Project objectives

The project on ***B**rain-**I**nspired Massive Radi**o** Communication **Net**work**s*** (*BioNets*) aims at new design paradigms for future wireless massive ultra-low power networks with an average density of at least 1 node/m^2 by new communication methods, inspired by the energy efficiency of the human brain. Current wireless node power consumption WLANs and cellular systems is in the order of $0.1 \div 1$ W per one transmission link. In comparison, an incredibly complex human brain, works with less than 10^{-9} W per neuron with up to 10,000 links. The goal of the project is to come up with intelligent structures of the future dense communication networks that, similarly as a human brain, will be able to operate in low-power regime while still exposing high reliability. The project will create a novel framework towards the possibility to borrow some of the human brain information flow mechanisms for future massive ultra-low power networks. The ultimate goal is a new paradigm for communication networks composed of a large number of low-complexity, low-energy nodes.

The scientific hypothesis of the *BioNets* project is the following: In the future massive radio communications, the capacity, reliability, and energy-efficiency can be significantly increased by the use of neural-system-inspired principles, in particular, human brain mechanisms.

Research to be carried out

Within the *BioNets* project the following research are planned. First, the application of brain communication principles for radio networks will be investigated, as well key scenarios and use-cases for massive radio communication. Radio technologies for energy-efficient, dense communication networks will be investigated, among which the option for back-to-analog communication at short ranges will be considered. The network-level techniques to deal with various network faults and assure connectivity will be investigated. Then, we will synthetize key intelligent technologies for massive radio communication, analyze and validate the research results. The project also plans to disseminate results in the international journals and conferences.

Motivation

Massive communication of multitude of devices constituting the Internet of Things (IoT), connected humans and machines, increased data rates, energy efficiency and reliability are key paradigms stated for 5G communication. These paradigms aiming at achieving 1000 times the system capacity, 10 times the energy efficiency, data rate, and spectral efficiency, and 25 times the average mobile cell throughput compared with today's 4G, are right in the focus of the *BioNets* project. The motivation behind the *BioNets* project is to reduce the cost associated with the introduction of the IoE technologies. The framework for massive radio communication that will be proposed has the potential to be used as reference for future built ultra-low power and reliable network architectures.

The motivation behind the *BioNets* project, most of all, is to allow for further deployment of high-data rate wireless communications thus, impacting connectivity within the information society. Moreover, it is our intended contribution to further development of borderless information society, electronic business and economic growth related to information and communication technologies (ICT). By addressing the energy challenges the project will have an impact on lowering ICT-related energy-consumption, CO_2 emission and electromagnetic exposure. By addressing network-reliability challenge, the project will impact the field of emergency-management, where connectivity and information transfer despite network faults and disorders are crucial.