2023-06751 - Research Internship - Implementation and Evaluation of Medium Access Control Modules in Satellite IoT Simulator

Contract type: Internship  
Level of qualifications required: Master’s or equivalent  
Function: Internship Research

About the research centre or Inria department

The Inria research centre in Lyon is the 9th Inria research centre, formally created in January 2022. It brings together approximately 300 people in 16 research teams and research support services.

Its staff are distributed at this stage on 2 campuses: in Villeurbanne La Doua (Centre / INSA Lyon / UCL) on the one hand, and Lyon Gerland (ENS de Lyon) on the other.

The Lyon centre is active in the fields of software, distributed and high-performance computing, embedded systems, quantum computing and privacy in the digital world, but also in digital health and computational biology.

Context

This work will occur in the Inria Agora research team in Lyon and the ANR STEREO national research project. The internship student will be supervised by Dr. Juan Fraire (Inria Agora) and will work closely with Prof. Alexandre Guittout (Université Clermont Auvergne) and Dr. Dana Iova (Inria Agora, INSA Lyon).

Assignment

Context

Over recent years, various new technologies have emerged, enabling long-range communication (up to tens of kilometers) with impressively low power consumption (18mA at 7dBm). These networks have played a crucial role in the Internet of Things (IoT) realm, facilitating architectural paradigms that offer unprecedented scalability and flexibility, including space-terrestrial communication. LoRa [1], when paired with LoRaWAN [2], stands out as one of the prominent technologies for long-range terrestrial communication networks. It is currently being adapted and enhanced to establish a link with Low-Earth Orbit (LEO) satellites - a strategy that is anticipated to revolutionize smart object data collection on a global scale.

Assignment

The process of evaluating the performance of LoRa/LoRaWAN within the context of LEO satellites is still in its nascent stage. In light of this, the Inria Agora research team in Lyon is developing FLoRaSAT (Framework for LoRa-based Satellite Networks) [3], an Omnet++ (C++) based discrete-event simulator for comprehensive satellite IoT simulations rooted in LoRa/LoRaWAN. While the simulator already accommodates orbital mechanics and routing solutions for satellite-to-satellite and satellite-to-gateway links, the LoRaWAN Medium Access Control (MAC) layer necessitates further enhancement. Specifically, LoRaWAN introduces three modes of operation called Class A, Class B, and Class C. In the current version of the simulator, LoRaWAN Class A is included, Class B is partially implemented, and Class C is yet to be added. A comprehensive performance evaluation and comparison of the LoRaWAN classes are also required.

Bibliography

[3] FLoRaSat simulator: https://gitlab.inria.fr/jfraire/florasat

Main activities

The student will have to:

- Familiarize with the Omnet++ framework, the FLoRaSat software architecture, and the LoRa/LoRaWAN technologies, explicitly focusing on Class A, B, and C.
- Develop a new C++ class (Omnet++ module) for LoRaWAN Class C and expand the existing LoRaWAN Class B module.
- Establish suitable Satellite IoT scenarios that incorporate LEO satellites and ground nodes.
- Carry out performance evaluation campaigns within the scenarios using the three LoRaWAN classes.
- Analyze the collected data, draw insights from the findings, and compile a comprehensive report.

Skills

Required Skills

We encourage applications from students pursuing a Computer Science or Computer Science and Engineering degree.

Warning: you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.
Engineering degree. Practical proficiency with programming languages (C/C++ and Python) is desirable. A solid understanding of mathematics and wireless networking is also preferred. Applicants must have fluency in English; proficiency in French is not a prerequisite but would be advantageous. We are seeking candidates who are empathetic, proactive, and self-motivated.

Benefits package

- Partial reimbursement of public transport costs
- Social, cultural and sports events and activities

Remuneration
Gratification at €4.05 per hour