Network Coding for Wireless Sensor Networks

**Laboratory:**
IETR-UMR CNRS 6164, groupe CPR (Communications, Propagation, Radar),

**Duration** 18 months

**Topic**
Recently the “green communications” paradigm has raised in reference to sustainable development for the information and communication technologies (ICT). The wireless world research forum (WWRF) has fixed a 50% decrease of CO$_2$ related to ICT as an objective up to 2020. In order to reach this purpose, the wireless network design criteria need to be reconsidered while keeping an important quality of service (QoS) which is only increasing with time.

The wireless sensor networks (WSN) are one of the applications directly concerned with energetic aspects and the work of the post-doc will be included in this framework. A WSN is a set of nodes with ad-hoc communication abilities whose the aim is to route an information flow from a particular sensor to a sink collecting the data. WSNs can be used for monitoring sites (naturals, industrials), security, smart cities, etc. A typical attribute of WSNs is their large number of nodes, i.e. from few hundreds to several thousands according to the application targeted. The drawback with large ad-hoc networks is the very low increase of the transport capacity (bit-meter/s) with the number of nodes [1,2]. This fundamental limit has been proved without considering particular protocols or PHY layer but it depends on the network topology. In particular, the authors in [3] have shown that the global network capacity could increase linearly with the number of nodes by using cooperative communication architectures.

In WSNs, the global throughput is not the first criteria to be optimized; end-to-end reliability as well as the network lifetime are the main constraints to be maximized. The objective of the project is to find the best strategies to be applied in order to keep order control the energy consumption and to ensure a low packet loss at the sink for an amount of data to be transmitted. In this framework, the network coding [4] is a promising technique in order to reduce the energy consumption [5].

The first stake of the project will be to extend the results in [1,3] to the energy consumption for large sensor networks in order to derive some bounds for practical strategies. The candidate should prepare a rigorous state of the art of routing and MAC protocols minimizing the energy consumption in the network. The proposed cooperative techniques (network coding and/or cooperative MIMO) should be compared to the theoretical bounds firstly established and also to the classical routing and MAC protocols for energy minimization in order to evaluate the efficiency of these techniques for large WSNs. The theoretical results could be used in order to propose more ambitious National and European projects.

**References**

**Key skills**
The candidate should have earned a PhD in one of the following field: electrical engineering, telecommunication and networking, signal processing, applied mathematics. He should have a strong background in mathematics (probability, statistics, optimization, special functions, algebra) and should be interested in information theory and digital communications (PHY, MAC). The candidate would have ideally knowledge at the network level (IP). He should be familiar with Matlab and C/C++ languages. A first experience with discrete event simulators would definitively be an asset.

**Key words:**
Cooperative network, network coding, cross-layer, cooperative MIMO, energy-delay tradeoff.

**How to apply:**
- Email a motivation letter
- Full CV showing your experience in the field with your publication records
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