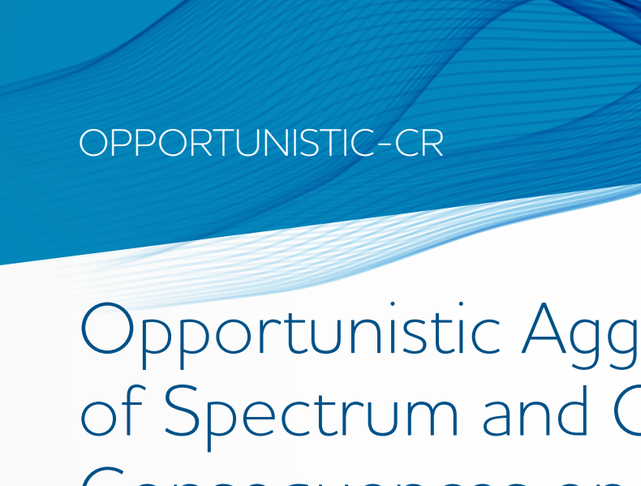
Opportunistic Aggregation of Spectrum and Cognitive Radios: Consequences on Public Policies

OPPORTUNISTIC-CR addresses several open problems in Cognitive Radio, namely the design of efficient cross-layering approaches for physical and MAC layers, the allocation of resources in a scenario where the bands can be shared by the different users as well as the parameterization of spectrum sensing schemes.



PROJECT WEBPAGE URL

http://www.it.pt/project_detail_p.asp?ID=1433

http://www.e-projects.ubi.pt/opportunistic-cr/

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Funding Agencies

Fundação para a Ciência e Tecnologia	40.401€
Start Date	01-01-2011
Ending Date	01-12-2013

Indicators

Journal Papers	17
Conference Papers	34
Concluded PhD Theses	3
Concluded MSc Theses	3

Two Main Publications

O. Cabral, F. Meucci, A. Mihovska, F.J. Velez and N.R. Prasad, **"Integrated Common Radio Resource Management with Spectrum Aggregation over Non-Contiguous Frequency Bands",** Wireless Personal Communications, vol. 59, no. 3, pp. 499-523, Aug. 2011 (available online DOI: 10.1007/s11277-011-0242-6).)

M. Luís, A. Furtado, R. Oliveira, R. Dinis, L. Bernardo, "**Towards a Realistic Primary Users' Behavior in Single Transceiver Cognitive Networks",** IEEE Communications Letters, vol. 17, no. 2, pp. 309-312, Feb. 2013 (available online DOI: 10.1109/LCOMM.2012.121912.122175).

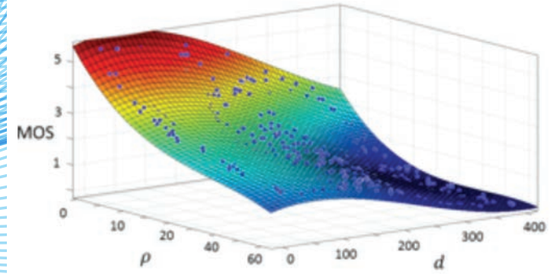

Fig. 1 Quality of experience as a function of the delay and information loss for audio applications

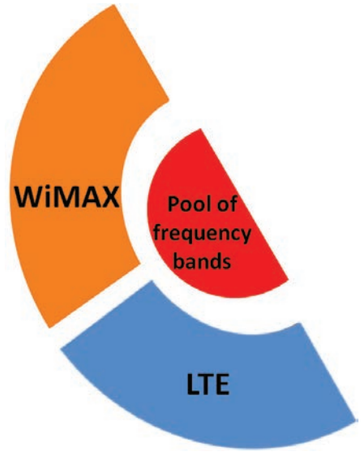

Fig. 2 Pool of frequency band in the context of dynamic spectrum access

GENERAL MOTIVATION AND OBJECTIVE OF THE PROJECT

Recent traffic forecasts of the International Mobile Telecommunications (IMT) market expect strong growths in the next decade. Given the reality that, currently, the licensed part of the radio spectrum is poorly utilized, this situation will only get worse unless we find new practical means for improved utilization of the spectrum. While substantial technological developments are expected to improve system capabilities of Next Generation Networks (NGNs), additional spectrum flexibility is needed to accommodate the predicted traffic growth for mobile/wireless communications and other services. One key enhancement feature for the next generation of wireless mobile networks is the support of higher data rates. In this sense, spectrum aggregation (SA) is attractive because it allows operators to deploy a system with larger bandwidth by aggregating several smaller contiguous or non-contiguous parts of the spectrum while providing backward compatibility to legacy users. The OPPORTUNISTIC-CR (PTDC/EEA-TEL/115981/2009) FCT project is a 3-year partnership between Instituto de Telecomunicações - Covilhã and Instituto de Desenvolvimento de Novas Tecnologias (UNINOVA/FCT/UNL) that started in January 2011. The objectives to be accomplished include physical and MAC layer aspects of cognitive radio (CR) systems, exploring advanced algorithms for multi-band access/selection, envisaging optimizing the offered capacity whilst maintaining the user service experience acceptable.

CHALLENGE, SPECIFIC ROLE OF THE IT TEAM

In CR systems an existing network of licensed users, named primary users (PUs), have the priority to use a set of pre-defined licensed spectrum bands, while a set of non-licensed users, named secondary users (SUs), opportunistically exploit unused portions of the spectrum avoiding causing interference to PUs, improving the quality of experience. Besides underutilization, the current problem of spectrum needs a different approach to enable the bandwidth required by IMT-Advanced (IMT-A) systems.

The concept of SA consists of exploiting multiple small spectrum fragments simultaneously (aggregation) to yield to a (virtual) single larger band and ultimately deliver a wider band service. Furthermore, SA allows that new high data rate wireless communication systems can coexist while reusing the spectrum of legacy systems.

MAIN WORK DESCRIPTION

During the first two years the research has been addressing several open problems in CR, namely the design of efficient cross-layering approaches for physical and MAC layers, the allocation of resources in a scenario where the bands can be shared by the different users and the parameterization of spectrum sensing schemes. The interference to PUs was also characterized for a CR network where the SUs are equipped with single-radios, providing important information about the interference caused to PUs and the maximum throughput achieved by the SUs. Significant advances were also made in the design of resource allocation schemes for a scenario where a pool of different bands can be shared by several SUs. Based on the proposal of a framework for the efficient integration of functionalities for dynamic spectrum use (e.g., SA) the research team has also analyzed opportunistic load and spectrum sharing aspects and its energy efficiency. The research team is now trying to figure out how to design optimal channel allocations policies according to the communication needs of SUs and the transmission opportunities observed in the channels. A proof-of-concept is currently being developed for a distributed CR network with GNU Radio Universal Software Radio Peripherals, which will incorporate most of the main achievements of the project.

TECHNICAL ACHIEVEMENT OF THE IT TEAM

Besides addressing efficient cross-layering approaches for physical and MAC layers, a framework has been proposed for the efficient integration of functionalities for dynamic spectrum use (e.g., SA) and integrated common radio resource management in the scope of IMT-A candidate systems.