Computer Communications 118 (2018) 40–49

Contents lists available at ScienceDirect

Computer Communications

journal homepage: www.elsevier.com/locate/comcom

Traffic management in the mobile edge cloud to improve the quality of experience of mobile video

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ARTICLE INFO

Article history:
Available online 8 September 2017

Keywords:
Mobile edge cloud
Traffic management
QoE
Mobile video

ABSTRACT

The use of mobile network traffic is increasing due to the development of communication devices such as smart phones. Data traffic accounts for more than voice traffic. Video traffic accounts for the largest proportion of mobile data traffic and this proportion is increasing. However, various mobile environments affect the status of the mobile network and limit the provision of video services using the Internet. Therefore, a method for improving the quality of experience (QoE) of a video service in mobile environments is required. This paper presents a traffic management method using the mobile edge cloud. The mobile edge cloud is placed in the mobile edge network and monitors the status of mobile terminals. Through the mobile edge cloud, it becomes possible to effectively manage the traffic of mobile terminals by the network. The proposed method manages video traffic from the content server on the Internet according to the edge network status and mobility of a mobile terminal, and provides video traffic to mobile terminals. This method, using the mobile edge cloud, leads to improvement of the QoE for mobile video users. The superiority of this method compared to currently available systems was validated by computer simulation.

1. Introduction

High speed mobile network service has become possible with recent developments of communications technology, and Internet access is possible at any time and any place. In addition, with the spread of smart phones, mobile services have been replaced by data services rather than voice services. Mobile data services include web, chat, online gaming, and video services, etc. Mobile video accounts for the greatest proportion of mobile services, and this proportion is increasing. There are many service providers for mobile video. As high quality video content provided by multimedia companies is increasing, mobile video traffic will continue to grow at a faster pace, and in 2020 it is estimated it will account for 75% of total mobile data traffic [1,2].

In Over the Top (OTT) services such as mobile video, wireless resources are becoming scarce as video traffic increases. Therefore, traffic management in wireless networks is becoming increasingly important. In particular, the importance of traffic and resource management in heterogeneous networks is increasing. For traffic management, existing technologies focus on network access control in heterogeneous networks consisting of cellular and WiFi networks. As 98% of video services use the hypertext transfer protocol (HTTP), the HTTP Range Request function can be used [3,4]. The HTTP Range Request function can request video data in a byte range to content servers [5]. This feature enables traffic management in heterogeneous networks. In general, cellular networks cover a wide area but the data rate can fluctuate. In contrast, because WiFi networks are only available in hotspots, they are subject to connectivity problems. That is, WiFi networks do not provide seamless connectivity for mobile terminals [6]. Therefore, proper traffic management according to the status of the access network is needed.

In the typical heterogeneous network, as shown in Fig. 1, a mobile terminal is a distributed system that is the subject of computing. For appropriate mobile services, the mobile terminal learns through statistical data as training examples. Although the technology of mobile terminals has improved, battery-based mobile terminals have limited computing resources. In addition, mobile terminals access content servers on the Internet cloud for video services. It is difficult for traffic management between the mobile terminal and the content server on the Internet cloud to cope with changes

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http://dx.doi.org/10.1016/j.comcom.2017.09.001
0140-3664/

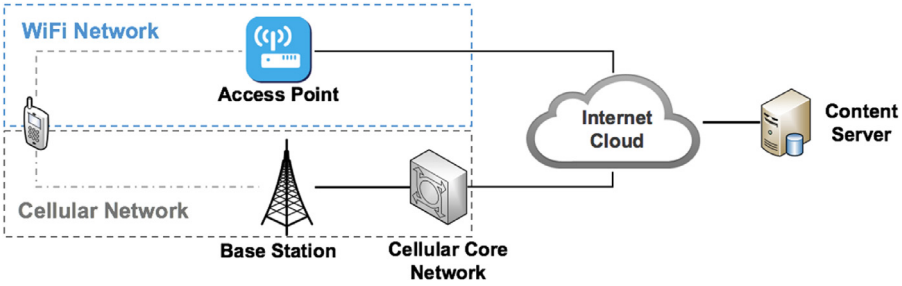

Fig. 1. Network system for mobile video services.

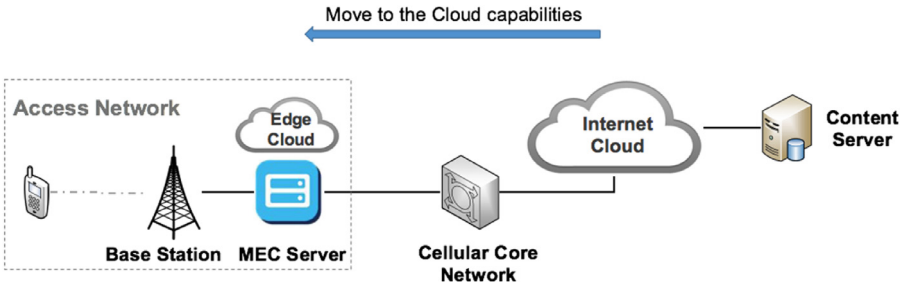

Fig. 2. Network system for the mobile edge cloud [7].

in status of the access network. Therefore, to improve the quality of experience (QoE) for users, a novel approach to the traffic management is required. This paper proposes an improved traffic management scheme using the edge cloud in the access network.

Mobile edge computing (MEC) is known as the edge cloud. The MEC moves computing resources from the Internet cloud to the access network. The MEC server organizes the edge cloud for the access network. Thus, mobile terminals can use the edge cloud for computing. The edge cloud provides the mobile terminals with low latency and improved bandwidth utilization [7–10]. As the edge cloud measures the status of the access network, a traffic management scheme employing the edge cloud can efficiently manage video traffic for mobile video services using the measured information. The MEC server estimates the access network status and applies policies for traffic management. It receives video traffic from the content server in advance and manages the traffic such that seamless service of the mobile terminal is maintained. In addition, the MEC server monitors the bandwidth required for the video service of the mobile terminal and instructs the mobile terminal to combine the cellular and WiFi networks to compensate for insufficient bandwidth. Therefore, the proposed traffic management scheme can lead to QoE improvement for mobile video services.

The remainder of this paper is organized as follows. Section 2 discusses the related work on the MEC in the mobile edge cloud and traffic management. Section 3 presents the proposed traffic management and network architecture for the scheme. In Section 4, the performance is evaluated through computer simulation. Finally, Section 5 concludes the paper.

2. Related work

2.1. Mobile edge computing (MEC)

The mobile edge cloud is organized by MEC servers in the access network. The MEC server is placed in a base station of the access network, and provides cloud services to mobile terminals in the access network. Mobile terminals with insufficient resources can use storage and computing resources of the MEC server. Fig. 2 shows the MEC network. As mentioned above, the MEC has moved the capabilities of the Internet cloud to the access network. The access network is connected to the MEC server in the edge cloud and the MEC server can monitor transmitted traffic in the access network. This enables various types of computing in the access network [7–9].

First, the MEC server can easily determine the status of the access network. It obtains statistics of the network status through relayed traffic via the MEC server. The parameters of the access network can be adjusted by analyzing the statistics. The access network can be managed efficiently through parameter adjustment. Second, the MEC server can understand the service information of mobile terminals. It also obtains statistics of service characteristics of mobile terminals. The service parameters of the mobile terminal can be controlled by analyzing the service statistics.

In general, data storage and analysis are performed in the Internet cloud. However, by employing the mobile edge cloud, these functions are carried out in the access network. Therefore, adaptive parameters can be used quickly and, thus, QoE for services can be improved.

2.2. Traffic management techniques

The key to traffic management for mobile video is to maintain the required bandwidth for video services in heterogeneous networks. Existing methods involve switching a network between cellular and WiFi to obtain better bandwidth or managing total bandwidth as common radio resources (CRR) in heterogeneous networks. The network switching scheme assumes that a network with better signal strength can provide better bandwidth but high signal strength does not guarantee better bandwidth because of various network elements. In general, a combination of service elements is used to switch the network in heterogeneous networks [11]. The CRR scheme selects a proper network according to usage of whole radio resources in the heterogeneous network to satisfy the service required bandwidth [12–15].

Typical traffic management employs user preference to guarantee the required bandwidth. According to the user preference, a mobile terminal selects a network for mobile video services and manages buffers to guarantee the required bandwidth. A video player on the mobile terminal controls the amount of requested traffic for mobile video services according to available bandwidth