2018-00806 - Connectionless Transmission in Wireless Networks (IoT)

Contract type : Public service fixed-term contract
Level of qualifications required: Graduate degree or equivalent
Other valued qualifications: Master 2 in Networking, Telecommunications or Computer Science
Function: PhD Position

About the research centre or Inria department
Located at the heart of the main national research and higher education cluster, member of the Université Paris Saclay, a major actor in the French Investments for the Future Programme (Idex, LabEx, IRT, EquipeX) and partner of the main establishments present on the plateau, the centre is particularly active in three major areas: data and knowledge, safety, security and reliability; modelling, simulation and optimisation (with priority given to energy).

The 450 researchers and engineers from Inria and its partners who work in the research centre's 31 teams, the 100 research support staff members, the high-level equipment at their disposal (image walls, high-performance computing clusters, sensor networks), and the privileged relationships with prestigious industrial partners, all make Inria Saclay Île-de-France a key research centre in the local landscape and one that is oriented towards Europe and the world.

Context
Within the framework of a partnership:
- collaboration between Inria teams INFINE (Saclay), EVA (Paris) - and also Inria team SOCRATE
- and with Nokia Bell Labs through the joint laboratory between Inria and Nokia Bell Labs

Assignment
The starting point for the thesis subject is "connectionless transmission" in the context of wireless communications (such as in Internet of Things, IoT). In some IoT scenarios, due to the massive number of IoT devices, the concept of well-controlled access has to be relaxed for efficiency (or simple feasibility). This is the case of for massive machine-type communications in cellular network [1]; this often been the case in IoT networks in unlicensed networks (LoRa, Sigfox, 802.15.4-based, ...). This is the case also for some forms of vehicular communications (802.11p based or in cellular [2]).

Main activities
The PhD thesis proposed research directions are:
- in this context, the initial subject will be to construct some next-generation access protocols, for IoT (or alternately for vehicular networks).
- One starting point are is the family of connectionless methods, where devices do not necessarily have to reserve resources prior to their transmission. This includes Non-Orthogonal Multiple Access (NOMA) [3], where multiple transmissions can "collide" but can still be recovered - with sophisticated multiple access protocols (MAC) that take physical layer/channel into account. One such example is the family of the Coded Slotted Aloha methods [4,5]. Another direction is represented by some vehicular communications where vehicles communicate directly which each other without necessarily going through the infrastructure. This is true also more generally in any wireless network where the control is relaxed (such as in unlicensed IoT networks like Lorax).
- An observation is that in such distributed scenarios, explicit or implicit forms of signalling (with sensing, messaging, ...) can be used for designing sophisticated protocols - including using machine learning techniques [6].
- During the thesis, some of the following tools could be used: protocol/algorithms design (ensuring properties by construction), simulations (ns-2, ns-3, matlab, ...) on detailed or simplified network models, mathematical modelling (stochastic geometry, etc...); machine-learning techniques or modelling as code-on-graphs [4,5, ...]
- Moreover, through cooperation with Inria Team SOCRATE, access methods and protocols could be further experimentally evaluated on the FIT CortexLab cognitive radio testbed (for which advanced physical layer and MAC building blocks are being implemented) or on FIT IoT-LAB, and might also be theoretically evaluated/compared considering optimal estimation and information theory bounds.

Benefits package

- Subsidised catering service
- Partially-reimbursed public transport
- Social security
- Paid leave
- Flexible working hours
- Sports facilities

Remuneration

- Monthly gross salary first 2 years: 1.982 euros
- Monthly gross salary third year: 2.085 euros