

Chapter 3.3

Migrating Web Services in Mobile and Wireless Environments

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ABSTRACT

Mobile devices enabled with Web services are being considered as equal participants of the Web services environment. The frequent mobility of devices and the intermittent disconnection of wireless network require migrating or replicating Web services onto adjacent devices appropriately. This article proposes an efficient method for migrating and replicating Web services among mobile devices through code splitting. Specifically, the proposed method splits the source code of a Web service into subcodes based on users' preferences for its constituent operations. The subcode with a higher preference is migrated earlier than others. The proposed method also replicates a Web service to other devices to enhance its performance by considering context information such as network traffic or the parameter size of its operations. 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, three application scenarios were devised and implemented.

INTRODUCTION

Web services (Huhns & Singh 2005; Stal, 2006), which are independent from operating systems and programming languages, have gained momentum as an enabling technology to realize business processes on distributed network environments such as the Web. Additionally, the technology of mobile devices is continually developing and thus allows for a new form of Web services, that is, mobile Web services (Schall, Aiello, & Dustdar, 2006; Sirirama, Jarke, & Prinz, 2006). However, 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. When a service cannot be provided during movement of a device, it can be migrated to an adjacent 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 bitmap image files as input, the service itself can be replicated and executed on the client side, resulting in saving resources.

Recently, research on Web service migration has been performed. However, most of the research targets desktop and wired environments or does not consider constraints such as low bandwidth of wireless and mobile environments. Therefore, the research approaches might take much longer time to migrate.

To resolve this issue, this article proposes a method for migrating Web services through code splitting. Specifically, an original code, 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, three application scenarios were devised and implemented.

Meanwhile, how to determine when and where to migrate services is an important issue. The migration of a service may be carried out by the request of a service provider or the change of context information, such as the shortage of battery level and the location change of a device.

It involves developing the context model and strategies or policies relevant to the migration of Web services. If a migration of a service is requested, the proposed framework collects the context information of neighboring devices based on the migration policy of the service. It computes the suitability values of candidate devices and determines a target host. To establish a migration policy, the proposed method is based on our previous approach (Kim & Lee, 2007), which is based on WS-Policy (2006). In this article, we do not discuss the context model and migration strategies, but focus on describing the migration method itself.

Meanwhile, the process of identifying when and where to migrate services is also an important issue. The migration of a service may be caused by context changes such as the battery shortage and location change of a device. 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 example, a service provider should be able to specify that if the CPU usage-ratio of an origin host is over 80%, a service should be migrated to a new device, which has enough processing power and supports J2ME. For this purpose, we propose a method to establish the context model and migration policy 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. In this article, we do not discuss the process of determining when to migrate a service to a specific target host, but focus on how to migrate a service to a target host efficiently.

The organization of this article is as follows. First, a brief survey of previous works is presented. Next, the methods of splitting Web services

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