

Chapter 11

A Generic Adaptation Framework for Mobile Communication

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ABSTRACT

Today, technologies are providing mobile terminals with much more powerful computational abilities. Such improvement has made it possible to run many complex applications on mobile devices. However, many of these new applications are also resource demanding. Lacking sufficient resources would cause performance failures and impact negatively on the users' quality of experience. In order to improve this, it is important to provide the users with an easy access to specifying their requirements. It is also crucial to monitor the system resources and make corresponding adaptation immediately according to the user's specifications. In this paper, the authors propose adaptation strategies that flexibly combine the process of monitoring and adaptation, which provides an easy way to specify user's requirements. By tuning the quality of service, the applications' demand on system resources is reduced, thus decreasing the chances of performance failures and improving the users' quality of experience.

INTRODUCTION

With the development of technologies, the functions of the mobile terminals are becoming more and more powerful; access to pervasive services is available in many areas. Users with powerful

mobile terminals are granted with the ability to access information and multimedia services from almost anywhere at any time.

However, there are still some restrictions impacting on the user's quality of experience (QoE) due to the limitation of the available resources: examples include a high CPU usage impacting

DOI: 10.4018/978-1-4666-2056-8.ch011

the system's ability to support burst computation requirements; or an environment that is changing when the user is roaming, thus affecting the available bandwidth, etc. In order to increase the user's QoE and avoid performance failures (also known as late timing failures [Cristian, 1991]), the mobile terminal should intelligently detect the changes of environment (battery capacity, bandwidth usage, CPU usage, etc.), and take proper adaptations promptly.

Many adaptation strategies are already developed in different domains, such as switching transcoding methods, or adjusting the tasks' priorities. However, adaptations are highly application-specific or domain-specific, which may bring conflicts between different application domains. For instance, in the power consumption domain, reducing the power could obtain a longer battery life, while in the communication domain, increasing the power may guarantee a better communication quality. Another feature of these application-specific adaptations is that they are normally hard bound with the application code and lack of flexibility to make reconfigurations in different environments.

Rather than scattering the adaptation logics in different applications and represent them as low-level binary code, architecture-based adaptation uses external models and mechanisms in a closed-loop control fashion to achieve various goals by monitoring and adapting system behavior across application domains. A well-accepted design principle in architecture-based management consists in using a component-based technology to develop management system and application structure (Kon, Costa, Blair, & Campbell, 2002; Sylvain, Fabienne, & Noel, 2008; Costa et al., 2007). However, in most of the above mentioned approaches, the configurations of applications and components are generally carried out before runtime; these systems still need to improve their ability to take runtime reconfigurations according to the change of system status.

In this paper, we are proposing an adaptation model to flexibly assemble the monitoring process of system resources, and provide an easy access for the users to specify their preferences. Adaptation logics are separated from applications and controlled by the system, while the reactions are still carried out on applications. Such a framework could flexibly implement, modify, and execute adaptation policies through users' preferences, thus helping avoid the performance failure and increase the users' QoE.

The rest of this paper is organized as follows: we will firstly introduce some design issues of the mobile adaptation frameworks; then we will present our adaptation model. Experiments of such an adaptation model will be given in and conclusions will be made.

DESIGN ISSUES

Many design issues need to be considered in developing adaptation framework for mobile systems, among which, we deem the following to be the most important ones:

When to take the adaptations:

- Choices here include deploying the adaptation policies in the installation phase, and adaptations at execution time (Houssos, Gazis, & Alonistioti, 2003). Our view is that if the adaptation schemes are solely configured in the setup time, they would lack of flexibility, while if there are too many operations during the runtime, this will also introduce extra costs such as extra time to switch the policies, and make the system too complex to design. In our design, we set our adaptation policies in the deployment time, however, still provide our users with access to switch adaptation policies and modify adaptation parameters during the runtime. Such runtime modi-

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