Editorial

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Biographical notes: Mohamed Hefeeda is an Assistant Professor in the School of Computing Science, Simon Fraser University, Canada, where he leads the Network Systems Lab. His research interests include multimedia networking over wired and wireless networks, peer-to-peer systems, and network security. He has co-authored more than 50 publications in reputable venues. His paper on the hardness of optimally broadcasting multiple video streams won the Best Paper Award in the IEEE Innovations 2008 conference. He and his students develop actual systems, such as PROMISE, pCache, svcAuth, pCDN, and mobile TV testbed, and contribute the source code to the research community. The mobile TV testbed software won the Best Technical Demo Award in the ACM Multimedia 2008 conference. The pCDN (peer-assisted Content Distribution Network) system is currently being field-tested by the Canadian Broadcasting Corporation, which is the largest online content provider in Canada.

Peer-to-Peer (P2P) multimedia streaming systems have received significant attention from academia and industry in the past few years. In these systems, a client receives a requested multimedia stream from multiple senders (peers), instead of relying on a dedicated streaming server. Since receiving peers are also potential senders to other peers, the system capacity grows and the reliance on the dedicated server diminishes as more peers join. Thus, P2P streaming systems have the potential to scale to large user communities in a cost-effective manner. However, because of the limited capacity and unreliability of peers, mechanisms are needed to efficiently manage the resources contributed by peers and to adapt to the dynamic nature of the network. This special section is dedicated to addressing all research challenges related to enabling the streaming of high-quality multimedia content in dynamic P2P systems.

Through open call for papers, authors were invited to submit papers that have significant research contributions to this special section. We also invited some authors of accepted papers in the special session on peer to peer video streaming that was held during the IEEE International Packet Video Workshop in May 2009 to submit extended versions of their papers for possible publication in this special section. All submitted papers have gone through a thorough multi-round review process, where each paper has been reviewed by at least three reviewers. Among all submitted papers, we selected three high-quality papers for this special section. A few highlights of these papers are described below.

One of the challenges facing P2P streaming systems is ensuring high video quality in presence of peer failures and/or sudden (unscheduled) departures. In live P2P streaming systems, peers usually form distribution trees, where many of them act as parents that relay video data to other peers, their children. If these parent peers suddenly fail, their children will likely observe drop in video quality. The paper by A. Raghuveer, Y. Dong, and D. Du, 'StatStream: providing statistical reliability guarantees in peer-to-peer live video streaming', tackles exactly this problem: ensuring quality in presence of failures. The authors propose an interesting framework, called StatStream, with the goal to achieve statistical Quality of Service (QoS) guarantee in P2P streaming systems. They first define two QoS parameters for P2P streaming systems:

i Video Quality Fluctuation

ii Stream Disruption Frequency.

These two parameters capture important aspects of the video quality perceived by users. Then, the authors propose a model to summarise the characteristics of peers, especially peers' reliability and upstream bandwidth. With these definitions and models, the authors develop algorithms to construct and manage the graphs over which the video data is delivered to peers. The constructed graphs provide statistical quality and stability guarantees on the two QoS metrics mentioned above. Bounds for the desired statistical guarantee are assumed to be specified by the content provider and could be used for billing purposes or establishing service level agreements between clients and providers. The authors show by simulations that the proposed framework and algorithms outperform others in the literature.

It has been reported in many measurement studies that BitTorrent is very popular and it generates a significant fraction of the whole Internet traffic; more than one-third of the total Internet traffic in some studies. Thus BitTorrent has received a considerable attention from the research community, where several analytical and experimental papers have analysed its performance. Yet, most of the previous works assumed that a peer participates in only one torrent, which is not actually the case in practice. In their paper, titled 'Multi-torrent: a performance study and applications', Y. Yang, A.L.H. Chow and L. Golubchiket address this important issue. The authors analyse the performance of multi-torrent peer-to-peer systems, where a peer is realistically allowed to participate (download and upload) in multiple torrents at the same time. Multi-torrent systems are useful in many applications, including quickly distributing correlated software updates and patches of online games. The paper shows that current BitTorrent systems do not provide enough incentives to peers to stay around as seeds in multi-torrent systems. Then, it presents an interesting and simple cross-torrent incentive scheme, which is called Cross-Torrent-based Tit-for-Tat (CTFT). CTFT does not require modifications to current BitTorrent implementations, and it uses only the information of peers' transmission rates. The paper also presents simulation experiments to demonstrate the merits of the proposed multi-torrent approach.

M. Alhaisoni, A. Liotta and M. Ghanbari, in their paper titled 'Resource-awareness and trade-off optimisation in P2P video streaming', study and experimentally compare the efficiency of four deployed P2P streaming systems: Zattoo and Sopcast for real time streaming, and Joost and Babelgum for video-on-demand services. The authors collect traffic traces from these networks and analyse them along several common performance metrics, including network locality, percentage of P2P traffic to the client/server traffic,

and the spread of the computational load across peers. The authors found that some of these performance metrics conflict with each other, meaning that tradeoffs among these metrics exist and should be optimised in order to strike a balance in the performance of P2P streaming systems. Based on their extensive analysis, the authors conclude that existing P2P streaming systems may not achieve good tradeoffs among the performance metrics defined by the authors. The authors then propose an optimisation method to find good performance tradeoffs, and they evaluate their method using simulation.