Project Achievements

CELTIC Telecommunication Solutions

Spectrum and energy efficiency in 4G communication systems and beyond

SPECTRA project aims at combining new cognitive radio algorithms with innovative approaches on Radio Frequency (RF) front-end and base band components. It brings novelties in key areas related to interference-limited and energy-efficient systems and demonstrates them on a developed proof-of-concept able to communicate cognitively in real time.

Main focus

The development of future wireless communications technologies raises some challenges in terms of energy efficiency and flexibility in the use of the spectrum resources. To address the corresponding challenges, SPECTRA project intended to design and validate new techniques for the global efficiency of wireless systems. More specifically, the following five major research topics have been investigated:

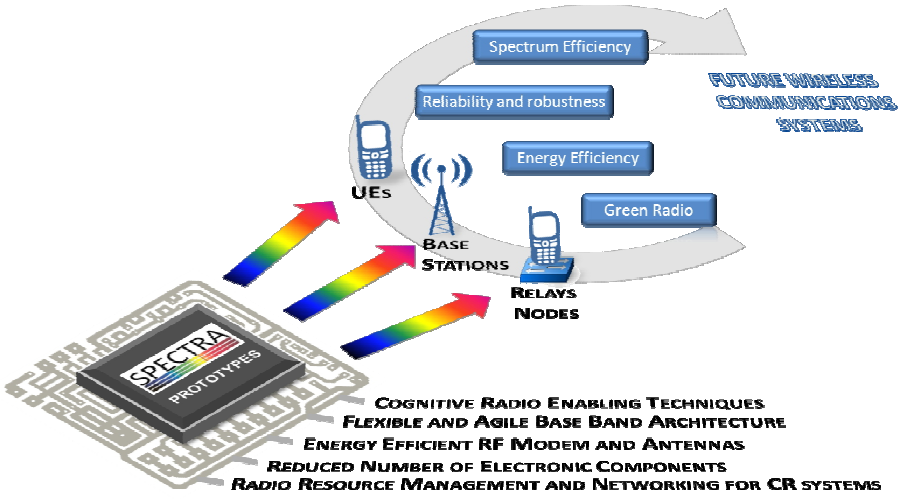
- Spectrum efficiency thanks to the use of cognitive radio techniques in wireless systems.
- Minimization of the number of electronic components thanks to agile RF architecture, versatile analogue/digital conversion and flexible base band architecture.
- Energy optimisation for wireless communication terminals by optimizing architecture design and algorithms implementation.
- Minimization of the generated interference in the environment by selecting the adequate band which can guarantee the shortest transmission distance and the minimum power consumption while preserving high Quality of Service.
- Reliability and robustness of communications, especially when related to public safety operations.

Approach

SPECTRA approach to fulfill the previously described objectives was organized in three phases:

In a first phase, SPECTRA refined the targeted scenarios and elaborated the system specifications by taking into account medium-term use cases and constraints of real systems. On this basis, the functionalities to be implemented in the proof of concept and the associated hardware requirements were derived.

In a second phase, enabling techniques based on cognitive radio principles were analyzed and developed: they cover in



SPECTRA

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Project ID: CP7-013

Start Date: 1 September 2010

Closure date: 31 August 2014

Partners:

CNRS-LEAT, France

Eurecom, France

INDRA Sistemas SA, Spain

Institut Mines Telecom, France

Monaco telecom, Monaco

TeamCast Technology SAS, France

Thales Communications & Security SAS, France

Co-ordinator:

Lorenzo Iacobelli

Thales Communications & Security SAS, France

E-Mail: lorenzo.iacobelli@thalesgroup.com

Project Website

www.celticplus.eu/projects/celtic-projects/call7/SPECTRA/spectra-default.asp

http://spectra-celtic.eu/

particular mechanisms for joint optimization of separate frequency bands, and radio resource management and networking. In addition, technology enablers at the transceiver design level, such as Software Designed Radio (SDR) approach, have been targeted to realize the base band and the RF architectures, including the antenna sub-system. Base band / RF co -design techniques have also been investigated to minimize the consumption and to allow the use of less demanding components.

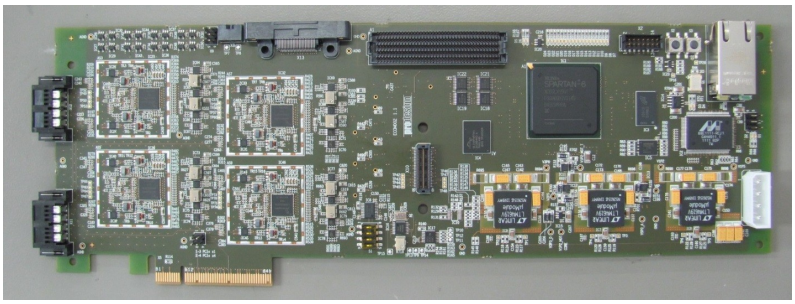
Finally, the third phase focused on system integration and validation, including real-time trials taking into account the inputs of first step, but also the constraints of real systems to validate cognitive radio concepts in a propagation environment reflecting the salient features of the chosen scenarios.

Achieved results

The main outcome of the SPECTRA project is the realization of a proof of concept able to communicate cognitively in real time.

On the hardware side, two different prototypes have been developed in order to cope with energy efficient Cognitive Radio sets in different scenarios. These prototypes included technological features developed all along the project, such as: compact multiband dual polarized multiple antennas, multi-port RF receiver front-end and flexible RF transmitter front-end from Digital to Analog Converter to Power Amplifier. These platforms are able to receive and transmit real-time signals for wireless systems (Cognitive Radio or not) in at least two different frequency bands.

In particular, LTE-based signals have been selected for validation of the proof-of-concept communications: validation tests also showed the capability of the main prototype to communicate with commercial equipment, demonstrating its full compatibility with currently deployed systems.



Software components have also been developed, from physical layer to applicative layers, including sensing and access techniques for cognitive radio, as well as Radio Resources Management mechanisms.

SPECTRA outcomes showed the feasibility of introduction of cognitive radio-based equipment and techniques in commercial networks and the benefit that can be obtained both from user and network provider perspective. Presentations have been done in conferences and standard meetings to support the concepts demonstrated by SPECTRA.

Finally, on the basis of the developed proof-of-concept several prototypes have been sold to companies and research centres. This is expected to lead to the development of a real product out of the prototype. Moreover the developed techniques and components, taken individually, have the potential to be integrated in mobile equipment to realise future products.

Impact

SPECTRA enabling techniques are expected to be exploited in the short term in the development of products, since the benefits that they can bring from a commercial standpoint are clear:

- In a Femtocells deployment, SPECTRA solutions will be integrated to deployed femtocells to reduce the wireless traffic from users to primary Base Station and hence improve the energy efficiency and the Quality of Service.
- In scenario relay deployment, relays will benefit from SPECTRA techniques to improve the quality of service of User Equipments at cell borders, decrease energy consumption for a given amount of communications or improve overall cell capacity.
- In a public safety scenario, energy efficiency and spectrum flexibility optimization provided by SPECTRA techniques will be associated to robustness and reliability required by high-end applications.
- To confirm the interest of the achieved results for the market, the cards developed in the frame of the proof-of-concept development have already found a market and have been purchased by industrial companies, operators and R&D centers (Agilent China, Orange labs, Alcatel Lucent…).

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.

Celtic Office

c/o Eurescom, Wieblinger Weg 19/4,
69123 Heidelberg, Germany

Phone: +49 6221 989 405, e-mail: office@celtic-initiative.org

www.celtic-initiative.org

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