



ERCIM "ALAIN BENSOUSSAN"  
FELLOWSHIP PROGRAMME



## Scientific Report

First name / Family name

Zeeshan Ali Khan

Nationality

Pakistani

Name of the *Host Organisation*

Norwegian University of Science and  
Technology (NTNU), Trondheim,  
Norway.

First Name / family name  
of the *Scientific Coordinator*

Prof. Dr. Peter Herrmann

Period of the fellowship

01/08/2016 to 31/07/2017

## **I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP**

During my stay at the NTNU, I worked under the guidance of Prof. Dr. Peter Herrmann in the Department of Information Security and Communication Technology. The research was focussed on the topic of Intrusion Detection System (IDS) for the Internet of Things (IoT) networks using trust-based solutions. The use of IDS was proposed to minimize the chances of Denial of Service (DoS) attacks. The solution concentrates on attacks that actively try to omit crucial communication between nodes. This can occur via insider attacks in which the intruder manages to compromise the routing capability of devices. To reduce the computing effort for the small devices, trust management was used which allows the emulation of trust relations in other entities by relatively lightweight but powerful mechanisms. Using special metrics, the trust values can be adapted based on the good and bad experiences one has with a trustee over time. This reflects the development of trust relations in quite a natural way. Moreover, we use some operators that allow us to consider recommendations by third parties and to aggregate the trust values of several entities with a trustee to a more general reputation. Finally, the proposed approach was evaluated with simulations by varying number of nodes and attackers.

## **II – PUBLICATION(S) DURING YOUR FELLOWSHIP**

1. Zeeshan Ali Khan and Peter Herrmann. A Trust Based Distributed Intrusion Detection Mechanism for Internet of Things. Proceedings of 31<sup>st</sup> IEEE AINA Conference, Taipei, Taiwan, March 2017.
2. Zeeshan Ali Khan and Peter Herrmann. How to Secure Internet of Things Devices in an Energy Efficient Way, ERCIM News, Number 109, April 2017, Pages 50-51.
3. Zeeshan Ali Khan, Johanna Ullrich, Artemios G. Voyiatzis and Peter Herrmann. A Trust based Resilient Routing Mechanism for the Internet of Things. To appear in proceedings of 12<sup>th</sup> ACM ARES Conference, Reggio Calabria, Italy, September 2017.
4. Zeeshan Ali Khan and Peter Herrmann. Recent Advancements in Intrusion Detection Systems for the Internet of Things. Submitted for review at the International Journal of Distributed Sensor Networks.

## **III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES**

1. Attended 31<sup>st</sup> IEEE International Conference on Advanced Information Networking and Applications (AINA) in Taipei, Taiwan in March 2017 and presented my accepted paper.
2. Attended a seminar at NTNU entitled “AI and IoT: Acquiring Knowledge in Resource-Constrained Environments” in June 2017.

## **IV – RESEARCH EXCHANGE PROGRAMME (REP)**

For my external research visit, I chose SBA Research, Austria. I visited Dr. Artemios G. Voyiatzis and I gave a talk to the group about my research activities. I got an opportunity to meet researchers and PhD students working in the domain of Information Security. We talked about the possibilities of collaboration in the common areas of research and worked on the completion of a research article.