Chapter 2.18
Information Management in Mobile Environments Using a Location–Aware Intelligent Agent System

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ABSTRACT

Recent rise in the level of comfort and demand to access various types of information using mobile devices can be attributed to the advancements in wireless as well as Internet technologies. This demand leads us to the new era of mobile computing. Location-based services (LBS) are engendering new passion in mobile services utilizing users' location information. Such spatio-temporal information processing entails the need for a dynamic middleware that accurately identifies changing user location and attaches dependent content in real-time without putting extra burden on users. Our work focuses on creating a distributed infrastructure suitable to support such scalable content dissemination. As a result this chapter offers a conceptual framework, location-aware intelligent agent system (LIA) in integration with publish/subscribe middleware to comprehensively address dynamic content dissemination and related issues. We discuss the operational form of our framework in terms of PUSH and PULL strategies.

INTRODUCTION

The plateau of the information superhighway keeps advancing amid the evolution of the Internet and related technologies. At the same time, popularity of mobile devices and rapid advancements in wireless technologies are making it convenient for users to access various types of information

available on the Internet over the wireless networks using their mobile devices. Moreover, as the array of mobile devices keeps expanding, users expect to be able to use different devices for accessing such information, entailing development of a research area called *mobile computing*. Although, mobile devices lack in terms of processing power, memory capabilities, display, connections to the wireless networks, and so forth, the demand for accessing dynamic content using mobile devices has grown ever more pressing (Kaasinen, 2003). On the other hand, timely and accurate data dissemination to and from various mobile devices using wireless networks and supporting technologies continues to be a progressively taxing research challenge.

Out of many challenging research issues in the mobile computing domain, a relevant challenge is context-aware computing. The term *context* refers to an application's operating environment, which consists of device location, device identity, user activity, time, state of other relevant devices, and so forth. Our focus in this chapter is on *location* and *time*. Location and time have a special relationship with regard to the content: *historical* (past) user locations and related content, *current* (present) user location and related content, and *future* user locations and related content. These scenarios represent the content usage as a function of location and time, giving rise to location-aware computing. Location-aware computing allows applications to be aware of a user device's physical location at any point in time. Applications can exploit this information for customizing their functional behavior and presentation. Users as well as providers of various types of mobile services can also rip the benefits of having access to this location information in a mobile environment. However, users are continuously moving along with their mobile devices, and hence, location information of the user and her/his device is temporal. Capturing invariably changing location information of mobile devices presents an intriguing challenge. The Federal Communications Commission's (FCC's) man-

date that wireless carriers in the United States be able to determine the approximate location of mobile phones making emergency calls is a key enabler for development of techniques to capture such temporal information regarding the user; it also provides an incentive to the cellular service providers to adopt above-mentioned location-aware systems. Examples of application of such location-aware systems include:

- **E-Deals:** A motel sends a promotional electronic coupon to mobile users passing by who are potential customers. Not only that, the motel can send some additional information regarding nearby restaurants and nearby attractions with applicable discounts if they take advantage of the e-coupon.
- **E-Directory:** A yellow page service that gives details on nearby services; for example, a user can locate the closest gas stations to her/his driving location, along with gas prices. Some additional information such as deals available on rotation of tires, car batteries, and so forth at a nearby auto center can be passed on to the user while presenting the user required information.

In performing the above tasks, location-aware systems need to combine the functionality of location-detection technologies (e.g., Global Positioning System, GPS), wireless or cellular telephone technologies (e.g., code division multiple access, CDMA), and information technologies (e.g., the Internet) under the scope of mobile computing to lay foundations for pervasive (anywhere, anytime) environments and services. On one hand, such services have the potential to dramatically improve usability of mobile devices and applications that adapt the content and presentation of services to each individual user and her/his current context of use. On the other hand, devising such location-aware systems is a tremendously complex task. Designers of location-aware systems have to keep in mind not only the continuous movement of mo-

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