**2023-06754 - M2 Research Internship in Low Power Wide Area Networks (LPWANs)**

**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 8th 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 (Centre / INSA Lyon / UCBL) 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 internship will take place in the Inria Agora research team in Lyon. The student will work under the joint supervision of Prof. Alexandre Guittton (LIMOS, University Clermont Auvergne), Dr. Oana Iova (INSA Lyon, Inria) and Prof. Fabrice Valois (INSA Lyon, Inria).

**Assignment**

Low-Power Wide Area Networks (LPWANs) are wireless technologies that allow battery-powered end-devices to communicate over long distances (up to 10-30 km) with very low power consumption. LPWANs are used in Internet of Things (IoT) applications for smart city such as pollution monitoring, smart agriculture, and asset tracking.

Recently, the LR-FHSS (Long-Range Frequency-Hopping Spread Spectrum (LR-FHSS)) technology has been proposed by Semtech to enable the communication of a massive number of end-devices and achieve better network capacity. While these characteristics opened the door for new applications such as the communication of end-devices situated on the ground with low Earth orbit (LEO) satellites, LR-FHSS is also the perfect solution for dense network deployments in city environments, being especially important for applications where scalability is crucial [2, 3].

At the moment, there are very few works on LR-FHSS, and most are based on simulations. That is why we intend to make real experiments in order to study the performance of LR-FHSS. The goal of this internship is to study the performance of LR-FHSS through real experiments. To do this, indoor and outdoor experiments will be conducted in order to analyze the trade-offs brought by LR-FHSS in terms of robustness, communication range, and network scalability.

**Main activities**

To study this topic, the following method will be used:

- The candidate will study the state of the art on the recent LR-FHSS technology.
- The candidate will learn how to use a LR-FHSS toolkit to send and receive LR-FHSS frames, and an USRP to capture real LR-FHSS transmissions.
- The candidate will setup an experimental scenario with automated configuration and data collection tools.
- The candidate will explore the performance of LR-FHSS achievable in indoor and outdoor environments.

**Skills**

The candidate must be studying for a Master's degree or an equivalent degree (e.g., engineering degree) in Telecommunications Engineering, Computer Science, or Electrical Engineering. Practical skills with programming languages (e.g., C/C++, Python) are required. Expertise in embedded systems will be positively valued. French language is not mandatory but welcomed. We look for empathetic, proactive, and self-driven applicants.

**Benefits package**

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

**Remuneration**

Gratification at €4.05 per hour

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**General Information**

- **Theme/Domain:** Networks and Telecommunications  
- **System & Networks (BAP E)**  
- **Inria: Centre Inria de Lyon**  
- **Starting date:** 2024-02-01  
- **Duration of contract:** 6 months  
- **Deadline to apply:** 2023-11-11

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**Contacts**

- **Inria Team:** AGORA  
- **Recruiter:** Oana Teodora Iova / oana.iova@inria.fr

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**Instruction to apply**

**Defence Security:** This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

**Recruitment Policy:** As part of its diversity policy, all Inria positions are accessible to people with disabilities.