Sensor Network for Dynamic and Cognitive Radio Access

SENDORA project develops a new approach of Cognitive Radio called Sensor Network aided Cognitive Radio in which a sensor network assists the cognitive radio actuation by monitoring the spectrum use. This project is led by Thales, Eurecom, NTNU, Telenor, KTH, TKK, Universities of Rome, Valencia and Linköping.

At A Glance: SENDORA

SEnsor Network for Dynamic and cOgnitive Radio Access

Project Coordinator

Bertrand MERCIER

THALES Communications

Tel: + 33 1 46 13 32 27

Fax: + 33 1 46 13 22 55

Email: bertrand.mercierb@fr.thalesgroup.com

Project website: www.sendora.eu

Partners: *Thales Communications (FR), Institut Eurecom (FR), Royal Institute of Technology - KTH (SE), Helsinki University of Technology - TKK (FI), Norwegian University of Science and Technology - NTNU (NO), Telenor ASA (NO), University of Valencia (ES), Università degli Studi di Roma "La Sapienza" (IT), Linköping University (SE)*

Duration: *Jan,2008 – Dec,2010*

Total Cost: *€5.63m*

EC Contribution: *€3.84m*

Contract Number: INFSO-ICT-*216076*

Main Objectives

Following current trends towards dynamic spectrum allocation and cognitive radio, SENDORA project develops a new approach to support the coexistence of licensed and unlicensed wireless users in a same area.

The capability to detect spectrum holes, without interfering with the licensed network currently in use, is the major difficulty faced today by the cognitive radio, even more when fine granularity of allocation in time and frequency is targeted. The key innovative concept developed in SENDORA is the "Sensor Network aided Cognitive Radio" technology, which allows to solve this issue thanks to the introduction of sensor networks. This concept is a system approach that involves a set of advanced wireless communications techniques like spectrum sensing, interference management, cognitive radio reconfiguration management, cooperative communications, end-to-end protocol design and cross-layer optimisation. All these enabling techniques together form a compound system able to improve the spectrum use in a significant way.

The key innovative concept developed in SENDORA is the Sensor Network aided Cognitive Radio

SENDORA project targets three major objectives:

- the identification and analysis of the business scenarios of the Wireless Sensor Network (WSN) aided Cognitive Radio technology
- the definition and simulation of the WSN aided opportunistic access and dynamic resource allocation strategies for cognitive radios, which first requires a detailed work on the enabling techniques
- the design of a flexible and reconfigurable architecture, and a demonstration through a proof-of-concept of the WSN aided Cognitive Radio technology

As SENDORA covers a broad range of current topics of interest in wireless communications, a project at European level is required to achieve these objectives. A link with regulation authorities and standardization bodies is also necessary due to the expected changes in the way the spectrum will be managed in the future.

Beyond the limited current state-of-the-art on cognitive radio, the proposed concept will allow to address a very dynamic and competitive mixed radio access between cellular and broadband technologies.

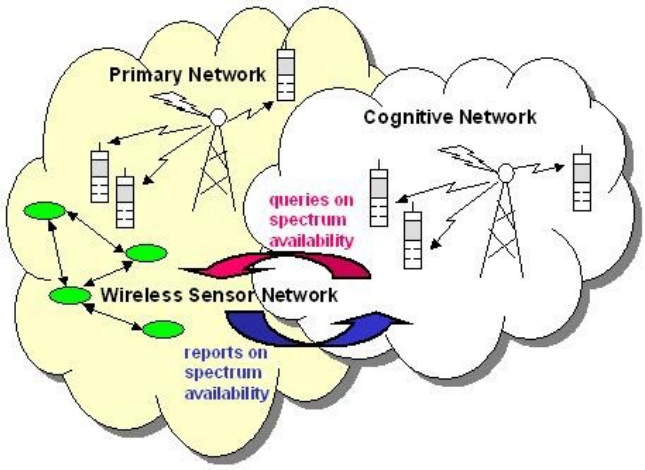
Technical Approach

SENDORA is divided into 8 Work Packages (WP). WP1 is dedicated to management activities. WP2 details the targeted scenarios, thus providing requirements for the other WP. The enabling techniques are then addressed in WP3-WP6. As the project considers the Sensor Network aided Cognitive Radio as an integrated system, strong interactions between these WPs have been identified.

WP3 is dedicated to spectrum sensing, that is, the design of new robust spectrum sensing algorithms, whose detection power will be enhanced by processing data from several sources in order to perform distributed detection of the primary licensed users.

WP4 addresses the cognitive actuation. The objective is to achieve an improved understanding of the cognitive radio control actuation loop that will become a key module of the radio terminal.

WP5 is dedicated to the collaborative communications within the sensor network. Novel physical layer cooperative transmission techniques will be designed, by modifying various approaches like Virtual Beamforming, Amplify & Forward, Decode & Forward, Compress & Forward.



WP6 is dedicated to the design of the end-to-end protocol stack of the sensor network, to allow data gathering and spectrum monitoring. The design and evaluation of a complete, cross-layer optimised protocol stack for end-to-end query dissemination and data gathering in the wireless sensor network will be addressed.

WP7 will address the integration of these enabling techniques and the demonstration of the concept in a realistic environment. A radio demonstrator will be developed, based on two hardware platforms: one platform dedicated to digital signal processing, and one RF platform with frequency agility. The foreseen demonstration will use a WiFi primary network as test-bed environment. The traffic will be analyzed and the degradations caused by the cognitive network will be measured. The improvements in the spectrum use will be also monitored.

WP8 is dedicated to dissemination activities.

Key Issues

Cognitive radio aims at improving the way the radio spectrum is utilized. Today's approach is based on dividing the spectrum into small pieces, each for a specific purpose. Since the applications use their spectrum to a limited extent, this leads to the unwanted situation of under-utilization of this scarce radio resource. While radio communications grow constantly, regulation authorities recognise that the current approach is reaching its limits. Consequently, cognitive radio and dynamic spectrum allocation are becoming key technologies and key research activities in the field of wireless communications.

SENDORA addresses this key issue and proposes a new approach and innovative techniques to support the coexistence of licensed and cognitive wireless users in a same area.

Expected Impact

The cognitive radio concept is expected to become the most important technique able to improve the efficiency of the radio spectrum use. It will represent a key technology on the way to future high-capacity wireless communications networks, and thus major impacts are expected.

In order to make the concept of cognitive radio applicable, the findings of SENDORA will provide inputs to standardization groups and regulation authorities. The project will thus contribute to the development of global standards for future networks.

An impact on the competitiveness of European telecommunications industry and academia is also expected. Indeed, the results of SENDORA will help them to take a strong position in the development of key technologies for future wireless broadband services. Hence, SENDORA will help reinforcing European industrial strengths in wireless networks and developing stronger synergies between the various actors of the sector.

New services and business opportunities are also expected to emerge from the cognitive radio concept. The scenarios and use cases considered in SENDORA will help to identify new industrial opportunities in Europe, for instance in the field of the Internet technologies.