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Editorial

Editorial for Computer Networks special issue on "Measurement-based optimization of P2P networking and applications"

Measurement plays an important role in various Peer-to-Peer (P2P) applications: for peer selection, data delivery and overlay construction. Since P2P systems may include hundreds of thousands of online peers at the same time, it is necessary for the measurements to be scalable. With a dedicated or co-located measurement element such as a network coordinate system or traffic monitor, a P2P system can utilize the measurement results to either improve the system's performance or ensure the system's robustness.

Currently P2P systems are the largest contributor to network traffic on the Internet. To enhance the data delivery efficiency while reducing the inter-domain traffic, different schemes like P4P and application layer traffic optimization (ALTO) [5] are proposed. By utilizing different sources of information, such as routing information from the ISP or real-time measurement results exchanged among the peers, traffic optimization can be performed. This can potentially satisfy both ISPs' operational cost and the users' experience.

In this special issue, we are pleased to introduce a series of state-of-the-art papers on this specific area. These articles cover the subject from a variety of perspectives, offering the readers an understanding of the measurement and optimization of P2P technologies. A total of four papers were finally selected for this special issue out of 21 submissions, among which 18 have gone through a strict peer review process while the other three were rejected as out of scope. They cover a broad range of the field of measurement-based optimization of P2P networking and applications. While some articles present more general issues of P2P and understanding their behavior and implications, others focus on new approaches to improve P2P design using measurements.

Distributed Hash Tables (DHTs) are increasingly employed by large-scale P2P systems. Monitoring DHT system traffic, usually by adding instrumented peers that passively participate in the DHT and log exchanged messages, allows one to detect design flaws, detect performance bottlenecks and determine how users use/abuse the system in practice. However, too few or too many monitoring peers may either be unable to capture the full feature of DHT traffic, or result in service interruption and biased measurements. In the first paper, Memona et al. [1] present a new technique, called Montra, which leverages the embedded redundancy in published content and routing to make the traffic monitors minimally visible to participating peers, minimizing system disruption. Experimentation with a Python implementation of Montra over two widely deployed DHTs (Kad and Azureus) shows that it can capture traffic with over 95% accuracy, with only a moderate amount of resources used in the monitor.

P2P networks are being increasingly adopted as an important resource pool for various information retrieval (IR) applications, such as user and content similarity estimation, content recommendation, ranking, and trend prediction. In the second paper of this special issue, Koenigsteina et al. [2] quantify the measurement effort required to obtain and optimize the information obtained from P2P networks for the purpose of IR applications. The study is based on a real data set collected from the Gnutella network. A wide range of challenges are discussed, including crawler design, difficulties in crawling, noise filtering, content convergence, distribution pattern of peering neighbors, and content sparseness, etc. The analysis shows the power-law nature of P2P data; thus an accurate view of popular content can be obtained by using a relatively small effort. In contrast, there are also some applications (e.g., trend prediction) which require a more exhaustive crawl, since they mandate collection of data from the "long tail". Moreover, the study shows that content and search queries are highly localized. Overall, this paper provides useful insights for processing P2P data in IR tasks.

Video files represent a large portion among the content shared using BitTorrent, one of the popular P2P file sharing applications. There have been some recent efforts on enabling BitTorrent for VoD services. Through measurements on PlanetLab and model analysis, Ma et al. [3] find that existing BitTorrent-based VoD systems are subject to a reduced system efficiency, due to their choice of sequential peer selection and lack of further consideration for other peer selection policies. Hence, the authors propose to select closest-ahead streaming peers to make a better use of a peer's upload bandwidth. In addition, a sliding window-based hybrid method is proposed, combining the

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rarest-first policy with the sequential policy for piece selection. The evaluation on PlanetLab shows that the proposed method achieves better performance than the sequential policy and BiToS (a previous approach for BitTorrent-based VoD service).

The large amount of traffic produced by video applications over P2P-based overlays motivates network operators to optimize this traffic. To enable better peer selection for data exchange, approaches exploiting locality awareness such as ALTO provide an interesting solution whereby peers have some knowledge of the underlying physical network and/or preferences of the operator. This approach, though beneficial to the network operators who save a large amount of their costly inter-domain traffic, does not provide real benefit to overlay users and content providers. In the last paper of this special issue, Pussepa et al. [4] propose a measurement-based collaborative approach, whereby a network operator gives incentives to highly active peers by increasing their upload and download capacities. This in turn motivates users to share more traffic among themselves, thus reducing the load on content providers. Therefore the novelty of this cooperative traffic management approach is its ability to be beneficial to users, content providers, and network operators.

We hope that these articles will help readers understand the state-of-the-art advances on the measurement-based optimization of P2P networking and applications, providing current visions of how the behaviors and implications of P2P systems may be measured, utilized or improved. In preparing this special issue, we wish to thank all the peer reviewers for their efforts in carefully reviewing the manuscripts to meet the tight deadlines. We are grateful to the co-editor-in-chief Harry Rudin for his timely and constructive suggestions.

Guest Editors
Xiaoming Fu
Yang Chen
Guy Leduc
Laurent Mathy

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Xiaoming Fu received his Ph.D. in Computer Science in 2000 from Tsinghua University, Beijing, China. After that he worked at the Telecommunication Networks Group, Technical University Berlin, Germany and then joined the University of Göttingen where he has been a full professor of computer science and heads the Computer Networks Group since 2007. He has also been a Specialist Task Force Expert at ETSI, a Fulbright Visiting Professor at UCLA, and Changjiang Scholar Visiting Professor at Tsinghua University, and spent visits at Cambridge and Columbia Universities. His research interests lie in architectures, protocols and applications of Internet-based systems, including reliability, resilience, and security issues for both wired and mobile wireless networks.

Prof. Fu has served on the organization or program committees of a number of conferences such as ACM MOBICOM, MOBIHOC, MobiArch, HotPlanet, IEEE INFOCOM, ICNP, ICDCS, IWQoS, and CCW. Currently, he is vice chair the IEEE Communications Society Technical Committee on Computer Communications (TCCC), and chair of the Internet Technical Committee of the IEEE Communications Society and the Internet Society (ISOC). He is also on the editorial board the Computer Communications Journal (Elsevier) and IEEE Transactions on Networks and Service Management, and served as a guest editor of IEEE Network Special Issues on Implications and Control of Middleboxes in the Internet. Prof. Fu is a senior member of IEEE, and member of ACM and GI.

Yang Chen is a research associate at the Institute of Computer Science, University of Goettingen, Germany. He is also an adjunct research scientist at Network and Human–Machine Speech Communication Research Institute, Department of Electronic Engineering, Tsinghua University. He received his B.S. and Ph.D. degrees from Department of Electronic Engineering, Tsinghua University in 2004 and 2009, respectively. He visited Stanford University (in 2007) and Microsoft Research Asia (2006–2008) as a visiting student. His research interests include P2P networking, Internet routing and online social networking. He has served/is serving as a guest editor of IET Communications Special Issue on Peer-to-Peer Systems and Online Social Networking, TPC co-chair of P2PNet'09, P2PNet'10, and HotPOST'11, Session chair/TPC member for several international conferences such as IEEE ICDCS, IEEE ICCCN, IEEE CCW, and IEEE GLOBECOM. He has published more than 40 referred papers in international journals and conference proceedings.

Guy Leduc is full professor in the EECS department of the University of Liège, Belgium, and since 1997 is the head of the Research Unit in Networking (RUN). He received his master degree in Electrical Engineering and his doctoral degree in Computer Science from the University of Liège in 1983 and 1991 respectively. His main research interests are traffic engineering, Internet Coordinate Systems, overlays, multimedia, congestion control, and the application of machine learning to networking. His research unit has been involved in several European projects including ANA on autonomic networking, ECODE on cognitive networking, ResumeNet on Resilient Networking, and the E-NEXT European network of excellence. His group was also involved in the development of TOTEM, an open-source traffic engineering toolbox. Since 2007 he has been the chairman of the IFIP Technical Committee (TC6) on Communications Systems, and was also the chairman of IFIP WG6.1 from 1998 to 2004. He is an area

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Laurent Mathy graduated in Electrical Engineering (Computer Science) from the University of Liège, Belgium, in June 1993 and received a Ph.D. in Computer Science from Lancaster University, England, in January 2000.

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Laurent was on sabbatical leave in 2006–2007, and spent time as a visiting research director at LAAS-CNRS in Toulouse, France, and as a visiting professor at the University of Liège and the University of Louvain-la-Neuve in Belgium.

He was the Director of Studies for the Advanced MSc Programme in Computer Science and the MSc in Networking and Internet Systems at Lancaster University, UK.

Laurent has many refereed publications and has extensively been serving the research community. In particular, he is a founding and steering committee member for the ACM CoNEXT conference, has served on the Technical Programme Committees (TPC) of top conferences in his field (e.g. ACM SIGCOMM, IEEE Infocom, ACM Multimedia, IFIP Networking, etc.), and was the TPC co-chair for IMC 2009 and ICCCN 2010.

He has enjoyed many invitations to give seminars, talks and tutorials, and serve on expert panels, and was the recipient of the Young Researcher Award of CFIP'99.