

# AI-Based Physical Layer and Procedures for 6G-NTN

## Research project plan

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The research activity roots into the HE JU SNS funded project 6G NTN aiming at researching and developing innovative technical, business, regulatory, and standardization enablers to achieve full and seamless integration of the Non-Terrestrial Network (NTN) component into the 6G. The vision is to extend coverage, resilience, and sustainability of next generation mobile networks, meeting needs and expectations of both vertical and consumer market segments, while unleashing new value chains and creating broad societal impact.

In this framework, the proposed research activity encompasses the study, design, and implementation of innovative AI based physical layer techniques and access procedures for both enhanced mobile broadband and IoT applications. In particular, the activity will assess how such techniques, part of which are being addressed also in terrestrial networks, can be designed for satellite architectures and can significantly improve the performance of a satellite network infrastructure, fully integrated in the 6G ecosystem for future Non-terrestrial Networks. Emphasis will be given to the very Low Earth Orbit satellites mega-constellations with/ without regenerative payload.

The activity will address, but will not be limited to, the design and assessment of random access procedures and channel estimation with reference to a scenario consisting of a dense constellation of very Low Earth Orbit Satellites each one equipped with a low-cost radiating element. Also, in order to optimize the workload of regenerative payloads and to address energy efficient communications, the activity will address adaptive functional splits between the ground and space segment, e.g., O-RAN based CU-DU split in NTN. In particular, the activity will be organized as follows

- definition of representative system scenarios;
- analysis of the existing literature for both T and NT applications;
- development of the system model, i.e., mathematical modeling, of the scenario under consideration;
- design and implementation of AI based techniques;
- performance analysis
- writing of scientific publications, project reports, and standardization contributions.

The project will be carried out in the framework of the 6G-NTN funded Horizon Europe JU SNS research project coordinated by the Digicomm Research group of the Department of Electrical, Electronic, and Information Engineering (DEI) at the University of Bologna and starting on January 1, 2023

The research environment is international and challenging. The working language is English. It is expected a strong interaction with several ongoing European Commission and European Space Agency initiatives.

The activity will be performed by using mathematical tools as well as numerical simulation mainly based on Matlab and C++.