The optimization of URLLC IoT protocols thus requires to reshape almost completely the non-human things in real time. Future 5G (and beyond) communications in order to control vehicles, drones, robots and any other complex synchronization, scheduling and coordination. This kind of communication is a key issue for instantaneously a short packet of information in the network, to one or several destinations, avoiding therefore, our objective is to design on-the-fly protocols allowing any radio node to transmit almost optimized for high rates data flows under steady-state regime or full buffer conditions. But future IoT and low latency communications (URLLC) is mandatory, which change deeply the paradigm of development of Internet of Things (IoT), the development of new protocols devoted to ultra reliable and low latency communications (URLLC) required for haptic services, impose extremely reactive protocols, which require new PHY/MAC designs.

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communication protocol stack to balance latency and reliability with side constraints such as energy efficiency or computational complexity.

The key elements for these communications are to reduce drastically the needs for synchronization, signalling and detection issues. The packet should be encoded such that all these steps can be performed jointly to avoid costly and long headers to be transmitted.

The proposed approach will rely on estimation theory and hypothesis testing techniques to design new optimal techniques to transmit very short packets (typically less than 100 bits) in a multi-user scenario. The key issue for such problem is to increase diversity at the receiver: multi-antennas reception, opportunistic relaying, joint transmission, multi-user detections are fundamental techniques that have to be reshaped in the context of small packets.

We will take care about the multi-objective framework: increasing reliability should not be done at a high price in terms of complexity or energy efficiency.

The candidate will leverage on recent results in information theory and on hypothesis testing to establish new performance bounds and to derive some fundamental trade-offs (e.g. energy-reliability, latency-reliability, energy-capacity,...), leading to the characterization of optimal multi-user transmission schemes in the Bayesian sens.

This framework will help to design new distributed coding techniques including opportunistic cooperation and relaying. The performance of the proposed algorithms will be confronted to the theory, validated by simulation and experimentally assessed on the platform FIT/CortXlab.

Some references relative to this topic:


Skills

Technical skills and level required:

- theoretical background: probability and statistics, algebra, functional analysis, optimization theory, signal processing.
- specialization in one of these fields: estimation theory, measure theory, information theory, coding.
- programming: familiar with Matlab, Python or C/C++ languages.
- experience in GNU radio programming is not mandatory but would be appreciated.

Languages:

- English: read/write/speak fluently.
- French is optional.

Relational skills:

- Strong autonomy, innovation, ideas.
- Like to collaborate, to confront ideas.
- Open mind.

Benefits package

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

Remuneration

Gross income: 1982€ the 1st and 2nd year; 2085€ the 3rd year.