M2 Internship on Data Analysis for Internet of Things

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 / 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 work will take place in the Inria Agora research team in Lyon, in conjunction with the ANR DOLL national research project. The internship student will be supervised by Dr. Oana Iova (Inria Agora, INSA Lyon) and will work closely with Prof. Alexandre Guitton (Université Clermont Auvergne), Prof. Fabrice Valois (Inria Agora, INSA Lyon), and Prof. Hervé Rivano (Inria Agora, INSA Lyon).

Assignment

Recent years have witnessed the surge of several new technologies that enable long-range communication (up to tens of kilometers) with extremely low-power consumption (18mA at 7dBm). These networks play a major role in the Internet of Things (IoT), where they enable architectural alternatives with degrees of scale and flexibility hitherto impossible. The most representative technology for long-range networks is LoRa [1], combined with the LoRaWAN [3] protocol, a breakthrough technology for smart object data collection that has gained global momentum.

Main activities

LoRaWAN networks are deployed all over the world, allowing end-devices to easily send the collected data to users. However, there is no knowledge of how these networks are used today, and what are the exact characteristics of the end-devices that use these networks. The goal of this internship is to assess and characterize the deployment of a LoRaWAN network and its end-devices, in an actual urban real-world environment. The Inria Agora team has deployed a LoRaWAN network in the La Doua Campus, Villeurbanne in 2019 and gathered data traces (almost) continuously for over three years (some interruptions are present in the data due to temporary hardware failure). Before being analysed, the raw data should be cleaned to avoid outliers and incoherent data collection. The student will then have to analyze the obtained data traces and gather different micro and macro indicators, such as:

- Number of end-devices and applications in the network, and their lifetime. This tells us how the network is used.
- Traffic observed in the network through the lens of uplink and downlink data traffic, confirmed uplink and join type of traffic together with the carrier frequency used for each type of packet, in order to characterize the gateway availability and reliability and the dynamics of the network.
- Physical settings for each packet, including bandwidth, spreading factor, coding rate, and packet length. All these parameters have an impact on the data rate, receiver sensitivity (including resilience to interference), transmission range, and energy-efficiency.
- Received signal strength indicator (RSSI) and signal to noise ratio (SNR) for each data packet, in order to further characterize the quality of the links in the network.

Bibliography:
[2] LoRa Alliance, LoRaWAN 1.1 Specification, 2017
Skills

Applicants studying for a Computer Science or Telecommunication Engineering degree are encouraged to apply. Practical skills with programming languages (e.g., C/C++, Python) and data visualization software such as Kibana are welcomed. French language is not mandatory but welcomed. We look for empathic proactive and self-driven students.

Benefits package

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

Remuneration

Gratification at €4.05 per hour

General Information

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

Contacts

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

About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

**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.

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.