

COST

Domain Committee "Information & Communication Technologies"

COST Action IC1004

Start Date 19 May 2011

Cooperative Radio Communications for Green and Smart Environments

MONITORING PROGRESS REPORT

Reporting Period: from 19th May 2011 (start date of the Action)
to 30th April 2012

This Report is presented to the relevant Domain Committee.
It contains three parts:

- I. Management Report*** prepared by the COST Office/Grant Holder
- II. Scientific Report*** prepared by the Chair of the Management Committee of the Action
- III. Previous versions of the Scientific Report; i.e., part II of past reporting periods***

The report is a "cumulative" report, i.e. it is updated annually and covers the entire period of the Action.

Confidentiality: the documents will be made available to the public via the COST Action web page except for chapter *II.D. Self evaluation*.

Based on the monitoring results, the COST Office will decide on the following year's budget allocation.

Executive summary (max.250 words):

The scientific scope of IC1004 is on the Radio Communication Systems and Networks, within the framework of the Energy Efficiency and Smart Environments (SEs). The optimal exploitation of the radio channel through its study and modelling, 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.

After one year of activities, IC1004 accounts with a total of 275 individuals participating from research institutions and companies, almost a 10% out of Europe. IC1004 meetings are attended by more than 100 experts, being MC members only 1/3 of them. The fact that the majority of participants to COST IC1004 meetings cover the expenses by their own, clearly indicates that the activity in IC1004 is generating significant results, not only in terms of the meeting discussions with colleagues, but mainly on the scientific networking of methodologies, standards, references, techniques, models and tools.

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 3 technical meetings celebrated so far, IC1004 has organized 2 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. ESRs participating to the Action have also taken benefit of 6 granted STSMs and 22 grants to attend the first Training School.

The Action IC1004 is publishing a Newsletter three times per year, with the technical and organisational highlights of its activities.

I. Management Report prepared by the COST Office/Grant Holder



I.A. COST Action Fact Sheet

- **COST Action IC1004 - Cooperative Radio Communications for Green Smart Environments**
- **Domain ICT**

- **Action details:**

CSO Approval: 02/12/2010
Entry into force: 17/01/2011

End date: 18/05/2015
Extension: (day/month/year)

• **Objectives** Smart Environments (SEs), like the human body, energy efficient buildings, vehicular or urban environments, are populated by many devices connected by wireless networks. The radio channel is central to SEs, as it impacts the design of transmission techniques and communication protocols. Radio communications in SEs need to be green and based on cooperative paradigms to mitigate the effect of interference and improve efficiency. This Action addresses research issues in the field of cooperative radio communications to make our society cleaner, safer, and more energy efficient. The main goal of the Action is 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. Training of young researchers is also one of its main objectives, to be pursued e.g. via annual training schools. Europe will benefit from the activities of this Action, as GSEs will be one of the key components of the broader field (and exploding market) of the Internet of Things, a domain of interest to many large and small companies in Europe. COST is the ideal framework, as it allows very efficient cooperation among industries and academia

- **Parties:** list of countries and date of acceptance (28)

Austria (25/01/2011)	Ireland (07/02/2011)	Spain (02/02/2011)
Belgium (09/03/2011)	Israel (17/01/2011)	Sweden (10/05/2011)
Bulgaria (17/01/2011)	Italy (17/01/2011)	Switzerland (05/07/2011)
Croatia (13/09/2011)	Luxembourg (24/05/2011)	United Kingdom (17/01/2011)
Cyprus (24/06/2011)	Netherlands (31/01/2011)	
Czech Rep. (27/04/2011)	Norway (18/01/2011)	
Denmark (08/06/2011)	Poland (04/03/2011)	
Finland (25/01/2011)	Portugal (18/01/2011)	
FYR of Macedonia (25/02/2011)	Romania (11/02/2011)	
France (01/03/2011)	Serbia (21/01/2011)	
Germany (20/01/2011)	Slovakia (10/03/2011)	
Greece (17/01/2011)	Slovenia (12/07/2011)	

- **Intentions to accept:** list of countries and date

- **Other participants:**

Beijing University of Posts and Telecommunications, Wireless Technology Innovation Institute	China
COMSEARCH	United States of America
La Trobe University	Australia
Motorola Mobility US	United States of America

National Institute of Information and Communications Technology	Japan
The Communications Research Centre	Canada
Tokyo Institute of Technology	Japan
Tongji University	China
Universidad Icesi	Colombia
University of Montenegro	Montenegro

Chair: (Narcis Cardona, iTEAM Research Institute, Universitat Politècnica de Valencia, Camino de Vera S/N 46022, Valencia, Spain, +34 963879580 (ncardona@iteam.upv.es))

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Administrative Officer: (Aranzazu Sanchez, aranzazu.sanchez@cost.eu)

• **Action Web site:** <http://www.ic1004.org/>

• **Grant Holder Representative**(Roberto Verdone, roberto.verdone@unibo.it)

• **Working Groups** (list of WGs and names and affiliations of participants¹)

- TWGB - Body Environment, chaired by Raffaele D'Errico (FR) and Kamyaz Yazdandoost (JP);
 - 97 participants
- TWGV - Vehicular Environment, chaired by Alexander Paier (AT) and Erik Strom (SE);
 - 129 participants
- [TWGI](#) - Indoor Environment, chaired by Pawel Kulakowski (PL) and Katsuyuki Haneda (FI)
 - 150 participants
- TWGU - Urban Environment, chaired by Thomas Jansen (DE) and Sana Salous (UK)
 - 131 participants
- [TWGO](#) - OTA (Over-the-air Testing), chaired by Gert Pedersen (DK) and Wim Kotterman (DE)
 - 36 participants
- [WG1](#) – Radio Channel, chaired by Claude Oestges, U.C.L. (BE)
 - 195 participants
- WG2 – Radio Signalling, chaired by Alister Burr, U.York (UK)
 - 107 participants
- WG3 – Radio Networks, chaired by Silvia Ruiz, U.P.C. (ES)
 - 145 participants
- [SWG 1.1](#) – Antennas, chaired by Buon Kiong Lau (SE)
 - 39 participants
- SWG 2.1 – PHY layer Cooperation and Relaying, chaired by Jan Sykora (CZ)
 - 35 participants

¹ The lists of participants to every Working Group can be found at www.ic1004.org under “minutes” of every meeting. Only number of participants is reported here.

I.B. Management Committee member list

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I.C. Overview activities and expenditure

(year) Budget

Total Action Budget: 133.700 €

Remaining Action Commitment:

Meetings

Meeting Type	Date	Place			Cost	Total
2 nd MC Meeting	19-21 October 2011	Lisbon, Portugal				40.017,83 €
3 rd MC Meeting	8-10 February, 2012	Barcelona, Spain				26.631,65 €
4 th MC Meeting	2-4 May, 2012	Lyon, France				25.797,28 ² €

STSM

Beneficiary	Date	Place			Cost	Total
Zoran Utkovski	19-29 January 2012	Chalmers University of Technology (SE)				1.000 €
Nikola Gvozdenovic	19-24 February 2012	University of Bristol, Bristol(UK)				690 €
Imran Latif	19-23 March 2012	UPC, Castelldefels (ES)				900 €
Wei Wang	19-23 March 2012	Aalborg University, Aalborg (DK)				1.000 €
Geoffrey Hilton	12-12 March 2012	Vienna University of Technology, Vienna (AT)				800 €
Thomas Jensen	21-30 May 2012	Universitat Politècnica de Valencia, Valencia (ES)				1.000 €

Workshops

Title	Date	Place			Cost	Total
Small Cell Cooperative Communications	May 2 nd , 2012	Lyon, France				3.000 €

Schools

Title	Date	Place			Cost	Total
Training School Vehicular Connectivity	21-23 May 2012	Vienna, Austria				11.000 €

Dissemination

								Cost	Total
									3.053,49 €

Others

Bank fees:									468,95 €
									200 €

Secretariat

									17.333,88 €
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Action Total : 132.893,08 €

² Expenditures and allocated budget for activities after 30-April-2012 are included (blue numbers)

II. Scientific Report prepared by the Chair of the Management Committee of the Action, describing results achieved during the Action operation in this period, in no more than 3 pages (the report is “cumulative”). All items listed in Sections A, B, and C, below, must be addressed.

Additional documentation such as extended scientific reports, proceedings of workshops, seminars or conferences may be provided separately as an annex to this report, and should be referenced in the report.

II.A. Innovative networking

- *Innovative knowledge resulting from COST networking through the Action. (Specific examples of Results vs. Objectives)*
 - After deployment of LTE first commercial Networks, many issues remain open on the optimum configuration and tuning of the Radio Access elements. In IC1004 different LTE and LTE Advance simulation platforms have been compared for both, DL and UL, at physical layer and system level, testing different **scheduling algorithms**, as well as analysing ways to **reduce interference through coordination**. Discussions have arisen inside WG3 sessions that have been extended outside the meetings. Examples of this are: the STM of EURECOM (Sofia Antipolis, France) visiting UPC (Barcelona, Spain) in March 2012 and working now in a joint paper, and the TUWien (Viena, Austria) visit to UPC (Spain) at the end of May 2012 to compare simulation platforms, being also invited to act as joint PhD supervisors.
 - Femtocells are becoming crucial in the current development of Access Networks. In IC1004, several simulation analysis in synthetic and real scenarios, as well as measurements, coming from different research teams, have allowed a detailed comparison and discussion among partners: Braunschweig University (Braunschweig, Germany), UM (Malaga, Spain) and UPV (Valencia, Spain). Specific tools to **model indoor to indoor and indoor to outdoor interference effects on capacity** are being investigated. A workshop on this subject has been organised on May 2012 by IC1004 in cooperation with iPLAN FP7 project.
 - **Smart city** technologies and applications have being discussed by university research teams UB (Bologna, Italy), IST (Lisbon, Portugal) to City responsible institutions (IMI, Barcelona, Spain), mainly about how research works addressing **sensor networks and ad-hoc networks configuration** can be deployed in real scenarios. It is expected that urban networks, as well as advanced resource management for heterogeneous networks and applications, will become one of the key research activities of the IC1004 WG3.
 - By combining competences from the IC1004 partners, across countries, institutions, and scientific disciplines, discussion in WGV has spawned ideas on how to model, characterize, and estimate the **vehicle-to-vehicle and vehicle-to-road side radio channel at the 6 GHz band**, currently allocated for traffic safety applications. Such knowledge is instrumental for designing efficient wireless systems to enable traffic safety and traffic efficiency applications, which, in turn, will make the road transport system safer (less accidents, injuries, and fatalities) and more efficient (less traffic jams, fuel consumption, and emissions), and thereby contributes to the Action’s objectives.
 - In the scope of TWGB “Body Environment” a number of strong collaborations have been established. In particular the knowledge sharing between different IC1004 participants, such as CEA-LETI (Fr), NICT (Jp), IST-UL (P), UCL (B), UPV (Es) is contributing to the creation of a **new channel model for body-centric applications**. Further collaborations between different research institutes, e.g. between UniBO (It) and CEA-LETI (Fr), have been producing significant results on cross-layer network

design from channel modeling to PHY-MAC protocol performance evaluation, thanks to the participants' knowledge sharing in different fields.

- Among other smart spaces, indoor scenarios are one of the most complicated to model and to manage. In IC1004 a very simple method to **simulate complex radio wave propagation in enclosed space**, such as indoor scenarios, by means of a room acoustics theory has been proposed. The method was originally brought by a group in the Aalborg University and is now widely verified and exploited by the participating institutions of COST IC1004.
 - IC1004 TWGI has worked on a robust passive **indoor localization technique** for security and safety measures. The method exploits polarization information of the electromagnetic field propagation to localize and classify an object of interests. The COST networking allows inter-institution activities for a feasibility study including experimental testing of the proposed technique.
 - The **impact of vegetation on the wave propagation** and hence the signal quality in mobile communication systems is an important factor for the planning of the networks. State of the art propagation models like e.g. empiric models (Okumura-Hata, COST 231, etc.) or ray-optical models (Ray-Tracing, Ray-Launching, etc.) neglect the vegetation so far. Recent activities in the urban environment group of IC1004 extended the existing models and reached significant higher prediction accuracy by integrating the impact of vegetation into the models. This is of high interest for system simulations in urban and even more in sub-urban scenarios.
 - The user traffic in mobile communication systems is increasing steadily in the last years. To enhance the network throughput the cell sizes will decrease and femtocells will serve hot spot areas or private apartments. Hexagonal simulation scenarios roughly meet the network behavior in large scale scenarios. The smaller the coverage area the higher the impact of the immediate surroundings of the serving cell. Hence more realistic simulation scenarios are needed. Activities in the IC1004 urban environment group aim at developing **realistic simulation scenarios** including different cell sizes, radio access technologies and data traffic models.
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- *Significant scientific breakthroughs as part of the COST Action. (Specific examples)*
 - The introduction of femtocells in mobile communication networks will significantly impact the character of the networks. Femtocells are not part of the planning process of a network but will influence the planned network. First research results in the area of **femtocells interference management and mobility optimization** show that special attention has to be given to these cells. In the urban environment group the impact of femtocells to the network is one of the main research topics.
 - Antenna design and statistical **antenna modelling for BANs**
 - Channel characterization and **modelling for on-body**, off-body and body-to-body communications
 - MAC protocol and relay techniques for **cooperative BANs**
 - Method to model **shadowing fading phenomena due to vehicles** obstructing the direct propagation path between the transmitter and receiver. This is major step towards understanding this important propagation mechanism in the vehicle-to-vehicle radio channel.
 - Real-time ultrawideband multi-antenna **channel sounder at 60 GHz** band, providing significant capability to analyze the effectiveness of multiple antenna systems in the millimeter-frequency range that can offer very high data rate transmission.
 - Statistical radio channel models for surgery rooms in a hospital at 60 GHz frequency band developed by three Universities and research institutes in Finland and in Japan. The channel model serves as a fundamental tool for the feasibility study and the design of radio systems to realize a **smart hospital**.

- *Tangible medium term socio-economic impacts achieved or expected. (Specific examples)*
 - IC1004 is a good example of industrial involvement in COST, with the necessary mix between **Industry and Academia**, in the best sense. There is no other benefit for companies to come than grasping what's going on in academia and transfer some of their own needs. It's probably a purer way than in projects, where funding creates some bias. 36% of the participant institutions to COST IC1004 are Companies.
 - The knowledge produced as the result of the Vehicular Communications WG work is expected to impact **ETSI standardization** work on intelligent transport systems, and hence will impact the safety, comfort, and environmental impact of the road transport system in the future.
 - For the first time in this COST Action a **City is participating** as full member, with the added value of being the final responsible of the deployment and monitoring of different open and private networks (based on WiMax, Zigbee, WLAN technologies among others) as well as closely involved in the design and coordination of new applications oriented to improve quality of service in green environments and citizens' life.
 - Efforts will be done in obtaining **reference scenarios** based on real heterogeneous networks where the different research teams could test their applications and ideas, sharing the results at next meetings.
 - An important item was the participation of many COST institutions in the official LTE Round Robin for **ETSI 3GPP RAN4**, organised by Vodafone, which was held to reveal similarities and differences between the several proposed OTA technologies.
 - A **liaison with the North-American CTIA** MOSG (MIMO OTA Sub Group) was established, meaning bilateral information exchange.
 - A **database** of actually measured **antenna patterns** of small terminals for use in the TWG was created, to be used in systems simulations.
 - Simulation activities to **support the choice of MIMO** OTA technology by 3GPP and CTIA at the end of this year has started in IC1004. To this end, Agilent licensed TWG MIMO OTA members to use its system simulator Systemvue.
- *Spin off of new EC RTD Framework Programme proposals/projects. (List)*

(See Annex 1)
- *Spin off of new National Programme proposals/projects. (List)*

(See Annex 1)

II.B. Inter-disciplinary networking

- *Additional knowledge obtained from working with other disciplines within the COST framework. (Specific examples)*

COST IC1004 has established liaisons with several regulatory bodies, PF7 projects, International Organisations and other COST Actions.

The objective of such liaisons is first to get from the other groups a wider view on some of the topics the Action is dealing with. In particular, we are interested in knowing about the energy consumption aspects of the radiocommunications equipment and the backhaul transport networks, as well as to find the way to increase the energy efficiency of the RANs. In this sense we have invited to participate to the Action to representatives from Greentouch, Greenet and Earth. A second topic of interest to the Action participants is to include in our analysis the antenna effects, not only on the propagation modelling but also on the overall transmission

systems design. To cover this aspect, we are establishing links to COST VISTA, with some plans to create an inter-Actions Working Group.

A second and very important aspect of our relations to outer fora is to make our results be known outside the Action. In this sense, we have invited to participate to our meetings to representatives from ETSI, 3GPP, CTIA, URSI, and start providing inputs to such standardisation and regulatory bodies.

- *Evaluation of whether the level of inter-disciplinarity is sufficient to potentially provide **scientific** impacts (Specific examples) and **socio-economic** impacts (Specific examples)*

Some working groups of IC1004 are already taking advantage of the interdisciplinary discussions with some invited experts and colleagues, with results on mid term scientific results and long term socioeconomic impacts:

- Urban networks working group has involved in IC1004 the Information System of the City of Barcelona, getting a complementary knowledge of the requirements for the design and coordination of wireless sensor networks aimed to improve the quality of services and **citizens' life in green and smart city** environments.
- Vehicular communications group, by discussions with manufacturers and ETSI standardisation experts, has developed some knowledge which is instrumental for designing efficient wireless systems to enable traffic safety and traffic efficiency applications, which, in turn, will make the **road transport system safer** (less accidents, injuries, and fatalities) **and more efficient** (less traffic jams, fuel consumption, and emissions).
- Some experts in implanted systems are joining the discussions with Body Communications WG participants at IC1004. In the mid- and long-term, the wireless body environment (WBE) is supposed to **revolutionize health monitoring**, with its huge number of possible applications in home, hospital, elderly care and emergency cases. As this service permits remote monitoring of several patients simultaneously, it could also potentially decrease health care costs. Moreover Wireless Body Area Networks are expected to provide new functionalities of applications in people's every-day life such as sport, leisure, gaming and social networks.

II.C. New networking

- *Additional new members joining the Action during its life, and*
- *Total number of individual participants involved in the Action work. (Number of participants. Give % of female and of Early Stage Researcher participants)*

The Action started on May 19th, 2011, the MC meeting was attended by 28 of the National Delegates. The Action has organised four technical meetings so far, with the following progress:

	Institutions	Individuals ³	ESR	Women
Lund, June 2011	62	94	38 (40%)	10 (11%)
Lisbon, October 2011	78	190	72 (38%)	22 (12%)
Barcelona, Jan 2012	94	230	124 (54%)	29 (13%)
Lyon, May 2012	112	342	200 (59%)	49 (15%)

The percentage of **Industry vs. Academia** is also relevant: 40 over 112 registered institutions are companies, so the **36%** of the total.

³ *Number of registered individuals who have participated to at least one technical meeting*

- *Involvement of Early Stage Researchers in the Action, in particular with respect to STSMs, networking activities, and Training Schools. In addition, justification should be provided if less than 4 STSMs were carried out during the year.*

From the very beginning of the Action, ESRs have been in the centre of IC1004 strategy. One of the first decisions the Steering Committee took was to promote the participation to ESRs in leading activities in IC1004, to the point that

- 5 of the Topical **Working Group Chairs** are ESRs: Katsuyuki Haneda, Pawel Kulakowski, Thomas Jansen, Raffaele D'Erico, Alexander Paier

At the end of the first year period, ESRs have also been supported by COST IC1004 in:

- **6 STSMs** have been granted to ESRs among those participating to the Action
- **22 ESRs** have **granted** to participate to the first Training School

Additionally, in two of the meetings (those not co-located with Workshop), the Action has organised two **Tutorials**, free of charge for any COST IC1004 participant, attended by 40_50 people, most of them PhDs and ESRs:

- 2 Tutorials from Prof. Tadashi Matusumoto and Dr. Misha Dohler

Finally, there are other **non-tangible outcomes** in COST for ESR to take advantage of IC1004 like in any other forum in the European Research Area. ESRs find in COST those colleagues who are working in the same topics, both senior researchers from other institutions and young people in their same situation, who in some years will take responsibilities and could propose joint participation to future projects. When a young researcher comes to a COST meeting to show the results of a research work, what can be expected is to have long and constructive discussions about it, taking back after the meeting some new ideas on how to improve the investigations. This is radically different if the young researcher attends a big conference, where a very limited time slot is assigned for the presentation, very few questions are expected and the audience is usually of wider scope.

- *Involvement of researchers from outside of COST Countries. (Number of participants from non-COST Countries approved by the CSO. Give % of such participants from countries with reciprocal agreements. Specify their contribution)*

COST IC1004 has received numerous expressions of interest from non-COST institutions to participate. At the current stage, and apart of some applications in progress, the **11 non-COST institutions** accepted are:

- ComSearch, a global company based in the USA, global provider of spectrum management and wireless engineering products and services. Their contribution to COST IC1004 is in the propagation modelling in forest and urban areas, to the Working Groups 1 and U
- Motorola Mobility, the recently created company from the former Motorola, is developing smartphones, tablets, wireless accessories, end-to-end video and data delivery, and management solutions, including set-tops and data-access devices. In IC1004 the participation of Motorola is twofold: on the technical contributions and discussions about Over-the-Air testing (OTA) and as one of the major liaisons to CTIA, the North American association of wireless carriers and their suppliers, as well as providers and manufacturers of wireless data services and products.
- NICT, the National Institution of Information and Communication Technology is the Administrative Agency which supports Communication Technology Development in Japan. They role in IC1004 is providing research results for technical discussion on

antennas and propagation models for Body Area Networks. One representative from NICT is co-chairing the Topical Working Group B.

- Tokio Institute of Technology, the largest institution for higher education in Japan dedicated to science and technology, is providing to COST IC1004 their results mainly on antenna technologies, and also to radio channel modelling (WG1) and Body Area Communications (WGB)
- JAIST, Japan Advanced Institute of Science and Technology (JAIST) is one of the leading research-oriented universities in Japan. The participation to IC1004 is enriching the Action discussions in the area of Cooperative Transmission Systems, with the valuable inputs from Prof. Tadashi Matsumoto on point-to-point to multi-point to multi-point communications, including cooperative wireless communications, based on the iterative detection and decoding techniques, included in our Working Group 2.
- Tongji University; in China, and in particular its School of Electronics and Information Engineering, is contributing to COST IC1004 in the area of Radio Channel Modelling (WG1) and some results to Energy Efficiency in Mobile Networks (WG3)
- BUPT; Beijing University of Posts and Telecommunications, is contributing to radio channel sounding for relay, coordinated communication and multi-user MIMO systems, with technical inputs to WG1, 3 and TWG-O
- ICESI; a Colombian University, is taking to IC1004 the view of the mobile telecommunications networks in special scenarios like the Andean area, and contributes mainly to Radio Networks (WG3) and Urban Environment (WG-U) on Radio Resource Management and Cognitive Radio
- Communications Research Centre Canada (CRC) is a Canadian Government institution that operates as part of the Canadian Government Department known as "Industry Canada" and conducts independent research on topics associated with radio communications, and radio broadcasting. CRC is participating to the WG1 in IC1004 in the area of Radio Propagation and Channel Modelling.
- University of Montenegro; COST Neighbour Country. The initial proposal was to contribute to OFDM based cooperative systems, but up to date they have not attended any meeting.
- La Trobe University; Australia, entered the action under the condition of "**Reciprocal Agreement**" Country. The intention was to contribute with their experience on green computing, but up to date they have not attended any meeting.

To summarise, the 11 non-COST institutions which are part of the IC1004 members are:

- 2 are no active by now (Montenegro and La Trobe)
 - 9 are very active, among which
 - o 2 are Companies (Motorola and Comsearch)
 - o 2 are Governmental Agencies (NICT and CRC)
 - o 5 are Universities (JAIST, BUPT, Tokio, Tongji and ICESI)
 - 9% (1/11) of the non-COST Institutions is from a reciprocal agreement country.
- *Advancement and promotion of scientific knowledge through publications and other outreach activities. (Number of publications and other outreach activities that resulted from COST networking through the Action. Complete list should be given in an annex)*

Participants to COST IC1004 meetings have produced and discussed 270 **technical documents** in 4 technical meetings so far. An increasing percentage of them are joint works among two or more Action participants. The complete list of documents can be found at www.ic1004.org under "meetings".

Some of such **joint results** have already produced **literature**, being the list still short because the Action is in its first year term. (See Annex 2)

The Action is also producing a **Newsletter**, three times per year, in which a selection of the recent results discussed in technical meetings are summarised, as well as the news on the Action ongoing activities: <http://www.ic1004.org/index.php?page=newsletter>

COST IC1004 is editing a **Special Issue** on Small Cell Cooperative Communications to be published by Springer in the EURASIP Journal on Wireless Communications and Networking

In addition, IC1004 has organised **Special Sessions** at several conferences for 2012:

- EuCAP, Special Sessions 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/>
- European Wireless, Special Sessions on "Wireless Body Area Networks", 18-20 April, Poznan (PL)
- ICC, participation at Special sessions on "Cognitive and Cooperation for Green Networking" (in coop. with C2POWER), and "Cooperative and Cognitive Mobile Networks (in coop. With COcONET); Ottawa (Canada) 10-15 June <http://www.ieee-icc.org/>
- IC1004 Special Session (Workshop) on "Cooperative Radio Communications" at Future Network & Mobile Summit 2012, Berlin (Germany) 4 - 6 July ; <http://www.futurenetworksummit.eu/2012/>
- IC1004 Special Sessions at IEEE ComSoc CAMAD 2012, Barcelona (Spain) 17-19 Sept; <http://camad2012.av.it.pt/>
- IC1004 Special Session to URSI-ISSSE'2012 Conference, Potsdam (Germany) 3 - 6 Oct; <http://www.issse2012.org/>
- IC1004 Special session on "Body Environment Communications" to CEMA'12 Conference, Athens (Greece) 8 -10 Nov <http://tu-sofia.bg/ENG/fktt/cema12>

- *Activities and projects with COST network colleagues.*

(See Annex 1)

- *The capacity of the Action members to raise research funds.*

In IC1004 we understand that the philosophy of COST Actions is to serve as a networking activity, assuming that the individual participants are getting funds from other public or private programs. Inside IC1004 the results of research projects are shown, being COST meetings a way for dissemination of such results, but also a framework where to discuss the ongoing work, with colleagues who are not partners to those same funded projects. COST IC1004 has also played a match-making role among their participants, resulting in consortiums that obtain large research grants, including those from EU framework programs. Up to date, COST Actions contracts have been not related to other FP7 instruments, but our proposal, as mentioned in the Position Paper sent to Horizon2020 consultancy, is that some budget at such projects can be eligible for partners to participate into COST Actions.

Annex 1 includes the list of all the projects prepared during 2011 and 2012 by COST IC1004 participants, many of them being joint proposals to EU FP7 Calls 8 to 10

II.D. Self evaluation

Indicate in no more than 1 page what, in the opinion of the MC, were the main successes, drawbacks (if any) and the key difficulties encountered (if any).

As listed in previous sections, the scientific, networking and dissemination initial **objectives of COST IC1004 for the first year term have been reached**. So, after one year of activities, this Action is a success in many senses, and has overcome some initial difficulties mostly related to the late known of the total final budget for the first year term, which produced delay in planning the Action activities.

COST IC1004 is at the end of the first year period (18th May 2012) large in terms of participants, with a total of above 300 individuals from **112 research institutions and companies**. IC1004 meetings are attended by more than 100 experts, being MC members only 1/3 of them. This makes the activity of this action being funded by COST only in a small percentage of the direct costs incurred by the participants, in the range of 20%, while results obtained from the COST Action activities are reported as a global outcome, making the effectiveness of the funding be artificially higher, since 80% of the total cost of the Action is masked by the volunteer participation of companies, universities and research centres not reimbursed by COST Administration. But on the other hand, the fact that the majority of participants to COST IC1004 meetings cover the expenses by their own, clearly indicates that **the activity in IC1004 is generating significant results and interest**, not only in terms of the meeting discussions with colleagues, but mainly on the scientific networking of methodologies, standards, references, techniques, models and tools.

COST IC1004 bases their success in the **networking effects** produced within its framework, which are not relaying on any partnership contract or specific funded competitive objectives, but on the **bottom-up approach** of sharing results, and the technical discussions among its participants. COST IC1004 is understood by its participants as a networking instrument, where results from projects funded by many different sources are discussed, and a natural **coordination between the participant researchers' interests** is reached.

Early Stage Researchers (ESRs) are taking advantage of COST IC1004 like in any other forum in the European Research Area. ESRs find in COST those colleagues who are working in the same topics, both senior researchers from other institutions and young people in their same situation, who in some years will take responsibilities and could propose joint participation to future projects. When a young researcher comes to a COST meeting to show the results of a research work, what can be expected is to have **long and constructive discussions** about it, taking back after the meeting some new ideas on how to improve the investigations. This is radically different if the young researcher attends a big conference, where a very limited time slot is assigned for the presentation, very few questions are expected and the audience is usually of wider scope.

IC1004 is a good example of **industrial involvement** in COST, with the necessary mix between industry and academia, in the best sense. There is no other benefit for companies to come than grasping what's going on in academia and transfer some of their own needs. It's probably a purer way than in projects, where funding creates some bias.

In IC1004 we understand that the philosophy of COST Actions is to serve as a networking activity, assuming that the individual participants are getting funds from other public or private programs. Inside IC1004 the results of research projects are shown, being COST meetings a way for dissemination of such results, but also a framework where to discuss the ongoing work, with colleagues who are not partners to those same funded projects. COST IC1004 has also played a **match-making role among their participants**, resulting in consortiums that obtain large research grants, including those from EU framework programs. Up to date, COST Actions contracts have been not related to other FP7 instruments, but our proposal, as mentioned in the **Position Paper sent to Horizon2020** consultancy, is that some budget at such projects can be eligible for partners to participate into COST Actions.

III. Previous scientific report(s)

Part II of past periods' reports are to be found here.

(N.A.), Action started in May 2011

ANNEX 1. List of Joint Projects and Proposals

FP7 Call 8

Status	Acronym	Type	COST Institutions Involved
negotiations	METIS	IP	iTEAM-UPV Valencia, Chalmers Univ., Aalto University, Ericsson, U.Oulu, U. Karlsruhe, KTH
Funded	DIWINE	STREP	Toshiba Research UK, Czech Technical University, Univ. York
not funded	DANCER	STREP	CTTC and Univ York
negotiations	SEMAFOUR	IP	Braunschweig Univ, Ericsson, TNO
not funded	GREENCELL	STREP	Universidad Carlos III de Madrid (UC3M), King's College London (KCL), IST (UBI, Portugal)
not funded	NEMO	STREP	Eurecom (FR), Alcatel-Lucent Bell Labs (FR), ftw. (AT), UCL (BE), TU Berlin (DE)
Funded	GREENETS	STREP	ATESIO, Univ. Braunschweig
Evaluation	BEACON	STREP	University Goce Delcev Stip (UGD), Chalmers University of Technology (CHALMERS), Technical University Wien (TU WIEN)
Evaluation	NatNet	STREP	University of Ulm (UULm), Aalborg University (AAU)
Negotiation	LexNET	IP	LexNET "Low EMF Exposure Fure Networks", Paris-Tech, CEA-LETI, IST-TUL and IBBT (UGent/IBBT)
Funded	(NEWCOM#)	NoE	Vienna University of Technology, Université Catholique de Louvain, Eurecom, Aalborg University, Univ Bologna, IST Lisbon
not funded	Awareness	IP	Lund University, Ericsson AB, Aalto University, Università di Bologna, WIND Telecomunicazioni S.p.A, ZIGPOS GmbH
evaluation	ABSOLUTE	IP	University of York and University Duisburg-Essen
not funded	SIMPLICITY	STREP	CTTC, University of Edinburgh, Toshiba Research Europe Limited TREL UK, Centre National de la Recherche Scientifique CNRS, Univ. of Bristol UNIVBRIS UK, SIRADEL SIR France
Not funded	VIA VIRIDIS		Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V. Heinrich-Hertz-Institut, FTW Telecommunications Research Center Vienna, IMST GmbH, Kungliga Tekniska högskolan

Other FP7 Calls

Status	Acronym	Type	COST Institutions Involved
Funded	WHERE2	STREP	Siradel, University of Rennes 1, Eurecom, Aalborg University, German Aerospace Center (DLR)
Funded	SELECT	STREP	CEA, Univ. Bologna, ENSTA
not funded	SAFARI	STREP	Call 7, Univ. Bristol, VTT Finland
funded	Greenet	ITN	Universitat Politècnica de Catalunya (UPC), Centre Tecnològic de Telecomunicacions de Catalunya (CTTC), University Degli Studi di Trento, Instituto de Telecomunicações (IT).
funded	WiCoSe	ITN	U.Cartagena, UBI Portugal, Univ. Lille,
evaluation	ETNAtv	STREP	UPV (Spain - coordinator), FUB (Italy) and ICESI (Colombia)
evaluation	ETNAtv	Supporting	Univ. Cartagena, Univ. Bologna, AGH University of Science and Technology

Other joint projects

Status	Founder	Title	COST Institutions Involved
funded	The German Israeli Foundation for Scientific Research and Development (G.I.F)	Cognitive broadband wireless mesh networks	Universitaet Duisburg-Essen and Ruppin Academic Center
funded	Program Tournesol (Hubert Curien Partnerships)	" Wireless channel in industrial environment: Characterization and minimization of EM exposure".	Univ Lille/ Univ Gent(Belgium)
Funded	Campus International sur la sécurité dans les transports (CISIT)	" Optimization of ground to train communication in tunnel"	Univ Lille/UPCT
Funded	Bilateral	"Advanced technologies for next generations of mobile broadband communication systems"	Jozef Stefan Institute Ljubljana, (Slovenia) and University of Montenegro
Funded	Swedish Research Council	Coding for Future Wireless Communication Networks	University Goce Delcev Stip (UGD), Chalmers University of Technology (CHALMERS)
funded	German Science Foundation	Non-coherent communication for future wireless networks	University Goce Delcev2000 Stip, Macedonia and Ulm University
funded	FP7-ENV-2010. Cooperation	Balkan GEO Network - Towards Inclusion of Balkan Countries into Global Earth Observation Initiatives	University of Novi Sad, Serbia and Institute of Jozef Stefan, Ljubljana, Slovenia

National projects

Status	Country	Title	COST Institutions Involved
funded	Finland	MIMOTA	University of Oulu, Aalto University, Nokia, Pulse Finland, Elektrobit, ETS - Lingren
funded	Montenegro	Advanced Solutions for Improving Performance of Wireless Cooperative Infrastructures	University of Montenegro
Evaluation	Ireland	IMAGES: Interference Mitigating Absorbers for Green Energy Systems	Dublin City University
funded	Spain	GEOCOM	iTEAM-UPV Valencia and U.P. Catalunya
funded	Czech Republic	Channels and energy efficient concepts for low power green smart devices	Brno University of Technology
Funded	Denmark	4th Generation Mobile Communication and Test Platform Platform	Aalborg University
funded	Denmark	Mobility Stipends – Information and Communication Technology	Aalborg University
funded	Spain	Self-optimising heterogeneous mobile radio access networks	Univ. of Málaga

funded	Spain	Adaptive techniques of radio resource management in B3G networks	Univ. of Málaga
funded	France	Localization system for mobile phones	Univ. Lille and Siradel
funded	Portugal	Opportunistic Aggregation of Spectrum and Cognitive Radios: Consequences on Public Policies	IST-U Beira Interior
funded	Portugal	Cross-Layer Optimization in Multiple Mesh Ubiquitous Networks	IST-U Beira Interior
funded	Portugal	Prototypes for Efficient Energy Self-sustainable Wireless Sensor Networks	IST-U Beira Interior
funded	Portugal	LTE-Advanced Enhancements using Femtocells	IST-U Beira Interior
funded	Luxembourg	Cooperative and Cognitive Architectures for Satellite Networks	University of Luxembourg
rejected	Spain	Cognitive Radio Generation+	U. Cartagena and U.P. Valencia iTEAM
funded	Spain	Radio Channel Characterisation at 60GHz	Univ. Cartagena
funded	Spain	General radio concepts for energy efficient mobile communications	Univ. Carlos III
funded	Austria	Signal and Information Processing in Science and Engineering	T. U. Graz
funded	Austria	LOBSTER	T.U. Graz
funded	Sweden	Distributed antenna systems for efficient wireless systems	Lund University
funded	Sweden	Channel modeling for multiuser MIMO with multiple base stations	Lund University
funded	Sweden	Excellence center at Linköping Lund in information Technology	Lund University
funded	Sweden	High Speed Wireless Center - HSWC	Lund University
funded	Sweden	Novel antenna system design paradigm for high performance mobile communications	Lund University
funded	Sweden	Antenna-channel harmonization for throughput enhancement in advanced mobile terminals	Lund University
funded	Switzerland	Full wave time domain methods for "simple but not simpler" propagation modelling	Fribourg University of Applied Sciences
funded	Serbia	Development and modeling of energy-efficient, adaptable, multisensor and multiprocessor low-power electronic systems	Institute Mihajlo Pupin
funded	Finland	Joint Advanced Development Enabling Next Generation Energy Efficient Wireless Networks	VTT Finland
funded	German Science Foundation	Advanced Analog Signal Processing	Ulm University

Annex 2. Joint Publications between COST IC1004 partners

- [1] W. Thompson, R. Cepeda, M.A. Beach S. Armour ; “Antenna Mounting for Ultrawideband On-body Communications and Channel Characterisation”, IEEE Trans MTT (UWB SPECIAL ISSUE), Volume: 59, Issue: 4, Part: 2, April 2011, pp 1102 – 1108, DoI 10.1109/TMTT.2011.2114130
- [2] W. Thompson, R. Cepeda, M.A. Beach S. Armour, ‘Ultra-wideband frequency dependency of capacity and diversity in multi-antenna indoor environments’, IET Communications, Vol. X, No. X, ISSN 1751-8628, doi: 10.1049/iet-com.2010.1057, XXXX 2012, pp XX -XX
- [3] P.K. Gentner, G.S. Hilton, M.A. Beach, C.F. Mecklenbrauker, ‘Characterisation of ultra-wideband antenna arrays with spacings following a geometric progression’, IET Communications, Vol XX, No XX, ISSN 1751-8628, doi: 10.1049/iet-com.2010.1054, XXXX 2012, pp XX -XX
- [4] Davide Dardari, Francesco Guidi, Christophe Roblin and Alain Sibille. "Ultra-wide bandwidth backscatter modulation: processing schemes and performance", Eurasic Journal on Wireless Communications and Networking, July 2011
- [5] Samuel Van de Velde, Henk Wymeersch, Paul Meissner, Klaus Witrisal, and Heidi Steendam “Cooperative Multipath-Aided Indoor Localization”
- [6] J. Poutanen, F. Tufvesson, K. Haneda, V. M. Kolmonen, P. Vainikainen: *Multi-link MIMO channel modeling using geometry-based approach* IEEE Transactions on Antennas and Propagation, No. 99, 2011.
- [7] C. Mecklenbräuker, A. Molisch, J. Kåredal, F. Tufvesson, A. Paier, L. Bernadó, T. Zemen, O. Klemp, N. Czink: *Vehicular channel characterization and its implications for wireless system design and performance*; Proceedings of the IEEE, Vol. 99, No. 7, pp. 1189-1212, 2011.
- [8] B. K. Lau, J. Bach Andersen: *Simple and efficient decoupling of compact arrays with parasitic scatterers*; IEEE Transactions on Antennas and Propagation (Special Issue on MIMO Technology), Vol. 60, No. 2, pp. 464-472, 2012.
- [9] T. Abbas, J. Kåredal, F. Tufvesson, A. Paier, L. Bernadó, A. Molisch: *Directional Analysis of Vehicle-to-Vehicle Propagation Channels*; IEEE Vehicular Technology Conference, IEEE 73rd Vehicular Technology Conference 2011-spring, Budapest, Hungary, 2011-05-15/2011-05-18. (BibTeX)
- [10] X. Gao, A. Alayon Glazunov, J. Weng, C. Fang, J. Zhang, F. Tufvesson: *Channel measurement and characterization of interference between residential femto-cell systems*; EuCAP 2011: 5th European Conference on Antennas and Propagation, Rome, Italy, 2011-04-11/2011-04-15. (BibTeX)
- [11] K. Haneda, J. Poutanen, V. M. Kolmonen, L. Liu, F. Tufvesson, P. Vainikainen, C. Oestges: *Validation of the COST2100 channel model in indoor environments*; Proc. Newcom++/COST2100 Joint Workshop, Paris, France, 2011-03-15. (BibTeX)
- [12] K. Haneda, F. Tufvesson, S. Wyne, M. Årlelid, A. Molisch: *Feasibility study of a mm-wave impulse radio using measured radio channels* 2011 IEEE 73rd Vehicular Technology Conference (VTC Spring), Budapest, Hungary, 2011-05-15/2011-05-18. (BibTeX)
- [13] J. Poutanen, K. Haneda, L. Lin, C. Oestges, F. Tufvesson, P. Vainikainen: *Parameterization of the COST 2100 MIMO channel model in indoor scenarios*; Proceedings of the 5th European Conference on Antennas and Propagation (EUCAP), Rome, Italy, pp. 3606-3610, 2011-04-11/2011-04-15. (BibTeX)
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 - [17]Fernando J. Velez, Maria del Camino Noguera, Oliver Holland and A. Hamid Aghvami, "Fixed WiMAX Profit Maximisation with Energy Saving through Relay Sleep Modes and Cell Zooming," Journal of Green Engineering (Special Issue from WPMC 2010), Vol. 1, No. 4, July 2011, pp. 355-381.
 - [18]O. Holland, C. Facchini, A. H. Aghvami, O. Cabral, and F.J. Velez, "Opportunistic Load and Spectrum Management for Green Radio" Chapter in the book Green Radio Communication Networks, edited by E. Hossein, V. Bhargava, G. Fettweis, Cambridge University Press, Cambridge, UK, 2012.
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 - [21]M. Barbiroli, C. Carciofi, D. Guiducci, A. Guidotti, E. Tarantino, G. Riva "Advantages and disadvantages of the introduction of IMT systems at 800 MHz", International Conference on Electromagnetics in Advanced Applications, ICEAA 2011, September 12-16, 2011 Torino, Italy. On page(s): 1184 – 1188. Print ISBN: 978-1-61284-976-8.
 - [22]M. Barbiroli , C. Carciofi , V. Degli Esposti, P. Grazioso, D. Guiducci, V. Petrini, G. Riva "Planning Criteria to Improve Energy Efficiency of Mobile Radio Systems" IEEE-APS Topical Conference on Antennas and Propagation in Wireless Communications, APWC 2011, September 12-16, 2011 Torino, Italy. Print ISBN: 978-1-4577-0046-0.
 - [23]C. Carciofi, M. Barbiroli, D. Guiducci and G. Riva "Smart meter standardisation as a market enabler and flexible information demands" Cigré International Symposium The Electric Power System of the Future, 13-15 September 2011 - Bologna (Italy).
 - [24]A. Guidotti, P. Grazioso, M. Barbiroli, C. Carciofi, D. Guiducci and G. Riva: "Analysis of coexistence and mutual interference between mobile and digital television systems - Análisis sobre coexistencia e interferencia mutua entre los sistemas móviles y la televisión digital", S&T Sistemas y Telemática, Revista de la Facultad de Ingeniería, Universidad ICESI, Cali, Colombia, Vol. 9, n. 19, ISSN 1692-5238, Octubre-Diciembre de 2011, pp. 9-30
 - [25]S. A. Torrico, K. L. Chee, and T. Kürner, "A Propagation Prediction Model in Vegetated Residential Environments – A Simplified Analytical Approach," *European Conference on Antennas Propagation (EuCAP)*, Rome, Italy, pp. 3435-3439, April 11-15, 2011.
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