used by MSSs to disseminate information or to forward the responses from the server to a target client. Each cell has an identifier (CID) for identification purposes. A CID is periodically broadcasted to all the MCs residing in a corresponding cell.

The wireless application protocol (WAP) is a technology that plays a major role in the field deployment of the mobile computing model (Open Mobile Alliance). WAP is an open, global specification that empowers users with mobile devices to easily access and interact with information and services instantly. It describes how to send requests and responses over a wireless connection, using the wireless session protocol (WSP), which is an extended and byte-coded version of HTTP 1.1. A WSP request is sent from a mobile device to a WAP gateway/proxy to establish an HTTP session with the target Web server. Over this session, the WSP request, converted into HTTP, is sent. The content, typically presented

Figure 1. Representation of the mobile computing model



in the Wireless Markup Language (WML), is sent back to the WAP gateway, where it is byte-coded and sent to the device over the WSP session.

REQUIREMENTS FOR MISs

The role of an MIS is to provide information to mobile users through wireless communication networks. Two aspects are highlighted here: information and network. Information has to be available, taking into account terrain and propagation techniques. Plus, the information exchange has to be secured. A security problem inherent to all wireless communication networks consists of third parties being able to easily capture the radio signals while in the air. Thus, appropriate data protection and privacy safeguards must be ensured. Regarding the network element, this latter needs to consider failure cases and recover from them.

1. **Information Availability Requirement:** This illustrates the need for a user to have uninterrupted and secure access to information on the network. Aspects to consider are: survivability and fault tolerance, ability to recover from security breaches and failures, network design for fault tolerance, and design of protocols for automatic reconfiguration of information flow after failure or security breach.
2. **Network Survivability Requirement:** This illustrates the need to maintain the communication network “alive” despite of potential failures. Aspects to consider are: understand system functionality in the case of failures, minimize the impact of failures on users, and provide means to overcome failures.
3. **Information Security Requirement:** This illustrates the importance of providing reliable and unaltered

information. Aspects to consider are: confidentiality to protect information from unauthorized disclosure, and integrity to protect information from unauthorized modification and ensure that information is accurate, complete, and can be relied upon.

4. **Network Security Requirement:** This illustrates the information security using network security. Aspects to consider are: confidentiality, sender authentication, access control, and identification.
5. **Additional Requirements of MIS Have Been Put Forward:** Indeed, the increasing reliance and growth in information-based wireless services impose three requirements—availability, scalability, and cost efficiency—on the services to be provided. Availability means that users can count on accessing any wireless service from anywhere, anytime, regardless of the site, network load, or device type. Availability also means that the site provides services meeting some measures of quality such as short, acceptable, and predictable response time. Scalability means that service providers should be able to serve a fast-growing number of customers with minimal performance degradation. Finally, cost effectiveness means that the quality of wireless services (e.g., availability, response time) should come with adequate expenditures in IT infrastructure and personnel.

CHALLENGES AND POSSIBLE SOLUTIONS IN MISs

The requirements discussed above pose several crucial challenges, which must be faced in order for MIS applications to function correctly in the target environment.

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