



ITC 28 in Würzburg  
12–16 September 2016  
University of Würzburg, Germany

QCMan 2016 Preface

# **Proceedings of the Fourth International IEEE Workshop on Quality of Experience Centric Management**

**Co-located with the 2016 28th International Teletraffic Congress –  
The First International Conference in Networking Science & Practice**

Thomas Zinner, Oliver Hohlfeld, Raimund Schatz, Prasad Calyam  
(QCMan 2016 Workshop Co-Chairs)

Friday 16<sup>th</sup> September, 2016

## Volume Editors

Tobias Hoßfeld  
University of Duisburg-Essen  
Modeling of Adaptive Systems  
Schützenbahn 70  
D-45127 Essen, Germany  
[tobias.hossfeld@uni-due.de](mailto:tobias.hossfeld@uni-due.de)

Brian L. Mark  
Dept. of Electrical and Computer Engineering  
George Mason University  
4400 University Drive, MS 1G5  
Fairfax, VA 22030-4444, USA  
[bmark@gmu.edu](mailto:bmark@gmu.edu)

Gary Chan  
The Hong Kong University of  
Science and Technology  
Clear Water Bay, Kowloon  
Hong Kong  
[gchan@cse.ust.hk](mailto:gchan@cse.ust.hk)

Andreas Timm-Giel  
Hamburg University of Technology  
Institute of Communication Networks  
Am Schwarzenberg-Campus 3  
D-21073 Hamburg, Germany  
[timm-giel@tuhh.de](mailto:timm-giel@tuhh.de)

*Proceedings of the 28th International Teletraffic Congress (ITC 28). The meeting is held during 12-16 September 2016 at the University of Würzburg, Germany. ITC 28 is technically co-sponsored by IEEE Communications Society (IEEE ComSoc) and the Information Technology Society within VDE (ITG VDE), and in-cooperation with ACM SIGCOMM.*



*ITC is the first international conference in networking science & practice, first held in 1955.*

Technical and production support provided by:  
Patrick Kellenberger (CPS Production Editor)  
Conference Publishing Services (CPS), IEEE Computer Society  
10662 Los Vaqueros Circle, Los Alamitos, California 90720-1314  
Email: [pkellenberger@computer.org](mailto:pkellenberger@computer.org)  
Phone: +1 714 821 8380 Ext. 2105 Fax: +1 714 761 1784

© 2016 International Teletraffic Congress.

Personal use of this material is permitted. However, permission to reprint or republish this material for advertising or promotional purposes or for creating new collective works for resale or redistribution to servers or lists, or to reuse any copyrighted component of this work in other works must be obtained from the author.

ISBN: 978-0-9883045-1-2 (print)  
ISBN: 978-0-9883045-2-9 (USB)

Published by ITC Press.

For further information regarding ITC and its related events, please visit <http://itc-conference.org> or <http://www.i-teletraffic.org>, or write to [contact@i-teletraffic.org](mailto:contact@i-teletraffic.org).

## Welcome Message from QCMan 2016 Co-Chairs

The Fourth International IEEE Workshop on Quality of Experience Centric Management (QCMan) will be held in Würzburg, Germany in conjunction with ITC 2016, which is technically co-sponsored by IEEE Communications Society (IEEE ComSoc) and the Information Technology Society within VDE (ITG VDE), and in-cooperation with ACM SIGCOMM. The workshop is supported by the University of Würzburg, RWTH Aachen, AIT Austrian Institute of Technology, and the University of Missouri.

In recent years, the Internet has evolved from a pure packet forwarder to a provider of complex and high demanding services and applications (e.g., video, voice, online gaming, cloud applications). These services and applications are typically managed through a set of Quality of Services parameters (e.g. packet loss, delay, jitter). However, it is widely agreed that the management of these services and applications should be based on their quality as perceived by the end user: the Quality of Experience (QoE). However, this QoE centric management is greatly challenged in today's Internet by (i) the stringent QoE requirements of the supported services and applications (e.g., timing constraints, loss intolerance) and users (e.g., unpredictability of user behavior, request for high quality services), (ii) the plethora of service consumption possibilities (e.g. for video: live vs. on-demand, managed vs. over-the-top), (iii) the inherent complexity of services and applications which can be offered to users in several ways to reach the same QoE level, and (iv) the difficulty in assessing the quality as perceived by the end user also due to insufficient insight in the psychological and sociological factors of the service and application consumption.

QCMan 2016 aims at providing an international forum for researchers exploring this rapidly evolving domain of QoE Centric Management. Current research aspects are reflected in the technical program of QCMan 2016, which consists of five full and two short paper presentations and is complemented with both a motivating keynote and a panel discussion. The panel discussion focuses on discussing challenges of managing QoE for immersive media-rich applications. The program is further complemented by a keynote entitled "What's the number? Monitoring IP-based video with standardized QoE models", given by Alexander Raake, who is a professor and head of the Audiovisual Technology Group at TU Ilmenau. The keynote emphasizes efforts in QoE management by exploring the complete model development cycle - from model creation in user studies over ITU standardization to ISP-level deployment - and its challenges; based on lessons he and his team learned while creating and standardizing the IPTV quality model now recommended by the ITU.

A total of 19 papers were registered, 15 papers were finally submitted and 4 paper were withdrawn. All submitted papers underwent a rigorous review process with 3-4 reviews per paper. Based on these reviews, 5 full papers and 2 short papers were selected for publication, resulting in an acceptance rate of 46.67%.

The technical contribution of these full papers falls within three topic areas. The first area comprises new insights for video streaming techniques. The first paper investigates the current implementation of the YouTube streaming algorithm. Drawbacks of the algorithm are investigated and the optimization potential is quantified using user- and network centric metrics (YouTube Can Do Better: Getting the Most Out of Video Adaptation). More generic insights on the impact of bandwidth fluctuations on the QoE in video streaming are highlighted in the second paper (Impact of Variances on the QoE in Video Streaming).

In the second area, application-awareness and application-network interaction are discussed. The first paper provides insights into cloud service placement and the impact of the network design on the QoE. Further, a mechanism based on application-aware network infrastructure clustering is proposed and investigated (Application-Aware Infrastructure Clustering for Cloud Service Placement to Enhance User QoE). A generic approach for comparing application-network interaction mechanisms is presented in the second paper (Towards a Framework for Comparing Application-Network Interaction Mechanisms).

The third area features a paper on new QoE management solution taking personal aspects of QoE into account. Based on multi-agent technology a personalized QoE management is proposed.

Both short papers provide new insights into the impact of delays on the user perceived application quality in the context of two fundamentally different application types. The first short paper considers an online gaming use case of Minecraft, and provides an assessment of the impact of network latency on the QoE of casual gamers (Insensitivity to Network Delay: Minecraft Gaming Experience of Casual Gamers). The second short paper considers an enterprise environment use case within a SAP system, and features a correlation of response times and subjective user ratings on the perceived application performance using machine learning (Correlating QoE and Technical Parameters of an SAP System in an Enterprise Environments).

Last but not least, we would like to take the opportunity to thank a number of people whose hard work and commitment were essential to the success of this workshop. First and foremost, we would like to thank the authors of submitted papers for their hard work in compiling their submissions. Second, we would also like to express our gratitude to the Technical Program Committee for their effort and solid work in all phases of the workshop preparation and the Steering Committee of the QCMan workshop series. Third, we express our sincere appreciation to the organizers of ITC 28 in Würzburg, in particular Phuoc Tran-Gia and his team at the University of Würzburg, and Tobias Hossfeld, University of Duisburg-Essen, Germany. Furthermore, we thank Christopher Metter for his technical support.

We hope that our program will provide you with inspiring ideas and thoughtfully presented solutions. To further enrich the experience, we would like to encourage the workshop attendees to actively participate during the sessions.

QCMan 2016 Workshop Co-Chairs

Thomas Zinner, University of Würzburg, Germany

Oliver Hohlfeld, RWTH Aachen, Germany

Raimund Schatz, AIT Wien, Austria

Prasad Calyam, University of Missouri, USA

September 2016

## QCMan 2016 Committees

### Workshop Co-Chairs

Thomas Zinner	University of Würzburg, Germany
Oliver Hohlfeld	RWTH Aachen, Germany
Raimund Schatz	AIT Wien, Austria
Prasad Calyam	University of Missouri, USA

### Technical Program Committee

Luigi Atzori	University of Cagliari, Italy
Andreas Blenk	TU München, Germany
Niels Bouten	Ghent University, Belgium
Pedro Casas	AIT Wien, Austria
Mainak Chatterjee	University of Central Florida, USA
Marinos Charalambides	University College London, GB
Amy Csizmar Dalal	Carleton College, USA
Tasos Dagiuklas	Hellenic Open University, Greece
Saptarshi Debroy	University of Missouri-Columbia, USA
Katrien De Moor	NTNU, Norway
Sebastian Egger	AIT, Austria
Markus Fiedler	BTH, Sweden
Dennis Guse	TU Berlin, Germany
Tobias Hossfeld	University Duisburg-Essen, Germany
Lucjan Janowski	AGH University of Science and Technology, Poland
Steven Latré	University of Antwerp, Belgium
Stanislav Lange	University of Würzburg, Germany
Hugh Melvin	National University of Ireland Galway, Ireland
Sebastian Möller	TU Berlin, Germany
Peter Pocta	University of Zilina, Slovakia
Alexander Raake	TU Ilmenau, Germany
Martin Reisslein	Arizona State University, USA
Ulrich Reiter	TH Köln, Germany
Werner Robitza	TU Berlin, Germany
Patrick Seeling	Central Michigan University, USA
Christian Timmerer	Alpen-Adria-Universität, Austria
Martin Varela	VTT Technical Research Center of Finland, Finland
Florian Wamser	University of Würzburg, Germany

### Steering Committee

Antonio Liotta	Eindhoven University of Technology
Filip De Turck	Ghent University – iMinds, Belgium
Steven Latré	University of Antwerp – iMinds, Belgium

# 2016 International Workshop on Quality of Experience Centric Management (QCMan)

Friday 16<sup>th</sup> September, 2016

- 09:00 – 10:00 **Keynote** by Alexander Raake (TU Ilmenau, Germany)  
*What's the Number? Monitoring IP-based Video with Standardized QoE Models*
- 10:00 – 10:30 *Multi-Agent Systems for Personalized QoE-Management* by Amro Najjar; Xavier Serpaggi; Christophe Gravier; Olivier Boissier
- 10:30 – 11:00 Coffee Break
- 11:00 – 12:30 *YouTube Can Do Better: Getting the Most Out of Video Adaptation* by Christian Moldovan; Christian Sieber; Poul Heegaard; Wolfgang Kellerer; Tobias Hoßfeld  
*Towards a Framework for Comparing Application-Network Interaction Mechanisms* by Susanna Schwarzmann; Thomas Zinner; Ognjen Dobrijević  
*Impact of Variances on the QoE in Video Streaming* by Christian Moldovan; Tobias Hoßfeld
- 12:30 – 13:30 Lunch
- 13:30 – 14:00 *Application-Aware Infrastructure Clustering for Cloud Service Placement to Enhance User QoE* by Dmitrii Chemodanov; Prasad Calyam
- 14:00 – 14:40 Short Paper: *Insensitivity to Network Delay: Minecraft Gaming Experience of Casual Gamers* by Oliver Hohlfeld; Hannes Fiedler; Enric Pujol; Dennis Guse  
Short Paper: *Correlating QoE and Technical Parameters of an SAP System in an Enterprise Environment* by Kathrin Borchert; Matthias Hirth; Thomas Zinner; Decebal Constantin Mocanu
- 14:40 – 15:00 Coffee Break
- 15:00 – 16:00 Panel: *What Are Challenges in Managing the QoE of the Upcoming Wave of Immersive Media-rich Applications?*
- 16:00 – 16:15 Closing

# ITC 28 Sponsors



The International Advisory Committee (IAC) of the ITC has decided to offer a number of travel grants that will be available to support full-time students for attending ITC 28. The IAC financially supports three prestigious awards for ITC 28: Best Paper Award, Best Student Paper Award, Best Demo Award.

## Silver Sponsor



## Bronze Sponsor



## Bronze Sponsor



## Technical Sponsors

ITC 28 is technically co-sponsored by IEEE Communications Society (IEEE ComSoc) and the Information Technology Society within VDE (ITG VDE), and in-cooperation with ACM SIGCOMM.

