

# Reconfigurable OFDMA-based Cooperative Networks Enabled by Agile Spectrum Use

*The project aims at providing ubiquitous wireless solutions to reach bit rates higher than 100Mbps with peak throughputs higher than 1Gbps. The goal is addressed by devising methods for improved and opportunistic spectrum usage, advanced multi-user cooperative transmission and ultra-efficient MAC design.*

## At A Glance: ROCKET

**Reconfigurable OFDMA-based Cooperative Networks Enabled by Agile Spectrum Use**



### Project Coordinator

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**Duration:** 1/2008 – 12/2009

**Total Cost:** €4,34m

**EC Contribution:** €3,00m

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## Main Objectives

ROCKET seeks to define wireless solutions capable of delivering bit rates higher than 100 Mbps with peak throughputs higher than 1 Gbps, based on reconfigurable OFDMA cooperative networks enabled by agile spectrum usage. While increasing peak rates is a natural must-do for new standards, providing homogeneous high rate coverage is equally important as it guarantees a constant user experience over the whole served area and is the key enabler to a higher average spectral efficiency of the system. Those goals are inline with the IMT-Advanced requirements and match the requirements of the IEEE 802.16 Task Group m for Advanced Air Interface.

**Ubiquitous high bitrate wireless services entail rethinking cellular architectures. Opportunistic use of the available spectrum and MIMO relaying are the ROCKET target technologies**

In order to guarantee a strong focus and efficiency ROCKET spans the scope research to two questions which will be at the centre of future IMT-advanced system design:

- How can the bandwidth be enlarged and make the whole system benefit from it?
- How can the system spectral efficiency be increased and provide ubiquitous high bitrate coverage?

Those questions are addressed by devising methods for improved spectrum management, advanced multi-user cooperative transmission, collaborative inter-cell operation and ultra-efficient MAC design. Moving from theory to implementation, a highly efficient prototyping platform (empowered by state-of-the-art multi-core processors) accommodating PHY, MAC and Networking functionality, will be used to prove the computational feasibility of key MAC and cooperation concepts.

The activities of the project will be timely scheduled according to the activities of the working groups in the standards, namely in 802.16m and 3G-LTE. Results are to be spread into a wider audience for maximum impact, but also the protection of knowledge is considered as a crucial aspect. The ROCKET consortium expects to generate techniques and results well beyond the state-of-the art in

cutting edge technologies and aims at producing valuable intellectual property rights to boost world wide competitiveness of the partners.

## Technical Approach

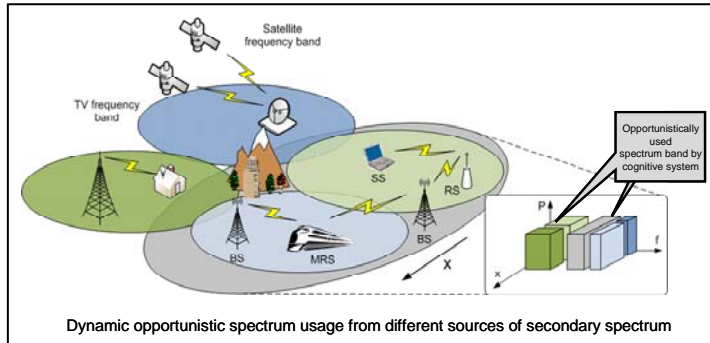
At an early stage of the project, the system performance indicators and system design options for reasonable backwards compatibility with existing standards will be determined. These will be taken as a basis for the proof of the technical concepts in the scenarios chosen in WP1 (lead by ICOM).

The core of the work plan follows a methodology based on three basic aspects: technical development, evaluation/proof of concept, and impact. Once the marketable user and application scenarios have been defined, the technical scenarios will be used as a basis for the development of the pillars of the project:

- Spectrum enlargement (in WP2, lead by UniS)
- Advanced cooperative communications (in WP3, lead by MOT) and collaborative communication strategies (in WP4, lead by UPC)
- Ultra-efficient MAC design (in WP5, lead by RWTH)

While it seems natural that a new definition of a MAC layer is required to give adequate support to the opportunistic use of the spectrum and the multi-user cooperative transmission schemes, it is less evident under which rationale the cooperative schemes are to efficiently use the enlarged bands. Three possible strategies enlighten how they complement each other:

1. The requirements for unused bands may be different for the base station and for the relay stations, thus leading to scenarios of potentially enhanced spectrum reuse as compared to scenarios of direct transmission between base stations and mobile stations.
2. Some of the cooperative transmission schemes are able to significantly increase the transmission rate if the resources are balanced adequately in one or some of the links (from source-to-relay, relay-to-destination or source-to-destination). These additional resources can be obtained opportunistically.



3. Inter-cell coordination of radio resources foresees the existence of a pool of resources, some intra-system and some other borrowed opportunistically, that may be used jointly for enhanced spectrum efficiency and improved perceived users' quality.

These crucial aspects require close interaction between WP2, WP3 and WP4, and a continuous updates on the activities for the definition of the ultra-efficient MAC, in WP5.

In every workpackage, the exploration of fundamental limits of these systems will be used as a guideline to devise novel communication strategies advantageously trading with optimality, feasibility and yet compatibility with target standards.

The WP6 consists of the development of the architecture on a hardware platform that will proof the concept by considering the following practical aspects: the design of the antennas, the RF imperfections and the baseband processing constraints.

## Expected Impact

The ROCKET project can be regarded as an accelerator of the delivery of wireless broadband services to individuals, communities and businesses that may otherwise have difficulty to access these services with the current existing technologies. In this sense, it will positively influence the life of new users joining the wireless broadband world.

ROCKET will also impact telecom manufacturers and telecom operators and

reinforce synergies between them. The former will be provided the ability to improve their business growth with more competitive products. The latter will be able to extend their market share by reducing network deployment, operating costs and provide ubiquitous access and new services.

Experience and innovative concepts are skilfully and successfully combined in ROCKET leading to liable strategies for access network deployment. This will provide the subscriber with a full range of services in a cost efficient manner thus opening opportunities to new business development.

