Final Project Report
(Executive Summary)
Form

I. Title of Proposed Project:

Mobile IoT

II. Project Leader:

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IV. Total Amount (US$):

US$ 79,370 (US$ 46,200 for 1st year, US$ 33,170 for 2nd year)

V. Duration (6-36 Months):

24 Months (1 April 2016 – 31 March 2018)

VI. Executive Summary

Internet of things (IoT) with billions of devices/sensors makes it possible to build smart cities/smart nations to improve the quality of life for individuals, and brings benefits and opportunities to enterprises. Wireless sensor network (WSN) is a key enabler for IoT, smart city, and smart nation. Compared to a fixed deployment, Mobile IoT with mobile gateway has several advantages such as less required number of nodes, easier deployment, better flexibility and scalability, and lower costs. However, some challenges associated with Mobile IoT deployment need to be addressed.

In this project, we address some of these challenges pertaining to connectivity (which includes connectivity between sensor nodes to the mobile gateway and the connectivity from the mobile gateway to the information sink); protocol stack development and low latency scheduling in large scale deployment, as well as testbed development for proof of concept in several application scenarios. When long range communications is used to connect the different nodes, we propose a hybrid group paging scheme for LTE networks, which allows dynamic priority allocation to different group of nodes. The scheme is able to provide smaller average access delay and higher successful access probability to the important nodes group.

When short range communications is used instead, the information must be propagated in a multi-hop manner. In this case, we propose a connectivity optimization method to find the best way to deploy sensor nodes which act as relay to convey information from the mobile gateway to the information sink at any time. As far as the information transmission from the source to the mobile gateway, we propose a target coverage optimization method which guarantees that all target location is covered by at least one sensor node, and at the same time providing a best placement of nodes to ensure the presence of multi-hop link to the mobile gateway. It is shown that our proposed method uses less number of deployed sensor nodes, and the tradeoffs with respect to the communication radius, mobility speed, and number of mobile gateway are analyzed.

In the context of large scale deployment consisting of different WSN and mobile gateway, we propose a scheduling mechanism that minimizes the delay between relay node and mobile gateway. Adaptive scheduling mechanism within each WSN that provides low delay between sensor nodes and relay nodes according to the traffic patterns is also proposed. These scheduling mechanisms are shown to be useful in providing low latency communication in Mobile IoT environment. A small testbed that implement the operation of adaptive scheduling mechanism based on TSCH 802.15.4e has been developed as a proof of concept.

In this project, we also develop system testbeds addressing different real world applications including environment monitoring using LoRaWAN technology, mobile surveillance technology, as well as wireless grid technology. These testbeds demonstrates the relevance of the Mobile IoT in bringing benefits to the society.

The outcome of our works above have been published in international conferences and journals, as well as contributed to standardizations and patents. As the outlook of the technology that we have developed here, we foresee that Mobile IoT will find its wider application to other areas such as smart farming and smart aquaculture. This technology will also help the community to adopt sustainable practices, and improve the productivity and quality of life in general, as well as promote new collaboration for relevant activities on IoT-based solution with other partners in the future.