http://www.ic1004.org

NEWSLETTER

Cooperative Radio Communications for Green Smart Environments

Number 6, November 2013

Newsletter Editor: Alain Sibille, Telecom ParisTech, France

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

Editorial

Dear readers,

The availability of spectrum is paramount to the operation of mobile communications, especially now as high data rate services are more and more spectrum-greedy in order to provide the expected performance to an increasingly large number of users. However it is well known that the current "command and control" approach for spectrum allocation is very inefficient in many cases and causes a real waste of this scarce resource. Cognitive radio and various forms of dynamic spectrum access have been investigated for long in academia and among operators, but effective implementation is still to be expected. It is impeded by the lack of suitable regulation, which is a key aspect. Fortunately things seem to be moving. First of all, white space zones for trials are being created, which will help see up to what extent the new techniques are effective in providing a better utilization of the spectrum. Secondly, political initiatives tend to inject momentum into exploiting white spaces. For instance, the regulator Ofcom has recently named industry participants for 6-month trial's in UK. In France, at least one license for TVWS trials has beeen delivered and the Ministry of Digital Ecoomy has missioned an economist to investigate the levers for a more open and efficient spectrum policy, based e.g. on the. "licensed shared access". For sure these initiatives should boost R&D and innovation to implement DSA techniques in 4G and 5G mobile networks. We can anticipate some positive impact on our research in Actions such as IC1004.

Related to that is the entering in force, early 2014, of the new H2020 framework for european support to research & innovation. In our area the 5G PPP will address spectrum efficiency and, being mostly driven by industry members, should steer it towards really operational techniques, able to make the best of the upcoming regulations. Let us hope, again, there will be room for our involvement and commitments in this framework.

Alain Sibille

Chairman's Address

Dear Colleagues,

IC1004 has just crossed its halfway point. The third year of activities started with our successful participation to FuNeMS conference, in Lisbon, where we gave some snapshots on what the Action is about, with five presentations made at the COST special session. More recently, 25th of September in Ghent, we got a great success in the organisation of the Joint workshop on Terminal Antenna Systems for 4G and Beyond, in cooperation with our sister Action IC1102 (VISTA). We couldn't had found better venue for joining the two COST Actions groups of experts, as the naming of Ghent comes in fact from the old Celtic word "confluence", and indeed during the meeting many confluent ideas and complementary approaches to the future of wireless communications systems and technologies have been discussed.

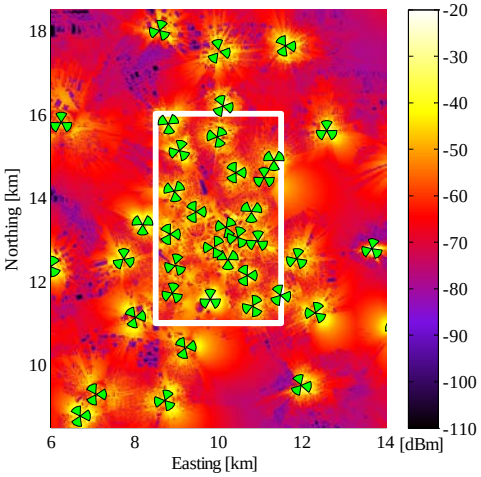
The work in the several disciplinary and topical groups is already around common understanding of models and proposals of standard procedures, scenarios, methods. This is what we expected to happen and, beyond that, the Action has just launched a specific working group devoted to promoting the contribution from IC1004 to standards, mainly but not only about channel models. Results from our external liaisons are also visible already at this stage, with several Training Schools and other dissemination events jointly organised, and being organised in cooperation with other Projects and Actions. To mention the two closer events, IC1004 will be present at the Future Networks 12th FP7 Concertation Meeting, where I am invited to talk about COST Actions in the ICT Domain, and at the COST-TERRA meeting in November, to strength the liaison with IC0905.

Enjoy the reading and be welcome to join us at any of our coming events.

Narcis Cardona

Highlights

One of the active topics in TWG-U is the IC 1004 Urban Hannover Scenario. The first version of this “ready-to-use” simulation environment has been presented (TD(13)08054) during the Ghent Meeting. The scenario consists of a complete LTE network, which has been modelled and predicted with 3D pathloss predictions for the entire city area of Hannover, Germany (see figure on the right). In addition, sophisticated modelling approaches for user mobility patterns and data traffic have been employed. The goal of this activity is to provide a common scenario that ensures the comparability of simulation results, which are based on this scenario. A link to the scenario download page is given in the paper.



Radio Networks Working Group (WG3) work and discussion are focusing on Energy Efficiency techniques applied to a wide number of technologies and networks as HETnets, LTE and LTE-A, cognitive and mesh networks and future 2020 networks. Interference reduction, the use of relays, virtualization, cooperation, network sharing, power consumption, dynamic switching on/off of radio resources have been proposed and analyzed through the different contributions.

Within the Topical WG on indoor (TWGI), several valuable results were presented, such as further validation of the reverberation effect in room electromagnetics. Specifically, the decay of the delay profile is predicted from volume and absorption area of the environment. Such models have been developed in the context of room acoustics and translated to electromagnetics recently. The work presents an experimental validation of these models employing channel measurements. Input parameters have been modified e.g. by opening windows. Other contributions propose to exploit multipath components for indoor localization. Motion algorithms are investigated for simultaneous estimation of receiver and scatterer positions. The tracking of multipath components is achieved through extended Kalman and probability hypothesis density (PHD) filters.

A new sub-working group SWG 1.2 on «Channel modelling contribution to standardisation» has been created. The Chair person has been elected (Tommi Jämsä, Finland). The main goals are as follows:

- Contribute measurement results to 3GPP 3D study
- Focus in the short term on user equipment height and distance dependent elevation parameters and path loss, on the modeling of diffraction
- Concentrate on 5G standards: METIS, LTE-A evolution, WiFi evolution etc.

The 8th MC meeting (Sept 25-27, 2013, Ghent, Belgium) was accompanied on Sept. 25 by a joint Workshop with the IC1102 VISTA COST Action. The topic was be “Terminal Antenna Systems for 4G and Beyond” and the schedule was as follows:

Session 1 – “Terminal Antenna Innovations in RF Circuits”

Session 2 – “Terminal Antenna Design with Characteristic Modes”

Session 3 – “Emerging Topics in Terminal Antenna Research”

Session 4 - “Performance Characterization & OTA Testing of Advanced Terminals”

The overall feeling of participants was that such a topic was of high interest to both Actions, since now terminal antenna design cannot be well achived without a solid consideration of the use cases, of the propagation environment and of the physical layer schemes used by the radio system.

Following the workshop, a "special cluster" of **IEEE Antennas and Wireless Propagation Letters** has been accepted in order to host journal papers on this topic.

Guest Editors: Buon Kiong Lau, Lund University, SE)
Marta Martinez Vazquez (IMST, DE)

Left: Joint IC1102 - IC1004 workshop in the yard of Het Pand, the culture and congress centre of Ghent University

Right: picture of the new IC1004 participants in the Het Pand Library

Selected scientific topic: "Inter-BAN Interference Evaluation & Mitigation: A Preliminary Study", by Mehdi Alasti, Martina Barbi, Kamran Sayrafian and Roberto Verdone (TD(13)08060)

A Body Area Network (BAN) is a radio standard for wireless connectivity of wearable and implantable sensor nodes located inside or in proximity to the human body. Many applications of BANs require reliable communications between the sensor nodes and their controller. As there are currently no coordinating mechanisms among multiple co-located BANs, co-channel interference in adjacent BANs could impact the reliability and in general the quality of the service experienced by a receiver node within an individual BAN. In this paper, we present a simulation platform that allows statistical evaluation of interference in multi-BAN scenarios as well as performance of mitigation algorithms. Fig. 1 shows a typical scenario where multiple BANs (represented by circles) can be distributed in a virtual room. Each BAN including a coordinator and several sensor nodes can move in a given direction, to represent random people walking inside a room. Initial position and speed of all BANs are programmable.

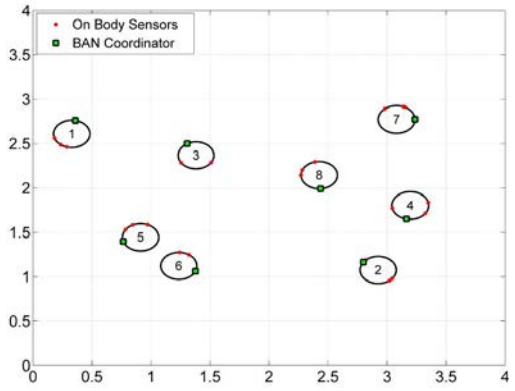


Fig. 1: Sample multi-BAN scenario in a virtual 4 m x 4 m rectangular room.

Assuming a simple TDMA transmission protocol for each BAN, we propose uncoordinated slot assignment strategies that can help mitigate and ease inter-BAN interference. Simulation results in our preliminary studies support the effectiveness of our approach. For example, Fig. 2 demonstrates the histogram of the experienced Signal to Interference Ratio (SIR) under no mitigation (i.e. Static Assignment) as well as our proposed slot assignment protocols (Random and Minimum Interference Assignment) for the random walking scenario. As observed, both strategies improve the experienced SIRs across multiple body area networks.

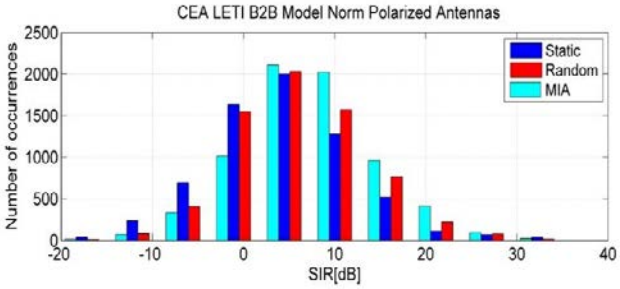


Fig. 2: Histogram of the experienced Signal to Interference Ratio for the random walking scenario

For more details please contact: ksayrafian@nist.gov

Selected scientific topic: "Modeling, Analysis, and Simulation of Temporal Birth-Death Radio Channels using Spatial Point Processes", by Morten Lomholt Jakobsen (TD(13)08048+TD(13)08049)

Stochastic radio channels models incorporating temporal birth-death transitions of individual multipath components have been considered since 1990. However, only few analytical properties of birth-death channel models are known. The birth-death behavior causes the channel model to steadily reconfigure itself and so makes it challenging to analyze it. Essentially, the instantaneous number of multipath components is changing according to a random process (Fig. 1) and it is not straightforward how to keep track of individual multipath components as time goes on.

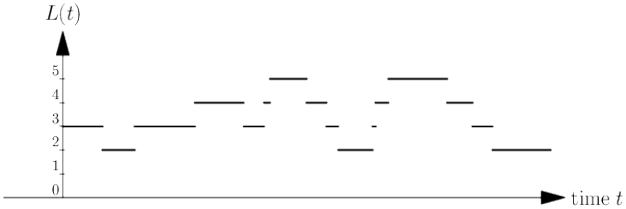


Fig. 1: The temporal birth-death random process describing the instantaneous number of multipath components in the radio channel (but no information about individual path components).

In this work we show how temporal birth-death channel models can be conveniently incorporated and analyzed using an approach based on spatial point processes (Fig. 2). Individual multipath components can be straightforwardly tracked and this feature allows for a variety of novel results to be derived. Under facilitating assumptions the channel transfer function is shown to be wide-sense stationary in both time and frequency (despite the birth-death behavior of the individual multipath components). The time-frequency correlation function is product-structured in such a way that large-scale and small-scale correlation properties are separated. The large-scale correlation properties are exactly those arising from the birth-death transitions. Apart from obvious analytical benefits, the spatial point process perspective offers also additional and detailed insight in the context of computer simulation. In particular, we show how to initialize the birth-death process in a state of equilibrium (no need for burn-in periods) and we show as well how to efficiently simulate its temporal evolution by direct use of inherent Markov properties.

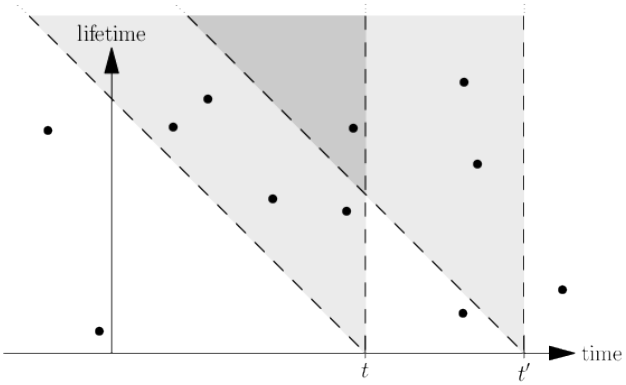


Fig. 2: A two-dimensional point process (black bullets) used to generate the temporal birth-death process in Fig. 1. Multipath components (i.e. points) contributing jointly to the channel at both time instances *t* and *t'* are exactly those falling in the dark gray intersection region.

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Selected scientific topic: "Polarization discrimination, among MIMO OTA test methods", by Istvan Szini, Michael Foegelle and Doug Reed (TD(13)08007)

MIMO antenna systems (MAS) radiation performance is commonly evaluated based on a set of antenna centric Figures of Merit (FoM), including antennas total efficiency, branch imbalance and magnitude of complex (or envelope) correlation coefficient. Alternatively Over the Air (OTA) test methods for MAS were created in order to analyze a single FoM: the absolute data throughput. While antenna centric FoM provides a preliminary overall insight, these FoM are based on farfield measurements taken in test setups with uniform incoming power, meaning that antennas are passive and measuremed in Single-Input-Single-Output (SISO) configurations. This ignores the role of the propagation channel as well as the influence of the transmitter polarization changes due environmental effects.

In this paper the performance of MAS is analyzed accounting for different channel models, with and without controllable spatial characteristics and by comparing the radiation performance of the User Equipment (UE) under predefined MAS polarization characteristics. The objective is to verify if the antenna centric FoMs for MIMO are sufficient to predict UE radiated performance and if the current MIMO OTA test methods can adequately discriminate the performance of MIMO devices based on polarization diversity. The Initial results (summarized in Fig.2) indicate that such devices do present different evaluated data throughputs according to the various methods, depending on the capability of these methods to discriminate the polarization of incoming signals.

For more details please contact: Istvan.Szini@motorola.com

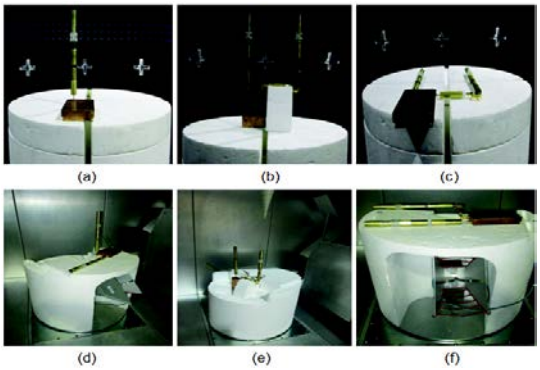


Fig. 1: MIMO antenna system based on 1/2λ dipoles, (a) cross-polarized at AC, (b) V co-pol at AC, (c) H co-pol at AC, (d) cross-polarized at RC, (e) V co-pol at RC, (f) H co-pol at RC.

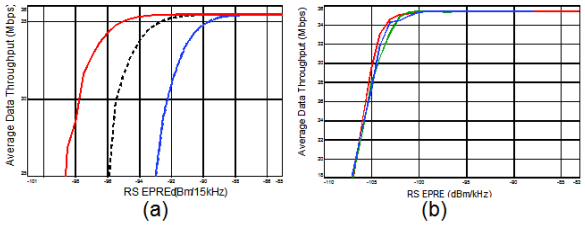
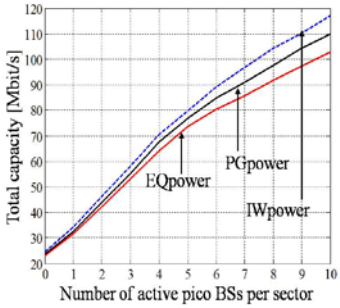


Fig. 2: (a) Average Data throughput measured at anechoic chamber (AC), cross-polarized antennas (red, Fig. 1a), V co-pol. (black-dash, Fig 1b), H co-pol (blue, Fig. 1c). (b) Average Data throughput measured at reverberation chamber (RC), cross-polarized antennas (blue, Fig. 1d), V co-pol. (red, Fig 1e), H co-pol (green, Fig. 1f)

Selected scientific topic: "The impact of deploying pico base stations on capacity and energy efficiency of heterogeneous cellular networks", by Nasr Obaid and Andreas Czylwik (TD(13)08056)

The growth of energy consumption driven by a rise in data rate demand and services, requires cellular operators to extend their infrastructure to meet these demands. To address this issue, deployment of low power base stations (BSs) in traditional macrocells have recently being considered to offer high data rates and simultaneously reduce the load of the macrocellular networks. However, the massive and unplanned deployment of small cells and their uncoordinated operations raise important questions about the energy efficiency in heterogeneous cellular networks. In this paper, the impact of deploying a number of pico BSs on the system performance of a macrocellular network is investigated. We analyze the energy efficiency of the downlink macro-picocell heterogeneous network, measured by the sum capacity divided by the power consumption of the BSs. An adaptive power control based on the iterative waterfilling scheme has been implemented to control the power among the macro and the pico BSs. The numerical results show that the total capacity improves as the number of pico stations increases, but the energy efficiency is improved only for a reasonable number of pico base stations. Moreover, the iterative waterfilling power allocation scheme improves the energy efficiency even with introducing more pico base stations as compared with other power allocation schemes. This work provides essential understanding for successful deployment of power efficient heterogeneous networks.

Three different power allocation schemes are compared by system level simulations of a heterogeneous network: equal power distribution (EQpower), a potential game based power allocation (PGpower) and an iterative waterfilling approach (IWpower). Simulation results are presented in Figs. 1 and 2 which show clearly that iterative waterfilling outperforms the other two power allocation schemes. Furthermore, it can be observed that there is an optimum number of pico BSs which maximizes the energy efficiency.



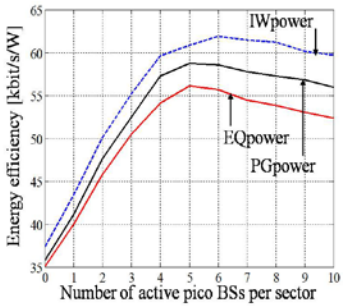


Fig 1 (left): Total capacity per macrocell site versus number of active pico base stations per macro sector

Fig. 2 (right): Energy efficiency versus number of active pico base stations per macro sector

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Obituary: Pertti Vainikainen, Aalto University, Finland

Dear colleagues of IC1004 and of previous COST Actions,

I was writing the Chairman's address as usual after our technical meetings, when I received very sad news from Aalto colleagues, reporting that Prof. Pertti Vainikainen passed away on 21st of September. Pertti was really appreciated in COST, and not only in IC1004 but also in previous Actions in which we have been involved together for the last 20 years, like COST2100, 273 and 259. His contributions to our models and channel measurement procedures, as well as the close cooperation he established through COST with many institutions in Europe will remain in this Group memory and will keep being reference for the future researchers in Radio Communications. Pertti passed away only two days before our 8th scientific meeting, to which he had contributed in two of the technical documents that were presented by his students and colleagues from Aalto. He is in our memories and prayers.

Narcis Cardona

Next Training School (open to anyone, see here for updated information)

"Beyond 4G Networks in Cities: From Theory to Experimentation and Back" (Barcelona, Spain, November 25-28, 2013)

Organized jointly with the NEWCOM# Network of Excellence

Three Experimental Tracks: Radio Channel Characterisation / Localisation / Multi-Hop Networks

- Keynote Opening by Werner Mohr, NSN
- First day: theory (three tracks in sequence)
- Second day: practice (three tracks in parallel) OR seminars
- Attendees: max 15 students per experimental track plus open access to the seminars
- Lecturers: part form IC1004, part from Newcom#, part from outside

Organizer: Dr. Miquel Payaro (CTTC)

Short course at Eucap 2014 (open to anyone, see here for updated information)

"Radio channels for cellular communications" (The Hague, Netherlands, April 11, 2014)

Organized jointly with the NEWCOM# Network of Excellence

Topics: channel characterisation, PHY layer, Flexible interfaces, IoT applications.

Organizers: Claude Oestges (UCL, Louvain, BE)
Thomas Kürner (T.U. Braunschweig, DE)

Next Management Committee meeting: the 9th MC meeting will take place in Ferrara, Italy (5-7 Feb. 2014).

10th Management Committee meeting: the 10th MC meeting will take place in Aalborg, Denmark (26-28 May 2014).

COST IC1004 White Paper to H2020: "Scientific challenges towards 5G mobile communications"

This white paper is the result of exchanges within IC1004 and has been written by a group of high level experts of the Action, aiming at dissemination towards the EU Commission and the general public. The main goal is to provide inputs for the preparation of the future R&D programs on "beyond 4G". The table of contents is shown below:

A. Future new scenarios for wireless communications
- A.1. The second terminal revolution: beyond human interfaces
  - A.1.1.Overview
  - A.1.2.Manage a future car, drive a mobile base station
  - A.1.3.Cities to have senses, and become smart
  - A.1.4.The body becomes wirelessly connected for Health and Wellness
  - A.1.5.From extremely dense traffic scenarios to moving networks
- A.2.New paradigms for Network Architecture: ultra-flexible RAN
- A.3.Simplify to improve: Green, Efficient and Ubiquitous Broadband
- A.4.Wider and broader links but, where and how in the Spectrum?

B. Research Challenges
- B.1. Paving the way to the new RAN architecture paradigm: From Cloud to Virtualisation
- B.2. Enabling Technologies for Wireless Body Environment Networks
- B.3. Optimal Deployment of Massive MIMO Networks
- B.4. Unveiling and exploiting the vehicular radio environment
- B.5. Maximise Spectrum Efficiency, ensure Wireless Access universality and resilience
- B.6. A Network-Aware Physical Layer for Multihop Networks
- B.7. Modelling, Testing, Standardizing the future Wireless scenarios

The full paper can be found here.

EURACON

European Association of Communications and Networking

EURACON is a non-profit Association of Communications & Networking, aiming at:

- Organise and endorse European Conferences, European workshops, and all associated events in the field of Communications and Networking (hereinafter, C&N);
- Support European Schools, as well as M.Sc. & PhD programmes on C&N;
- Create or endorse (on-line) scientific publications (books, periodicals) with the highest scientific standards in C&N
- Create a European web portal about research and education in C&N based also on the former European ViCe-WiCom (Virtual Centre of Excellence in Wireless Communications);
- Circulate and exchange information among European scientists and engineers in C&N, and promoting standardisation;
- Facilitate contacts between, on the one hand, the academic and scientific milieu and, on the other hand, industry, services and Institutions at the European level in C&N;
- Promote European research on C&N;
- Promote and harmonize co-operation across national C&N communities and Societies;
- Support the EC in the definition of the research agenda in C&N;
- Coordinate and manage large-scale C&N research and formation initiatives

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RADIO SCIENCE

Radio Science
Opened Special Issue:
Green Radio Communications

Associate Editor: Sana Salous

Guest Editor: Alain Sibille

Papers accepted from May 1, 2013

Submission deadline: December 31, 2013

See the Radio Science Web Site for further details and access to the CFP

A special section on, "Green Radio Communications", to be published in the Journal of Radio Science, has been approved. The Special Section will open for submissions in GEMS on May 1, 2013 and close to submissions on July 31, 2013. The special section will include invited papers and we are pleased to announce that three invited authors have already accepted our invitation to submit review papers. The special section is also open to all members of the COST IC1004 Action and to radio scientists. Please submit your contribution after the 1st of May to ensure that it is included in the special section and we look forward to a successful issue on Green Radio Communication.

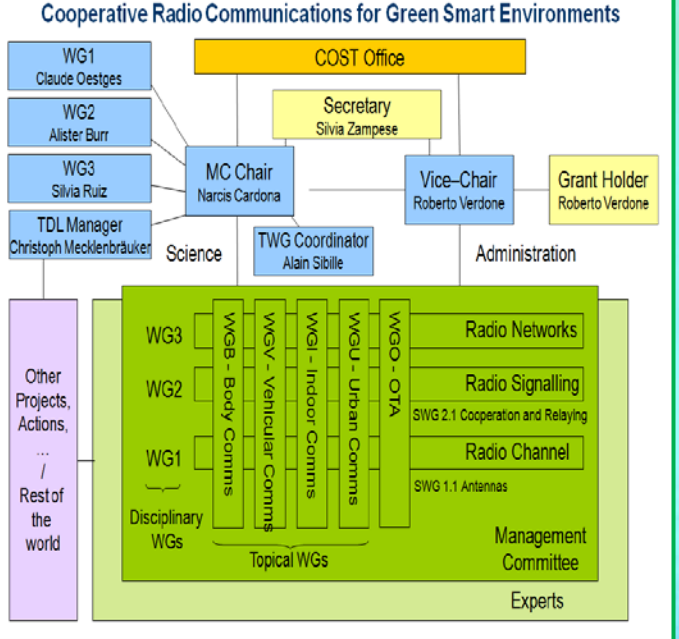
About COST IC1004

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

The MoU and all information can be found at http://www.ic1004.org or by contacting the secretariat at secretary@ic1004.org



Facts & Figures

Number of signatory 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: **121**

Number of non-COST entities (institutes, etc.) currently participating: **14**

Number of MC Members: **52** (+ Chair)

Number of registered experts: **504**

Number of meetings / year: **3**

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

Number of completed STSM: **17**

Number of presented TD/workshop papers: **545**

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