

# Project Information



## Green Terminals for Next Generation Wireless Systems

Green-T aims at limiting energy consumption in multi-standard mobile terminals for wireless communication, to prolong the operational times and to avoid active cooling, using cognitive radio and cooperative strategies, while also focusing on preserving a proper level of quality of service and security for the applications.

### Main focus

Mobile terminals for future wireless communication need to limit the energy consumption to prolong the operational times and to avoid active cooling. In fact, without new approaches for energy saving, there is a significant threat that the 4G mobile users will be searching for power outlets rather than network access, and will become once again bound to a single location; some authors describe this effect as the "energy trap" of 4G system.

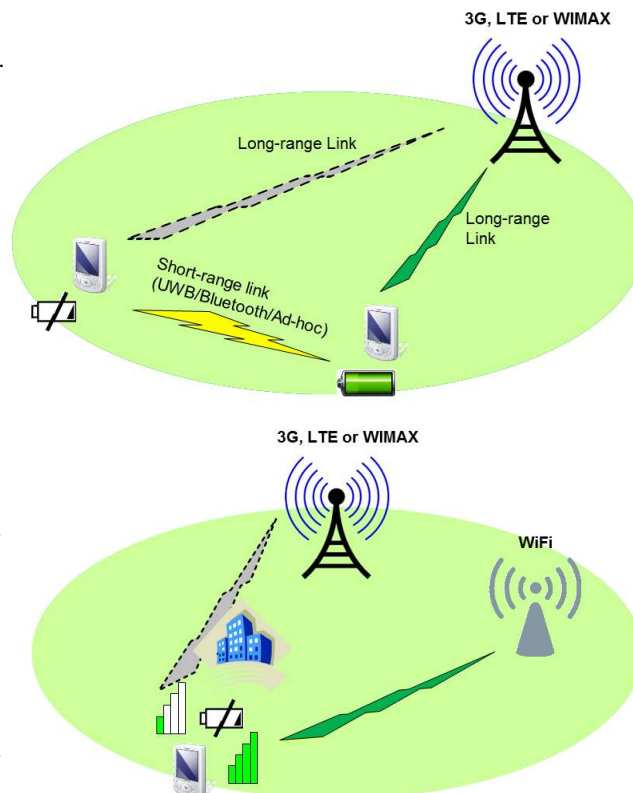
Since in typical mobile terminals of cellular systems, up to half of the power consumption comes from communication-related functions like baseband processing, RF and connectivity functions, GREEN-T will dedicate its efforts towards saving energy on the mobile terminal side, especially addressing the energy dissipation for the communication-related functions. Green-T focuses on taking advantage of the good channel conditions of short range communications, in addition to context awareness, to save energy spent in the communication of wireless mobile devices. Green-T aims at achieving up to 50% reduction in the energy consumption of mobile devices in functions related to communications. This will lead to up to 20~30% increase in battery lifetime of mobile devices.

### Approach

GREEN-T will dedicate its efforts towards saving energy, by exploiting short-range cooperation between mobile terminals, and green vertical handovers for heterogeneous networks. Furthermore, these ideas will be extended to address the notion of cognitive/smart terminals.

GREEN-T will investigate key research domains under the basic categories of cognitive radios, cooperation, Vertical handovers, reconfigurable radio transceivers and security.

**Cognitive radios** are the tools to collect context information about the environment surrounding the mobile terminal, like available RATs (Radio Access Technologies)



**GREEN-T Technical Approaches**  
(a) Short range Cooperative approach, (b) Green Vertical Handover approach



## GREEN-T

Project ID: CP8-002

Start Date: 1 July 2011

Closure date: 30 June 2014

### Partners:

A2UICT, Korea

CTTC - Centro Tecnológico de Telecomunicaciones de Catalunya, Spain

Huawei, Sweden

Infostrada, Cyprus

Instituto de Telecomunicações, Portugal

Instituto Politecnico de Castelo Branco, Portugal

Iquadrat, Spain

I&IMS, Spain

Magister Solutions, Finland

Mecalbi, Portugal

Mobivery, Spain

Portugal Telecom Inovação, Portugal

MPY-Oyj, Finland

PrimeKey, Sweden

Taoglas, Ireland

University of Oulu, Finland

WIT-Waterford Institute of Technology (TSSG), Ireland

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### Project Websites

[www.celticplus.eu/projects/celtic-projects/call8/GREEN-T/green-t-default.asp](http://www.celticplus.eu/projects/celtic-projects/call8/GREEN-T/green-t-default.asp)

<http://greent.av.it.pt>

and mobile nodes in the vicinity of the mobile terminal, battery level of mobile terminals, etc. Based on the context information, mobile terminals will perform informed decisions, with the goal of saving energy while preserving required QoS of the applications.

**Cooperation** between mobile terminals will be considered as a viable strategy to save energy, where low energy consumption can be achieved through multi-hop communication. Cooperative diversity can be achieved by multiple mobile devices acting as an array of antennas. Business models and incentives for mobile users to cooperate are essential elements for the success of cooperation.

**Green Vertical Handover** will be possible for mobile terminals equipped with multiple RAT interfaces, moving in 4G wireless networks that perform as a heterogeneous all-IP infrastructure. GREEN-T will utilise context information about network and mobile environment to perform energy saving via cognitive vertical handover.

**Green Reconfigurable Radio Transceivers** will also be designed. GREEN-T will also investigate new hardware (RF, BB and Antennas) design for flexible multi-standard mobile devices with power consumption as a main metric for the device operation.

**Security** will be investigated since great threats can affect cooperative distributed systems. Misbe-

having nodes will be detected and removed from the cooperative networks, while preserving both the privacy of the users, and the energy-saving properties of the system.

## Main results

GREEN-T commits to the creation of tangible outputs, which will include:

- a. System level simulation environment; to evaluate the realistic energy gain of cooperative strategies according to defined performance metrics and benchmarks.
- b. LTE emulator platform; to serve as an experimental platform for operators to investigate new deployment scenarios for LTE energy saving.
- c. Energy-efficient demonstrators for cooperation with short-range and vertical handovers; The GREEN-T is in line with the European strategy on Green communications, and can provide the knowledge that will be the base of new products and even new industries. Particularly, the energy efficiency solutions will have a very direct impact on the network operator OPEX, and hence significantly change the operator's competitiveness.
- d. A mobility handover testbed; to demonstrate the proposed green vertical handover algorithms. The testbed will include

different types of RATs, such as UMTS, WiMAX and WiFi. The LTE emulator is planned to be integrated in the mobility testbed as well.

- e. Test chips will be implemented in certain target technologies and dedicated validation/evaluation boards will be realized.
- f. Incentives to encourage cooperation among users/handsets and develop attractive business models for the network/service providers to stimulate and motivate cooperative networking among users and between heterogeneous networks.

## Impact

GREEN-T commits to the creation of tangible outputs, which includes not only implementations and showcases, but also inputs to standardisations and regulations whenever applicable, such as contributing to, future editions of the ERO (European Radiocommunications Office) workshops on SDR/CR, and finally through creation of commercially exploitable intellectual property. By definition, GREEN-T is a research not a development project – however with having a rather large number of SMEs and industry – with a clear scope for commercial exploitation of the project outcomes.

GREEN-T plans to contribute to different standardisation bodies, including but not limited to ETSI AFI ISG, Femto Forum, IETF-IRTF, and 3GPP standardisation body's LTE and LTE-Advanced projects. In addition, the industrial partners of GREEN-T (Huawei and Portugal Telecom Inovacao) intend to integrate the innovations in the project in their commercial products, whenever possible.

## About Celtic

Celtic is a European research and development programme, designed to strengthen Europe's competitiveness in telecommunications through short and medium term collaborative R&D projects. Celtic is currently the only European R&D programme fully dedicated to end-to-end telecommunication solutions.

**Timeframe:** 8 years, from 2004 to 2011

**Clusterbudget:** in the range of 1 billion euro, shared between governments and private participants

**Participants:** small, medium and large companies from telecommunications industry, universities, research institutes, and local authorities from all 35 Eureka countries.

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