Chapter 49
A Novel Application Offloading Algorithm and an Optimized Application Servers Placement for Mobile Cloud Computing

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ABSTRACT

An application's offloading algorithm to over go the limitations of mobile terminals, namely their lack of computing capacity and limited battery autonomy is introduced. The proposed Mobile Application's Offloading algorithm enables to shift applicative jobs from mobile handsets to remote servers. The novelty of MAO consists in considering the Quality of Experience as an additional decision test before proceeding to application offloading. Based on various traffic scenarios, researchers study the efficiency of the MAO algorithm and show its performance in terms of rejected jobs and energy savings. First, the researchers consider the case where the application servers were placed systematically at the antenna's site. For a more realistic context of Mobile Cloud Computing, they extend the analysis by considering the case where the remote servers can be placed at different splitting points of the infrastructure. They assess by means of closed-forms fitting functions the performance of the MAO algorithm. Authors end this article with proposing an optimized applications servers placement.

1. INTRODUCTION

The low performance and quick battery consumption of existing mobile handsets have been important factors influencing energy consumption on mobile terminals and fundamental challenges in the mobile computing environment. To encompass such challenges, recent studies towards mobile cloud computing propose a selective mobile-to-cloud offloading service by moving a mobile application from a resource

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restricted mobile device to a fast server in the cloud during run time (Bakos, 2002; Gitzenis, 2004). These offload schemes have risen as a promising solution to improve both the performance of mobile applications and the battery autonomy of mobile devices significantly by means of a transient offloading of some of the applications activated by the end-user from the mobile terminal to a remote server. More exactly, it is assumed that all the applications installed on the mobile terminal are also available on the remote servers. In the rest of this paper, each time the authors refer to applications offloading, they mean more precisely the upload of the input data to activate a given application on the remote server and the download of the obtained result of the process from the remote server back to the mobile handset. The round-trip time (RTT) between the mobile terminal and the remote server is a key parameter that must respect the level of interactivity required. The RTT depends itself on the instantaneous quality of the radio channel. Several investigations have been recently achieved so far to extend the battery autonomy of mobile terminals (Gitzenis, 2004; Vallina-Rodriguez, 2013; Niroshinie, 2013; Shiraz, 2013). By leveraging the increased CPU capacity of a remote server, the execution time of offloaded applications may be significantly reduced while enabling to reduce energy consumption on the mobile terminal. In a broader perspective, thanks to the increased RAM and CPU capacities and to the energy autonomy of the remote server, it becomes possible to provide context-aware services to the mobile users (Ma, 2012; Cuervo, 2010).

During the last ten years, several investigations known as Next-Generation Access Networks (NGAN) have been dedicated to the design of innovative access infrastructures favoring fixed/mobile convergence (FMC). In practice, NGANs consist in the deployment of a unified metro/access infrastructure for carrying both fixed access traffic and mobile backhauling traffic on the same optical infrastructure. Concerning radio-mobile traffic, NGAN covers the antennas sites up to the Radio Network Controller sites.

As introduced in Carapellese (2013), Wavelength Division Multiplexing- Passive Optical Networks (WDM-PON) are viewed as the most promising candidate for FMC infrastructures. Their large bandwidth capacity and their transparency enable to transport on the same optical infrastructure both fixed access traffic and mobile backhauling traffic by benefitting from WDM technology (Carapellese, 2013). In that sense, Radio Access Networks should inherit in the longer term of some of the features of metro/core WDM networks. Self-cicatrization in case of fiber cut or device failure, dynamic bandwidth scalability and wavelength routing reconfigurability are some of the advanced functionalities that should be available in NGANs. In this prospective context, applications servers' placement and applications offloading mechanisms will probably drive in the coming years to a new generation of radio-mobile networks.

This paper is organized as follows. In Section II, the authors review the related work on offloading systems for mobile. In Section III, they present the accurate analytical approach of the MAO algorithm and its main components. In order to evaluate numerically the efficiency of new offloading approach, they have investigated by means of computer simulations various scenarios in section IV. They then discuss in Section V the performance of the MAO algorithm. In Section VI, they propose various fitting functions and they deal the problem of the remote servers' placement in the perspective of a unified metro-access WDM infrastructure and some of the original results obtained in this matter are also presented and analyzed in the end of Section VI. They conclude and discuss future work in Section VII.