Chapter 7

Adaptation of Cloud Resources and Media Streaming in Mobile Cloud Networks for Media Delivery

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ABSTRACT

Multimedia content delivery is one of the use cases of Mobile Cloud Networks. Cloud Networks are then called Media Clouds. Since mobile devices are becoming increasingly important receptors of Multimedia content, Mobile Cloud Computing is undertaking an important role for delivering Multimedia content from the Cloud through the Internet towards the Mobile users. On the other hand, high requirements of Multimedia content streaming establish the necessity of cross-layer mechanisms for avoiding or decreasing the effects of, for example, mobile network congestion or cloud congestion. This chapter introduces an exemplary solution, at the application layer, which takes into account the state of the network for efficient Media streaming in Mobile Cloud networks (Media Mobile Cloud). Concretely, the presented solution proposes a novel adaptation algorithm that adapts not only Media bitrate in the case when there is a congestion in Mobile last mille, but also adapts Media content source when the Cloud suffers from congestion.

1. INTRODUCTION

Given the tremendous evolution of multimedia-related technologies over the Internet, the demand for an efficient, unified, secure and seamless media distribution solution has never been greater.

Today media content (TV, video, music) distribution generates a significant part of the global Internet traffic and the amount of this traffic is expected to double in 2015, compared to 2012 (Consumer Internet Traffic, 2012-2017), reaching more than 30 PB/month out of an overall traffic of 50 PB/month.

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Adaptation of Cloud Resources and Media Streaming

Cloud Computing has emerged as a new paradigm for hosting and delivering services over the Internet. Having been mainly exploited as resources infrastructures for computing costly applications, now cloud solutions have been extended and may be exploited as media distribution systems, acting as a virtualized complete serving infrastructure to a large number of end users. To achieve high network performance, the today’s clouds are based on Data Centres infrastructures located all around the globe. In this way, a Service Provider can leverage geo-diversity to achieve Media Delivery to the final users. The challenging issue still remains the quality of the delivery coming up to the user’s expectations, without escalating the cost. This is the idea behind the so-called Media Cloud\(^1\), which refers to the use of Cloud Computing resources for delivering Media content to the end users.

Mobile Cloud Networks (MCN) are a great opportunity for Media delivery integrating mobile users (Bourdena, Pallis, Kormentzas, & Mastorakis, 2013) and media content servers but, at the same time, it presents a number of challenges due to the limit of resources in the mobile access networks as well as to the congestion of the cloud (Dinh, Lee, Niyato, & Wang, n.d.).

In fact, most of the recognised problems of MCN (Mongay & Krawiec, 2014; Mousicou, Mavromoustakis, Bourdena, Mastorakis, & Pallis, 2013) affect directly Media delivery and should be addressed to for offering integrated solutions of Media Mobile Clouds. The issues specified below have been already approached within the ongoing FP7 MONICA\(^2\) project (MONICA project):

- Limited processing power in mobile devices, which makes difficult the implementation of complex mechanisms.
- Limited bandwidth in wireless connection.
- Variability of wireless connections. For example, the bandwidth changes in short-time scale due to the nature of the wireless, which causes variable quality of transmission.
- Network disconnection situations, which may bring problems of transmission stability.

The first three have serious repercussions for the quality of Media delivery. Therefore, additional mechanisms at different layers should be introduced for safeguarding the quality of the Media experience. MONICA assumes that Mobile networks should be adapted to accommodate the services offered by the cloud (among others, Multimedia delivery service) and Clouds should evolve to recognize and remove the limitations of Mobile networks.

MONICA project proposes to solve some of these issues at the network layer. So, the project focuses primarily on identifying constraints of mobile devices and improving their efficiency. Along this line, the scenario of application migration is considered and the proposed solution lies in the increase of bandwidth resources (reservation) for maintaining the Quality of Experience by the reduction of jitter and delay.

The general idea of improving the quality of the services in MCN environments consists in the orchestration of atomic services that consider Mobile End User requirements together with the limitations of wired networks and the access to the cloud. Moreover, these services should take into account the cloud itself, i.e., the limitations of hardware and geographical distribution. In other words, the services in MCN tend to extend the Cloud concept by considering end-to-end scenario (Mongay & Krawiec, 2014) and not only data centres infrastructures. Such was the approach of FP7 Mobile Cloud Networking\(^3\) project (Mobile Cloud Networking project) started to implement novel mobile network architecture and technologies. They to support on-demand network provisioning based on guaranteed resources contracted with multiple heterogeneous domains by different Service Level Agreements. The agreements consider

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\(^1\) Media Cloud

\(^2\) MONICA project

\(^3\) Mobile Cloud Networking project
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