NEWSLETTER

http://www.ic1004.org

Cooperative Radio Communications for Green Smart Environments

Number 1, March 2012

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COST IC1004 Chairman: Narcis Cardona, Univ. Politecnica Valencia, Spain

Editorial

IC1004 is a european COST Action (www.cost.eu) on **Cooperative Radio Communications for Green Smart Environments**. A Smart Environment (SE) is a physical space populated by sensors, actuators, embedded systems, user terminals and any other type of communicating device, which cooperatively pursues given tasks by exchanging information and share all types of resources such as radio spectrum or energy. Radio communications clearly constitute an essential element of SEs, for which important concerns such energy efficiency, connectivity, reliability and economy are paramount to their successful development and penetration into our daily lives. This is why a "green" approach is strongly necessary.

Examples of SE can be found in domains such as health (body area networks), transports (smart cars), energy (smart metering) and many others. They often constitute specific environments with their own requirements and constraints and therefore must often be treated specifically.

The radio channel is central to the paradigm of GSEs. It can be seen as a resource (the physical support to information exchange) and as a limitation when channel impairments forbid fast and error free delivery of data. SE, through their specificities and sometimes the complex character of the radio propagation, are in this respect less known than other media such as land or satellite propagation media. The optimal exploitation of this resource through its study and modeling, through the development of cooperative transmission techniques and through the design of self-organizing and energy efficient protocols and algorithms, is the major goal of IC1004.

The Action heavily elaborates over the past one COST 2100 and its predecessors (COST 273, COST 259, COST 231, COST 207), whose incredibly stable success for nearly three decades is a strong encouragement to pursue this european collaboration into IC1004 for 4 more years. Let me hope that you will find in this newsletter enough reasons to join us in this encouragement or even join us in the Action.

Alain Sibille

Chairman's Address

Dear Colleague:

It is my pleasure to open this first issue of the IC1004 Newsletter after 9 months of activities of this COST Action.

Every COST Action is intended to be a scientific networking framework, an open forum for discussion, an instrument to coordinate research activities, to meet colleagues and to establish new relations between institutions and companies around a common research topic. And this is exactly what IC1004 is from its very beginning. What makes the difference in IC1004 is the dimension of the Action, in many senses: the number of registered participants (>230), the technical documents discussed so far (210), the links established to other projects and bodies, and the involvement of 37 countries, 9 of them out of the EU. This big group of colleagues is at the same time well balanced in terms of the industries involvement, the increasing participation of women and the contributions and responsibilities of early stage researchers.

At the end of the first year period, the training and dissemination activities organized is also huge, making many researchers in and outside the Action take benefit of the knowledge generated by the IC1004 participants. To mention the most relevant activities, apart from the three technical meetings celebrated so far, IC1004 has organized two tutorials, one training school on Vehicular Connectivity, a workshop on Cooperative Small Cells, a joint training school on Body Communications, and 10 special sessions in international conferences like EuCAP, FuNeMS, ICC, European Wireless, URSI-ISSSE, CEMA and CAMAD.

Only the commitment of many colleagues have made possible to keep this Action running and to reach the current status of organization and the start up of numerous scientific networking activities already performed and scheduled. My sincere gratitude to the Steering Board and the Technical Committee of IC1004.

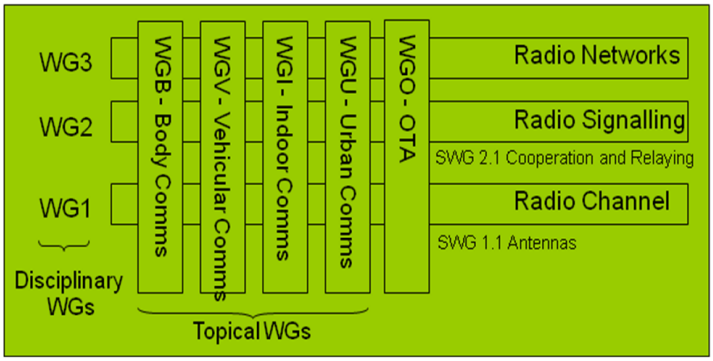
Enjoy the reading !

Narcis Cardona

Highlights

IC1004 started on January 2011 and will end on May 2015. The structure of the Action is based on a matrix approach, elaborating on the idea that (vertical) Topical Working Groups (TWGs), which address specific SE, need to be supported by Disciplinary Working Groups (DWGs), whose role is to carry out wireless communications wide research from the lowest physical layers up to wireless networking.

After the kickoff meeting on 19 May 2011, 3 Management Committee Meetings (MCM) have already taken place, resulting in the presentation of 208 Technical Documents (TD). We highlight below some of the directions and early results of the working groups.



The Topical Working Group on **Body** Environment (WGB) mostly deals with Body Area Networks (BAN) research. Many works address channel modeling for BANs, including on-body, off-body and in-body scenarios and antennas for BANs. Statistical models for antenna and channels are developed and, based on them, cooperative PHY/MAC protocols for BANs are now designed owing to the excellent collaborations between several of the laboratories active in WGB.

The Topical Working Group **Indoor** (WGI) brings together expertise from the disciplinary WG towards indoor environment research needs. Early contributions have focused on 3 topics: one is indoor wireless localization, with new solutions coming up based on ultra wideband techniques and passive (device-free) sensor networks. The second is 60 GHz where consolidated indoor channel measurements and modeling works are jointly performed and discussed between several research groups. The third, energy efficiency and traffic sharing for femtocells and LTE networks, is expected to be one of the key subject of the upcoming workshop on “Small Cell Cooperative Communications” organized by IC1004 in May 2012 (see below).

Vehicular communications (WGV), similarly to the other TWG, address combined radio channel and PHY/networking aspects. Recent works provide realistic simulations in urban environments from ray tracing and PHY layer models for e.g. vehicle-to-vehicle scenarios on highway and in cities. Novel ideas such as relayed radio channels are being explored and measurement campaigns carried out accordingly. WGV will contribute to a training school (TS) for Vehicular Connectivity, which is organized at FTW in Vienna (May, 21-23, 2012, see below).

The TWG on **Urban Communications** (WGU) deals with the coexistence of different RATs (GSM, UMTS, LTE, …) and cell types (Macro, Micro, Pico, Femto). The first goal is to establish reference simulation scenarios allowing detailed system simulations including 3D buildings shapes, land-use classes, user mobility, different cell types and frequency bands. Energy efficiency and performance enhancement of wireless networks is one of the key topics. Another one is smart cities, with mesh networks including a huge number of nodes that permanently measure and deliver data to increase the quality of life. WGU is also interested in various multiple antenna technology including colocated and distributed MIMO.

WGO (MIMO OTA) focuses on the assessment and the contribution to standardization of test methods for multiple antenna terminals, expected to penetrate the market very soon with the deployment of 4G networks. The complexity of terminals whose performance deeply involves antennas and signal processing and is impacted by the channel characteristics, requires hard work on the best way to evaluate this performance in an economical, reproducible and efficient manner. A world level cooperation has been engaged on this topic (already within COST 2100), with this group of IC1004 playing a key role.

The **Radio Channel group** (WG1) will target the extension of the previous COST models (COST 273, COST 2100), in order to seamlessly integrate multiple environments (from body to outdoor), therefore relying on the research carried out at the topical level. The migration from a base-station centric approach to a more flexible model including peer-to-peer aspects will be one of the main challenges. A new aspect of IC1004 in radio channel modeling with respect to past actions is the emergence of hybrid methods, involving the application of numerical electromagnetic methods for system-oriented channel models.

SWG 1.1 on **antenna system aspects (ASA)** specifically develops models and methods for enhancing the performance of single and multiple antenna terminals. As opposed to the traditional antenna design approach of satisfying requirements defined by antenna parameters, ASA adopts a holistic approach, in which the emphasis is the impact of the antenna system as well as its interaction with the surroundings on the overall communication system performance.

Radio Signalling (WG2) considers physical layer techniques applicable across smart environments in general, including MIMO signalling, coding and modulation. A sub-working group (SWG2.1) on **physical layer cooperative techniques** has also been established, covering relaying, 'virtual MIMO' and wireless network coding, and in general to advance the application of the network-aware physical layer in wireless networks.

Radio Networks (WG3) mainly address the design of future networks and the resource management for smart environments, with increasingly complex scenarios, a high node density, heterogeneous devices and air interfaces, different frequency bands, network protocols and technologies. This concerns in particular LTE and LTE-A deployment considering scheduling, techniques to improve channel state information, admission control, cooperative multi-point Trx and traffic re-distribution in femto-cells. Resource and Spectrum Management as well as Opportunistic Spectrum Access for a wide spread of different Radio Technologies are also at the heart of WG3 research.

Selected scientific topic: "Non-Coherent and Semi-Coherent Denoise-and-Forward Schemes for Two-Way Relaying", *by Zoran Utkovski and Petar Popovski* (TD(12)03026)

It is known that bi-directional (two-way) communication between the terminals in a network with relays assisting the communication increases the spectral efficiency of the network. However, with the benefit of higher throughput comes the burden of more overhead as well as an increased effort in channel estimation. Most schemes for relaying require prior knowledge on the channel at the terminals and at the relays. In contrary to these schemes, we look at scenarios where either no channel knowledge, or only partial (realistic) channel knowledge is assumed. We denote these scenarios as non-coherent and semi-coherent, respectively. We combine the paradigm of subspace-based communication originally developed for non-coherent point-to-point channels, with two-way relaying schemes based on denoise-and-forward (DNF). DNF is a form of wireless physical layer network coding scheme where the relay does not jointly decode the signals from the terminals, but it maps the received signals into symbols from a discrete constellation and broadcasts. The aim of this work is to demonstrate that denoising can be performed without any, or at least only with partial channel knowledge.

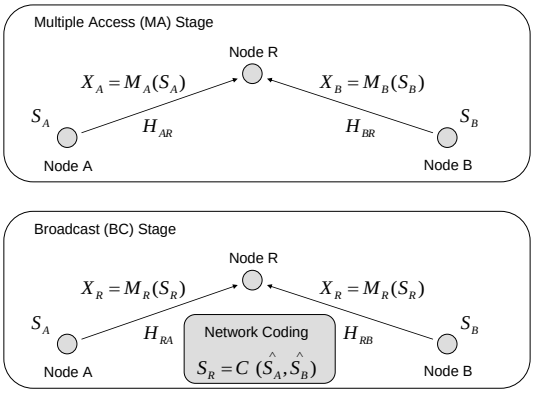


Fig. 1: Denoise and Forward as a form of wireless network coding

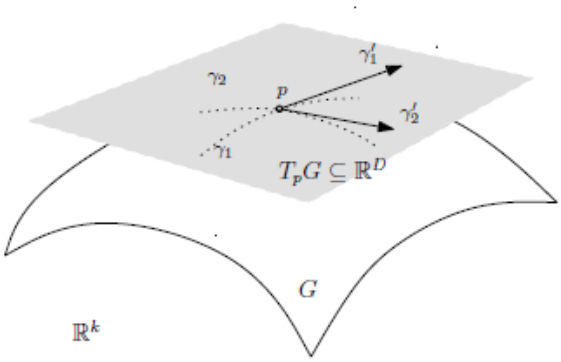


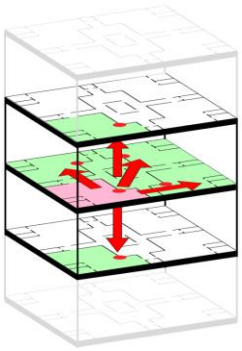
Fig. 2: Subspace-based communication; The coding space is the Grassmann Manifold

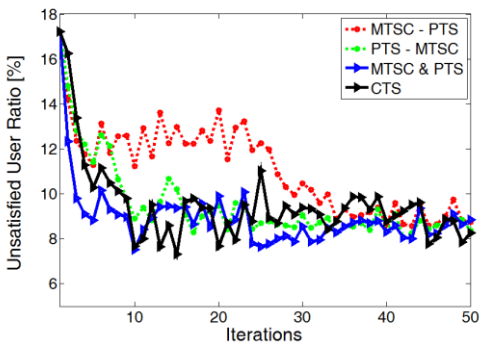
More details from the full paper

Selected scientific topic: "Refined approaches for traffic sharing in enterprise LTE femtocells", *by J. M. Ruiz-Avilés, S. Luna-Ramirez, M. Toril and F. Ruiz* (TD(12)03013)

Femtocells are a promising solution for the provision of indoor coverage and capacity. In this paper, we investigate the problem of re-distributing traffic demand between Long-Term Evolution (LTE) femtocells with open access in an enterprise scenario. We evaluate several traffic sharing algorithms based on automatic tuning of femtocell parameters. Firstly, we consider classical traffic sharing techniques that perfom cell re-sizing by tuning handover margins or femtocell transmit power iteratively. Then, we propose the combination of both techniques to overcome the limitations of individual approaches. Different combination schemes are conceived, ranging from executing the algorithms sequentially to running both in parallel or alternating methods. The proposed algorithms are implemented by fuzzy logic controllers and performance assessment is carried out in a dynamic system-level simulator.

Preliminary results have shown that the proposed methods can decrease call blocking in scenarios with uneven spatial traffic distribution, but some of them deteriorate network connection quality significantly. Having identified interference from the originally congested femtocell as an important limitation, the variation of handover margins has been restricted. Thus, part of the congestion relief effect is achieved while connection quality is kept almost unaltered. Simulation results have also shown that, by making the most of handover margins first, deviation of transmit powers can be kept to a minimum.

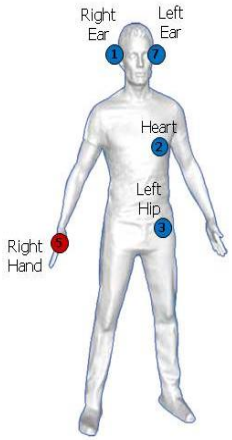


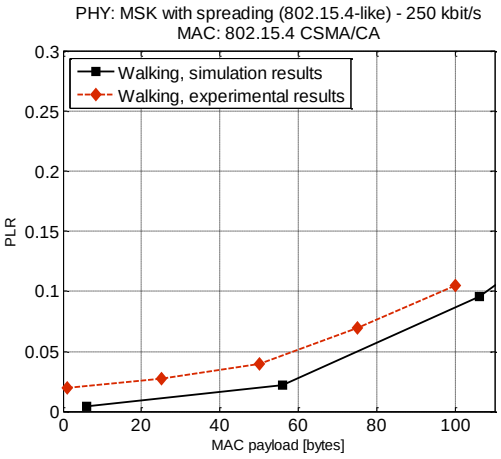


For more details please contact: jmruiz@ic.uma.es

Selected scientific topic: "On-Body Area Networks: from Channel Measurements to MAC Layer Performance Evaluation", *by Ramona Rosini, Flavia Martelli, Mickael Maman, Riccardo Cavallari, Eugenio Guidotti, Raffaele D'Errico, Chiara Buratti and Roberto Verdone* (TD(12)03060)

This work is the result of a collaboration between the French research institute CEA-Leti and the Department of Electronics, Computer Science and Systems (DEIS) of the University of Bologna, carried out in the framework of the IC1004 Action and the FP7 project WiserBAN. Three different Medium Access Control (MAC) for Body Area Networks (BANs) were investigated, by benchmarking their performance in terms of Packet Loss Rate (PLR), average delay and energy consumption.
The innovative aspect introduced in the study is the integration of real channel data in the simulator, to account for the impact of a realistic propagation channel on the system performance. Dynamic real-time BAN measurements were performed at 2.45 GHz, both in indoor and anechoic environments, using different human subjects to consider the human body variability. The reference scenario, used both in simulations and in the measurement campaign, reproduces nodes emulating hearing aids, a cochlear implant, an insulin pump, a cardiac implant and a handset coordinator (Fig. 1).
Numerical results show that the choice of the best performing protocol depends on the performance metric of interest, as well as the channel and the antenna considered. The consistency of simulation results was proven by implementing one of the proposed MAC schemes on commercially available devices. The same trend for the PLR as a function of the data payload was found, showing an excellent agreement between experimental and simulated data (Fig.2).
The results obtained show that the ideal MAC scheme for BANs should be designed the most flexible as possible, in order to adapt it according to the particular application requirements.





For more details please contact: ramona.rosini@unibo.it

Selected scientific topic:

"A contactless evaluation Method on the powering of an Active RFID Tag with On-Chip Antenna",
by Philipp K. Gentner, Guenter Hofer, Arpad L. Scholtz and Christoph F. Mecklenbräuker (TD(12)03054)

A wireless method to power an active tiny transmitter on a tag is inductive coupling, where the energy to power the tag's transmitter is drawn via a small antenna from a radio frequency magnetic field. In this paper, we present a contactless method to determine the voltage delivered by the rectifier of an RFID circuit connected to an on-chip antenna. The chip, with an overall size of 1mm^2, is designed to backscatter energy with a modulation frequency proportional to the voltage delivered by the rectifier. Hereby it becomes possible to investigate inductive coupling between an excitation coil, which is part of a reader, and a coil on-chip, without the need of bond wires or other physical connections to the chip. The chip's operational area at constant heights above the excitation coil, as well as the behavior with increasing distance is measured and discussed.

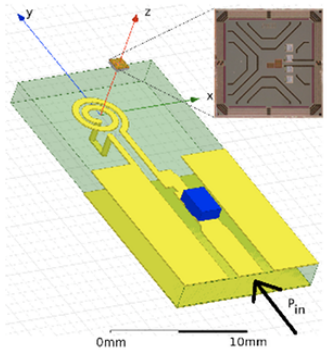


Fig. 1. Inductive coupling scenario. The silicon chip with the OCA is placed in close distance in z-direction directly above the center of the excitation coil. Also a microphotograph of the chip with a 4-turn coil antenna is shown.

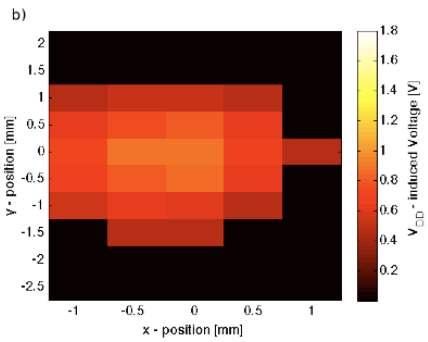


Fig. 4. Measured V_{DD} at a height of z = 1.5 mm above the excitation coil.

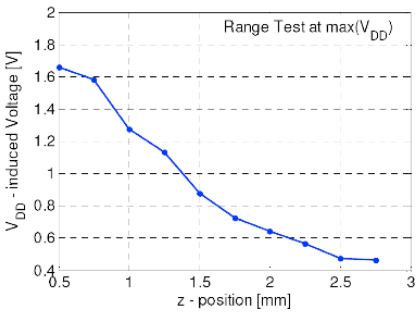


Fig. 5. Range test in z-direction with $P_{in} = 8.6$ dBm at max V_{DD} position.

More details from the full paper

Upcoming events organized or co-organized by COST IC1004

Next Management Committee meeting : Lyon (France), 3-4 May 2012 (participation requires registration to the Action)

March 2012:

- IC1004 special sessions at EuCAP, on "Joint antenna-channel issues in Body Area Networks" and "Novel methods in radio channel modelling for smart environments", Prague (Czech R.) 26-30 March, http://www.eucap2012.org/

April 2012:

- Special session on Wireless BAN at the 18th European Wireless Conference, 18-20 April, Poznan (PL),

June 2012:

- Participation at 2 Special sessions: "Cognitive and Cooperation for Green Networking" and "Cooperative and Cognitive Mobile Networks; International Conference on Communications, Ottawa (Canada) 10-15 June

July 2012:

- IC1004 Special Session (Workshop) on "Cooperative Radio Communications" at Future Network & Mobile Summit 2012, Berlin (Germany) 4 - 6 July

September 2012:

- IC1004 Special Sessions at IEEE ComSoc CAMAD 2012, Barcelona (Spain) 17-19 Sept; http://camad2012.av.it.pt/

October 2012:

- IC1004 Special Session to URSI-ISSSE'2012 Conference, Potsdam (Germany) 3 - 6 Oct;

November 2012:

- IC1004 Special session on "Body Environment Communications" to CEMA'12 Conference, Athens (Greece) 8 -10 Nov.

+About 20 conferences/courses/events with COST participants involved in the organisation: see the COST IC1004 web site

1st COST IC1004 open workshop (joint with the iPlan Project)

The 1st COST IC1004 open workshop **"Small Cells Cooperative Communications"** will take place in Lyon, France, on May 2, 2012. This workshop is intended to serve as a discussion framework on advances on smalls cells technologies, including not only indoor residential femtocells but also rural, enterprise or picocells systems. More details on the aim and scope can be found on the workshop web site.

- Radio propagation simulation tools: indoor, outdoor and hybrids
- Measurements, trials and demonstrators for small cells
- Broadband Femtocell Network architectures
- 3GPP LTE HetNets
- Coexistence between macrocellular and femtocell networks
- Cooperative femtocell networks
- Enterprise femtocells
- Indoor radio propagation models
- Interference management and coordination: (e)ICIC
- Interference modelling, analysis, avoidance, and mitigation
- Mobility support and handover
- PHY/MAC design for 3G, WiMAX, and LTE small cells systems
- Power saving and energy efficient mechanisms in small cells
- Radio network planning tools
- Regulatory aspects
- Resource allocation (RRM)
- Routing algorithms
- Self-organising femtocell networks
- Backhaul load reduction, including distributed compression and network coding
- Trade-offs between femtocells, picocells, relaying and DAS systems

Paper submission:	27 February 2012
Acceptance:	30 March 2012
Camera-ready:	18 April 2012

Chairs: Jean-Marie Gorce (jean-marie.gorce@insa-lyon.fr) and Narcis Cardona (ncardona@iteam.upv.es)

Local Organizer: Guillaume Villemaud (guillaume.villemaud@insa-lyon.fr)

In the context of the workshop, a **Special Issue on Small Cell Cooperative Communications** is going to be edited by **EURASIP Journal on Wireless Communications and Networking**. See http://jwcn.eurasipjournals.com (deadline : June 30)

Training Schools (open to anyone, see http://www.ic1004.org for updated information)

1ST COST IC1004 TRAINING SCHOOL: "VEHICULAR CONNECTIVITY" (VIENNA, AUSTRIA, MAY 21-23, 2012)

General Outline:

- Introduction to wireless propagation;
- Information theory background: Multi-user communications, rate-reliability trade-off, and delay-constrained capacity.
- Vehicular channel characterisation from measurements
- Models for vehicular channels
- Vehicular on-board antennas and RF architecture
- Physical layer design: OFDM and Forward Error Correction
- Multiple access: CSMA/CA and STDMA, MAC layer design
- IEEE 802.11p performance simulation
- IEEE 802.11p performance measurements
- Intelligent Transport System: architecture aspects

Organizer: Christoph Mecklenbräuker (e-mail: cfm@nt.tuwien.ac.at)

Registration: by March 31st, see details on http://www.ic1004.org/index.php?page=1st-training-school

WISERBAN - TRAINING SCHOOL: "WIRELESS BODY AREA NETWORKS" (BOLOGNA, ITALY, JUNE 4-6, 2012)

The training school is jointly organized by the COST IC1004 Action and by the WiserBAN project.

Organizers: C.Buratti (WiserBAN), R.Verdone (IC1004)

Registration: by May 21st via email at secretary@ic1004.org

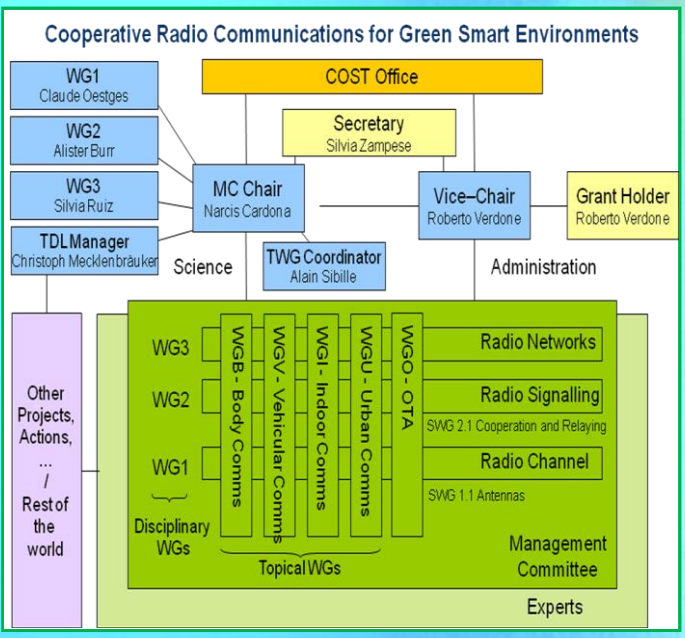
About COST IC1004

COST IC1004 is the Action on **"Cooperative Radio Communications for Green Smart Environments"**, belonging to the ICT Domain of the COST framework (see www.cost.eu). This Action addresses research issues in the field of cooperative radio communications to make our society cleaner, safer and more energy efficient. It started on January 2011 and will end on May 2015. Among many activities, 3 meetings and at least one training school are organized per year.

The Action goals are:

- to increase knowledge of cooperative communications applied to Green SEs (GSEs), by exploring and developing new methods, models, techniques, strategies and tools, in a context enriched by deep industry-academia links
- to play a supporting role to European industry through the focused interest of Working Groups
- to train young researchers in the field of cooperative radio communications for GSEs

All information can be found at http://www.ic1004.org or by contacting the secretariat at secretary@ic1004.org



Facts & Figures

Number of signatories countries: **28**
Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom.

Number of non-COST countries: **7**
Australia, Canada, China, Colombia, Japan, Montenegro, USA

Number of COST country entities (institutes, etc.) currently participating: **94**

Number of non-COST entities (institutes, etc.) currently participating: **9**

Number of MC Members: **51** (+ Chair)

Number of registered experts: **> 230**

Number of meetings / year: **3**

Number of training schools / year: **≥1**

Number of presented TD: **208**

Average number of participants / meeting: **120**