Guest Editorial: Special Issue on “QoE Management for Multimedia Services”

Quality of Experience (QoE) has received a great deal of attention over the past years and has become a prominent issue for delivering services and applications. A significant amount of research has been devoted to understanding, measuring, and modeling QoE for a variety of media services. The next logical step is to actively exploit that accumulated knowledge to improve and manage the quality of multimedia services. Of particular interest are effective and scalable solutions leveraging new and emerging networking paradigms for the purposes of controlling and optimizing QoE.

Following an open call for articles, the aim of this special issue was to solicit novel contributions to multimedia research focusing on the key challenges related to managing QoE. We received a total of 31 submissions, which went through a rigorous review process. In addition to an introductory survey article, seven articles were finally selected to appear. Given space restrictions, a number of high-quality articles unfortunately could not be accepted. The eight articles in this special issue cover a wide range of topics, including QoE modeling and consideration of user factors, novel QoE management architectures for adaptive bitrate streaming, and technical and economic challenges related to cooperative QoE management approaches.

As an introduction to the special issue, we present a survey article entitled “A Survey of Emerging Concepts and Challenges for QoE Management of Multimedia Services,” authored by the team of guest editors. The article addresses QoE management in the context of ongoing developments, such as the move to softwarized networks, the exploitation of big data analytics and machine learning, and the steady rise of new and immersive services (e.g., augmented and virtual reality). The implications of such paradigm shifts are discussed in terms of new approaches in QoE modeling, and the need for novel QoE monitoring and management infrastructures.

A key aspect of QoE research is identifying and understanding user-related factors. With multimedia delivery having been traditionally optimized for the “average user,” individual preferences and user factors have for the most part been neglected. The article “Measuring Individual Video QoE: A Survey, and Proposal for Future Directions Using Social Media,” authored by Zhu, Guntuku, Lin, Ghinea, and Redi, considers using social media as an alternative for conducting internet-based subjective evaluation. Moving from a controlled laboratory environment to a “real-life” environment, they present and release an open-source Facebook application designed for studying individual experiences for videos, and they show that reliable results may be obtained. Their approach considers the collection of additional user information available from Facebook, which can provide important input for modeling individual user experiences.

In light of the wide adoption of HTTP adaptive streaming (HAS), a number of articles address topics related to various video streaming QoE management aspects. The article “Quality of Experience-Centric Management of Adaptive Video Streaming Services: Status and Challenges,” authored by Petrangeli, Van Der Hooft, Wauters, and De Turck sets the stage by surveying works aimed at extending the classical purely client-based structure of adaptive video streaming to fully optimize users’ QoE. The authors systematically classify works based on where the optimization takes place, investigating the usage of server- and network-assisted architectures and of new application and transport protocols. Future directions and major challenges are discussed.

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Following the surveyed approaches and challenges of network-assisted architectures, the article “SABR: Network Assisted Content Distribution for QoE-driven Adaptive Bitrate Video Streaming,” authored by Bhat, Rizk, Zink, and Steinmetz, implements and evaluates a novel architecture that uses a Software Defined Infrastructure (SDI) to efficiently manage CDN networks and improve QoE for adaptive bitrate (ABR) video streaming. Their network-assisted approach provides clients with information needed to make well-informed decisions on segment retrieval, such as the presence of segment quality levels in caches, or bottleneck bandwidth information. A key feature of their approach is that minimal modifications are necessary at the client, i.e., while necessary information is provided to clients, there is no direct participation in video retrieval decisions made by the player. The performance of the proposed system and different caching strategies are extensively analyzed in terms of QoE improvements.

With video interruptions being one of the main QoE influence factors for video streaming services, the implementation of buffer policies plays a key role in managing QoE. The article “A Generic Approach to Video Buffer Modeling using Discrete-Time Analysis,” authored by Burger, Zinner, Dinh-Xuan, Wamser, and Tran-Gia, provides valuable insights into the relationships between the parameters of the buffer policy, network dynamics, and video playback. The authors model the video buffer as a GI/GI/1 queue with pq -policy using discrete-time analysis, and they further evaluate the impact of network and video bitrate dynamics on the video playback quality based on the buffer policy. Their proposed model allows for optimizing the trade-off between wasted traffic (in case of video abortion) and user-experienced video quality.

Turning the focus toward live video broadcasting from mobile devices, the article “Can You See What I See? Quality of Experience Measurements of Mobile Live Video Broadcasting,” authored by Siekkinen, Kämäräinen, Favario, and Masala, reports on a large-scale measurement study to explore service usage patterns, bitrate adaptation logic, and various factors impacting QoE. Focusing on the Periscope service, and comparing it to Facebook Live, they investigate objective, indirect measurements of QoE, including transmitted video quality, playback stalling, end-to-end latency, and battery consumption. Their findings provide valuable insights into potential service design aspects that could improve QoE in the future for such services.

Focusing on live streaming and challenges related to server-side bottlenecks, the article “PMS: A novel scale-adaptive and quality-adaptive hybrid P2P/multi-source solution for live streaming,” authored by Brunea-Queyreix, Batalla, Lacaud, and Negru, proposes a DASH-compliant multi-source streaming solution that simultaneously utilizes several servers and exploits expanded bandwidth and link diversity in distributed heterogeneous infrastructures. As a second contribution, the authors consider leveraging end-users’ connectivity capacities by exposing a hybrid peer-to-peer/multi-source live streaming solution, thus extending scalability capabilities and achieving high QoE. The authors evaluate their system and distributed quality adaptation logic over flash crowd events with cloud servers and 300 peers spread out around France.

Finally, with different players involved in the service delivery chain, the article “QoE-aware OTT-ISP Collaboration in Service Management: Architecture and Approaches,” authored by Floris, Ahmad, and Atzori, discusses different approaches for collaboration between Over the Top (OTT) content/service providers and Internet Service Providers (ISPs) when managing services. After considering both technical and economic aspects, they propose a general reference collaboration architecture. Simulations are conducted to compare different approaches in terms of QoE provided to the users, profit generated for the providers, and QoE fairness. Their results help to understand the potential implications of collaborative efforts and pave the way for future studies to further address technical realization aspects and economic incentives.

The guest editors thank all the authors who submitted their work to this special issue, as well as the large number of reviewers who provided their expert opinions. We finally thank the ACM

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All of the articles included in this special issue provide novel insights and help to advance the exciting research field of managing services and networks while putting focus on the end user experience. We hope that readers will find the articles stimulating and useful for their ongoing and future research.

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