Guest Editorial: Special Issue on P2P Cloud Systems

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Since the success of Amazon's Elastic Compute Cloud (a.k.a. EC2), the concept of cloud computing has been quickly adapted worldwide, from major content providers (such as Google and Microsoft), solution providers to small business enterprise. In contrast to traditional Internet services, cloud computing provides not only storage capacity, but also computing powers. It allows end-users to access data from anywhere at anytime. It equips enterprises with IT solutions at low cost. Such computing services are supported by large data and processing centers that may or may not located at the same location. Despite the massive computing power, storage capacity and great flexibility, cloud computing is facing challenges in sustainability, privacy, security, robustness, data migration, throughput, and many more. Harnessing all the distributed storage and power together in a seamless architecture is also a great challenge. To address these, peer-to-peer (P2P) techniques have been proposed, e.g., in data centers, at the core as overlay network, and at the edge of the cloud, so that cloud services can be provided in the most effective manner.

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The goal of this special issue is to foster and exchange ideas on innovative work for P2P cloud computing. It has been successful in attracting many high-quality submissions in the areas of novel P2P or overlay technology for cloud computing, P2P solutions for storage and data migration, green computing and energy efficiency, and overlay and P2P techniques to support Internet and mobile streaming cloud, economics and management issues in P2P cloud systems, etc. After a rigorous review process, we have carefully selected five papers, covering a rather wide spectrum related to the area of P2P cloud systems.

The paper “Cost and Profit Driven Cloud-P2P Interaction”, authored by Jacob Chakareski, proposes a utility-driven scheduling strategy to improve video quality, and to reduce frame-freeze frequency and play-out latency in a video streaming system. In contrast to existing proposal, the new strategy takes advantages of both the cloud and P2P infrastructures. On one hand, the cloud is used manage P2P systems, especially in discovering neighbors. On the other hand, peers are awarded by the cloud for their contributions in assisting other peers. In addition to analytical study, the author also provides simulation results to support the claims

The paper “Liquidstream II - Scalable P2P Overlay Optimization with Adaptive Minimal Server Assistance for Stable and Efficient Video On Demand”, authored by Konstantinos Deltouzos, Ilias Gkortsilas, Nikolaos Efthymiopoulos, and Spyros Denazis, proposes a Video on Demand system based on scalable P2P network. With the focus on design of Liquidstream II, the paper addresses challenging issues in seeking an effective P2P method for optimizing video communication process. The discussions include distributed and effective peer discovery mechanisms, optimization mechanisms for P2P overlay, and methods for invoking distributed media servers with minimum server assistance. In addition to mathematical analysis, the authors also provide a significant amount of simulation results to support the studies.

The paper “A Survey of Peer-to-Peer Overlay Approaches for Networked Virtual Environments”, authored by EliyaBuyukkaya, MahaAbdallah, and Gwendal Simon, reviews the key design approaches that have been considered over the last decade for constructing P2P-networked virtual environment (NVE) systems. The authors analyze the advantages and shortcomings of each approach, and examine a few representative system architectures built based on them. The authors argue that none of the existing solutions can provide the necessary requirements of an actual NVE system and posit that only via hybrid P2P-Cloud approaches can they be met.

The paper “Integrating Peer-to-Peer and Clouding Computing for Massively Multiuser Online Games”, authored by Hanna Kavalionak, Emanuele Carlini, Laura Ricci, Alberto Montresor, and Massimo Coppola, is to utilize the advances of Peer-to-Peer techniques and Clouding Computing methods to solve large-scale multi-client and multi-server problems, which makes the paper as a part of broader, ambitious work to build a completely flexible infrastructure. The focus of this paper is to manage “events” and mapping of physical nodes with virtual nodes to meet QoS and budget requirement. Their approach is driven by both practical and theoretical considerations. The overall proposal is representative of a good applied research activity. Their research studies are interesting and comprehensive. Simulations support the general ideas.

In “Locality-aware Streaming in Hybrid P2P-Cloud CDN Systems,” authored by Jian Zhao, Chuan Wu and Xiaojun Lin, the authors study the optimization of a locality-aware hybrid P2P-cloud CDN system for video-on-demand, where the content providers pay for bandwidth they use. The study is to strike the best tradeoff between bandwidth consumption in the cloud and the undesirable inter-ISP traffic. By means of stochastic analysis and optimization techniques, they optimize the caching and request distribution for the cloud CDN to achieve locality-awareness so as to minimize the overall cost. Extensive simulations have been conducted to study the cost-effectiveness of the network.

Last but not the least, we would like to take this opportunity to thank all the authors who submitted their high-quality works to this special issue. We also owe much to all the volunteering reviewers for their hard work in providing timely reviews on the submissions. We hope that this special issue will give you a glimpse of the vast and diverse research directions in P2P cloud. Through concerted effort, we believe that our future cloud systems will be designed and deployed with higher efficiency, better service, and lower cost.

S.-H. Gary Chan is currently Professor and Undergraduate Programs Coordinator at the Department of Computer Science and Engineering, The Hong Kong University of Science and Technology (HKUST), Hong Kong. He is also the Director of Sino Software Research Institute at HKUST. He received MSE and PhD degrees in Electrical Engineering from Stanford University (Stanford, CA) in 1994 and 1999, respectively, with a minor in business administration. He obtained his B.S.E. degree (highest honor) in Electrical Engineering from Princeton University (Princeton, NJ) in 1993, with certificates in Applied and Computational Mathematics, Engineering Physics, and Engineering and Management Systems. His research interest includes multimedia networking, wireless networks and mobile computing.

Professor Chan was an Associate Editor of IEEE Transactions on Multimedia (2006–11), and a Vice-Chair of Peer-to-Peer Networking and Communications Technical Sub-Committee of IEEE Comsoc Emerging Technologies Committee. He has been Guest Editors of IEEE Transactions on Multimedia (2011), IEEE Signal Processing Magazine (2011), IEEE Communication Magazine (2007), and Springer Multimedia Tools and Applications (2007). He was the TPC chair of IEEE Consumer Communications and Networking Conference (CCNC) 2010, Multimedia symposium in IEEE Globecom (2007 and 2006), IEEE ICC (2007 and 2005), and Workshop on Advances in Peer-to-Peer Multimedia Streaming in ACM Multimedia Conference (2005).

Professor Chan’s research projects on wireless and streaming have received several ICT (Information and Communication Technology) awards in Hong Kong, Pan Pearl River Delta and Asia-Pacific regions due to their commercial impacts to industries (2012 and 2013). He is the recipient of Google Mobile 2014 Award (2010 and 2011) and Silver Award of Boeing Research and Technology (2009). He has been a visiting professor or researcher in Microsoft Research (2000–11), Princeton University (2009), Stanford University (2008–09), and University of California at Davis (1998–1999). He was a William and Leila Fellow at Stanford University (1993–94), and the recipient of the Charles Ira Young Memorial Tablet and Medal, and the POEM Newport Award of Excellence at Princeton (1993). He is a member of honor societies Tau Beta Pi, Sigma Xi and Phi Beta Kappa.

Mea Wang is currently an Assistant Professor in the Department of Computer Science at the University of Calgary. She received her Bachelor of Computer Science (Honours) degree from the Department of Computer Science, University of Manitoba, Canada, in 2002. She received her Master of Applied Science and Ph.D. degrees from the Department of Electrical and Computer Engineering at the University of Toronto, Canada, in 2004 and 2008, respectively. Her research interests include Peer-to-Peer networking, multimedia networking, cloud computing and networking system design and development. Her work on practical network coding for P2P multimedia streaming system, “R2: Random Push with Random Network Coding in Live Peer-to-Peer Streaming,” has been highly recognized and won the 2009 Multimedia Communications Best Paper Award. She has been serving as an Associate Editor for the Journal of Communications since 2010, the Guest Editor of the Special Issue on “Multimedia Streaming (P2P)” and the Special Issue on “Multimedia Streaming (Scalability)” for IEEE Multimedia Communications Technical Committee E-Letter in October and December 2009, respectively.

Jacob Chakareski completed the M.Sc. and Ph.D. degrees in electrical and computer engineering at the Worcester Polytechnic Institute (WPI), Worcester, MA, USA, Rice University, Houston, TX, USA, and Stanford University, Stanford, CA, USA. He is an Assistant Professor of Electrical and Computer Engineering at the University of Alabama. He was a Senior Scientist at Ecole Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland, where he conducted research, supervised students, and lectured. He also held research positions with Microsoft, Hewlett-Packard, and Vidyo, a leading provider of Internet telepresence solutions. Chakareski has authored one monograph, three book chapters, and over 100 international publications, and holds 5 US patents. His current research interests include graph-based information processing, computer networks, immersive communication, and social computing. He also pursues ultrasound and interactive 3D video applications in telemedicine, remote sensing, biomedicine, and community-based health care.

Dr. Chakareski is a member of Tau Beta Pi and Eta Kappa Nu. He is a recipient of the Technical University Munich Mobility Fellowship, the University of Edinburgh Chancellor's Fellowship, and fellowships from the Soros Foundation and the Macedonian Ministry of Science. He was the recipient of the Texas Instruments Graduate Research Fellowship at Rice University, the Swiss NSF Ambizione Career Development Award, the Best Student Paper Award at the SPIE VCIP 2004 Conference, and the Best Paper Award of the Stanford Electrical Engineering and Computer Science Research Journal for 2003. He was the Publicity Chair of

the Packet Video Workshop 2007 and 2009, and the Workshop on Emerging Technologies in Multimedia Communications and Networking at ICME 2009. He has organized and chaired a special session on telemedicine at MMSP 2009. He was the Technical Program Co-Chair of Packet Video 2012 and the General Co-Chair of the IEEE SPS Seasonal School on Social Media Processing 2012. He is an Advisory Board member of Mainframe2, an innovative visual cloud computing start-up with a bright future.

Bin Wei received his Ph.D. in Computer Science from Princeton University. His research interests include Multimedia, Peer-to-Peer, and Mobile Computing. His contributions to multimedia communications focus on the middleware which provides multimedia services for various user devices ranging from display walls to handheld devices by building prototype systems. He also works on improving communication performance and user experience with mobile devices. He has many publications about the work in major international technical conferences and journals. He also served as the TPC chair and co-chair for multiple international conferences. For the past several years, he has served as the Secretary and Vice Chair for IEEE COMSOC Multimedia Technical Committee (MMTC).