



ERCIM "ALAIN BENSOUSSAN"
FELLOWSHIP PROGRAMME



Scientific Report

First name / Family name

Yaser Dalveren

Nationality

Turkey

Name of the *Host Organisation*

Norwegian University of Science and
Technology (NTNU)

First Name / family name
of the *Scientific Coordinator*
Period of the fellowship

Mohammad Derawi

01/09/2019 to 31/08/2020

I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

The research works performed during the fellowship can be categorized in four main topics:

A. A survey/review on IQRF technology

IQRF is a new and promising technology that could be an alternative to current wireless technologies in the field of Internet of Things (IoT). In recent years, some studies in the literature have been started to emerge on the use of IQRF technology to integrate IoT with smart environments or monitoring systems. However, only few studies on smart city implementations using the IQRF technology have been introduced. Thus, in the first part of the fellowship, it was aimed to provide a review on the usage of IQRF for the design of IoT-based smart cities. For this purpose, the surveys were conducted to provide an overview of the smart city architecture, and challenges/requirements in integrating IoT to smart city were investigated. Then, common low-cost IoT wireless technologies which can be used for smart cities were defined and their advantages/disadvantages were identified. Meanwhile, I attended a conference as a listener in order to have insights on the IoT technologies. This, in

fact, considerably contributed to my research (see Section III.1). Next, the actual and potential usage of the IQRF technology in smart city applications was examined. Additionally, the potential benefits of the IQRF technology over relevant technologies in several aspects were reviewed by making theoretical comparisons based on the technical documentations. The results achieved from these research efforts have been published in a journal paper (see Section II.1).

B. Safe smart traffic based on IQRF technology

This work has been conducted as a part of an ongoing project led by scientific coordinator, Prof. Mohammad Derawi. The purpose of the project is to develop a prototype IoT solution that improves traffic safety using vehicle-to-infrastructure (V2I) based on IQRF technology. During the fellowship, it was targeted to scrutinize the existing IoT-based smart transportation systems especially in terms of road safety. To this end, initially, IoT applications in smart cities were overviewed. A literature review was then carried out to present the current state of knowledge about IoT-based smart transportation systems proposed for achieving safer roads. The main characteristics of the project method along with the obtained results have been presented in an international conference (see Section III.2). Soon, it will be published in the proceedings of that conference (see Section II.2).

C. Smart Municipalities IoT Solutions (UNION): A project proposal

During the fellowship, I also participated in project proposal preparation for the IKTPLUSS¹ call. The main purpose of this project is to solve and link the key IoT challenges such as interoperability, big data, energy efficiency, information security, and value creation for the development of sustainable IoT ecosystem for smart Gjøvik municipality, Norway. In this context, a comprehensive study was conducted to develop and propose innovative, adaptive, and sustainable solutions in order to overcome these challenges. The project proposal was then prepared and submitted on January 2020. Unfortunately, the application has been rejected. However, after making some improvements based on the comments, it is planned to resubmit the proposal in a future round.

D. Propagation study for an IQRF network

Real-world deployment of IQRF network requires an accurate prediction of network coverage and performance. It is then necessary to comprehend the propagation impairments affecting the propagation links in order to design IQRF networks. Thus, during the fellowship, it was aimed to conduct propagation study on the estimation of IQRF network coverage in the urban environment. As a first step, it was planned to perform the measurements to assess the practical capabilities of IQRF technology. However, due to Covid-19 pandemic, we were not able to complete this step. Instead, measurement scenarios were determined, and proper path loss models were identified to be used in the simulations. Simulations were then performed for each scenario, and initial results were obtained. After making the real measurements, which is expected

¹ <https://www.forskningsradet.no/en/>

to be completed by a PhD student who pursues his studies under the supervision of Prof. Mohammad Derawi, a comprehensive analysis of the propagation in terms of the range and received power will be provided. This, therefore, constitutes a future direction of our research.

II – PUBLICATION(S) DURING YOUR FELLOWSHIP

1. M. Bouzidi, Y. Dalveren, F. A. Cheikh and M. Derawi, "Use of the IQRF Technology in Internet-of-Things-Based Smart Cities," in *IEEE Access*, vol. 8, pp. 56615-56629, 2020, doi: 10.1109/ACCESS.2020.2982558.
2. M. Derawi, Y. Dalveren, F. A. Cheikh, " Internet-of-Things-Based Smart Transportation Systems for Safer Roads," in *Proceedings of the IEEE 6th World Forum on Internet of Things (WF-IoT)*, to appear.

III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

1. IoTERA²⁰¹⁹: Conference about IoT technology use cases for IoT techs., October 8-9, Prague, 2019 (as a listener).
2. IEEE 6th World Forum on Internet of Things (WF-IoT), which has gone virtual because of the Covid-19 pandemic, June 2-16, 2020 (as a presenter).

IV – RESEARCH EXCHANGE PROGRAMME (REP)

I visited the department of Intelligent and Autonomous Systems, Centrum Wiskunde & Informatica (CWI), Amsterdam-Netherlands, where the local scientific coordinator is Dr. Eric Pauwels between February 24 and March 1, 2020. During the visit, I gave a talk on my research work to the team led by Dr. Pauwels, and I found an opportunity to meet several researchers to share the findings and discuss the future works/new ideas. This visit provided me a great chance to explore various IoT-related topics for potential further collaboration.