NB-IoT over Non-Terrestrial Networks

Research project plan

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The research activity addresses the design and assessment of NB-IoT adaptation for Non-Terrestrial Networks. It encompasses the study and implementation in MATLAB of the main elements of the NB-IoT air interface, with the aim of identifying adaptations to be included to support NB-IoT communication in non-terrestrial link, and the design and assessment of the identified modifications. The activity will be strongly linked to ESA and EC initiatives and to the Third Generation Partnership Program (3GPP) Study and Work items for release 18+.

The Internet of Things (IoT) market is exponentially growing. Market forecast predict that IoT devices will be half of the global connected devices within the next few years, with 14.7 billion Machine-to-Machine connections by 2023 and more than 25 billion by 2025. Devices such as alarms and detectors, smart meters, trackers, and wearables will be employed for automotive and agriculture, environment monitoring, infrastructures surveillance and management, healthcare, energy and utilities, logistics, good tracking, etc. on a global scale. A crucial requirement of any infrastructure serving the IoT market will therefore be to guarantee ubiquitous connectivity to the low-cost, low-powered devices. However, it is widely accepted that this requirement will not be met by the terrestrial network alone. There will be, in fact, vast areas of the globe where the terrestrial infrastructure deployment will be unfeasible or not economically viable, thus leaving those areas un- or under-served. For these reasons, the 3GPP has recently launched a study item addressing the Narrowband IoT (NB-IoT) support for NTN. The study item, starting at the beginning of 2021, will assess the performance of NB-IoT over NTN and identify the needed adaptations.

The research activity proposed in this project falls into this global framework and aims at providing significant contributions to the progress of the state-of-the art in this field. Building on the know-how portfolio of the research group in which the selected candidate will work, the activity will, in particular, address aspects such as the coverage extension through Low Earth Orbit or very Low Earth Orbit Satellite, adopting beamforming and intersatellite links, and the initial synchronization and random access procedures.

The Research Fellowship activity will entail

- the definition of representative system scenarios;
- the analysis of the state of the art of NB-IoT terrestrial and satellite air interface and architecture;
- the selection of promising techniques and approaches and the design of innovative and original ones;
- the assessment of the benefits by means of theoretical tools and numerical simulation in scenarios setups characterized by increasing complexity and adherence to the actual working conditions of future systems;
- the production of scientific contributions to conferences, journals, reports, and standardization bodies;
- the participation in collaborative research projects (meeting, teleconference, etc).

The activity will be carried out in the framework of funded international research projects currently ongoing for the Digicomm Research group of the Department of Electrical, Electronic, and Information Engineering (DEI) at the University of Bologna. The research environment is international and challenging. It is expected a strong interaction with several ongoing European Space Agency initiatives.

The candidates shall have a background on ICT engineering with a focus on Communications theory and Satellite Communication Systems. C++ and Matlab programming skills are required.

The working language is English.