



COST

***Cognitive Radio and Networking for Cooperative
Coexistence of Heterogeneous Wireless
Networks***

IC0902

Start date: 11/12/2009

End date: 10/12/2013

Maria-Gabriella Di Benedetto

Chair, Sapienza University of Rome, Italy

Jocelyn Fiorina

Vice Chair Supélec, France



Scientific context and objectives (1/2)

- **Background / Problem statement:**

Significant research efforts that focus on flexibility in spectrum management are currently underway in Europe and worldwide

Open research issues cover a wide range of aspects, such as: 1) Designing hardware for reliable spectrum sensing: this is fundamental to unlicensed secondary systems operation; 2) Defining algorithms for efficient, dynamic link adaptation; 3) Designing protocols for cooperation in spectrum sensing and sharing; 4) Defining network functions, such as routing and admission control, that incorporate internal and external network status; 5) Defining communication and representation languages for cognitive information exchange

This Action proposes to address these challenges, and therefore to bring a significant and practical contribution to the development of cognitive engines for wireless communications

- **Brief reminder of MoU objectives:**

The Action proposes to address the above challenges, and bring a significant and practical contribution to the development of cognitive engines for wireless communications by:

- Coordinating research and development activities in the field of flexible spectrum use, spectrum sharing, and intersystem coexistence, based on cognitive radio and cognitive networks
- Defining a European platform for cognitive radio and networks based on a cross-layer design approach encompassing all layers of the protocol stack
- Active participation and impact on the standardization activities and regulation processes inside and outside Europe
- Formation of Early Stage Researchers towards the development of a new generation of researchers in the field of cognitive radio



Scientific context and objectives (2/2)

The Action addresses the following five key Technical Challenges (TCs)

- TC1 Definition of cognitive algorithms for adaptation and configuration of a single link according to the status of external environment
- TC2 Definition of cooperative cognitive algorithms based on information exchange at a local level:
 - Design of cooperative spectrum sensing algorithms
 - Design of cooperative relaying schemes
 - Design of advanced network coding schemes
- TC3 Definition of network-wide mechanisms:
 - Design of admission control strategies
 - Design of routing protocols
- TC4 Definition of mechanisms for intersystem coexistence and cooperation
- TC5 Definition of the cross-layer cognitive engine
- AND
- Definition of a representation language for the exchange of information between the application layer engine and lower layers; such language must be able to describe concepts and variables related to all aspects of the device, from radio parameters to network performance indicators, to application requirements
- **A unique contribution of the Action is the creation of a reference for experimental testbeds and platforms for cognitive radio, collecting and organizing inputs from all over Europe and worldwide: creation of a blog and a wiki <http://newyork.ing.uniroma1.it/IC0902/CognitiveTestbeds>**



Working groups

Working Groups (WG) map 1 to 1 the Technical Challenges:

WG1 - single link adaptation, such as spectrum sensing, measurement and shaping, and interference suppression

WG2 - definition of cognitive mechanisms taking advantage of cooperation of devices in spatial proximity, according to the research issues identified as part of TC2

WG3 - extension of cognition from the single network device to the whole network

WG4 - intersystem cooperation and coexistence under both technical and standardization/regulation points of view

WG5 - introduction of cognition in devices above the network layer, exploring the definition of a cross-layer cognitive engine.

Several research topics encompass Technical Challenges. We have formed for now 3 Special Interest Groups:

SIG1 - Information representation languages

SIG2 - Learning and artificial intelligence

SIG3 - Mobility management for cognitive wireless networks

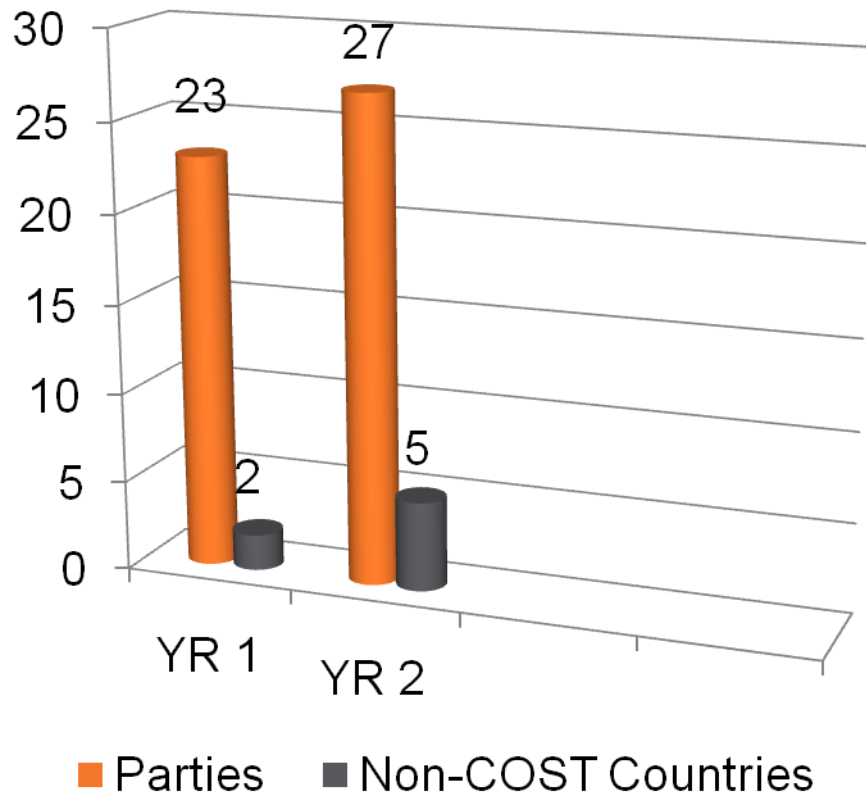
SIG4 - Positioning



Challenges

- WG1 and WG2 are the most scientifically consolidated ones. When cognitive concepts must impact networks and cross-layer engines, this corresponds to embryonic research, as occurs in WG5 where there appears to be a slower set-up of the activities. Speed-up should be triggered by the new outcomes from WG1 and WG2. In order to help this process we have decided in the Action to have an industrial co-leadership of WGs. This intention was pursued and successful and right now we do have an industrial co-leader for all WGs.
- A very useful activity has been launched: the creation of a common platform for experimental testbeds in order to exchange, implement and experiment the theoretical algorithms.

Action Parties

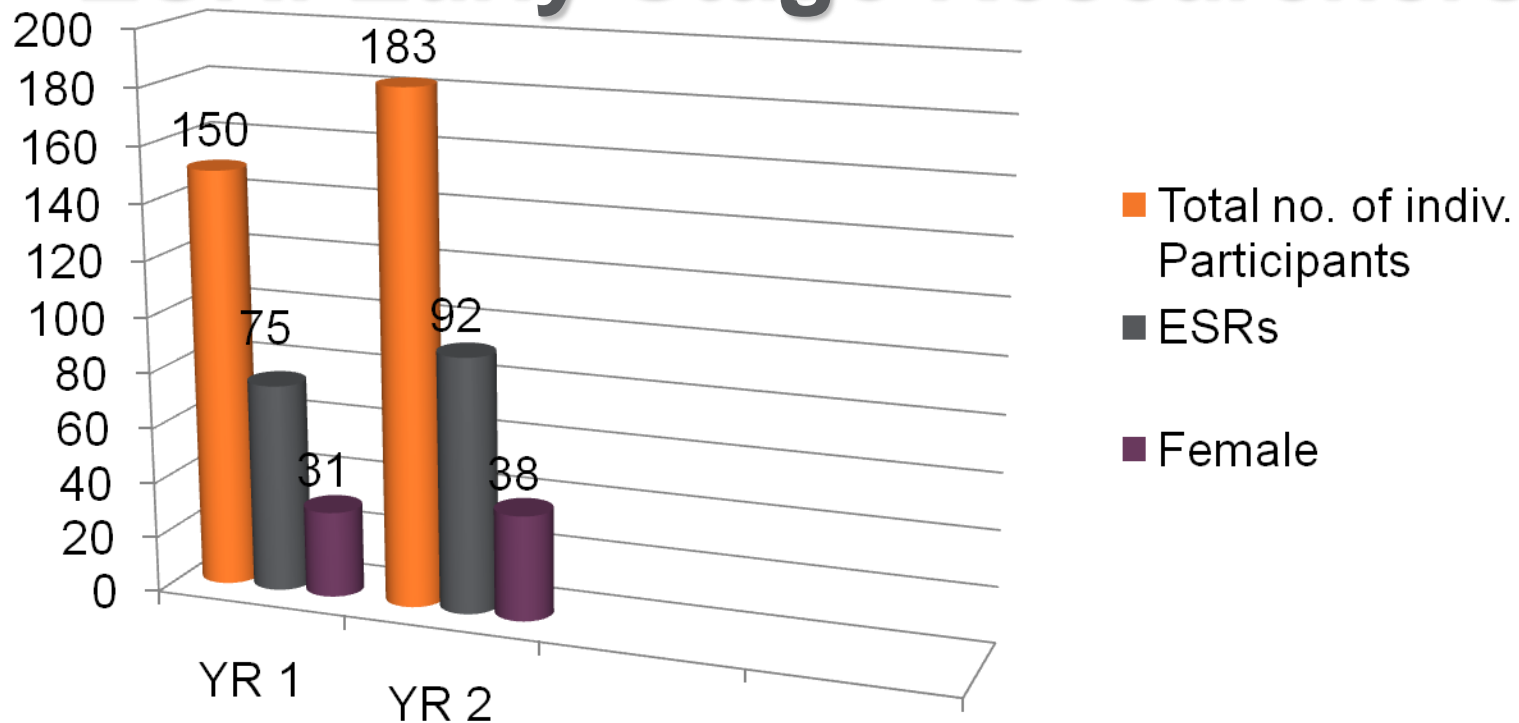


Participating parties

Currently: **27 COST countries and 5 non-COST** (US, China, Australia, Canada, Ispra EU center)

Action participants: number of researchers involved

ESR: Early Stage Researchers



Use of COST Instruments

Activity (No.)	Year 1	Year 2	Year 3	Year 4
MC/WG Meetings	2	1 +1 in Oct.		
STSMs	2	3		
Training Schools	0	1 in July		
Workshops or Conferences	1	1 in Oct.		
Joint Publications	11	6+...		

Our action relies on all the possible instruments, two more STSMs were planned to happen in the first year but have been put on the second year for administrative reasons. The workshops are important meeting points to present the technical contributions.