# STSM Report

- **STSM title**        : "Auditing edge network impairments through blockchains"
- **STSM Applicant :** Dr. Madhusanka Liyanage
- **Host**              : Dr. Stefano Secci
- **Host Institute**    : Sorbonne University (previously UPMC - Paris VI), Paris, France
- **Period**            : 2018-06-20 to 2018-06-30
- **Working group**     : WG3  (Technology-related disasters)


- **Purpose of the STSM:**

The purpose of this visit is to establish a research collaboration between LIP6, Sorbonne University and CWC (Centre for Wireless Communications), University of Oulu focusing on blockchain.

- **Description of the work carried out during the STSM**

I was invited to visit LIP6, Sorbonne University (previously UPMC - Paris VI), Paris, France by Dr. Stefano Secci. On arrival, I had a meeting with Dr. Stefano and he explained his research on blockchain and Mobile Edge Computing (MEC) domains. Moreover, he explained briefly about ongoing projects in his research group. I also explained my research experience and discussed the objectives of STSM. The main topic of STSM is "Auditing edge network impairments through blockchains" which is a research topics which will be addressed under WG3 (Technology-related disasters) in Cost Action CA15127. Therefore, we agreed to work on blockchain research. I also met few other researchers at LIP6 as well as the research group of members of Dr. Stefano.

## Public Seminar

I conducted a public seminar on my current research project called 6Genesis (the 6G-Enabled Wireless Smart Society & Ecosystem) for researchers at Sorbonne University. The 6Genesis flagship project is focused on the development of wireless technology, exploring the implementation of the fifth generation of mobile communication technology (5G) and the development of the 6G standard. The flagship will support industry in bringing the 5G standard to the commercialization stage by carrying out large pilots with a test network. It will also develop essential technology components needed for 6G, targeting areas such as wireless connectivity and distributed intelligent computing and novel applications of these. In addition to communication between people, the research will focus on communication between devices, processes and objects. This will contribute to enabling a highly automated, smart society, which will penetrate all areas of life in the future. More Info: http://www.oulu.fi/university/6gflagship

The public seminar was interested to many researchers and it opened up many collaborative research areas.

**Collaborative Research**

Then, I discussed the research work with three Phd students (. i.e. Nikola Bozic, Kahina Khacef and Marianna Belotti) at LIP6. Among them, I was interested to continue working with Nikola Bozic and, Kahina Khacef as they are quite close to the research work at my team. Nikola is working on Securing Virtual Machine Orchestration with Blockchains. The goal of this research is to present how blockchain can be used to secure cloud/NFV orchestration operations and in particular to enhance the authentication of orchestration commands in the lifecycle of cloud services. Nikola was interested on implementation aspects of our recent paper, which was published on WoWMoM 2018 conference. We agreed to continue our collaboration further, especially to investigate new domain such as SDN control plane where this approach can be used.

Kahina Khacef is building a blockchain platform to secure the private data of users. This research is quite relevant to two of my students' thesis works. i.e. Privacy protected Healthcare scheme based on blockchain and Blockchain based Proxy Re-Encryption scheme to secure IoT data. We had a discussion on how to continue this collaboration further. For instance, we proposed the possibility for Kahina to visit university of Oulu for a research visit and work along with my students.

I also had a discussion with Dr.Thi-Mai-Trang Nguyen about the possibility to use 5G Test Network (https://5gtn.fi/) as a testbed for her research. One of her PhD students is working on NB-IoT. At University of Oulu, We have a 5G Test Network, which has about 500 IoT sensors and two NB-IoT supported LTE macro cells. Therefore, it is possible to use this network for collaborative research work and the student might visit University of Oulu to conduct his experiment.

**Future collaboration with the Host institution (if applicable):**

To strengthen our collaborations, Dr. Stefano and I have discussed two possible collaborative activities.

1. Dual-degree Program: We initiated the discussion about starting a Dual-degree PhD program between University of Oulu and Sorbonne University. I have already interviewed one possible candidate from the position. We agreed to kick off this task after the summer vacation.
2. ITN Proposal: We have agreed to submit a joint H2020 MCSA ITN proposal for January 2019 call. We discussed the topic for the proposal and agreed to circulate the detail description by September 2018.

**Foreseen publications/articles resulting from the STSM:**

1. **Book Chapter:** chapter 4 of Part 2 entitled "Design problems towards a reliable virtualized network": As a part of this research visit, I have completed my first contribution for above book chapter

2. **Magazine Article:** We are working on magazine article Titled " Driving forces for Multi-Access Edge Computing".

*Abstract:* The emergence of Multi-Access Edge Computing~(MEC) technology aims at extending cloud computing capabilities to the edge of the radio access network. MEC network architecture provides real-time, high-bandwidth, low-latency access to radio network resources, allowing operators to open their networks to a new ecosystem and value chain. Moreover, these recent technological advancements will provide new insight to the design of future 5th Generation (5G) cellular networks and its applications. This paper describes five key technologies i.e., Software Defined Networking (SDN), Network Function Vitalization (NFV), Network Slicing, Information Centric Networking (ICN) and Internet of Things (IoT) that intensify the widespread of MEC systems and its adaptation. The motivation is to provide the associativity between above five technologies with MEC in 5G mobile networks. We discuss the key concept each technology along with their potential impact on the development of MEC based systems and research challenges that remain.

**Created by:** Madhusanka Liyanage, Oulu, Finland 03.07.2018