Chapter 107
Mobile Cloud Media:
State of the Art and Outlook

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ABSTRACT

Leveraging Mobile Cloud Computing (MCC), resource-poor mobile devices are now enabled to support rich media applications. In this chapter, the authors briefly review basic concepts and architecture of mobile cloud computing, and focus on the technical challenges of MCC for multimedia applications. Specifically, they discuss how to save energy, ensure Quality of Experience (QoE), deal with stochastic wireless channels, support security and privacy, and reduce network costs for rich media applications. Prototypes, ongoing standardization efforts, and commercial aspects are also reviewed. The authors conclude this chapter with a discussion of several open research problems that call for substantial research and regulation efforts.

1. INTRODUCTION

Mobile cloud computing is a new technology of increasing interest from industry, academia, and government. Cloud computing makes it possible to provide infrastructure, platform, and software as services for users from any computer with an Internet connection. Mobile cloud computing then extends such services to mobile devices. As there are six billion mobile phone subscribers worldwide (Wikipedia, Mobile Phone), mobile cloud computing has the potential to have far-reaching impacts in the wireless industry and in our society.

Last decades have witnessed tremendous increase in the popularity of video and interactive video (such as video conferencing and online gaming). With the prosperity of mobile devices, there are huge interests for people to watch video and play online games on mobile devices. According to Cisco's recent study (Cisco 2013), among all the mobile data traffic across the world, 66.5% of them will be video related by 2017. This number was 51% by the end of 2012. As mobile devices are limited by speed, memory and energy, they could not support rich media applications, were it not for cloud applications and services. It is

DOI: 10.4018/978-1-4666-8200-9.ch107

forecasted that cloud applications will account for 84% of total mobile data traffic in 2017, compared to 74% at the end of 2012. These facts tell us that as the gap between the demand from users and capability from mobile devices never gets smaller, we have to resort to cloud computing for providing rich media application on mobile devices.

Although cloud computing is envisioned to bring rich media applications to mobile devices, several key challenges need to be addressed to fully harvest the high potential of mobile cloud computing. As the battery life of mobile device is rather limited, how to save energy is of great importance. Inherent from wireless communications, mobile cloud computing is characterized by limited bandwidth and large network latency. The intermittent network connection may also cause big problems for many cloud based applications. In face of fluctuating wireless networks and longer response time, how to ensure acceptable user experience is quite challenging. The open air interfaces make mobile cloud computing more susceptible to malicious attacks, and the distributed storage in the cloud may also result in privacy issues. Last but not least, online gaming or video streaming usually take an extended period of time and transmit a large amount of data, which may easily consume a user's data budget. The consumers may need to pay a lot to the wireless networking service provider. The relatively high network costs may prevent some consumers from using mobile cloud computing. In this chapter, we briefly review basic concepts and architecture of mobile cloud computing, and then focus on the technical challenges of MCC for multimedia applications. Specifically, we discuss how to save energy, ensure quality of experience (QoE), deal with stochastic wireless channel, support security and privacy and reduce network costs for rich media applications. Prototypes, ongoing standardization efforts and commercial aspects are also reviewed. Finally, we discuss several open research problems in mobile cloud computing that call for substantial research and regulation efforts.

The remainder of this chapter is organized as follows. Section 2 discusses the basic concepts and architecture of mobile cloud computing. We discuss technical challenges and review proposed solutions of MCC for multimedia application in Section 3. Section 4 reviews prototyping, ongoing standardization efforts and commercial aspects. Open research problems are discussed in Section 5. Section 6 concludes this chapter.

2. BACKGROUND OF MOBILE MULTIMEDIA CLOUD

2.1. Mobile Computing

Generally speaking, mobile computing can be regarded as a combination of the enabling technologies, network infrastructures, software applications and electronic devices that enable access to the Internet at any time and any place. From a narrower point of view, mobile computing offers great flexibilities to access network services and helps to eliminate the time and place restrictions imposed by wired networks and traditionally fixed electronics.

Mobile computing directly benefits from the advances of wireless communication technologies. The enabling technologies include Wireless Local Area Network (WLAN) technologies such as Wi-Fi (IEEE 802.11 series), cellular technologies such as Long Term Evolution (LTE), Bluetooth, satellite communications, Femtocell, etc. With the development of these technologies and the deployment of network infrastructures, mobile device such as smartphone, tablet computer, GPS, etc. is enabled to connect to the Internet and run all kinds of software. Typical applications include mobile browser, mobile online gaming, positioning, and location-based services, etc.

Mobility is well supported by mobile computing. However, inherited from wireless communications, mobile computing has several limitations as follows.