Chapter 12
Runtime Discovery and Access of Web Services in Mobile Environments

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ABSTRACT
Mobile devices are turning out to be more pervasive, and it is becoming increasingly necessary to integrate Web services into applications that run on these devices. This book chapter introduces an architecture for dynamically invoking web service methods from mobile devices with minimal user intervention that only involves entering a search phrase and values for the method parameters. The architecture overcomes technical challenges that involve consuming discovered services dynamically by providing a mediation server whose responsibility is to discover needed services and build the client-side proxies at runtime. The architecture offloads the mobile devices energy-consuming tasks that involve communication with servers over the Internet, and XML-parsing of files, and on-the-fly compilation of source code. The presented experimental evaluation includes scalability measurements, and device battery energy savings.

INTRODUCTION
Web services have emerged as a popular middleware for offering remote method invocation. The basic function of web services is standardizing how services expose their data and interfaces, and how applications can discover and interact with them. Within a few years, most of the devices that access the Web in general and Web Services in particular will be mobile. Therefore, we will need solutions encompassing networking, system and application issues involved in realizing mobile access to web services. Integrating web services with mobile device applications is advantageous for many reasons, including the following:

- Mobile devices are starting to carry the same functionality as laptops and desktops, and more and more applications are coming mobile-ready. In many cases, smart phones have become mobile offices and extensions of the corporate network.
• As mobile devices become more popular, the applications they support are becoming increasingly complex. Web services extend the capabilities of applications by allowing them to communicate with other remote applications where data or services are available.

• The ability to efficiently locate and invoke web services from mobile devices is still not fully developed. While there are no fundamental impediments preventing the usage of web services technology on mobile devices, there is a wide range of infrastructural issues that need to be addressed (Yu, Liu, Bouguettaya, & Medjahed, 2008).

This book chapter describes a novel system that provides mobile device applications a methodology for integrating with web services and exploiting their reachability to perform extended functions and access remote data that otherwise would have been prohibitively costly. The contribution of the proposed system is two-fold. First, it offers dynamic invocation capability of web service functions with minimal overhead and reduced delays, and second, it introduces a distributed model for caching web service responses in Mobile Ad hoc Networks (MANETs) to further improve the mobile application’s response time. The proposed system differs from earlier schemes in that it is complete, fully dynamic, employs generic technologies, and is not restricted to a particular platform. Indeed, the survey that is presented in the following section shows how the solutions in the literature either only allow non-dynamic access to deployed web services from mobile devices, or provide dynamic access to services, but not from mobile devices. Furthermore, and in addition to offering a solution to a current problem, the performance evaluation data prove that the system is viable and useful. We actually build a prototype and use it to test the system’s performance in terms of device battery energy savings and scalability.

We also provide a qualitative assessment of the system’s adaptability to emerging mobile device platforms and discuss the provisions that could be applied to the architecture in order to build security mechanisms into the system.

In the next section, we give an overview of previous research and attempts that were done to provide mobile device applications access to remote web services. Next, we explain the different issues that the proposed system was designed to address, and then describe the system and its properties. This is followed by describing a prototypical implementation accompanied with performance results and analysis.

BACKGROUND AND PREVIOUS WORK

Several approaches have been proposed in the literature for enabling dynamic interfacing to web services from mobile devices. Starting with Gehlen and Pham (2005) who suggest a solution for using Peer-to-Peer (P2P) Web services in ad-hoc networks, two different P2P realizations are presented: one in which a stand-alone node acts as a broker and another where no centralized service-broker is available, where some nodes within the environment must provide the broker service. The paper presents a Java-2 Micro Edition (J2ME) implementation that was used to analyze the memory usage and response time of the SOAP server. Another system was presented to study the resource consumption and performance of providing web services on mobile phones (Chatti, Srirama, Kensche, & Cao, 2006). The analysis of a prototype developed using Personal Java on a Sony-Ericsson P800 phone shows that the implementation is able to handle up to eight concurrent users with reasonable time delays. Finally, two architectures were proposed for accessing web services from mobiles (Rendón, Pabón, Vargas, & Guaca, 2006). They use the J2ME Web Services API (WSA) and Short Messaging Service (SMS)