Semantic-Based Access to Composite Mobile Services

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ABSTRACT

In this paper, the authors propose novel access methods and a multi-channel organization for mobile users to effectively access composite M-services in wireless broadcast networks. The authors first propose a broadcast-based infrastructure to address the challenges of efficient usages of composite M-services. They then define a few semantics for accessing broadcast based M-services and discuss the strategies of efficiently accessing M-services based on the semantics. The authors also propose several channel organization that are suitable for the broadcast-based M-service structure and provide analytical models for them. They conduct a comprehensive experimental study on the proposed access methods.

Keywords: Access Method, Composite Mobile Services, M-Services, Semantic-based Access, Wireless Broadcast Networks

INTRODUCTION

The past years have witnessed a boom in wireless technologies (Senn, 2000). Sophisticated wireless devices such as cellular phones and PDAs (Personal Digital Assistants) are now available at affordable prices. Recent wireless broadband technologies, such as Wi-Fi, WiMaX, UWB and 3G/UMTS are bringing the promise of large bandwidth everywhere. Wireless applications today enjoy much larger bandwidth than in the past. Wireless bandwidth is expected to be further increased with emerging technologies in the near future. With the extra bandwidth at hand, we now can deploy more wireless applications and make more information available on the air. This encourages the emergence and development of Mobile commerce (M-Commerce), which refers to the conduct of business over wireless communication and devices (Varshney, 2002). M-commerce becomes very popular nowadays due to its wide application fields, such as mobile office (e.g., working while on the move), mobile advertising (e.g., location sensitive advertisements), and mobile financial applications (e.g., banking and payment for mobile users) (Varshney, 2002; Malladi, 2002). To support wireless-oriented service in M-commerce, a new generation of Web services (M-services) has emerged. An M-service is a Web service that is accessible by mobile clients via wireless networks.

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Broadcasting is an important means of delivering M-services to users in wireless environment. The advantages of the broadcasting include its simplicity in implementation (e.g., requires no interaction), better scalability (e.g., supports any number of users) and little limitation on mobile clients (e.g., only requires receiving capability). Once information is available on the air, the response time for retrieving information is not dependent on the number of users. Broadcasting can also save power at the client side by avoiding power consuming uplink operations on mobile devices. Wireless broadcasting is usually used to deliver frequently accessed information to a large number of users, such as traffic reports, weather forecast, stock market report, etc. The broadcast mode works particularly well for applications that have a large user base and comparatively small set of data to be delivered. For example, it would be extremely inefficient for the wireless base stations to process a large number of requests that ask for the same service on an on-demand basis. A more suitable approach for this scenario is broadcasting. Frequently accessed services can be made available on broadcast channels so that mobile users can retrieve them directly.

The increasing number of M-services and larger amount of data introduce new challenges. It would be difficult for mobile users to discover new services in wireless networks. Furthermore, traditional wireless applications are normally executed independently. This mode may not be sufficient to fulfill some complex user requirement that is beyond the capability of any single application. With the increasing number and variety of M-services, it is natural and practical to compose multiple services together to provide a value-added service. By doing this, we can address the limitation of single service invocation and make full potential of the available M-services. The current wireless broadcast infrastructure provides no capability for supporting M-service composition. In Xu (2003, 2006), we proposed a broadcast based M-services infrastructure and efficient access methods. However, only single services were considered in our previous works. The focus of this paper is on designing efficient access methods for composite services. Service composition provides a flexible way of aggregating or combining different services. In particular, we leverage semantic knowledge about compositions represented by Business Process Execution Language (BPEL) (Andrews, 2003) graphs to design efficient semantic access to M-services and wireless data.

The rest of the paper is organized as follows. First, we present a novel wireless broadcast infrastructure that supports discovery and composition of M-services. We then study the semantics of the proposed infrastructure and how to use these semantics to efficient access composite services. We also present different broadcast channel organizations and discuss how to access services and data using these organizations. We conduct practical study on the proposed access methods. Finally, we present some concluding remarks.

**BROADCAST-BASED M-SERVICES INFRASTRUCTURE**

In this section, we propose a broadcast based composite M-services infrastructure. The main challenges for supporting composite M-services in wireless broadcast systems are as follows:

**Service discovery:** For users to be able to use the provided services, they must know what services are available and how to find suitable services to satisfy their needs. Typical service discovery strategies are interaction oriented. Users usually need to browse through the service registry, which is located on the server side, to find suitable services. In a broadcast-based environment, users passively listen to broadcast channels and filter on the received information. There would not be any active interaction between mobile users and wireless servers. New service discovery strategies that are suitable for broadcast-based environments need to be developed.
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