International Journal of Mobile Computing and Multimedia Communications
Volume 10 • Issue 3 • July-September 2019

Mobile Edge Computing:
Cost-Efficient Content Delivery in Resource-Constrained Mobile Computing Environment

Michael P. J. Mahenge, Wuhan University of Technology, China & Sokoine University of Agriculture, Morogoro, Tanzania
Chunlin Li, Wuhan University of Technology, Wuhan, China
Camilius A. Sanga, Sokoine University of Agriculture, Morogoro, Tanzania

ABSTRACT

The overwhelming growth of resource-intensive and latency-sensitive applications trigger challenges in legacy systems of mobile cloud computing (MCC) architecture. Such challenges include congestion in the backhaul link, high latency, inefficient bandwidth usage, insufficient performance, and quality of service (QoS) metrics. The objective of this study was to find out the cost-efficient design that maximizes resource utilization at the edge of the mobile network which in return minimizes the task processing costs. Thus, this study proposes a cooperative mobile edge computing (coopMEC) to address the aforementioned challenges in MCC architecture. Also, in the proposed approach, resource-intensive jobs can be unloaded from users' equipment to MEC layer which is potential for enhancing performance in resource-constrained mobile devices. The simulation results demonstrate the potential gain from the proposed approach in terms of reducing response delay and resource consumption. This, in turn, improves performance, QoS, and guarantees cost-effectiveness in meeting users' demands.

KEYWORDS

Big-Data-as-a-Service, Cloud Computing, Content Delivery, Mobile-Edge Computing, Quality of Service, Resource-Constraint

INTRODUCTION

Mobile Cloud Computing (MCC) is considered to be important in this era of technological advancement in order to improve performance in resource-constrained mobile devices through unloading resource-intensive loads to the cloud for processing and storage. However, the overwhelming growth of big data and latency-sensitive applications bring challenges that require innovative approaches to meet users' and systems requirements (Hashem et al., 2015; Skourlelopoulos et al., 2017). For example, big data produced by sensors and multimedia require intensive resources for computing, storage and bandwidth. Therefore, innovative approaches which merge the capability of Mobile Edge Computing (MEC) and cloud computing are needed to provide cost-effective content delivery and improve Quality

DOI: 10.4018/IJMCMC.2019070102

of Experience (QoE) in resource-constrained computing devices (Holzinger et al., 2015). Innovative approaches use Information and Communication Technologies (ICTs) especially MCC, MEC, and Internet of Things (IoTs) to enhance performance and wellbeing, improve Quality of Service (QoS) and QoE, lower costs and resource consumption, and improve participation of stakeholders in service delivery (Mahenge & Mwangoka, 2014).

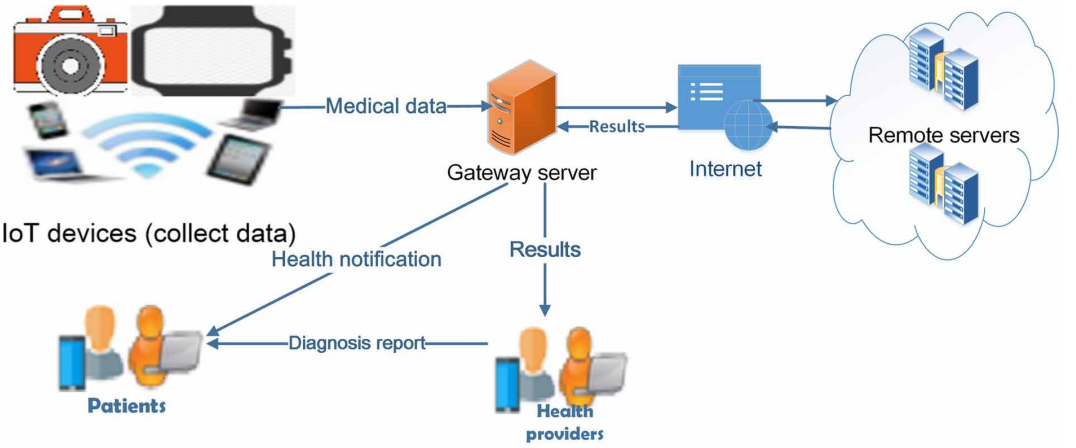
The innovation in the IoTs (e.g. smart mobile devices and sensors) and cloud computing enable data to be acquired anywhere and anytime as well as processed on time with wireless distribution using IoTs (Sundmacker et al., 2016). IoTs devices such as sensor nodes are used to gather patients' raw data which pass through gateway for aggregation and control in mobile-based cloud E-healthcare application (Figure1). The patients' data are uploaded into the cloud for processing, analysis and storage. The analyzed data are sent wirelessly to the health provider for further analysis, review and interpretation of the results. The health provider can take the required action for healthcare service delivery by consulting the patients online or physically. Furthermore, the rapid advancement of mobile computing devices such as smartphones, laptops, notebooks and tablets facilitate easy access to health services anywhere and anytime. Also, it enables materialization of emerging highly demanding services and applications. However, these mobile computing devices are limited in terms of battery life, storage and capability to handle applications demanding massive processing within a short period of time. Moreover, uploading data into the cloud for processing might be costly in terms of bandwidth and resource consumption (Shi et al., 2016). Also, data transportation and centralized processing can cause response delay which has impact on QoE.

Motivations and Contributions

Mobile data traffic has grown rapidly and will grow more in the coming years (Cisco, 2017) due to increased demands of big data (Skourlelopoulos et al., 2017) and latency-sensitive applications (Carlini, 2016). Such growth triggers challenges to legacy systems in MCC architecture. For mobile devices, problems originate from limited energy sources and resource such as low processing capacity, storage, and bandwidth. For cloud-based mobile applications, problems originate from network latency, processing time, data transportation from the device to the cloud as well as data processing and responding back to the service consumer. These problems, in return, become barriers for attaining the demands for low latency, QoE, cost-effectiveness, and location awareness (Siddiga et al., 2016; Soo et al., 2017).

To address such challenges, the MEC architecture deployed closer to end-users at the Base Station (BS) of cellular networks has been proposed to boost cloud computing (Patel et al., 2014). According

Figure 1. Example of mobile-based cloud E-healthcare



Neighborhood-Based Route Discovery Protocols for Mobile Ad Hoc Networks

Sanaa A. Alwidian, Ismail M. Ababneh and Muneer O. Bani Yassein (2013). *International Journal of Mobile Computing and Multimedia Communications (pp. 68-87).*
www.igi-global.com/article/neighborhood-based-route-discovery-protocols/80428?camid=4v1a

Robust Intelligent Control of Mobile Robots

Gordon Fraser, Gerald Steinbauer, Jörg Weber and Franz Wotawa (2009). *Mobile Computing: Concepts, Methodologies, Tools, and Applications (pp. 597-617).*
www.igi-global.com/chapter/robust-intelligent-control-mobile-robots/26534?camid=4v1a