Scientific Report

First name / Family name	Miloud Bagaa
Nationality	Algerian
Name of the *Host Organisation*	NTNU
First Name / family name of the *Scientific Coordinator*	Ilangko Balasingham
Period of the fellowship	01/02/2015 to 31/01/2016

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

I hadthe pleasure to work in a professional environment at Norwegian University of Science and Technology (NTNU), which is the largest and the best engineering university in Norway. During my research work at NTNU, I learned a lot from Prof. Ilangko Balasingham on how to write interesting papers and good research proposals. During my fellowship, I was focusing on investigating in a wide variety of topics: Internet of Things (IoT), energy harvesting in wireless sensor networks (EH-WSN), device-to-device communications and Software Defined Networking (SDN). My aim during this fellowship was the interconnection of different IoT objects to the cloud network while mitigating the signalling and saving energy consumption. For this reason, during my fellowship, I wrote and submitted one research proposal on how to interconnect the different IoT objects to the cloud network while mitigating the signalling overhead.The energy scavenging from ambient sources represents a promising solution

for sustaining continual operation for wireless sensor networks and IoT devices. For this reason, I am also interested in exploring recent advances in EH-WSN technologies in order to extend the network lifetime of IoT devices.

During my research work, I studied the better way to interconnect IoT objects to the cloud network using standardized protocols, such as 6LowPAN, 6TiSCH and CoAP. To facilitate the interconnection management of IoT to the cloud network, I did some work on SDN, Network Function Virtualization (NFV) and Fog computing technologies. These technologies will help me in the future to extend the IoT applications pool and enable large network deployment of IoT services, such as smart cities, disaster management and healthcare applications. To meet the challenge in real environment, we built a real test bed by using Libelium devices to monitor the luminance, passive infra red (PIR), humidity and temperature. We developed a framework that sensed measurements by different devices to the Meshlium, the latter saves the sensed measurements into a separate MySQL database server for later use. We developed also some tools that allow the real time display of different measurements to ease the tasks for the end user.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

II.1 Journals

- ✓ MiloudBagaa, Ali Chelli, DjamelDjenouri, Ilangko Balasingham, and Kimmo Kansanen "Constrained Relay Node Placement in Wireless Sensor Network with Realistic Communication Channels", IEEE Trans. Wireless Communication (under review).

- ✓ Ali Chelli, MiloudBagaa, DjamelDjenouri, Ilangko Balasingham and Kimmo Kansanen "One-Step Approach for Two-Tiered ConstrainedRelay Node Placement in Wireless Sensor Networks", IEEE Wireless Communication Letters (under review)

II.2Conferences

- ✓ MiloudBagaa, Mohamed Younis and Ilangko Balasingham "Data aggregation tree construction strategies for increasing network lifetime in EH-WSN", in IEEE Globecom'15, San Diego, USA, Dec. 2015.

- ✓ MiloudBagaa, Mohamed Younis and Ilangko Balasingham "Optimal Strategies for Data Aggregation Scheduling in Wireless Sensor Networks", in IEEE Globecom'15, San Diego, USA, Dec. 2015.

- ✓ MiloudBagaa, AdlenKsentini, Tarik Taleb, RikuJantti, Ali Chelli and Ilangko Balasingham "An efficient D2D-based strategies for Machine TypeCommunications in 5G mobile systems" in IEEE WCNC'16, Doha, Qatar, April 2016.

- ✓ AdlenKsentini, MiloudBagaa, TarikTaleb and Ilangko Balasingham "On using bargaining game for Optimal Placementof SDN controllers " in IEEE ICC'16, Kuala Lumpur, Malaysia, May 2016.

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

- ✓ Writing successful proposals for MarieSkłodowska-Curie and the Research Council of Norway OSLO, Norway, 06 May 2015.

- ✓ MELODY II workshop, Bergen – Trondheim, Norway 14-17 April 2015.

- ✓ Home project meeting, IFE / Kjeller, Norway, 09 October 2015.

- ✓ Globecom'15 conference, San Diego, USA, 6-10 December 2015.

IV – RESEARCH EXCHANGE PROGRAMME (REP)

University of Rennes 1 / IRISA Lab, France, 06 September until 08 October 2015. During the research exchange, I did some research work with Prof. AdlenKsentini, I learned many things from his a long experience in NFV, Device to Device communication and SDN. We held many meetings, where we discussed on how to integrate the IoT to the cloud network by exploring these technologies. The discussion resulted in joint works, which are already accepted in two conferences IEEE WCNC'16 and IEEE ICC'16. Currently, we plan to extend at least of these works into a transaction journal.