http://www.ic1004.org

NEWSLETTER

Cooperative Radio Communications for Green Smart Environments

Number 2, June 2012

Newsletter Editor: Alain Sibille, Telecom ParisTech, France

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

Editorial

Dear readers,

In this 2nd issue of the COST IC1004 Newsletter (NL) we inaugurate a new special section, giving the floor to a participant of the Action or an invited non member, in the form of an address or of an interview, intended to highlight a subject of topical or special interest for the Action. For this 1st edition, we have chosen to interview Benoît Derat, CEO of ART-FI, who talks about the assessment of SAR in mobile devices and why this topic might be a new research activity in IC1004.

Let me now say a few words about LTE. LTE will be a major step for wireless communications in the coming years, with the deployment of new networks and the launch of a bunch of new services, which will be made possible by the large amount of spectrum freed in many countries. However, in order to get the best from the resource, much research and technology developments are still needed. We see it in IC1004, where, since its beginning, about 50 presentations in 3 meetings have been presented on femtocells, radio channels, OTA, interference mitigation, resource allocation, cooperative techniques etc. Very clearly this will remain a strong focus for IC1004 over the Action duration..

Green and blue are the colors of the NL. Green recalls that one of our goals is to devote efforts to the reduction of energy consumption. But green should be understood in a broader sense, meaning a global friendliness to nature, a better optimization of resources, a reduction of electromagnetic pollution and all sorts of savings. Clearly, there are many levels where concurrent improvements can be brought to the network and device technologies. IC1004 is well suited for that, combining expertise from physical to network layers, including antennas and propagation. Blue evokes “blue sky research”, i.e. a research not driven by applications but mainly addressing knowledge as such. The history of science has proved that many fruitful ideas come from initially untargeted research. We should keep this in mind, as COST is a unique and perfect framework for a mix of industry driven and academic scientific goals.

Alain Sibille

Chairman's Address

Dear Colleagues,

Welcome to the second issue of COST IC1004 Newsletter and also to our ever-growing family of readers ! This issue is published right at the end of the first year period of the IC1004 Action activities, having covered all our initial objectives well above our expectations. In the recent months the Action has established new liaisons, strengthening the relations to regulatory and standardization bodies, and international associations, including IEEE, 3GPP, CTIA, URSI, among others. We have welcomed to the Action many new participants, mainly from Europe, but also from American and Asian institutions and companies, reaching a total of more than 300 individuals, among which 55% are Early Stage Researchers. The success of this COST Action can already be measured in terms of the increasing number of joint activities, participant countries, non-funded percentage of participations, industries involvement, published documents to literature, standards, policy bodies, training schools, etc. But the major outcome of the Action is the networking among researchers from Academia and Industry, which after one year of activities has started to be consolidated as a “Network of Knowledge” in Radio Communications.

COST IC1004 has recently submitted a position paper to the Horizon2020 consultancy on the Future Network Technologies Research and Innovation in Europe, which includes our views on some research challenges and on the role that COST Actions can play in the Future EU Framework. The document is publicly available through Europe’s Information Society Portal and at the Action web page.

I would like to conclude this short introduction to the Newsletter by expressing my gratitude to all those who have contributed to the IC1004 presentations and discussions in our workshop and technical meetings during this first year term, being the newsletter contents a small but representative selection of the most recent and relevant ones.

Highlights

The **last Management Committee meeting** (MCM) took place in Lyon on May 3-4, 2012. As usual, a large number (58) of "Temporary Documents (TD)" was presented, addressing the various research goals targeted by COST IC1004. However, this meeting was special, in that it was **preceded by a workshop**, organized by the same team, on the topic of **"Small Cell Cooperative Communications"**. The difference between a workshop and a MCM is that while the former is open and managed like a traditional workshop (with reviewed papers, based on usual scientific criteria), the latter makes no selection of TDs, which are all presented during a MCM. The main advantage is that the full TDs can be provided up to one week before the MCM, which means that the very latest results can be presented. This is well ahead of international conferences, for which typically a lapse of 6 months time exists between submission and presentation. This is the reason why TDs are subject to intense discussions during the MCM and this also explains why TDs are not publicly available and also cannot be considered to be a prior publication, when their authors choose to submit their work later in a traditional journal or conference.

The Lyon workshop program can be found here. The list of TDs of the 4th MCM can be found here.

In connection with the workshop, a special issue of the EURASIP Journal on Wireless Communications and Networking on Small Cell Cooperative Communications has been launched, with a submission deadline on June 30, 2012.

The scientific activities of IC1004 Working Groups have been discussed at the Lyon MCM. Planning for next year in WG1 has been clarified, leading towards a **better integration of the various results obtained during the first year**, in terms of channel characterization. In particular, this concerns the way to use results from numerical tools in order to validate geometry-based stochastic channel models.

WG3 discussions have been oriented to favor a **deeper insight into the optimization of different type of networks**, in terms of: interference and power consumption reduction, energy saving, selection of the proper scheduling rules, network topology and spectrum monitoring facilities. Results have been shown considering LTE-A, LTE femtocells, Zigbee and WSNs as main platforms for both simulations and measurements.

SWG1.1 has been in discussion with Dr. Benoit Derat, CEO of ART-Fi, on promoting the sub-working group as a **discussion platform for SAR (specific absorption rate)** research, especially from the antenna perspective and in the spirit of COST IC1004 (see the interview below). As a concrete step towards this goal, Dr. Derat, who is intimately involved in SAR research and standardization, was invited to give a plenary talk on some latest results on SAR research during the Lyon meeting. The sub-working group also discussed the formulation of a memorandum of understanding, which will be used in order to gauge the interest among relevant parties for such a platform.

In TWGI, **small-cell indoor deployment** was one of the active topic areas of the participants, which for example covered multipaths reverberation modeling, correlation modeling in distributed antenna channels, base station deployment in multi-service environments, interference management with terminal coordination and installation of leaky cables as a distributed access point. Another active topic of TWGI was the characterization of RFID systems that utilize backscattered signals from ultra wide band tags. The characterization covered comprehensive modeling of tags as well as of backscattering channels, intended to evaluate the feasibility of this type of RFID system.

Much of the activity of TWGV was focused on the organization of the **training school on Vehicular Connectivity**, which turned out the be a big success: the interest was so high that registration had to be closed ! The lecture room at FTW, Vienna, was filled to capacity by some 45 attendees from industry, academia, and research organizations who listened to talks from eight recognized experts during an intense three days. The discussion climate was excellent, both in sessions and coffee breaks, which proved to be equally fruitful for young masters and PhD students as well as for seasoned veterans in the field.

This issue's pictures

A picture of the audience at the 1st COST IC1004 training school on vehicular Connectivity, organized at FTW, Vienna. Let the organizers be warmly thanked for the success of the event and the benefit for auditors !

COST IC1004 continues receiving new young researchers. 29 ESRs joined the group in our 4th MCM in Lyon, 2-4 May 2012. This group of smiling young faces is a promise for the Action success and for future research results !

Interview: Benoît Derat, CEO, ART-Fi SAS

[IC1004]: SAR (Specific Absorption Rate) is certainly a very important issue for regulation authorities, manufacturers and operators. But why should it be a topic of interest for COST IC1004 ?

[Benoît Derat]: the first Smart Environment cited in COST IC1004's MoU is the human body. In researching towards efficient communications with antenna systems (the main focus of SWG 1.1) on or in the human body, SAR has to be part of the complete picture. I believe COST IC1004 could become the only forum considering the whole picture.

[IC1004]: actually, there has been plenty of work in the past years on SAR assessment. Is the problem still of scientific or is it more of political nature?

[Benoît Derat]: new scientific challenges continue to arise as wireless devices and usages evolve. Developing faster methods to face the multiplication of test configurations or ensuring a good coverage of the variety of real life exposure conditions are just two examples.

[IC1004]: one of the difficulties in evaluating SAR is to account for the variability from one person to another, one use case to another... How can we address this, when health issues are at stake?

[Benoît Derat]: measured SAR shall be higher than the expected value during intended use in a significant majority of users. Although the concept states simply, it hides years of laborious work to verify this conservative statement. More work is needed.

[IC1004]: up to what extent do you think it is currently, or will be in the near future, possible to base SAR assessment on simulation, and conversely should any reliable assessment be necessarily made experimentally?

[Benoît Derat]: today, EM simulation allows solving problems of nearly arbitrary complexity. Yet, the modeling of wireless devices remains a major challenge in computing accurate SAR values, as this requires a nearly total knowledge of the DUT. Efficiently combining numerical and experimental techniques is probably a promising alternative towards more advanced SAR assessment.

[IC1004]: if manufacturers want to demonstrate compliance with health & safety regulations, they must carry out measurements that are typically complicated and extremely lengthy to perform. Is it not a serious contender to enforcing too strict SAR requirements?

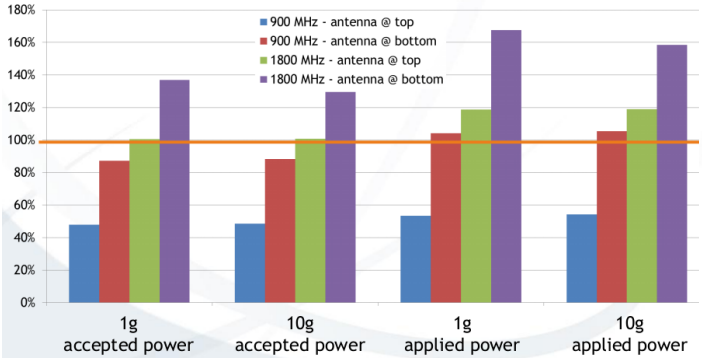
[Benoît Derat]: current SAR compliance testing techniques definitely lead to very heavy duties on the manufacturers. In the past years, significant research effort has been put in developing innovative approaches for faster SAR assessment. In April 2012, my company introduced the first working system capable of high absolute accuracy SAR evaluation in a matter of seconds. This technology will definitely help manufacturers to alleviate the SAR measurement load and focus on innovation.

[IC1004]: most concerns about SAR came from the traditional handset use for phone conversations, but now that data mode starts to dominate and smartphones are handheld far from the head, doesn't it become much less of an issue ?

[Benoît Derat]: the ICNIRP (International Commission of Non-Ionizing Radiation Protection) guidelines, applied by many regulators worldwide, distinguish between SAR in the head or trunk and SAR in the limbs. The ICNIRP SAR limit in the limbs is twice higher, which accounts for the "larger tolerance" of those body parts to RF exposure. Still, compliance has to be evaluated and the IEC 62209-2 standard describes methods for measuring the SAR when the device is not held at the ear. Finally, new usages also created new issues to deal with like simultaneous transmission over e.g. WiFi 2.45 & GSM900, when the user makes a file upload and a call at the same time.

[IC1004]: thank you !

Benoît Derat received the Engineer degree from Supelec, France, in 2002 and a PhD in Physics from the University of Paris XI, Orsay, France in 2006. From 2002 to 2008, he served as the international expert and representative for SAGEM Mobiles on SAR and EMF. Since 2004, B. Derat has been continuously involved in the development of SAR measurement and computation standards as a member of the IEC 62209 and ICES TC34. In 2009 and 2010, he co-founded the companies Field Imaging and ART-FI selling innovative SAR measurement instrumentation, as well as EMF problem solving and antenna design services.



Left: excerpt from the presentation of B. Derat at the 4th COST IC1004 MCM in Lyon, May 2012 "Impact of the hand on head SAR". The full presentation can be requested from the author at:

benoit.derat@art-fi.eu

Selected scientific topic: "Energy Efficiency of 802.11n versus LTE Advanced femtocell networks based on a 3D deployment tool", *by Margot Deruyck, Emmeric Tanghe, Wout Joseph, and Luc Martens* (TD(12)04015)

This study compares the energy efficiency of a 802.11n network and an LTE Advanced femtocell network. Both networks are designed by the GRAND (Green Radio Access Network Design) tool, which is developed by the authors and allows to design wireless access networks with a minimal power consumption based on 3D building information. In order to take the 3D building information into account, an algorithm is developed that combines Line-of-Sight propagation, where a direct (straight) line can be found between the transmitter and the receiver, and non-Line-of-Sight propagation, whereby this direct line is blocked by e.g., objects, people, buildings, etc. Such an algorithm allows estimating the required number and locations of base stations more accurately. Furthermore, an appropriate metric is defined, which allows comparing the energy efficiency of the networks. This metric is based on the network's power consumption, coverage, capacity, and number of served users. Applying GRAND and the proposed algorithm on a suburban area of 1.2 km^2 in Ghent, Belgium, shows that (based on our assumptions) the LTE Advanced femtocell network is about 2.5 times more energy-efficient than the 802.11n network.

.

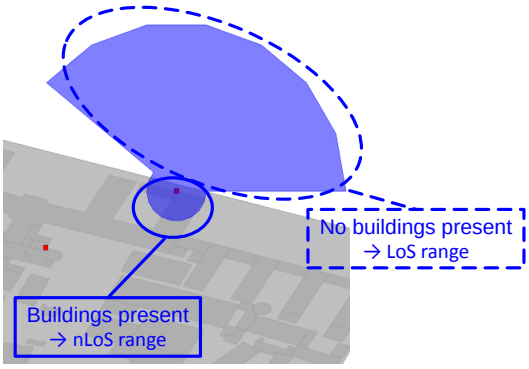


Fig. 1: Algorithm principle for combining LoS and nLoS propagation.

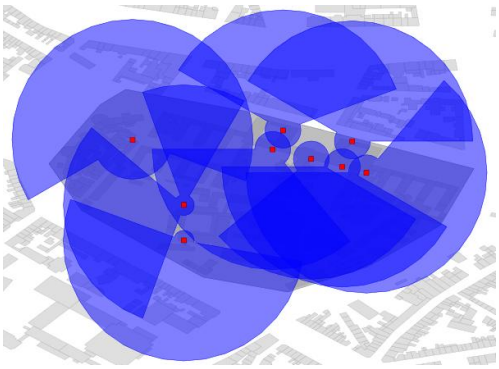


Fig. 2: LTE femtocell network resulting from the GRAND tool.

For more details please contact: margot.deruyck@intec.ugent.be

Selected scientific topic: "3D performance analysis of a heterogeneous LTE network with urban femto-cells", *by Florian Letourneux, Yoann Corre, Erwan Suteau and Yves Lostanlen* (SC3WS-1-1)

Femto-cell technology recently gained attention due to its potential benefits for mobile operators (significant capacity offload and extension of the coverage at low cost) but deployment strategies are still in question, such as the femto-cell access mode (open or closed) and the spectrum usage to adopt. Consequently, reliable coverage simulations of sophisticated metrics are necessary in the perspective of massive femto-cell deployments leading to heterogeneous topologies.

This paper introduces a novel predictive solution, which relies on a suite of simulation tools. It includes random deployments of FAPs (Femto-cell Access Points) in all building floors of realistic environments, advanced realistic path-loss predictions and 3D LTE system-level performance analysis (considering all floors) providing coverage statistics (see Fig. 1), spectral efficiency coverage maps (see Fig. 2) and total downlink throughput. The proposed technique clearly distinguishes the throughput delivered by macro-cells and femto-cells and provides a unique way to estimate the macro to femto-cell capacity offloading. The software solution, which permits analyses of realistic 3D LTE heterogeneous networks performance, can be used for operational deployments or for case studies towards the elaboration of engineering rules and business models.

A first study shows a large improvement of coverage quality for FAP users (see Fig. 1.) but also a very significant degradation including large zones without service (see curve with rounds) for non-subscribers in the vicinity of closed access FAPs. A second study shows the impact of a corporate open access FAP deployment on network coverage (see Fig. 2) and throughput in a real environment which enables to provide high user peak data rate (above 10Mbps in the presented scenarios).

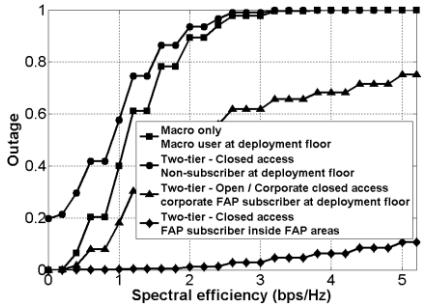
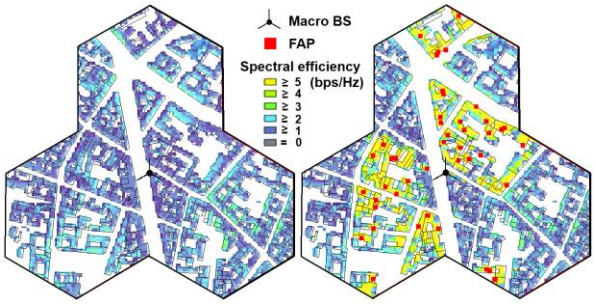


Figure 1. First study - Spectral efficiency CDFs of macro- only and two-tier network.



a) macro- only b) two-tier network.

Figure 2. Second study - Spectral efficiency maps at the third floor.

For more details please contact: ylostanlen@siradel.com

Selected scientific topic: "Simple Model for Complex Building Scattering in Urban Environment Based on a Three Macro Propagation Phenomena Approach", by M. Ait-Ighil, F. Pérez-Fontán, J. Lemorton, F. Lacoste, C. Bourga, M. Bousquet (TD(12)04058)

Obstructions, delayed multipath echoes, Doppler spreading or depolarization are highly impacting performance in communication systems. The actual trend is to improve semi-deterministic tools by using hybrid physical-statistical channel simulation. In this context, a new three Components model or 3CM has been designed in order to reproduce building scattering in an efficient way that strongly reduces the computation time. The method divides the total radiation pattern of a complex façade into three macro propagation phenomena. The specular component is a forward reflection originating from wide and smooth surfaces. The backscattering component is a double bounce reflection due to dihedral effects taking place near protruding balconies and receding windows. The incoherent scattering comes from small features present on facades. The 3CM is based on electromagnetic approximations such as Physical Optics that allow it to be frequency scalable, polarimetric and suited for dielectric materials. The three macro propagation phenomena approach here described lends itself to easy integration into conventional ray tracing tools.

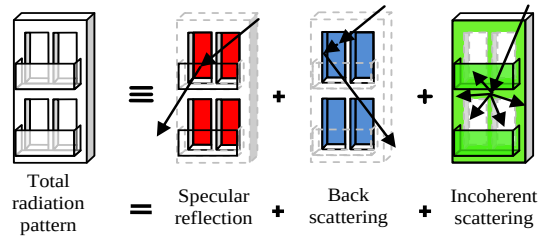


Fig. 1: Decomposition principle of the 3CM

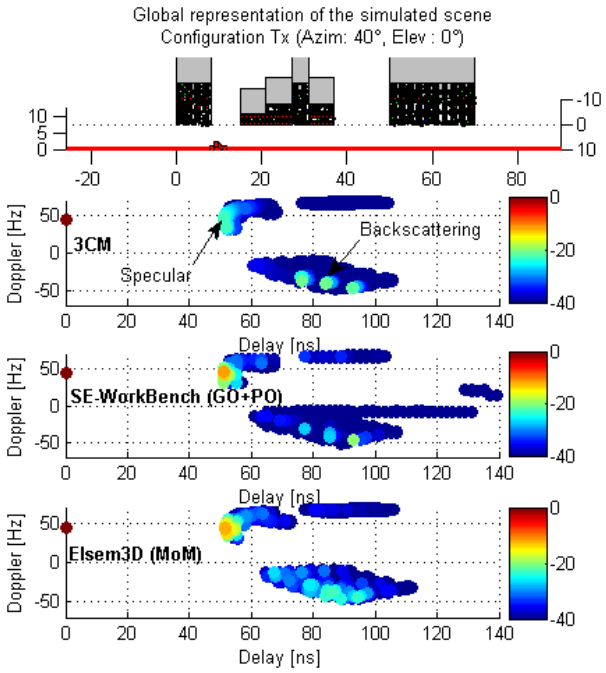
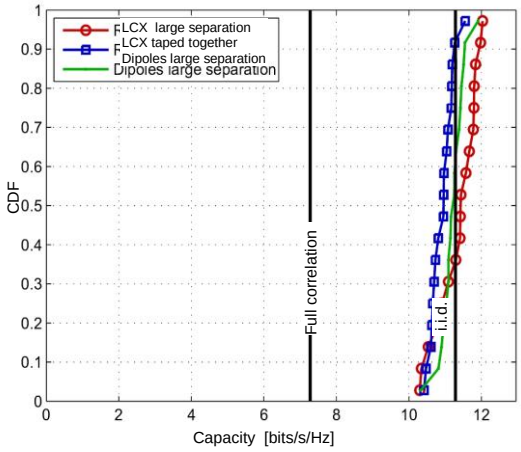


Fig. 2: Power delay/Doppler channel impulse response [dB/LOS]. Validation with usual numerical EM methods.

For more details please contact: mehdi.ait_ighil@onera.fr

Selected scientific topic: "Leaky Coaxial Cable MIMO Performance in an Indoor Office Environment", *by Jonas Medbo and Andreas Nilsson* (TD(12)04008)

This study has been performed in order to improve the understanding of the performance of leaky feeders used in MIMO radio access deployments i.e. when multiple antennas are used at both the transmitter and the receiver. In order to achieve this, a measurement campaign has been conducted in an indoor office environment at 2.4 GHz using two transmit and two receive antennas. Several configurations of leaky feeders and dipole antennas (as a reference case) at the access node have been investigated. The corresponding MIMO channel performance has been evaluated. The main finding is that leaky feeders provide as good a performance as well separated dipole antennas. The measured performance is very close to the performance of the favorable i.i.d. channel (i.e. the channel providing the maximum MIMO richness). Even taping two leaky feeders together does not degrade the performance significantly. The advantage with the leaky feeders is that they provide much more uniform signal strength over the coverage area.



MIMO capacity (2x2) for leaky feeders (LCX) and dipoles in the corridor scenario. The corresponding levels for the i.i.d. and fully correlated MIMO channels are marked with solid black lines.

Photograph of two leaky feeders installed beneath the suspended ceiling in the corridor.

For more details please contact: jonas.medbo@ericsson.com

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

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.

The school will give an inter-disciplinary view of the technology trends in the field of Wireless Body Area Networks (WBANs) and their potential in supporting healthcare applications. Ten lectures will be given on aspects related to application requirements, radio components for WBANs, WBAN radio channel characterization and antenna design issues, PHY and MAC communication protocols for WBANs, and application use cases. Two lectures will be given by industry representatives (SORIN and Telecom Italia), some by scientists from international research centres (CEA-Leti, France, and NICT, Japan), the remaining by University researchers (EPFL, TUB, UNIBO). A demo of WBAN, currently developed within the WiserBAN project at the University of Bologna, will be shown on the third day. Upon request, PhD students might be subject to evaluation in order to achieve a certificate to be used for getting credits at own University.

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

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

Next Management Committee meeting: the next MC meeting and presentation of technical Documents (TD) will take place in Bristol, UK (September 24-26, 2012). Only registered COST IC1004 members can participate. Information on our to join can be found on the web site here.

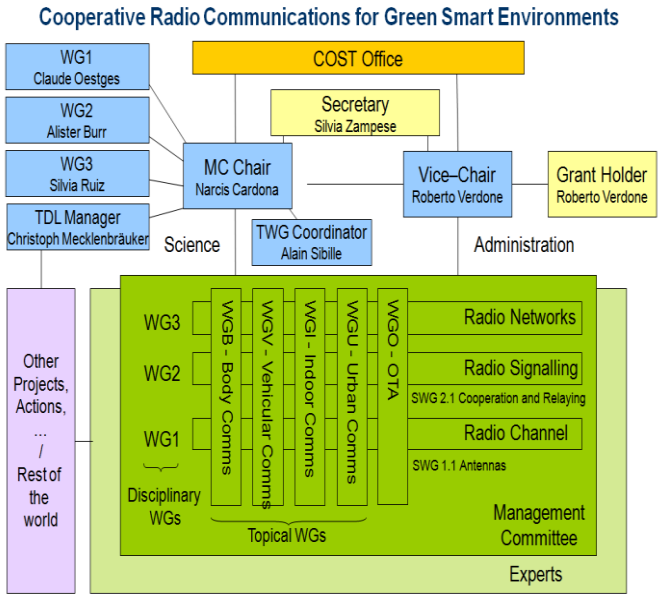
About COST IC1004

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 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: **105**

Number of non-COST entities (institutes, etc.) currently participating: 11

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

Number of registered experts: **275**

Number of meetings / year: **3**

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

Number of presented TD/workshop papers: **275**

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