

SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

Action number: CA15127 RECODIS: Resilient communication services protecting end-user applications from disaster-based failures

STSM title: Redaction of the RECODIS Book Chapter 2.6: Quality role in wireless communications under weather-based disruptions

Grantee: Dr. Rasa Bruzgiene, Kaunas University of Technology, Lithuania

Host: Assoc. Prof., Dr. Peter Pocta, University of Zilina, Slovakia

STSM start and end date: 04/04/2018 to 12/04/2018

Working Group: WG2 - Weather-based disruptions

PURPOSE OF THE STSM

The applicant of this STSM, i.e. Rasa Bruzgiene, is working together with the colleagues from Austria, Latvia and Slovakia on quality assessment techniques, that could be used for a design or an update of the existing wireless communication networks and could also help in an improvement of their resilience in the face of the weather-based disruptions and outages. The joint research work covers the possible solutions for different wireless communications, where the quality (as a basic factor) can help in forecasting the upcoming disruptions of the communication link or even network outages by creating the alerts in order to react and prevent a service performance degradation or even its unavailability; as a part of network design process by deploying new network topology reconfiguration and re-routing mechanisms. Since this scientific joint work is performed under the COST RECODIS umbrella, it was decided to finalize the main ideas and publish the results in the chapter of the upcoming RECODIS book. This chapter should provide the state-of-the-art information regarding the main role of quality in wireless communications, where the heavy weather conditions can cause the service performance degradation or even seriously disrupt the communication network, making the communication services, provided by the network, unavailable.

Due to this, the overall goal of this STSM was to update the structure of the Chapter 2.6 with the corresponding sections and subsections coming from the joint investigations involving all the above listed partners and to analyse the possibilities to implement joint experiments focusing on a creation of the alerts based on the objective assessment of service quality perceived by the end user (QoE metrics). In order to achieve this goal, the host, i.e. Assoc. Prof. Peter Pocta, was chosen, since he is focusing on Quality of Service (QoS) and Quality of Experience (QoE) in the context of different communication services and technologies. Moreover, the research infrastructure, which the host institution has, could be used for the planned joint experiment.

So, the main objectives were:

1. to get familiar with the infrastructure (its hardware/software aspects) at the host institution;
2. to identify the possibilities, best scenarios for an implementation of the joint experiments, including and continuing the scientific work, started as the STSM at the TU-Graz, Austria on April, 2017 (Ref. no. COST-STSM-CA15127-36916);
3. to contribute, together with the host, to the chapter 2.6, update its structure and content with the corresponding sections and subsections.

The output of this work provided major input to the chapter 2.6 of the upcoming COST RECODIS final book and will be used for further investigations within the objectives of the RECODIS WG2 group.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSM

During the whole stay in Slovakia and work at the University of Zilina (UNIZA), the following activities were done:

- *regular meetings* with the host, i.e. Assoc. Prof. Peter Pocta, aimed for sharing his knowledge on the quality investigations (in a broad sense) over different communication services and technologies as well discussing the possibilities how to use different quality parameters in wireless communication in the face of the weather-based disruptions;
- *regular meetings* with the researchers from the Department of Multimedia and Information - Communication Technology, i.e. Prof. Peter Brida, Dr. Juraj Machaj, discussing their achievements in researching the vulnerability and dependence of weather conditions to different wireless systems and networks;
- *meeting* with the invited guest, i.e. Assoc. Prof. Damian Grzechca from Faculty of Automatic Control, Electronics and Computer Science of the Silesian University of Technology (Gliwice, Poland) and a discussion with him about the object identification and localization at the airport restricted area as well an indoor positioning importance in the case of emergency situations;
- *visit* to the laboratories at the UNIZA Faculty of Electrical Engineering and inspection of the infrastructure and its capabilities in various application areas – from mechatronics to telecommunications;
- *familiarization* with the network emulators (Linux-based and Windows-based) and detailed analysis of their capabilities to serve as a part of the test bed for the planned joint experiment involving Slovakian and Austrian colleagues;
- *identification* of the QoS data required for the performance evaluation part of the joint experiment and *planning* of the further steps to achieve the required results for the creation of the alerts, which should be used at a pre-disruption phase in the context of wireless communications;
- *contribution* to the book chapter with the host, his colleagues from the Department of Multimedia and Information - Communication Technology, i.e. Peter Brida, Juraj Machaj, by updating its structure and including new subsections covering especially a work done by Prof. Brida and Dr. Machaj;
- *detailed analysis* and discussions regarding the content of the sections and subsections of the book, to which the co-authors from Slovakia are going to contribute;
- *discussions about* and *agreements upon* practical issues regarding the preparation of a book chapter – platform and templates for writing, timeline and internal deadlines, telcos and other means of communication;
- *summarization* of the results during this STSM for further cooperation with the colleagues from UNIZA within the objectives of the RECODIS WG2 group.

The main points, that were considered the most important for the STSM grantee when it comes to the work carried out during the STSM, are presented in the next section below.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

The main focus of Rasa Bruzgiene's work during this STSM was on the contribution to the Chapter 2.6 of the RECODIS book together with the host and his colleagues from the UNIZA – Prof. Peter Brida and Dr. Juraj Machaj. After long discussions and analysis of the colleagues' research experience and results, it was decided to reorganize the structure of the book chapter by adding new subsections and its related content in the second and third sections of this chapter. The newest structure of the chapter 2.6 is presented in Table 1.

Table 1. Structure of the chapter 2.6

No.	Section	Subsections	Planned length	Responsible co-authors
0	Presentation of the chapter	Abstract, Introduction	1 page	Rasa Bruzgiene
1	Background –	1.1 Quality classification (QoS, QoD,	3-4	Rasa Bruzgiene

	meaning and position of quality	QoP, QoE, QoR, etc.) 1.2 Correlation between all quality levels/aspects	pages	and Peter Pocta
2	Vulnerability of wireless communications over different weather conditions	2.1 Optical Wireless Communications – high frequency 2.2 Wireless Sensor Network – low frequency, data rates 2.3 Modular wireless positioning systems – impact of weather on wireless signals in such systems (<i>added new</i>)	6 pages	Erich Leitgeb, Pirmin Pezzei, Nadezda Kunicina, Anatolijs Zabasta, Peter Brida, Juraj Machaj
3	Techniques and methods for quality application in a face of disruption	3.1 Creation of alerts in order to react and prevent service performance degradation. 3.2 Re-configuration of a network topology and re-routing mechanisms 3.3 Design of a network and positioning issues (<i>added new</i>)	10 pages	All co-authors
4	Conclusions of the chapter	Conclusions	1 page	Rasa Bruzgiene
5	References	References	2 pages	Rasa Bruzgiene

The sections No. 0, 4 and 5 will cover the usual information such as an abstract, introduction, conclusions and list of the references. As the whole chapter is dedicated to the role of quality in wireless communications and its usefulness in the face of the weather-based disruption the section 1 – *Meaning and position of quality* – serves as the background for understanding the general classification of quality. The section focuses on different levels of the performance of communication services and correlation with the resilience of the communication system. The section 2 describes the investigations, which show the impact of the weather conditions on various wireless communication systems. This section was updated with the new subsection 2.3, which will show a vulnerability of modular wireless positioning system to the different weather conditions. It was proven by different research works, that appropriate wireless positioning systems can be used in relation to a design or re-configuration of wireless communication network (at the pre-disruption phase) and for target searching, military applications or missions of finding/rescuing survivors in the post-disaster relief. Due to this, the co-authors, i.e. Prof. Brida and Dr. Machaj, will investigate a performance of their modular positioning system in different weather conditions, in particular its dependence on weather conditions, and will include these results in the subsection 2.3. The major part of the whole chapter is allocated to the section 3, which will present solutions, how to use the different quality metrics in the face of disruption in wireless communication systems and increase the resilience of such systems as well. It is worth noting here, that the solutions in section 3 are also related with the investigations, which are going to be presented in section 3. Moreover, these both sections will provide important insights based on experimental results and results obtained from the grantee's previous STSMs (Ref. no. COST-STSM-CA15127-36916 and COST-STSM-CA15127-38829).

In relation with this, the joint experiment involving the following colleagues Erich Leitgeb, Pirmin Pezzei, Peter Pocta and Rasa Bruzgiene is planned for the upcoming third COST RECODIS grant period. The infrastructure of the UNIZA will be used for this experiment and the results will be used for a creation of the solution, which will be described in subsection 3.1 of the book chapter. The general structure of the test bed, which will be used for the experiment, is presented in Figure 1.

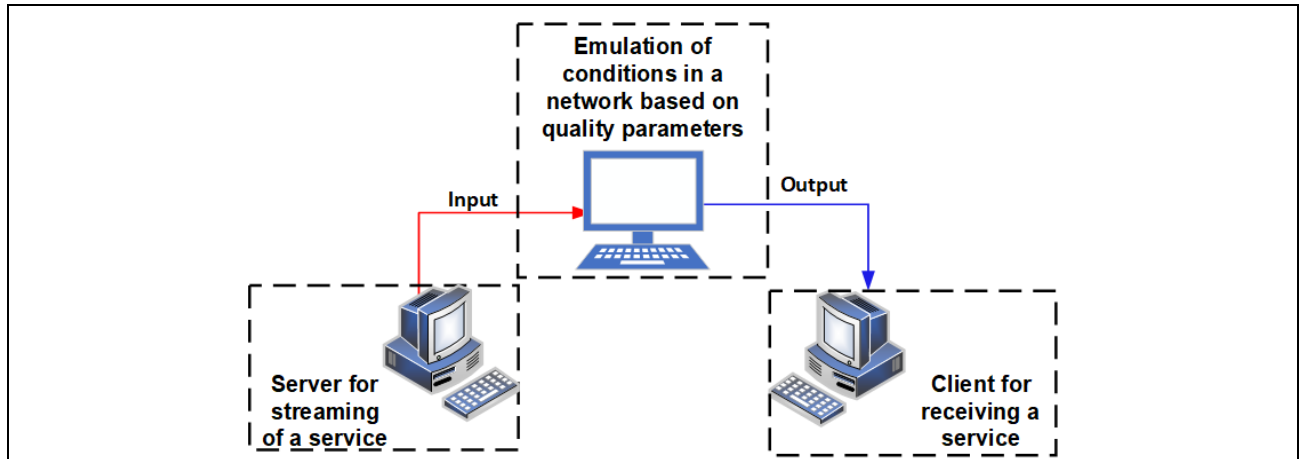


Figure 1. General structure of a test bed for a planned experiment, related with subsection 3.1

The QoS parameters coming from a network layer of Optical Wireless communication system (when it is affected by the weather conditions – fog, rain, snow) will be used as the initial data for an emulation of conditions in the corresponding network. The purpose of this experiment is to receive a range of objective QoE metrics, which could help in an identification of sudden and extremely sensitive threshold for a user dissatisfaction with a performance of a service. The alert of the upcoming disruption of the wireless communication will be based on an evaluation of quality perceived by the end user.

In order to properly organize the work and communication between all the partners, the practical issues regarding the preparation of a book chapter were discussed. It was decided to use a web-based real-time LaTeX platform (www.overleaf.com) for drafting a text of the chapter. The internal deadlines and timeline for telcos were created as well.

FUTURE COLLABORATIONS

Based on the results, that were achieved during the period of this STSM, the host, i.e. Assoc. Prof. Peter Pocta and the STSM grantee Dr. Rasa Bruzgiene agreed to collaborate on joint investigations, papers and conferences not only on the topics that will arise within COST RECODIS WG2 activities, but also on others, which will combine the expertise and knowledge of both sides as well.

Short term collaboration – to perform experiments to find a threshold for a user dissatisfaction with a performance of the service over Optical Wireless communication system in the face of the weather-based disruptions and to create an alert based on the evaluation of objective QoE metrics.

Long term collaboration – 1) to work together on a preparation of the chapter of the COST RECODIS final book; 2) to extend the joint investigations, prepare scientific publications and research proposals.

These plans for the host and grantee joint collaborations will enable us to submit joint publications, participate at international conferences, visit each other more often, and get useful results for further joint work.