MEASUREMENTS AND APPLICATIONS OF QOE FOR MULTIMEDIA COMMUNICATIONS


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With the rapid development of smart devices and mobile networks, multimedia services will dominate most of data traffic in 4G/5G networks. Applications such as conversational videos, online multimedia sharing, remote education, etc. have gained their popularity and will become more ubiquitous among customers. Traditional criteria for evaluating the overall performance of networks are usually summarized in several objective aspects such as error rates, bandwidth, throughput, transmission delay, availability, etc., which are commonly called quality of service (QoS). However, to evaluate the subjective quality of multimedia services, only part of QoS can be involved (e.g., transmission delay), which is not a suitable measure. Quality of experience (QoE), on the other hand, is a subjective measure on the overall performance of network services from user's perspective, which is also called the perceptual QoS from user's perspective.

Since user's experience is the ultimate evaluation criterion of the network services, there is urgent demand for applying QoE into multimedia communications. However, currently, it is hard to guarantee the quality of experience (QoE) of the multimedia communications, due to the differences of service characteristics and the human perception limits. In addition to QoE, future wireless networks also need to optimize ithe video service continuity for special cases, such as high-speed moving and surge in traffic, which generates a need for data-driven QoE prediction models. Besides, QoE-based network management is promising for improving the quality of multimedia services. In a word, despite the advantages of applying QoE to multimedia communications, QoE measurement and QoE-based network optimization impose many new challenges. This special issue aims to bring together researchers to publish state-of-the-art research findings of services and communications in QoE for multimedia communications. The special issue is composed of 7 papers organized as follows.

Specifically, the first work, entitled "Secure Mobile Crowdsensing Based on Deep Learning", from Xiamen University (China), investigates secure mobile crowdsensing and presents ways to use deep learning (DL) methods (e.g., stacked autoencoder, deep neural networks, convolutional neural networks, and deep reinforcement learning) to improve MCS security (including authentication, privacy protection, faked sensing countermeasures, intrusion detection and anti-jamming transmissions). Further, it discusses the performance gain of these DL-based approaches compared to traditional security schemes and identifies the challenges that should be addressed to implement these approaches in practical MCS.

The second work is entitled "Two-Phase Rate Adaptation Strategy for Improving Real-Time Video QoE in Mobile Networks", from Tsinghua University (China). This work proposes an RNN-based continuous QoE prediction model and a playback phase-based rate adaptation strategy. The RNN-QoE model accounts for three descriptive factors (video quality, rebuffering, and rate change) with reflection on the impact of cognitive recency. For rate adaptation, the proposed two-phase strategy considers that the key QoE-aware factors do not stay the same during playback, and designs different rate adapta-

tion methods for each phase to improve users' real-time QoE with a target and simplify the QoE optimization.

The third work is entitled "SQoE KQIs Anomaly Detection in Cellular Networks: Fast Online Detection Framework with Hourglass Clustering", from University of Science and Technology of China. This work proposes a two-step clustering scheme named SQoE-ADCL online to detect and locate the cause of anomaly for cellular networks. SQoE-ADCL uses Hourglass clustering algorithm to generate anomaly codebooks and to locate the root cause for each anomaly code. The SQoE-ADCL system analyzes anomaly on SQoE KQIs and then conducts trouble shooting on rKPIs in large scales.

The forth work is entitled "Topology Based Reliable Virtual Network Embedding from a QoE Perspective", which comes from Beijing University of Posts and Telecommunications (China), concentrates on the reliable virtual network embedding (VNE) methods to satisfy the different QoS/QoE requirements of VNE. Inspired by the node ranking with the theory of Markov random walks, we propose the comprehensive metrics of node reliability, which reflects the reliability of node according to its reliability and its connected link reliability, to measure topology-aware reliability ranking of the node.

The fifth work is entitled "Heterogeneous Quality of Experience Guarantees over Wireless Networks", which comes from Xidian University (China), proposes an indirect way to quantify the effective capacity of wireless network subject to diverse QoE. It provides a QoE guarantees model for cellular wireless networks and converts the effective capacity maximization problem into the equivalent convex optimization problem. This work also develops the optimal QoE-driven power allocation scheme, which can maximize the effective capacity.

The sixth work is entitled "QoE-Driven Social Aware Caching Placement for Terrestrial-Satellite Networks", from Tsinghua University (China). It proposes a QoE-driven caching placement optimization for video streaming, which considers the required video streaming rate and the social relationship among users. Social ties between users are used to designate a set of helpers with caching capability. The caching placement is formulated as an optimization to maximize the user's average QoE subject to the storage capacity constraints of the helpers and the cloudlets.

Finally, the seventh work, entitled "A Novel Deep Learning Method for Application Identification in Wireless Network" from Beihang University (China), presents a novel deep learning based method for application identification, which enables effective resource allocation management to meet users' service expectations. It analyzes the requirement of managing QoE for wireless communication, and reviews the limitation of the traditional identification methods. After that, a deep learning based method is proposed for automatically extracting the features and identifying the type of application.

To sum up, this special issue has collected high-quality papers from the main universities, institutions and projects for working on the measurements and applications of QoE for multimedia communications. These works provide potential to measure and optimize QoE in wireless communications.

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Biographies

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Mérouane Debbah, received his Ph.D. degree in the Ecole Normale Supérieure Paris-Saclay (France). Since 2014, he is the Vice-President of the Huawei France R&D center and director of the Mathematical and Algorithmic Sciences Lab. His research interests lie in fundamental mathematics, algorithms, statistics, information & communication sciences research. Mérouane Debbah was the recipient of the ERC grant MORE, the 2015 IEEE Communications Society Leonard G. Abraham Prize, the 2015 IEEE Communications Society Fred W. Ellersick Prize. He received 19 best paper awards, among which the 2007 IEEE GLOBECOM best paper award, the Wi-Opt 2009 best paper award, the 2010 Newcom++ best paper award, the WUN CogCom Best Paper 2012 and 2013 Award, the 2014 WCNC best paper award, the 2015 ICC best paper award, the 2016 IEEE Communications Society Best Tutorial paper award, the 2016 European Wireless Best Paper Award, etc.

Chunxiao Jiang, received the B.S. in information engineering from Beihang University in Jun. 2008 and the Ph.D. in electronic engineering from Tsinghua University in Jan. 2013, both with the highest honors. From Feb. 2013 - Jun. 2016, Dr. Jiang was a Postdoc in the Department of Electronic Engineering Tsinghua University, during which he visited University of Maryland College Park and University of Southampton. Currently, he is a research-track faculty member, an assistant research fellow, in Tsinghua Space Center, Tsinghua University. He is a recipient of the IEEE Globecom Best Paper Award in 2013, the IEEE GlobalSIP Best Student Paper Award in 2015, and the IEEE Communications Society Young Author Best Paper Award in 2017. Since 2015, Dr. Jiang became an IEEE Senior Member.