Chapter 6

Autonomous Web Services Migration in Mobile and Wireless Environments

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ABSTRACT

With the emergence of powerful mobile Internet devices such as smartphones, mobile devices are expected to play the role of service providers or even brokers, as well as clients. However, the frequent mobility of devices and the intermittent disconnection of mobile and wireless network may degrade the availability and reliability of services. To resolve these problems, this paper proposes an efficient method for migrating and replicating Web services among mobile devices. Specifically, the proposed method splits the source code of a Web service into subcodes depending on users’ preferences for its constituent operations. For the seamless provisioning of services, a subcode with a higher preference is migrated earlier than others. To evaluate the performance of the proposed method, the effect of the code splitting on migration was analyzed.

INTRODUCTION

With the emergence of powerful mobile Internet devices such as smartphones, mobile devices are expected to play the role of service providers or even brokers as well as clients. Web services (Huhns & Singh, 2005; Stal, 2006) are standard-based technologies to implement a service-oriented architecture in an open environment such as Web. As Web services have been designed mainly for wired network and desktop environments, there is a growing interest in devising the mobile adaptation of the conventional Web services technologies like WS4D (Zeeb et al., 2007), which is called as
mobile Web services (Sirirama et al., 2006; Schall et al., 2006). Meanwhile, it is difficult to provide Web services on mobile devices seamlessly, since wireless and mobile environments still involve unstable connectivity unlike the typical client-server environment.

If Web services autonomously migrate among mobile devices in this unstable wireless environment, seamless provisioning of services would be possible. For example, when a service cannot be provided during the movement of a device, it can be migrated to an appropriate mobile device and provide its functionality continuously. Additionally, requests can be distributed by replicating the service to other devices when the requests are concentrated on one device. Moreover, in the case of a client’s request for a service that takes large parameters such as multimedia files, the service itself can be replicated and executed at the client side, resulting in saving resources. Therefore, the migration and replication of services is essential for the availability and reliability of services in mobile and wireless network environments.

A number of researches on Web service migration have been performed. Some of them define a migratable Web service and migrate them to an appropriate host according to contextual changes. For this purpose, Lin et al. (2008) propose migration policies. Depending on the monitoring result of network resources or service requirements, services are migrated or replicated to appropriate host devices. However, most of them target desktop and wired environments or do not consider the constraints of wireless and mobile environments such as low bandwidth. Therefore, their approaches might take much longer time to migrate mobile Web services.

In this paper, we propose a migration method of Web services through splitting their codes. Specifically, an original code of a service, which implements the functionality of a service, is split into subcodes based on users’ preferences to its constituent operations. The subcodes of higher preference are migrated earlier to minimize the latency of the operations of high priority and raise the efficiency of Web services migration and replication in wireless and mobile environments. To evaluate the performance of the proposed method, the effect of the code splitting on migration was analyzed. Furthermore, to show the feasibility of the proposed migration method.

Meanwhile, the process of identifying when and where to migrate services is an important issue. For the seamless provisioning of a service, we have to determine which device is the most suitable target host. This process involves a mechanism to describe context models and migration strategies, which are relevant to the migration of Web services in mobile environments. For this purpose, we employ the context model and migration policy proposed by our former research to determine when and where to migrate services in mobile environments (Kim & Lee, 2007). The method determines a target host based on the migration policy of a service as well as the information collected from devices in the neighborhood of the origin host that is hosting the service.

The organization of this paper is as follows. A brief survey of research trends on service migration is presented. Next, the methods of splitting Web services codes, and migrating and replicating them are described. The effect of splitting codes on migration is also analyzed through experiments. Finally, we summarize the conclusions and further studies.

**RELATED WORK**

This section summarizes research trends on the migration and replication of services as shown in Table 1. Sheng et al. (2009) replicate services for increasing the availability of Web services. The method periodically monitors the states of hosts and determines the number of services, which will be replicated, deployment time, and target hosts etc. However, this method is not suitable to