MASTER STUDENT INTERSHIP IN INTEGRATION OF IoT and SATELLITE NETWORKS IN EMERGING 5G SYSTEMS

Context

The advent of 5G communications represents a potentially disruptive element to enable the vision of a truly global Internet of Things (IoT). One of the key features of 5G is the focus on the integration of heterogeneous access technologies, including satellite communication systems. The decrease in their price, their wide coverage, and their native broadcast and multicast capabilities, ensure satellite communications are well positioned to complement terrestrial networks where they are not available, or when not operational any more. Hence, satellites play a key role in providing ubiquitous coverage and reliability in remote areas and enabling new IoT/M2M services. However, IoT devices are not equipped with satellite connectivity, and IoT protocols were not designed with satellite requirements in mind. In this view, a lot of tweaking and cross-layer optimization is still required to allow the collection of IoT data from (constellations of) satellites, load balance, and offload of terrestrial network to enable smooth integration of IoT and satellite networks.

Description

In the context of integrated (terrestrial) IoT and satellite networks in emerging 5G systems, the student can select one of the following topics, as focus of his/her internship.

Topic 1: Optimization of Application and Transport protocols for integrated IoT-LEO-based satellite systems

The student will develop optimization for IoT messaging protocols (MQTT, CoAP) in the presence of intermittent and short-lived connections between the IoT devices and LEO satellites. The impact of the transport protocol (TCP, UDP) on the application protocol will be also analysed. The student will investigate the suitability of TCP-RACK and the newly defined transport protocol QUIC for IoT data delivery via satellite access schemes.

Topic 2: LoRaWAN synchronization and scheduling with satellite backhauling

During the internship, the student will address synchronization issues between the LoRaWAN end devices and a mobile LoRaWAN gateway, installed on a LEO satellite. End devices' SF (Spreading Factor) and transmission power, gateway's duty cycle and half-duplex limitations will be taken into account when designing scheduling techniques, spanning from slotted-Aloha like to more advanced TDMA schemes. Finding the right trade-off between reliability and overhead will be a key factor in the design of such scheduling schemes, for both uplink and downlink IoT traffic patterns.

Topic 3: Network Configuration for 5G IoT Services over satellite

Leveraging on the 5G key technologies, Software Defined Network (SDN), and Network Functions Virtualization (NFV), the student will design admission control, access prioritisation mechanisms, and congestion control schemes for IoT data delivery over satellite. The proposed solution should provide QoS support for different types of IoT services, based on their specific requirements. Both reservation-based MAC protocols, traditionally used by satellites, and random access mechanisms will be investigated.

Profile

Education

End of an engineering cycle (Master of Science or Master 2) in Electronic Engineering, Computer Science or Applied Mathematics.

Skills

The ideal candidate should have some knowledge and experience in a number of the following topics:

- Internet of Things, and wireless networks
- MAC, transport and application protocols
- Satellite communications and backhauling
- Cross-layer resource allocation and scheduling
- QoS and Network Performance
- Network Resource Management (SDN, NFV)

The ideal candidate should also have some very good programming skills and experience (C-C++/Python/Java, etc.), general understanding of software quality and project management tools (Git, GitHub, etc), hand-on skills with embedded systems (ideally involving low power wireless devices), and basic knowledge of Linux based OS, would be also recommended. In fact, to test and evaluate his/her results, the PhD student will be using a simulated and / or a real-testbed environment.

Language

Fluent English (spoken and written) is mandatory

Other information

- *Duration*: 6 months
- *Starting date*: flexible (before December 2019)
- *Supervisor*: Dr. Maria Rita Palattella
- *Contact*: mariarita.palattella@list.lu
- *Host Institution*: Luxembourg Institute of Science and Technology (LIST) https://www.list.lu/

Application

Application should be submitted by email to Dr. Palattella, and include:

- Full CV, including list of publications (if any) and three referees (name, email address, etc.)
- Transcript of all modules and results from university-level courses taken
- Motivation letter (1 page max)

Applications will be processed upon arrival. Thus, prompt submission is encouraged.