Introduction to Special Issue on Multimedia Big Data: Networking

Multimedia, the biggest big data—including game media, social images, voices and videos, medical images, to name just a few—continue to outstrip the capacity of the traditional multimedia processing and analysis systems. To tackle this issue, researchers developed and presented many technologies and applications to connect big data to multimedia processing, which plays an important role in existing multimedia computing. Further, in real-time scenarios, such as cloud game systems, which have a strict delay limitation in interaction, multimedia data processing needs much higher performance networking support. However, networking for multimedia big data processing, communications, and applications has attracted less attention so far. Even though the size of multimedia big data has increased rapidly in recent years, it is difficult for fundamental networking technologies to handle the requirements of progressively complex processing and analysis. New networking technology also brings a new possibility of multimedia systems, for example, processing and analyzing increasing amounts of multimedia data generated by smartphones in developing mobile networks has become a very important field in multimedia big data computing. Therefore, since networking plays an essential role in multimedia big data computing, there is a critical need for research into a new concept: designs and implementation that can support more reliable, efficient and real-time multimedia big data computing, communications, and applications.

This special issue of *ACM Transactions on Multimedia Computing Communications and Applications (TOMM)* provides an opportunity to attract and bring together network architecture, video game system, multimedia streaming, distributed systems, and multimedia computing researchers along with big data and networking researchers with diverse backgrounds to contribute articles on theoretical, practical, and methodological issues for next-generation networks for multimedia big data computing and communications. There are twenty-six submissions for this special issue of *ACM TOMM*. Seven high-quality, creative, and interesting articles were selected and accepted, which discuss various challenges and emerging directions in networking for multimedia big data.

This special issue starts off with four articles concerning management and optimization for better performance and efficiency of multimedia big data computing in cloud data center networks. The first article by Amiri et al. is titled “Towards Delay-Efficient Game-Aware Data Centers for Cloud Gaming.” It presents a novel method for improving the Quality of Experience (QoE) within a cloud gaming data center, as well as a novel optimization-based method for near-optimally assigning game servers to gaming sessions and selecting the best communication path with a cloud gaming data center.

Video-on-Demand (VoD) cloud services currently dominate Internet traffic. Cloud providers have to rescale resources in a timely and adaptive manner to satisfy fluctuating user demands while meeting user requirements. By studying video management and resource allocation for a large-scale VoD cloud with distributed collaborative servers, the next article by Chang et al., “Video Management and Resource Allocation

for a Large-Scale VoD Cloud,” proposes a novel algorithm based on linear programming and a video clustering algorithm to minimize the deployment cost and resource allocation in a VoD cloud data center.

In contrast to managing video or allocating resources in a cloud data center, the article entitled “A Deployment Optimization Scheme over Multimedia Big Data for Large-Scale Media Streaming Application,” by Wu et al., addresses the issues in the migrating media streaming applications from private server clusters onto the cloud. The influence of local memory of each viewer to migrate large-scale media streaming applications to the cloud is introduced and a deployment optimization scheme is proposed to dramatically enhance utilization of reserved bandwidth.

The next article, by Kuang et al., “A Tensor-Based Framework for Software-Defined Cloud Data Center,” develops a novel tensor-based Software-Defined Networking (S-DN) model on a cloud data center for multimedia big data computation and communication. A framework is proposed to tackle the problems created by the tremendous amount of unstructured multimedia data in a cloud data center network.

Recent decades have witnessed skyrocketing consumer demand for mobile broadband access to multimedia data, that is, the so-called mobile multimedia, which have presented unprecedented challenges to networking researchers and engineers. Two articles focus on new communication models for better network performance of mobile multimedia computing. The first article, by Liu et al., “Device-to-Device Communication for Mobile Multimedia in Emerging 5G Networks,” presents a new model for network coverage probability and average rate analysis in Device-to-Device (D2D) multimedia communications overlaying two-tier downlink cellular networks.

The next article, “Real-Time Load Reduction in Multimedia Big Data for Mobile Internet,” by Kun et al., proposes a hybrid stream model to analyze video data for the mobile Internet through deep learning. Specifically, an improved Convolutional Neural Network (CNN) classification algorithm is designed to evaluate the importance of each video frame and video clip, and thus to enhance video classification. Next-generation networking is an important field for multimedia big data networking. As the most urgent technology in network generation networks, Software-Defined Networking (SDN) brings unprecedented network programmability to handle the explosive growth of big data driven by the popularization of mobile devices and pervasiveness of content-rich multimedia applications. However, with the era of network big data, existing simulation-based SDN studies always become time-consuming and even lose effectiveness when large-scale networks and a huge amount of network traffic are considered.

The last article, “Performance Modeling and Analysis of Software Defined Networking under Bursty Multimedia Traffic,” by Miao et al., presents a new analytical model to investigate the performance of SDN in the presence of the bursty and correlated arrivals modeled by the Markov Modulated Poisson Process (MMPP).

Overall, the collection of articles in this special issue provides a panoramic and inspiring view that spans a variety of issues and directions being researched by communities related to multimedia and networking. We hope that researchers who are active in the fields of multimedia, big data, cloud, mobile, and systems and networking will benefit from studying these articles in this special issue on networking for multimedia big data. We thank all of the authors who submitted their articles to our special issue; we especially thank the editorial members of *ACM TOMM*, Alberto Del Bimbo, Shervin Shirmohammadi, and Stefano Berretti, for their help and trust to realize this special issue. Most important, our appreciation also goes to the reviewers whose comments and observations led to the high quality of the accepted articles, and we sincerely thank them. To align with the topic of this special issue and save some paper, we would like to

highlight our special acknowledgment to a long list of reviewers and some interesting statistics of this special issue through your smartphone and the following QR code.

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