



Contents lists available at SciVerse ScienceDirect

Signal Processing: *Image Communication*

journal homepage: www.elsevier.com/locate/image

Editorial

Special issue on advances in 2D/3D Video Streaming Over P2P Networks

Future Media Internet will entail the distribution and dispensation of high quality multimedia content in an efficient, supple, and personalized way through dynamic and heterogeneous environments. Over the last decade Peer-to-Peer (P2P) multimedia communications have gained significant attention by the research community that can be one of the potential enablers of Future Media Internet. In such systems, a client builds complete videos using streams transmitted by multiple senders or 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 a single dedicated server shrinks as more peers join the network. Thus, P2P streaming systems have the potential to scale video services to large user communities delivering cost-effectiveness and improved Quality-of-Service (QoS) and Quality-of-Experience (QoE).

Advanced video processing optimizes coding efficiency by removing available data redundancy and thus introducing higher dependencies among processed data. As a consequence, a critical challenge emerges when robust video transmission over lossy channels is addressed. In P2P systems limited capacity and unreliability of peers impose additional challenges. Therefore, mechanisms are needed to efficiently manage resources contributed by peers and to adapt to the dynamic nature of P2P networking environments.

The aim of this special issue is to provide a selected sample of the latest research results aiming at improving endtoend QoE of video transmission over P2P networks. This issue starts with an invited paper that discusses multimedia streaming over P2P based on social norms. It is followed by a survey paper, which examines the current research challenges in P2P video streaming. The remaining papers each propose a unique solution to address the key challenges in 2D/3D video streaming over P2P.

The invited paper by Y. Zhang and M. van der Schaar “Peer-to-Peer Multimedia Sharing based on Social Norms” proposes a novel family of incentive protocols in P2P system by exploiting social norms. In these proposed protocols, each peer gets the social norm rewards and punishment

depending on their reputation based on its past behavior in the P2P system. In addition, this paper investigates the impact of various punishment schemes on the social welfare and how should the optimal social norms be designed if altruistic and malicious peers are active in the network.

The paper “Video Streaming over P2P Networks: Challenges and Opportunities” by N. Ramzan, H. Park, and E. Izquierdo is a survey on the topic of video streaming over P2P networks. Their paper discusses the latest trends in video coding and efficient video streamlining mechanism over P2P. Latest live and on-demand video streaming solutions are discussed in the perspective of different topologies of P2P systems. The paper also summarizes the key challenges and open issues for community to make substantial future improvements to the challenging problems of video streaming in P2P environment.

The contribution by Y. Xua, C. Zhu, W. Zengb, and X. J. Lia on “Multiple Description Coded Video Streaming in Peer-to-Peer Networks” applies stronger error resilience by using multiple description (MD) video streaming over error prone P2P networks. They propose a novel packet scheduling algorithm for receiver-driven MD coded video streaming where a receiver collects nodes’ information and generate a transmission schedule for MD coded video packets. The proposed scheduling algorithm for MD behaves better in a network with frequent peer churn over layered coding methods.

A paper “A Study of a Hybrid CDN-P2P System over the PlanetLab Network” by E. Baccaglinia, M. Grangettob, E. Quacchioc, and S. Zezzad proposes a hybrid CDN-P2P architecture for video contents delivery. The proposed CDN-P2P framework can efficiently deliver video over a heterogeneous and time varying network if peers can rely on an intermediate distribution layer between the CDN and the final users. The main benefit is significantly off-loaded and peers can experience low start-up delays.

The paper by I. Ullaha, G. Doyena, G. Bonnet, D. Gaitia “A Bayesian Approach for User Aware Peer-to-Peer Video Streaming Systems” addresses user behavior impact on the performance of P2P streaming systems. They propose a Bayesian network that captures all the elements making

part of the user behavior. The proposed network analyzes the user behavior in video streaming systems by exploiting the information found in a cross-analysis of numerous large-scale measurement campaigns. They also propose a method based on traces collection of the same user type that accelerates the learning process of the proposed network.

The contribution from R. Meier, and R. Wattenhofer “Peer-to-Peer Streaming in Heterogeneous Environments” presents novel techniques to cope with heterogeneous peers. A structured yet flexible overlay network is able to accommodate arbitrary heterogeneous sets of peers, and allows the delivery of video streams. The overlay employs a prefixed-based routing policy, similar to distributed hash tables, to gain desirable properties, such as an efficient distribution with low delay, robustness to churn, and guaranteed connectivity among all peers with a logarithmic overlay diameter. Scalable audio and video coding schemes and erasure coding schemes complement the overlay structure to address the varying capabilities and reliability of peers.

The paper “Multi-Stream 3D Video Distribution over Peer-to-Peer Networks” by Y. Ding, J. Liu, and S. Lian presents an initial attempt toward efficient streaming of 3D videos over a P2P network. They address the stream synchronization problem by a novel 2-stream 2-stage buffer design, together with weighted data scheduling and light-weight synchronization. They discuss a series of key practical issues toward implementing of 3D video streaming over P2P system, including the weight modeling for data segments, the interactions with the RTP/RTCP protocol stack, and the inter-operability with monoscopic video as well as extension to multi-view video.

The paper by Y. Zhou, T.Z.J. Fu, D.M. Chiu “Server-Assisted Adaptive Video Replication for P2P VoD” proposes a hybrid replication strategy for VoD over P2P, and give detailed description of how the server collects and maintains the feedback information, and how peers use that information to determine what videos to store and indirectly control their uplink bandwidth contribution. It also advocates why the hybrid strategy is much simpler and more practical than the combinatory optimization approach. The proposed approach helps to deal with peer churn, channel churn, and even non-stationary popularity of movies.

The paper “Redundancy Controllable Scalable Unbalanced Multiple Description Bit stream Generation for Peer-to-Peer Video Streaming” by M. Majida, and C. Abhayaratna proposes an approach for adapting the redundancy and data rate of descriptions coming from different peers. They first propose the constrained successive refinement of multiple description scalar quantization to obtain the robust scalable multiple descriptions and then propose the conditions for multi-channel unbalanced coding for joint decoding of the stream coming from different peers leading to efficient control of redundancy and data rate.

The contribution by S. Asioli, N. Ramzan, E. Izquierdo “A Game Theoretic Approach to Minimum-Delay Scalable Video Transmission over P2P” proposes a game theoretic framework for scalable P2P video streaming with a focus on optimal resource allocation and delay minimization.

The main novelty of the paper is to integrate minimum-delay streaming functionalities within an incentive provision mechanism. In addition to this, the proposed P2P system is designed for the transmission of scalable video where peers are discouraged from downloading videos with a quality which is higher than the one they can provide to other users.

The paper “Adaptive Streaming of Multi-View Video over P2P Networks” by S.S. Savas, C.G. Gürler, A.M. Tekalp, E. Ekmekcioglu, S. Worrall and A. Kondoz proposes a framework for adaptive streaming of Multi-View Video (MVV) using a server-assisted P2P overlay over IP. They used centralized server to assist P2P service start-up in case of failure and may handle authentication, copyright management and user permissions. The proposed adaptive P2P streaming solution carefully considers 3D perception issues specific to MVV, such as the effect of view and depth adaptation and the effect of packet losses in designing the proposed adaptation strategies.

The paper “Robust Mobile Video Streaming in a Peer-to-Peer System” by J. Noh, and B. Girod proposes a P2P-based mobile streaming that leverages the computing resources contributed by peers. In order to stream video to mobile devices, transcoding is often required to render video suitable for their small display, limited downlink speed, and limited video decoding capability. However, performing transcoding at a single peer is vulnerable to peer churn, which leads to video disruption. They propose interleaved distributed transcoding (IDT), a robust video encoding scheme that allows peers more capable than mobile devices to perform transcoding in a collaborative fashion. IDT is designed in such a way that transcoded sub streams are assembled into a single video stream, which can be decoded by any H.264/AVC baseline profile compliant decoder.

The contribution by E. Maani, Z. Chen, and A.K. Katsaggelos “A Game Theoretic Approach to Video Streaming over Peer-To-Peer Networks” discusses P2P system for multimedia streaming based on game theoretical approach. In the proposed framework, they consider peers as strategic players which make foresighted decisions in order to maximize their own video quality. A Markov Decision Process is employed to obtain the optimal resource allocation policy based on the other peers’ reciprocation history. The computational complexity of the proposed framework is addressed by an approximation method. In addition, a fictitious currency is introduced in the proposed framework to allow peers offering different prices for various parts of the video stream due to its different impact on the video quality.

In conclusion, we believe that the readers will benefit from the fascinating research works selected for this special issue. In addition, they will find appealing hints for future explorative activities on the broad field of video streaming over P2P networks.

We would like to thank all the authors and reviewers for their excellent original contributions and essential help in providing expert opinions and comments on the numerous paper submitted to this special issue respectively. Finally, we express our gratitude to previous Editor-in-Chief Murat

Tekalp who approved this special issue and current Editor-in-Chief Frederic Dufaux who helped in putting this special issue together.



Dr Naeem Ramzan (member of IEEE and fellow of HEA) received M.S in Telecom from Brest, France and Ph.D. in Electronics Engineering from Queen Mary University of London in 2004, and 2007 respectively. From 2004–2007 he worked on European Commission (EC) project aceMedia in the Multimedia & Vision Group in Queen Mary University of London. Currently, he is a senior researcher in the EU funded project CUBRIK and SARACEN. He started IEEE student branch in Queen Mary University of London and served as Co-chair of IEEE region 8 congress in 2008.

He had been a co-chair of Special session in ACM Multimedia Information Retrieval Conference, Philadelphia, USA 2010; International Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS), London, UK 2009; WIAMIS, Desenzano del Garda, Italy 2010; and WIAMIS, Delft, Netherlands 2011. He is also the co-organizer and co-chair of ACM Multimedia workshop on Social, Adaptive and Personalized Multimedia Interactive Access (SAPMIA), Firenze, Italy 2010; ACM Multimedia workshop on Social and Behavioral Networked Media Access (SBNMA) Scottsdale, Arizona, USA 2011; and ACM Multimedia workshop on User Experience in e-Learning and Augmented Technologies in Education (UXeLATE), Nara, Japan, 2012. He was the general chair of “Social Media Retrieval” Summer School, Antalya, Turkey, 2011. He is the author or co-author of more than 60 research publications.

He has served as Guest Editor of a special issue of the Elsevier Journal Signal Processing: Image Communication and IEEE COMSOC E-letter. Currently he is editing a book on Social Media Retrieval that will be published by Springer in “Computer Communications and Networks series”. He is also a project reviewer and evaluator for the EC.



Prof. Ebroul Izquierdo holds the Chair of Multimedia and Computer Vision and head of the Multimedia and Vision Group in the school of Electronic Engineering and Computer Science at Queen Mary, University of London. For his thesis on the numerical approximation of algebraic-differential equations, he received the Dr. Rerum Naturalium (PhD) from the Humboldt University, Berlin, Germany. He has been a senior researcher at the Heinrich-Hertz Institute for Communication Technology (HHI), Berlin, Germany, and the Department of Electronic

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Prof. Izquierdo is a Chartered Engineer, a Fellow member of the The Institution of Engineering and Technology (IET), a senior member of the IEEE, a member of the British Machine Vision Association, past chairman of the IET professional network on Information Engineering, member of the Visual Signal Processing and Communication Technical Committee of the IEEE Circuits and Systems Society and member of the Multimedia Signal Processing technical committee of the IEEE. Prof. Izquierdo is or has been associated and guest editor of several relevant journals in the field including the IEEE Transactions on Circuits and Systems for Video Technology, the EURASIP Journal on Image and Video processing, the Elsevier journal Signal Processing: Image Communication, The EURASIP Journal on Applied Signal Processing, the IEE Proceedings on Vision, Image & Signal Processing, the Journal of Multimedia Tools and Applications and the Journal of Multimedia. He has been member of the organizing committee of several conferences and workshops in the field and has chaired special sessions and workshops in ICIP, ICASSP and ISCAS. He has been the general chair of the European Workshop on Image Analysis for Multimedia Interactive Services, London 2003 and Seoul 2006, the European Workshop for the integration of Knowledge, Semantics and Content, London 2004 and 2005, the Mobile Multimedia Communications Conference MobiMedia, Algero2006, the International Conference on Content Based Multimedia Indexing, London 2008 and the IET Conference on Visual Information Engineering, Xian 2008.

Prof. Izquierdo has been involved in many EU funded projects including Panorama, Cost211, SCHEMA, Sambits, aceMedia, MESH, Papyrus, RUSHES, PetaMedia, Sala+, SARACEN, NextMedia, Eternal, VideoSense, etc. He has coordinated several other large cooperative projects including Cost292, BUSMAN, K-Space and 3DLife.

Prof. Izquierdo holds several patents in the area of multimedia signal processing and has published over 400 technical papers including chapters in books.



Prof. Hyunggon Park received the B.S. degree in Electronics and Electrical Engineering from the Pohang University of Science and Technology (POSTECH), Pohang, Korea, in 2004, and the M.S. and Ph.D. degrees in Electrical Engineering from the University of California, Los Angeles (UCLA), in 2006 and 2008, respectively.

Currently, he is an Assistant Professor at the Department of Electronics Engineering, Ewha Womans University, Seoul, Korea.

His research interests are game theoretic approaches for distributed resource management (resource reciprocation and resource allocation) strategies for multiuser systems and multiuser transmission over wireless/wired/peer-to-peer (P2P) networks. In 2008, he was an intern at IBM T.J. Watson Research Center, Hawthorne, NY, and he was a Senior Researcher at the Signal Processing Laboratory (LTS4), Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland, in 2009–2010.

Dr. Park was a recipient of the Graduate Study Abroad Scholarship from the Korea Science and Engineering Foundation during 2004–2006 and are recipient of the Electrical Engineering Department Fellowship at UCLA in 2008.



Prof Aggelos K. Katsaggelos received the Diploma degree in electrical and mechanical engineering from the Aristotelian University of Thessaloniki, Greece, in 1979, and the M.S. and Ph.D. degrees in Electrical Engineering from the Georgia Institute of Technology, in 1981 and 1985, respectively.

In 1985, he joined the Department of Electrical Engineering and Computer Science at Northwestern University, where he is currently a Professor holder of the AT&T chair. He was previously the holder of the Ameritech Chair of Information Technology (1997–2003). He is also the Director of the Motorola Center for Seamless Communications, a member of the Academic Staff, NorthShore University Health System, an affiliated faculty at the Department of Linguistics and he has an appointment with the Argonne National Laboratory.

He has published extensively in the areas of multimedia signal processing and communications (over 180 journal papers, 400 conference papers and 40 book chapters) and he is the holder of 19 international patents. He is the co-author of Rate-Distortion Based Video Compression (Kluwer, 1997), Super-Resolution for Images and Video (Claypool, 2007) and Joint Source-Channel Video Transmission (Claypool, 2007).

Among his many professional activities Prof. Katsaggelos was Editor-in-Chief of the IEEE Signal Processing Magazine (1997–2002), a BOG Member of the IEEE Signal Processing Society (1999–2001), and a member of the Publication Board of the IEEE Proceedings (2003–2007). He is a Fellow of the IEEE (1998) and SPIE (2009) and the recipient of the IEEE Third Millennium Medal (2000), the IEEE Signal Processing Society Meritorious Service Award (2001), the IEEE Signal Processing Society Technical Achievement Award (2010), an IEEE Signal Processing Society Best Paper Award (2001), an IEEE ICME Paper Award (2006), an IEEE ICIP Paper Award (2007) and an ISPA Paper Award (2009). He was a Distinguished Lecturer of the IEEE Signal Processing Society (2007–2008).



Dr. ir. J. A. Pouwelse is the scientific director of the P2P-Next project, the currently largest funded research project into Peer-to-Peer technology. He is an assistant professor at Delft University of Technology, The Netherlands. Some time ago Dr. Pouwelse conducted a 2-year measurement campaign of the BitTorrent P2P network. This detailed measurement discovered many unique properties of this P2P market leader. He delivered a statement for the Federal Trade Commission in Washington, was a visiting scientist at Massachusetts Institute of Technology (MIT), and spent three summers at Harvard University in Cambridge to study both the economic impact of BitTorrent on Hollywood as well as “Making Internet Bandwidth A Global Currency”.

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