Mobile Commerce Agents in WAP-Based Services

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With the increasing number of e-commerce services for mobile devices, there are challenges in making these services more personalized and to take into account the severely constrained bandwidth and restricted user interface these devices currently provide. In this paper we consider an agent-based platform for support of mobile commerce using wireless (WAP-based) devices. Agents represent mobile device customers in the network by implementing highly personalized customer profiles. The platform allows customization and adaptation of mobile commerce services as well as pro-active processing and notification of important events. Information to the customers is delivered both via WML-decks and SMS messages. Usage of the platform is illustrated by examples of valued customer membership services and subscription services support. Some details of a prototype platform implementation are briefly considered.

INTRODUCTION

The increasing number of mobile portable devices in use creates a great opportunity for development of a wide spectrum of mobile e-commerce services. The main advantage of these services is their high availability. Customers with a mobile device can enjoy these e-commerce services regardless of time or location. However, mobile devices, such as cellular phones and PDAs, are constrained by severe restrictions that might complicate practical use of e-commerce services. These restrictions are related to the limitations of wireless data networks when compared to wired networks (less bandwidth, more latency, lower connection stability, less predictability and less standardized protocols) and to the limitations of mobile handsets when compared to personal computers (small screen size, complicated text input, little memory, slow CPU and more constrained energy supply).

As a basic way of relaxing the above-mentioned problems and limitations, we see the following solutions:

• the connection time to the network service should be minimized,
• the precision of delivered information should be high in order to avoid exposing a large amount of useless information to be read on a small screen.

These solutions assume that as much work as possible should be done off-line without the mobile device being directly connected to the network.

Our approach towards reaching this goal is to provide a mobile device user with a personal software assistant that represents the customer’s profile and interests in his e-commerce activities. In order to implement such an assistant, we deploy the agent technology. The personal software assistant is implemented as a software agent. This agent operates in the Internet environment, and the users employ WAP-enabled mobile devices to communicate with their personal software assistant agents to take advantage of e-commerce services.

The rest of the paper is organized as follows. First, we describe some details of e-commerce services we would like to implement, as well as basic problems associated with their implementation. Then, we briefly consider the basic concepts of agent technology and WAP as enabling technologies. Next, we propose a solution for mobile e-commerce services utilizing software agents and WAP-based communication. Then, we give some additional details of a generic platform and a
prototype we have developed for various mobile e-commerce services. Finally, we present our conclusions and outline the future work.

**TWO EXAMPLES OF MOBILE E-COMMERCE SERVICES**

As our examples of mobile e-commerce services, we consider valued customer membership service support and subscription-based services.

The purpose of valued customer membership service is to provide members with special offers and with information about available products and services. Usually the service is applied by a shop or a chain of shops to provide membership benefits to their registered customers. Basically the service uses information about registered members to support mailing catalogues or booklets with particular offers. The main problem with such a service is its very low degree of personalization. The same offers and catalogues are usually sent to all members without consideration of their particular interests. This may cause customers to miss out on interesting offers as a result of them being hidden amidst a huge amount of non-relevant information. It is also possible that customers simply ignore non-personalized catalogues and offers. In order to achieve better personalization of services, more information about customers’ interests and preferences should be included in the membership database; however, this may contradict with privacy requirements (W3C, 2000). Even if the customers agree to disclose their preferences to the membership service, this can hardly be done in a flexible manner especially with huge centralized databases that assume a standard set of attributes for all customers.

Advertisements and information are usually sent to customers by regular mail. Usage of mobile portable devices for receiving these advertisements is not efficient when the limitations mentioned in the Introduction are taken into account. Nevertheless, getting the latest knowledge of good offers for some required products could be very valuable when booklets and catalogues are not readily available.

Our second example of an e-commerce service is support of a subscription service for mobile device customers. This is a well-developed service supported by many providers. In particular, we consider a stock market quotes notification service. The main problems with this service are similar to the above-mentioned problems with customers’ membership services. Customers wish to be notified about changes in quotes of selected stocks. In order to get such notification, they need to disclose their stock preferences to a service provider. This is not often desirable because the customers may wish to preserve their privacy about stock preferences. It is quite usual that customers’ quote notification preferences change over time. In this case, personalization is often poor because of the restricted ability of dynamic service customization imposed by the limitations of mobile devices.

**ENABLING TECHNOLOGIES**

Before we propose our solution to relax the limitations of wireless communications in mobile e-commerce services, we consider the basic features of two recent technologies: software agents and WAP.

**Software Agents**

In spite of diverse views on agents in different research communities, there is an increasing agreement of what the basic agent characteristics are (Bradshaw, 1997; Huhns et al., 1998; Jennings & Wooldridge, 1998; Nwana, 1996; Wooldridge & Jennings, 1995). We can summarize these characteristics as follows:

- **Agents represent an entity (human or another agent) in a computer environment and operate on behalf of the entity’s creator.**
- **Agents employ autonomous behavior and can operate without outside intervention.**
- **Agents employ pro-active goal-oriented behavior and can take initiative in order to achieve their goals.**
- **Agents react to changes in the environment; they perceive and affect the environment.**
- **Agents can communicate with each other and employ negotiation and/or coordination.**

The last four properties are usually referred to as weak intelligent agent properties (Wooldridge & Jennings, 1995). Additional properties are usually attached to agents. Among them we consider mobility and learning as very important properties.

In the moment mobile agent platforms are better developed than intelligent agent platforms. However, we would like to underline that considering only mobility as the main agent property is a simplification of the whole agent paradigm, and this might be misleading when potential applications for agents are considered.

The ability of agents to learn is also referred to as an intelligent ability that is very desirable to implement in an agent system. However, we admit that even when agents do not employ learning, they may introduce intelligent abilities into distributed computing and service support by employing autonomy, pro-activity, reactivity and social ability.

We should consider the following two views towards agents:

- **Individual view** – considers agents which do not cooperate or communicate with other agents,
- **Group view (Multi-Agent Systems)** – considers the behavior of a collection of autonomous agents communicating with each other in order to solve a given problem.

The first view employs autonomy, pro-activity and reactivity from the above-mentioned agent characteristics, but it doesn’t consider communication between agents as a vehicle for common problem solving. The second view underlines social ability and cooperative/competitive behavior between agents.
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