ERCIM "ALAIN BENSOUSSAN" FELLOWSHIP PROGRAMME

ERCIM
European Research Consortium for Informatics and Mathematics

Scientific Report

First name / Family name	Doreid Ammar
Nationality	French / Lebanese
Name of the *Host Organisation*	NTNU, Norwegian University of Science and Technology
First Name / family name of the *Scientific Coordinator*	Prof. Bjarne E. Helvik
Period of the fellowship	01/09/2015 to 31/08/2016

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The main research activity carried out during my ERCIM Alain Bensoussan Fellowship Programme is related to **Quality of Experience (QoE)-assessment of Web-based Real-Time Communication.** In the scope of the Telenor-NTNU research collaboration project "Quality of Experience and Robustness in Telecommunications Networks", we aim to: (i) identify the most relevant influence factors, with primary focus on technical (Quality of Service-related) factors, but also including non-technical (contextual, human level) influence factors; (ii) investigate in which way and to which extent factors influence users' QoE and corresponding user behavior; and (ii) from the understanding of these relations and thresholds, provide input to the development of QoE-aware adaptation strategies to reduce/avoid user annoyance, and foster user delight.

Additionally, other research activities related to **Performance Evaluation of Adaptive Video Streaming** and **Admission Control** have also been conducted during my fellowship at NTNU.

II – PUBLICATIONS DURING YOUR FELLOWSHIP

SITIS 2015

- *Title:* A Layered Model for Quality Estimation of HTTP Video from QoS Measurements

- *Authors:* Toni Mäki, Martín Varela and Doreid Ammar
- *Abstract:* HTTP video is quickly becoming a dominating type of traffic on the Internet, with popular services such as YouTube and Netflix being used by hundreds of millions of users daily, and showing ever-growing usage numbers. Understanding Quality of Experience (QoE) for these services is an important topic, and one that has been addressed in the literature. However, the available works focus on the impact of application-level events (e.g. stalls) on the perceived quality, but not on the underlying cause, i.e., network-level impairments, as the relation between Quality of Service (QoS) and QoE is significantly more complex than it was in the case of RTP/UDP based video, due to HTTP video being streamed over TCP. In this paper we present a first step in the direction of solving this QoS-to-QoE mapping for HTTP video, by providing a (parametric) layered model approach for network-side QoE monitoring.
- *Status:* Published in 2015 11th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS)

ERCIM News 2016 (105)

- *Title:* Quality of Experience-assessment of WebRTC Based Video Communication
- *Authors:* Doreid Ammar, Katrien De Moor and Poul Heegaard
- *Abstract:* Web real-time communication has enabled hassle-free, no installation, in-browser applications such as Google hangout and appear.in. Multi-party video conferencing has now finally been made easy. But how can we provide acceptable quality of experience in such an interactive service? Our research aims to gain insight into what matters, and how to assess, design, and manage the services accordingly.
- *Status:* Published in ERCIM news 2016 (105)

QoMEX 2016

- *Title:* Revealing the Dark Side of WebRTC Statistics Collected by Google Chrome
- *Authors:* Doreid Ammar, Poul Heegaard, Min Xie, Katrien De Moor and Markus Fiedler
- *Abstract:* Google Chrome provides a built-in tool to collect real-time session-related performance statistics of Web-based Real-Time Communication (WebRTC). Although the Chrome statistics have a number of limitations, we believe that they can be used in studies of Quality of Experience (QoE) aspects of WebRTC services. In this paper, we first reveal the limitations of the collected statistics and its consequences. We then discuss how to overcome these issues.
- *Status:* Published in the proceedings of the 8th International Conference on Quality of Multimedia Experience (QoMEX 2016)

ICCE 2016

- *Title:* Video QoE Killer and Performance Statistics in WebRTC-based Video Communication
- *Authors:* Doreid Ammar, Katrien De Moor, Min Xie, Markus Fiedler and Poul Heegaard
- *Abstract:* In this paper, we investigate session-related performance statistics of a Web-based Real-Time Communication (WebRTC) application called appear.in. We explore the characteristics of these statistics and explore how they may relate

to users' Quality of Experience (QoE). More concretely, we have run a series of tests involving two parties and according to different test scenarios, and collected real-time session statistics by means of Google Chrome's WebRTC-internals tool. Despite the fact that the Chrome statistics have a number of limitations, our observations indicate that they are useful for QoE research when these limitations are known and carefully handled when performing post-processing analysis. The results from our initial tests show that a combination of performance indicators measured at the sender's and receiver's end may help to identify severe video freezes (being an important QoE killer) in the context of WebRTC-based video communication. In this paper the performance indicators used are significant drops in data rate, non-zero packet loss ratios, non-zero PLI values, and non-zero bucket delay.

- *Status:* Accepted for publication in 2016 IEEE Sixth International Conference on Communications and Electronics (ICCE)

CSE 2016

- *Title:* Evaluation and Comparison of QoE-Based Admission Control Solutions
- *Authors:* Doreid Ammar and Martín Varela
- *Abstract:* The exponential growth of video traffic on the Inter- net calls for the deployment of network management strategies to enhance the quality experienced by the end-users (Quality of Experience – QoE). In this paper, we focus on admission control, in particular we survey two of the main Admission Control (AC) solutions, and we compare their efficiency and QoE-awareness when making admission decisions. We evaluate the solutions' performance by simulation, and compare them to the ideal QoE- based AC. The results show that only one of the investigated solutions can lead to satisfying decisions if it is properly tuned.
- *Status:* Accepted for publication in 19th IEEE International Conference on Computational Science and Engineering (CSE 2016)

ELSEVIER Computer Networks

- *Title:* KBAC: A Simple and Robust Queue-Based Solution for Admission Control
- *Authors:* Doreid Ammar, Thomas Begin and Isabelle Guérin Lassous
- *Abstract:* The continuous growth of volume of data traffic sent over the networks calls for intelligent bandwidth management strategies in order to provide a sufficient level of Quality of Service (QoS) for end-users. Admission control, which is used to forbid incoming flows of packets from entering a network when the available resource are deemed insufficient, aims at preventing overloading and congestion within the network. In this paper, we introduce a new solution for admission control, which is referred to as KBAC. It allows to implement a QoS policy expressed as a maximum value either on packet delay or on packet loss rate. Unlike existing methods, the KBAC solution is based on a simple queueing model, whose parameter values are automatically found and updated using collected measurements. The experimental results show that the proposed KBAC solution generally leads to a very good trade-off with nearly all (accepted) flows satisfying the QoS target while maintaining a high level of the network resource utilization. Additionally, throughout all explored examples, our solution tends to outperform three other tested solutions.
- *Status:* Pending – submitted to Computer Networks

ISM 2016

- *Title:* An Experimental Platform for QoE Studies of WebRTC-based Multi-Party Video Communication
- *Authors:* Doreid Ammar and Poul Heegaard
- *Abstract:* Web Real-Time Communication (WebRTC) enables easy to use, no installation, in browser applications such as Google hangout and appear.in.
- To increase the understanding of the Quality of Experience with the use of such applications for multi-party video communication requires an experimental platform where controlled studies can be conducted. This paper presents such a platform and a use case with a simple setup and test to demonstrate the features of this platform.
- *Status:* Pending – submitted to the IEEE International Symposium on Multimedia (ISM 2016)

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

Conference

- Name: QoMEX 2016 – 8th International Conference on Quality of Multimedia Experience
- Date: 06-08/06/2016
- Place: Lisbon, Portugal

Conference

- Name: ICCE 2016 – 6th International Conference on Communications and Electronics
- Date: 27-29/07/2016
- Place: Ha Long, Vietnam

Conference

- Name: CSE 2016 – 19th International Conference on Computational Science and Engineering
- Date: 24-26/08/2016
- Place: Paris, France

IV – RESEARCH EXCHANGE PROGRAMME (REP)

REP

- *Name of the REP organisation:* CWI
- *Country:* Netherlands
- *Research group:* Distributed and Interactive Systems – Amsterdam
- *Local scientific coordinator:* Pablo Cesar
- *Dates:* 21-30/03/2016
- *Experience:* The visit was very fruitful and led to a scientific collaboration with the CWI team.