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Location Management for Mobile Applications in Wireless Internet Environment

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ABSTRACT: Ith recent advances in devices, middleware, applications and networking infrastructure, the wireless Internet is becoming a reality. We believe that some of the major drivers of the wireless Internet will be emerging mobile applications such as mobile commerce. Mobile commerce applications present several interesting and complex challenges including location management of products, services, devices, and people. Further, these applications have fairly diverse requirements from the underlying wireless infrastructure in terms of location accuracy, response time, multicast support, transaction frequency and duration, and dependability. Therefore, research is necessary to address these important and complex challenges. In this article, we present an integrated location management architecture to support the diverse location requirements of m-commerce applications. The proposed architecture is capable of supporting a range of location accuracies, wider network coverage, wireless multicast, and infrastructure dependability for m-commerce applications. The proposed architecture can also support several emerging mobile applications.
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Architecture and Design - wireless communication.

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Additional Keywords and Phrases: Mobile commerce, location management, wireless Internet, wireless LANs, satellites, wireless multicast, mobile applications, infrastructure dependability.

1. INTRODUCTION

The wireless Internet has received significant interest among carriers, vendors, applications developers and users. In addition to wireless access to the Internet, it must deal with the adaptation of protocols and applications to the limitations of devices and wireless network. Only a few of these applications have been offered by providers thus far. These include preliminary versions of mobile financial services, mobile advertising, and location-aware services. Advanced versions of these applications will require location information of users, devices, servers, products, and services. These applications also have widely different location precision, response time.

2. LOCATION INTENSIVE

APPLICATIONS AND REQUIREMENTS

Several m-commerce applications have been proposed in the literature however, only some of these have been offered by wireless providers so far. In this section, we discuss three current m-commerce applications that require location support. These location-intensive applications are:

—Mobile financial applications
—Mobile advertising
—Location-based services.

Location Management for Wireless Mobile Commerce Applications. Mobile Financial Applications Mobile Financial Applications consist of mobile banking and brokerage services, mobile money transfer, and mobile payments. These applications could transform a mobile device into a business tool, replacing bank, ATM, and credit cards by letting a user

conduct financial transactions with mobile money. Out of these, about 53 million users are expected to have a mobile wallet. A mobile user attempts to purchase goods or services from a business or service provider, which then contacts a trusted third party, the wireless service provider, or a financial institution to authenticate the user and amount of purchase. Once approved, a mobile payment can be made and the purchase is completed. The corresponding funds can then be withdrawn from user's m-wallet, charged to user's phone bill, or subtracted from user's bank account. Alternatively, the user could pay using "mobile money" provided to him/her by another user or a third party mobile money provider. Mobile money can be moved freely among users either by using a local area wireless network or by using the wireless service provider Location-based Services.

These services utilize a user's location to provide location-aware content including information on restaurants, devices, users, and products. Location-based services can be offered in both "pull" and "push" modes. For example, one user might be interested in knowing the availability and waiting time at one or more restaurants close to her current location (pull). Another user might like to be informed when one of his friends is located in the same general area (push). In general, these services require location tracking of fixed, portable and mobile entities. Location information of all fixed entities can be kept in a separate database for each area, while location tracking of mobile and portable entities could be performed on-demand. When a mobile user enters an area, the list of services and location information can be provided based on current preferences and/or the history of choices. this scenario, once a user enters a designated area, the user information from previous networks and locations will be accessed. The system will also determine what types of location-aware services this user has subscribed to or is authorized to access. From an implementation point of view, several factors to consider are: (a) how to charge businesses for providing their location information to mobile users, (b) how to ensure correctness and usability of location information, (c) how to charge customers, and, (d) how to divide revenues among multiple wireless, location, and database providers.

We now discuss specific requirements of the three location-intensive applications. Mobile financial services require the location tracking of financial institutions, mobile users, transaction servers, and devices that are capable of accepting micro-payments. Such an application would require location accuracy of the order of few meters. Since a few devices are likely to be involved in any financial transactions, unicast mode of information transfer could be used. Due to the potential value of financial transactions, dependability of wireless infrastructure would be a critical requirement. On average, a user is likely to make a few such transactions in a day and we believe that most users would finish such transactions in a few seconds.

Mobile and user-specific advertising applications present very different requirements, since mobile advertising needs to reach specific users served by one or more wireless networks and the same message has to be transmitted to multiple users. So, location management, multicast and roaming across multiple networks are required. advertisements is not as high as financial transactions, wireless dependability is not so crucial. However, to cover a significant number of users in a given area, as is needed in mobile advertising, wireless multicast support is very important.

3. AN INTEGRATED LOCATION MANAGEMENT ARCHITECTURE

Having presented m-commerce applications and their specific requirements, we now present an integrated location management architecture. The proposed architecture (Figure 5) consists of several heterogeneous wireless networks including satellites, cellular, PCS and 3G networks, and, wireless LANs and PANs to support diverse location requirements. These are location precision, wireless coverage, multicast, and wireless dependability. The location precision requirement can be satisfied by using one of several wireless networks, which provide different levels of location accuracy. Since this architecture supports the roaming of a user across multiple networks, location co-ordination is necessary among networks, location tracking can also be performed using a wireless local area network (WLAN) or a personal area network (PAN). In cellular, PCS, and GSM, location tracking is done as follows: as long as the user stays in a certain location area, it does not update the location.

4. RESEARCH ISSUES AND FUTURE DIRECTIONS IN LOCATION MANAGEMENT

After discussing the requirements of m-commerce applications and our proposed location management architecture, we now turn to several interesting research problems related to location management in a wireless Internet. We will discuss application-specific design of location management schemes, computation of location management overhead, scalability and related issues in location-intensive mobile commerce applications. The design of application-specific location management schemes could be based on specific location requirements (such as required location accuracy and response time) of one or more applications. Then signaling, processing and storage requirements of location scheme could be

computed., Scalability of various location-intensive mobile commerce applications could be determined by network resources, the maximum number of concurrent location requests, the desired response time, and the number of transactions.

Interoperability issue will become important as some m-commerce applications involve multiple networks that provide different location performance. In such cases, interoperability must be ensured by agreeing on "minimum common functionalities". As locational resource requirements of some applications could exceed network resources and device capabilities, implement ability issues should be carefully addressed. The requirements can be measured using simulation tools and then the applications can be scaled-down or simplified to enhance implement ability. working with reduced locational accuracy, increased response time, reduced reliability and other factors. Another interesting problem is context awareness. Context awareness could be used in deciding if certain actions (such as pushing advertising information) should be completed at certain time. It is difficult to derive context awareness, but it is possible to use recent user actions in deriving a context.

CONCLUSIONS

In this article, we have presented the requirements of several location-intensive mobile commerce applications and an integrated location management architecture to support these requirements. The proposed architecture is shown to be capable of supporting diverse requirements of m-commerce applications in terms of location accuracy, wireless multicast, dependability, response time, and wireless coverage. We also showed how the proposed location architecture could be used to support future m-commerce applications. Our future research work includes location co-ordination among multiple wireless networks, location negotiation protocols for m-commerce, evaluation of m-commerce locational overhead, prioritization of location requests based on applications requirements, context (emergency, anxiety, etc), and processing delays. Other open research issues are interoperability, implement ability, middleware support, and context awareness. We hope that many of the above issues will be addressed in the near future, enabling the wide scale deployment of wireless Internet applications and services.

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