Internet-QoE Workshop

QoE-based Analysis and Management of Data Communication Networks

ACM SIGCOMM 2016 Workshop Proposal

ABSTRACT

The goal of the Internet-QoE workshop is to scale QoE out of the lab studies context and bring it to the analysis and operation of data communication networks, giving a use-centric perspective to the research performed by the SIGCOMM community. By fostering an explicit and deep integration of the end-user directly into the design, analysis and management of large-scale operational networks, we expect to reduce the gap between QoE research and its application to future network management paradigms, as well as to provide a more targeted end-user perspective to the research on data communication networks.

Keywords

User experience, QoE, network and Internet measurement, network management, traffic monitoring and analysis, QoE-aware networks, interdisciplinary workshop

1. MOTIVATION AND RATIONALE

Better understanding and improving the Internet has been the target of uncountable research efforts in the past 20 years. When addressing the functioning and performance of the Internet, the focus has traditionally be on metrics not necessarily linked to its main stakeholder: the end-user. However, the trend today in the development and evolution of systems, products and services is to include the end-user in the complete cycle, integrating as much information as possible about user preferences and personal profiles to increase success. Indeed, tailoring technological development to the specific needs and desires of the end-user is becoming more widespread, and networking is not oblivious to this. The success of key players such as Google or Facebook, the new wave of industry development (i.e., Industry 4.0) and even futuristic scenarios such as the *tactile* Internet are all examples proving this. Even more, the concepts of user-centric network management and operation are already on the table for the design of the future mobile network: the EU H2020 5G Infrastructure PPP (Public Private Partnership) call for innovation and research projects has identified end-user experience as one of the main guiding paradigms to enable a user/service driven management of the future 5G network [11].

When it comes to research, we are witnessing an increasing number of papers submitted to ACM SIGCOMM and other ACM related, top-level conferences (IMC, SIGMETRICS, MOBICOM, etc.) where the concepts of Quality of Experience (QoE) and user-centric networking are be-

ing pushed further into the analysis of large-scale network measurements and complex networks such as the Internet [1, 2, 3, 4, 5, 6, 7]. Particularly considering SIGCOMM, there have been a couple of workshops hosted by the main conference in the past (W-MUST in 2011-2012 [8, 9] and FhMN in 2013 [10]), targeting a similar direction. Unfortunately, even if these previous workshops had some slight success at their time, they did not achieve the goal of approaching QoE to the SIGCOMM community, and nowadays the concepts seem still somehow far for researchers attending the SIGCOMM conference. We have recently organized a NSF/FCC workshop on QoE in the Internet (http://aqualab.cs.northwestern.edu/NSFWorkshop-InternetQoE), which had a large participation of US-based researchers, highly recognized and very active in SIGCOMM. The purpose of the workshop was to understand the state of research with respect to QoE, and specifically to contemplate a community agenda to integrate QoE in the current Internet operations and analysis. Workshop participants all agreed on the relevance of QoE and its applications to real, large-scale networks, and thus we believe that we are approaching the right time to push strongly these ideas into the SIGCOMM community.

For the reasons we describe in the proposed CfP next, we are convinced that bringing QoE directly into the SIGCOMM community and SIGCOMM topics would foster a better and much stronger development of the QoE-based network and traffic analysis domain, as well as a more extended application of QoE concepts and metrics into real large-scale networking scenarios. One of the key elements we believe is so far missing within the SIGCOMM community is a deeper QoE know how and expertise. The QoE and the SIGCOMM communities are currently loosely overlapping. The major venue for QoE research is the QoMEX conference (http://qomex2016.lx.it.pt/), started back in 2009 in San Diego, CA. When comparing the organizing committees and PC members of both QoMEX and SIGCOMM venues, the lack of coincidence is evident. At the same time, QoMEX generally lacks papers applying the results obtained from subjective tests and crowd-sourcing studies to operational networks and large-scale traffic measurements, being as such sometimes far from the applied networking domain. It is exactly in this point where we want to make a major contribution with the Internet-QoE workshop: bringing QoE know how and expertise into the SIGCOMM community, and scaling current QoE expertise out of the small-scale lab tests and analysis.

For doing so, we have gathered a group of experts from both traffic analysis and QoE communities in EU and the US to conform a solid organization committee: from the Internet measurements domain we have Fabián Bustamante (Northwestern University) and David Choffnes (Northeastern University); from the QoE domain we have Martín Varela (VTT Technical Research Centre of Finland); finally, Pedro Casas (Austrian Institute of Technology) serves as a bridge between domains, based on his expertise on both sides. This mix of experts from both sides of the problem is the key ingredient for success of Internet-QoE.

2. CALL FOR PAPERS

Measuring and analyzing complex networks such as the Internet has been the focus of many research efforts for over two decades now. While this approach has lead to an improved understanding of the Internet and an enhancement of the management and operation of large-scale complex networks, little has been done to understand and manage the traffic and the network from a user-centric perspective. QoE remains a poorly understood domain, currently restricted to small scale lab studies and very far from the analysis of real large scale traffic measurements and networks. Especially in the industry, QoE has become a buzz word, far from its reality within the research community, and partly due to the complexity involved in deploying QoE-based network analysis and management solutions.

In addition, network operators and service providers currently struggle to keep their increasingly demanding customers happy in an increasingly competitive and complex environment, while remaining profitable at the same time. The sheer development of novel end-user services demands more and better user-centric quality concepts and metrics applied to real world operational networks. We see current and future networks becoming more and more end-user experience aware, but there is still a long way to go to make of QoE one of the guiding paradigms for network design, management, and operation. As a first step, we need to better understand real networks and their traffic through the eyes of the end-user.

The goal of the Internet-QoE workshop is to scale QoE out of the lab studies context and bring it to the design, analysis and operation of real world networks and traffic. By fostering an explicit and deep integration of the end-user directly into the analysis and management of traffic and networks, we expect to reduce the gap between QoE research and its application to future network management paradigms, as well as to provide a more targeted end-user perspective to the research on Internet analysis and its future development.

Internet-QoE brings together researchers and practitioners from the Internet measurements and analysis domain and the QoE modeling and assessment domain, as well as industry players willing to integrate QoE aspects into the DNA of their daily business, with direct applications in network dimensioning, monitoring, management, and troubleshooting among others. We invite submissions in the following non-exhaustive list of topics:

- QoE-aware networking
- Internet measurements related to QoE
- QoE characterization from Internet measurements
- QoE metrics for smartphones & mobile networks

- QoE-based traffic monitoring and troubleshooting
- Novel algorithms to improve Internet QoE
- QoE-based network management and analysis
- QoS/QoE mapping, metrics and measurements in the large-scale
- Application of QoE models and metrics to network and traffic analysis
- Tools and techniques to gather QoE-related Internet measurements
- Large-scale field trials shedding light on QoE aspects
- Qualitative measurements for Internet traffic analysis
- SDN for QoE-based network management
- QoE-based analysis of CDNs and Cloud networks
- Large-scale network simulation for QoE analysis
- Novel approaches for large-scale QoE crowd-sourcing

2.1 Submission Instructions

Submissions must be original, unpublished work, and not under consideration at another conference or journal. Submitted papers must be at most six (6) pages long, including all figures, tables, references, and appendices in two-column 10pt ACM format. Papers must include authors names and affiliations for single-blind peer reviewing by the PC. Authors of accepted papers are expected to present their papers at the workshop.

3. WORKSHOP DEADLINES

External deadlines:

- Paper registration deadline: 18th March 2016
- Paper submission deadline: 25th March 2016
- Paper acceptance notifications: 29th April 2016
- Camera ready due: 20th May 2016
- Workshop date: 22 August 2016

Internal deadlines:

- Workshop CfP announced: 21st December 2015
- Workshop CfP online: 21st December 2015
- Reviews due: 18th April 2016
- Discussion phase (remote): 20th-27th April 2016
- List of accepted papers: 28th April 2016
- Final program online: 13th June 2016
- List of organization details: 15th June 2016

4. COMMITTEES

Workshop Chairs:

- Pedro Casas, Austrian Institute of Technology, Austria
- Fabián Bustamante, Northwestern University, US
- Martín Varela, VTT Technical Research Centre of Finland
- David Choffnes, Northeastern University, US

Program Committee ([†]confirmed):

- Suman Banerjee, University Wisconsin Madison, US
- Rocky Chang[†], The Hong Kong Polytechnic University
- kc Claffy, CAIDA/USCD, US
- David Clark, MIT, US
- Sebastian Egger[†], Austrian Institute of Technology
- Nick Feamster, Princeton University, US
- Tobias Hoßfeld[†], University of Duisburg-Essen, Germany
- Lucjan Janowski[†], AGH University of Science and Technology, Poland
- Patrick Le Callet[†], Polytech Nantes, France
- Anirban Mahanti, NICTA, Australia
- Morley Mao[†], University Michigan, US
- Maria Papadopouli[†], University of Crete/ICS-FORTH, Greece
- Peter Reichel[†], University of Vienna, Austria
- Raimund Schatz[†], FTW Telecommunications Research Center Vienna, Austria
- Lea Skorin-Kapov[†], University of Zagreb, Croatia
- Florian Wamser[†], University of Würzburg, Germany
- Hui Zhang, Carnegie Mellon University and CONVIVA, US

5. WORKSHOP FORMAT

We target a **full-day workshop**, including **1 or 2 keynote talks**, **1 informal panel** (targeting interactive and lightly structured discussion), and **9 accepted papers** (10 max). Given the relevance of the topic in both the US and EU research communities and the deep contact we have with researchers in both sides, we expect to have in the order of **30 submissions**, which shall result in an **acceptance ratio of about 33%**. In terms of participation, we expect in the order of 20/30 participants.

We are planning the following keynote presenters:

- **Keynote 1:** Ion Stoica (Berkeley - University of California and CONVIVA) / Hui Zhang (Carnegie Mellon University and CONVIVA) - "Quality of Experience for Internet Video", TBC.

- **Keynote 2:** Jeffrey Erman (AT&T Research) - "Web Quality of Experience on Cellular Networks", TBC

- **Panel:** David Choffnes, Fabián Bustamante, Peter Reichel, Tobias Hoßfeld, Keynote 1 - TBC

6. WORKSHOP ORGANIZERS

Pedro Casas is Researcher at the Austrian Institute of Technology in Vienna, as well as member of the ARTES research group at Universidad de la República in Montevideo. Prior he was Senior Researcher at the Telecommunications Research Center - FTW Vienna, postdoctoral fellow at the CNRS-LAAS research lab in Toulouse, and research and teaching assistant at the Engineering Faculty of Universidad de la República in Montevideo. He received a PhD in Computer Science from Télécom Bretagne and Universidad de la República in 2010. His research topics are on the statistical characterization and analysis of network traffic, big data analytics and platforms, QoE assessment and monitoring, and machine-learning and data mining based approaches for Networking. He is co-author of more than 80 papers published in major journals and conferences, and has received 8 best paper and best workshop awards in the last 7 years. He is the chair of the International Workshop on TRaffic Analysis and Characterization (TRAC) series. **Website**: http://userver.ftw.at/~pcasas/

Fabián Bustamante is a professor of computer science at Northwestern University. He completed his M.Sc. and Ph.D. in Computer Science from the Georgia Institute of Technology. Before Georgia Tech, he studied and taught at the Universidad Nacional de La Patagonia San Juan Bosco (Argentina), from which he received both a 3-year and a 5-year-and-project degrees in computer science. His research interests span several areas of networks and distributed systems, both in wired and mobile networks. Fabián is a senior member of ACM and IEEE and a member of USENIX. He is an associate editor for ACM SIGCOMM CCR, IEEE Internet Computing and IEEE/ACM Transactions on Networking. Fabián co-organized and chaired the recent NSF/FCC Workshop on Quality of Experience in the Internet with David Clark and Nick Feamster. He is a recipient of the National Science Foundation CAREER award and the Science Foundation of Ireland E.T.S. Walton Visitor Award. **Website**: http://www.cs.northwestern.edu/~fabianb/

Martín Varela received his PhD and MSc from the University of Rennes 1 (Rennes, France), in 2005 and 2002 respectively. He has been an ERCIM fellow, and spent time at SICS and VTT, where he is currently a Principal Scientist. He has recently been a guest Senior Researcher at the Cooperative Systems Group at the University of Vienna. He leads VTT's work on QoE, and was a Finnish management committee member for the recently ended COST Action IC1003 Qualinet. He is currently co-chair for the IEEE MMTC QoE Interest Group. His research interests lie in the QoE domain, in which he has been active since 2002, with a particular focus on real-time QoE models for generic services, and applications thereof. He is particularly interested on issues related to QoE-driven cross-layer control, resource management and business applications. **Website**: http://www.cnl.fi/mvarela/

David Choffnes is an assistant professor in the College of Computer and Information Science at Northeastern University. His research is primarily in the areas of distributed systems and networking, with a recent focus on mobile systems and privacy. Much of his work entails crowdsourcing measurement and performance evaluation of Internet systems by deploying software to users at the scale of tens or hundreds of thousands of users. He earned his PhD from

Northwestern, and completed a postdoc at the University of Washington prior to joining Northeastern. He is a co-author of three textbooks, and his research has been supported by the NSF, Google, the Data Transparency Lab, VidScale, M-Lab, and a Computing Innovations Fellowship. **Website**: http://david.choffnes.com/

7. PRIOR HISTORY OF THE WORKSHOP

This is the first edition of Internet-QoE, so there is no direct prior history of it. However, the Internet-QoE workshop builds on the experience gathered from the following previous workshops:

- Tracking Quality of Experience in the Internet (NSF/FCC Workshop): recent efforts to integrate QoE in current Internet analysis, co-organized by Fabián Bustamante.

- Traffic Monitoring and Analysis Workshop (TMA): started back in 2009 by the COST TMA action (EU research community on traffic monitoring and analysis), now on its 8th edition. Pedro Casas and Fabián Bustamante are highly involved, as well as many PC members.

- Traffic Characterization and Analysis Workshop (TRAC): started back in 2010 and organized by Pedro Casas, now on its 7th edition.

- Quality of Multimedia Experience Conference (QoMEX): started back in 2009, now on its 8th edition. Martín Varela is highly involved, as well as many PC members.

- QoE-centric Network and Application Management Workshop (QoENAM): started in 2014 by Martín Varela and Raimund Schatz.

- Measurements Up the STack Workshop (W-MUST): 2 venues of this SIGCOMM workshop took place in 2011 and 2012. David Choffnes and Fabián Bustamante participated in the PC.

The main difference of Internet-QoE with all these venues is that we are targeting for the first time an explicit integration of both Internet measurements and QoE communities within the SIGCOMM community, bringing together experts from both sides in the organization committee. In addition, Internet-QoE serves as a meeting point to join the US and the EU communities working on QoE topics related to data communication networks.

8. TARGETS & DISSEMINATION

Internet-QoE is an interdisciplinary workshop, targeting both the Internet measurements community and the QoE community. One of the largest communities in EU related to traffic measurements and analysis is the TMA (Traffic Monitoring and Analysis) community. Many of the members on the organization committee are highly involved in the TMA community. Similarly, the main EU QoE community is represented by the COST action QUALINET (QoE in Multimedia Systems and Services), and also the organization committee is highly involved there. In addition, the SIGCOMM community is also represented within the organization committee and the PC, including both the SIGCOMM conference and the IMC conference. We believe

that such a plural and complete representation of the targeted communities within the organization committee and PC would highly increase the participation from their members at Internet-QoE. The dissemination of the CfP would be conducted by all the members of the organization committee and the PC, through the respective relevant means (i.e., mailing lists and web sites/blogs) in the multiple communities (Internet measurements and QoE, US and EU).

9. REFERENCES

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