WP4.1 – Direction and quality assurance of scientific activities

D41.1
First yearly report on scientific management and network promotion plan

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Abstract:
This document illustrates the most crucial steering and coordination functions of the Project Coordinator for the everyday proper working of the NoE.

Keywords:
Project Management, Quality Assurance, Promotion, Sustainability

Authors

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Beneficiary / Organisation</th>
<th>e-mail</th>
<th>Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marco Luise</td>
<td>CNIT</td>
<td><a href="mailto:marco.luise@cnit.it">marco.luise@cnit.it</a></td>
<td>Editor</td>
</tr>
<tr>
<td>Simona Moschini</td>
<td>CNIT</td>
<td><a href="mailto:simona.moschini@cnit.it">simona.moschini@cnit.it</a></td>
<td>Contributor</td>
</tr>
<tr>
<td>Rosa Martinez</td>
<td>CTTC</td>
<td><a href="mailto:rosa.martinez@cttc.es">rosa.martinez@cttc.es</a></td>
<td>Section Contributor (sec.3)</td>
</tr>
</tbody>
</table>

Reviewers

<table>
<thead>
<tr>
<th>Full Name</th>
<th>Beneficiary / Organisation</th>
<th>e-mail</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carles Anton-Haro</td>
<td>CTTC</td>
<td><a href="mailto:carles.anton@cttc.es">carles.anton@cttc.es</a></td>
<td>October 14, 2013</td>
</tr>
<tr>
<td>Carles Anton-Haro</td>
<td>CTTC</td>
<td><a href="mailto:carles.anton@cttc.es">carles.anton@cttc.es</a></td>
<td>February 27, 2014</td>
</tr>
</tbody>
</table>

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Executive Summary

This document presents a summary of the NoE activity in the first reporting period, and illustrates the most crucial steering and coordination functions of Project Coordination. Both general achievements and specific WP and Track activities are discussed, making sure that all WPs in the Joint Program of Activities make adequate progress towards their goals and deliver the planned documentation in due time and with the expected level of quality.

In addition to this, a strategy for the internal and external promotion of NEWCOM# is identified. Such strategy intends to start a *virtuous cycle*, to encourage an ever increasing number of institutions (and especially new Affiliate Partners from industry and Academia) joining and supporting the NoE.
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1. Summary of the project

This section sets an overview of the project, and contains the objectives and expected impacts, a short description of it, and ends by defining concisely the work performed and the achievements of the first year of activity.

1.1 Project Objectives

NEWCOM# is a research ecosystem to nurture a new generation researchers, and to help creating Institutions featuring excellent researchers with an inherent attitude to work in line with the NoE philosophy: interaction, cooperation, integration. The core concept of NEWCOM# is an NoE of a relatively large size, created for the purpose on one hand, to address medium-to-long term complex, interdisciplinary, fundamental research problems in the field of wireless communications and networking; and, on the other, to create a distributed European laboratory for the future Wireless Internet (EuWln) to also foster experimental research in the field.

As a consequence of this concept we may delineate the Scientific Objectives of NEWCOM# as follows:

4. Study of the low-energy-consumption and low-emission technologies in the field of radio interfaces, and their interplay with high spectral efficiency (MIMO) techniques.

Beyond the research objectives, NEWCOM# has Integration and Spreading-of-Excellence objectives, such as:

I. Building a strong link with the EC to interface with other projects and events, and exploit possible synergies with the Future Network and Mobile Summit and the RAS cluster.

II. Offer attractive opportunities for joint teaching activities, hands-on instruction, and increased student mobility through the issue of NEWCOM# Mobility Awards, and by assisting with the preparation of proposals for other EC mobility grants (like Marie
III. Contribute to the long-term sustainability of the NoE by creating a permanent environment for cooperative research: the EuWin lab (multisite European Laboratory of Wireless communication for the future Internet).

IV. Disseminate its results across the scientific community through jointly written papers, special sessions and journal issues, and improving dissemination of the research results to European industry organizing events hosted by Associate Partners at their own premises to facilitate participation of their staff members.

1.2 Expected Impact

- Strengthened positioning of European industry in the fields of Future Internet technologies, mobile and wireless broadband systems. A real contribution in terms competitiveness from NEWCOM# to companies will be given by the dissemination events (including in-company events) and by training.
- Developing the technology for the future generations of the European high-speed broadband and mobile network infrastructure.
- Increased economic and energy efficiency of access/transport infrastructures (cost/bit).
- Contributions to standards and regulation as well as the related IPRs, with a predominant role for Europe in standardization bodies and for a and Industry adoption of spectral-efficient broadband wireless systems, novel Internet architectures and technologies.
- European Dimension of Research and of the NoE.
- Durable integration and excellence of research.

1.3 The Consortium strength

12 of the 18 partners of the former NoE NEWCOM++, together with the two new partners Technical University of Dresden and University of Oulu, are bound to attain a new level of cooperation under the general coordination of the Italian Consortium CNIT. All of them bear a significant record of excellence and international recognition in the field of wireless communications and networking. This is exemplified by: (i) the large number of IEEE/EURASIP fellows (or equivalent) that the consortium counts with; (ii) their vast publication record (iii) the regular collaborations maintained with overseas institutions in the US and other regions; (iv) their widespread involvement in scientific societies (e.g. IEEE) and leading-edge publications at the highest level (i.e., Editor-in-Chief, Board of Governors); and (v) experience in the organization and chairing of large scientific conferences.

1.4 Structure of the JPA

The Joint Program of Activity (JPA) of NEWCOM# is articulated into four tracks: Theoretical Research (Track 1); The European Lab of Wireless Communications for the Future Internet - EuWin (Track 2); Training Dissemination and Human Capital (Track 3), and Management (Track 4), as shown in Fig. 1. Tracks 1 and 2 will host the so-called set of Integrated Core Research Activities. By this, we mean that research activities themselves will be instrumental in what concerns the actual integration of project...
partners. **Track 1** pursues medium-to-long-term, interdisciplinary research on the most advanced aspects of wireless communications like the Computation of the Ultimate Limits of Communication Networks, Opportunistic and Cooperative Communications, or Energy and Bandwidth-Efficient Communications and Networking). **Track 2** is devoted to the “EUropean laboratory of Wireless communications for the future INternet” (EuWIn) that will host researchers from within the network, from external Academic Institutions, and from European companies. EuWIn will be organized as a collaborative effort of the constellation of all NEWCOM# partners orbiting around three different reference sites at three different NEWCOM# Institutions: CTTC in Barcelona-Spain, CNIT in Bologna-Italy, CNRS/EURECOM in Sophia Antipolis-France, with focus on themes such as the implementation of novel Radio Interfaces, selected aspects in relation with the Internet of Things, and Flexible Communication Terminals and Networks of novel Radio Interfaces. EuWIn is also conceived as a tool to foster industry-academia cooperation through a number of activities such as visits, or the direct participation of companies in the actual research activities and/or use of lab infrastructure. **Track 3** is mostly devoted to Spreading of Excellence activities and, to some limited extent, non-research based Integration tools. It includes the organization of traditional dissemination events, winter/summer schools, conferences, workshops organization of in-company dissemination events to be hosted by some of the N# Affiliate Partners. This activity, along with the aforementioned EuWIn lab, turns out to be the main tool for the interaction with the wireless communication industry in general. **Track 4** will ensure the interaction and proper functioning of the network in terms of guaranteeing scientific excellence and proper management.

**1.5 Achievements during the first year**

The activities developed in the first 12 months of the project have been substantially compliant with the initial expectations. In terms of management, after the kick-off meeting held in Pisa at the end of November 2013, all project Boards have been nominated and are actively working toward the achievement of their own objectives.

The Executive Board (EB) members have met three times face-to-face, and three more using the videoconference tool SCOPIA licensed by CTTC to this purpose to all partners.

The NEWCOM# Office, led by Carles Anton-Haro at CTTC, the Managing Director, and composed by Simona Moschini at CNIT-Pisa and Rosa Martinez at CTTC, is in charge of the many day-by-day operations needed to synchronise the various activities with the deadlines set by DoW in terms of deliverables and milestones.

The Advisory Board (AB) is composed by: Sergio Benedetto from Politecnico di Torino (Italy) having Chair functions; Andrea Goldsmith from Stanford University (USA); Georges Karam from Sequans (France); Jorma Lilleberg from Renesas Mobile (Finland). The names speak for themselves, it is just worth mentioning that emphasis has been put on recruiting highly representative leaders form the wireless industry. The Advisory Board (AB) members have met 2 times using the videoconference tool giving a great contribution in terms of vision for the future and suggestions for greater integration of activities, especially on Track 2. A short written report has been prepared by the AB on October 30, 2013, and is attached to this deliverable with no changes as Annex II.

The NEWCOM# website is fully operational and fulfil its role of repository of the working WP documents and materials as well as a source of information for all network researchers.

**Track 1**, about fundamental and theoretical research, has organized one plenary meeting in
Paris and has issued 3 very thorough deliverables that report i) a review of the status of the art about the problems they deal with, ii) the description of the Joint Research Activities\(^1\) that has been identified and started within the various WPs, and iii) some preliminary results produce within the JRA\(\text{s}\) and leading to publications.

Track 2 “the European Laboratory of the Future Wireless Internet EuWIn\(^1\), about experimental research, has issued two series of deliverables (two documents for each of the three sites of the lab) describing the setup of the lab (in the first document), testing of such setup and JRA\(\text{s}\) (in the second document). With respect to the documents produced in Track 1, Track 2’s documents bear a lesser degree of maturity, and this is due to two factors: the NEWCOM\# partners already come from a successful experience of integration of theoretical research (NEWCOM++), so that their starting point in this respect is already very good – the same does not apply to the kind of experimental research that is being done in Track 2, and that is new to the NEWCOM\# community. Second, experimental research needs longer start-up and fine-tuning times, so that the time to get good research results are longer for Track 2 than for Track 1.

All research deliverables have been timely released and in addition, 33 joint papers and 68 individual papers have been presented at international conferences or accepted/published by international peer-reviewed journals. Notably, 33 of those publications turn out to be joint papers resulting from on-going collaboration among project partners. Publications can thus be regarded as one of the main achievements of the project in the first year. In Section 3, we conduct an in-depth analysis of those publications and other dissemination activities carried out by NEWCOM\# partners. The full list of publications can be found in Annex V.

In addition to the Kick-Off meeting held in Pisa in early November, one of the main outcomes of the period have been Track 2’s Inaugural Event of EuWIn, paired with the Emerging Topic Workshop on "Fundamental Research Through Experimentation" held in Bologna (July 8-10\(^1\) 2013). The events were well attended (almost 70 people) and counted with the presence of EC representatives. During the inaugural event, which was open to the general public, all EuWIn facilities were presented, both through talks and demos/posters. It included also a small exhibition where both research labs and local companies showcased their products/projects.

Track 3 has developed through a number of dissemination activities. Direct scientific dissemination have concerned various contributions to international conferences in terms of special sessions organized by NEWCOM\# researchers and the launch of a few special issues in international journals launched by editorial boards assembled within NEWCOM\#.

Dissemination through liaison with industries has started with a first event organized at Orange Lab in France, whilst a second one, originally planned in October 2012, has been delayed to January 2013 for logistics reasons. Organization of the first events has in particular setup a format suggesting what to do and not to do in subsequent editions. Training has developed though the organization of two well-attended one-week schools, devoted to PhD students and young researchers to help them in choosing and focusing their research activity, held in Sophia Antipolis (France) and Poznan (Poland).

Valorization of human capital has been achieved through the selection of the Best Paper Award, the Best Young Researcher’s Paper Award, and the Distinguished Research Award.

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\(^1\) A Joint Research Activity (JRA) can be defined as a group of researchers from two or more NEWCOM\# partners that, having identified research topic(s) of common interest, are willing to conduct R&D activities and disseminate their results (e.g. via publications or courses) in a collaborative and coordinated manner.
Concerning networking with other research project, NEWCOM# has signed a cooperation agreement with the FP7 NoE ACROPOLIS for experimentation in the filed of Cognitive Radio and white spaces, and with the Cost Action 2013. NEWCOM# is also contributing to the EC concertation activities, and in particular to the Radio Access & Spectrum (RAS) cluster.

To be noted is also the request of four European Institutions to become Associate Partners Type II (Academic or Public Research Institutions) of NEWCOM#: the University of Lund (Sweden), the University of Ghent (Belgium), Kadir Has University (Turkey) and University of Parma (Italy). The General Assembly has prepared a document to be signed by Associate partners Type II to include as much as possible researchers of those Institutions into JRAs and to consequently regulate possible IP issues.

In the Coordinator's opinion, NEWCOM# has fulfilled in a satisfactory manner its first year goals, and starts its second year of activities with a steady-state organisation and a fast pace towards the achievement of its ambitious objectives in integration, research and dissemination.
2. Project activities in year 1

In this section, a detailed description of the activities developed during the first year of the project is reported, for each of the work packages identified in the DoW. As the individual descriptions show, the work progress did not significantly deviate from the work plan in Annex I; all the deliverables of the first year have been produced and delivered in time, and the milestones have been achieved with a few minor delays approved by the Contract Officer. So, the project is fully in line with its expectations.

2.1 Project objectives for the period

We will take here the same approach that was used at the time of preparation of the Project proposal making a distinction between MACRO objectives and MICRO objectives of our work. The description in terms of micro-objectives is the subject of the detailed activity report that is done on a WP basis in a later section, and is summarized in the list of planned vs. achieved milestones and deliverables reported in Annex I of this document. What is on the contrary important here is to discuss the macro-objectives of the projects in the first reporting period (Y1), and we will do this on a synthetic Track-by-Track approach.

The main objective of the WPs in Track 1 was consolidating the good approach to integrated theoretical research that the partners inherited from previous experiences in former NoEs they took part in. In particular, the first and foremost objective was identifying Joint Research Activities (35 in total) and get them started. This was fully achieved, and is testified by numerous publications and project deliverables.

Track 2 objectives were slightly different than Track 1’s. Contrary to Track 1, none of the partners could boast experience in networking of experimental research, that has to be re-invented from scratch. So the first objective of the period was developing the local and global structure of the networked, multi-site lab EuWin. The objective was achieved and documented by a first group of deliverables, and was followed by an event that we can call the “vernissage” of the lab. Every site of EuWin (CNIT-Bologna, CNRS/Eurecom, CTTC) developed a specialized competence, and also established networking around its competence with other NEWCOM# partners. Second objective was preliminary testing of the facilities through a series of experimentation with the different infrastructures. This was also fully achieved and documented in the first part of the second group of deliverables. The first objective was common with Track 1, and was the identification of JRAs (18 in total). This was also satisfactorily done and documented (second part of the second group of deliverables). The status of maturity of the JRAs into Track 2 is less advanced than into Track 1, but form the description of the objectives above it is pretty natural that activities must have been slower to start up.

Coming to Track 3, the objectives of dissemination were twofold, namely, internal and external. For internal dissemination the project acted as planned in terms of valorization of human capital. In terms of external dissemination, many actions were taken starting form the development of the project website (see http://www.newcom-project.eu), to the signature of Associate Partners Agreement with 4 new academic partners that will be integrated into research activities, ending with the organization of two successful training schools, with three more coming up in the second reporting period. We will not insist on the many micro-objectives that the project has successfully reached. We just mention one aspect that needs improving, namely, “industrial liaison”. The objective was to have two events organized in Y1, and the project planned two but managed to organize just one, the second one being postponed to early Y2 for logistic reasons of the hosting industrial partner. The experience gained in the first event was that much effort is needed by NEWCOM# to be able to find a match between the industry expectation and what the NoE can offer. This a major point to
improve in the subsequent industry dissemination events (three already planned for the first half of Y2).

The objectives of Track 4 in terms of scientific management were those of a close coordination between the scientific activities of Track 1 and Track 2, and this was achieved through organization of a joint workshop held in January 2013 (next one scheduled in Lisbon in Jan 2014), plus a number of discussions and resulting coordination actions at the many meetings of the Executive Board (see the detailed list reported later on). Steering function of the activity were also played by the Advisory Board through a couple of internal meetings and a dedicated meeting with WP leaders. And last but not least, promotional material has been disseminated at many occasion with good acceptance.

2.2 Work progress and achievements during the period

The general organization of NEWCOM# revolves around three main axes called Tracks: 1) Theoretical research, 2) Experimental research, 3) Dissemination, Training and Human Capital, 4) Management. This deliverable reports on the main work and achievements from Track 1 to Track 3, whereas those corresponding to Track 4 can be found in the companion deliverable D43.1 ('Administrative Management').

2.2.1 TRACK 1

Track leader: Pierre Duhamel (CNRS)

In the “Theoretical Research” Track, NEWCOM# pursues medium to long term, interdisciplinary research on the most advanced aspects of wireless communications like the Computation of the Ultimate Limits of Communication Networks, Opportunistic and Cooperative Communications, or Energy and Bandwidth Efficient Communications and Networking.

WP 1.1 Performance Limits of Wireless Communications

WP Leader: Marouane Debbah (Supelec)

This WP in the Track of theoretical research faces difficult and long-term challenges in terms of deriving the performance limits of Wireless Communications. With respect to similar activities carried out in the past, the focus is “beyond point-to-point”: in addition to the classical issues related to the development of capacity-achieving and/or non-binary channel codes for communication links (an area in which NEWCOM# researchers reach absolute world excellence), the WP also tackle more modern problems, like multiuser capacity, capacity of and optimal signal processing techniques for large networks, the achievement of communication security through features of the PHY layer (only), just to mention a few. Particular attention is devoted to issues related to cooperative communications via relays and network modelling, to identify optimal relaying strategies and the relevant ultimate capacity.

A summary of WP1.1 progress towards objectives

The WP is divided into three Tasks, each with specific scope and objectives: Task 1.1.1 “Theoretical Limits of Communications and Networks”; Task 1.1.2 “Relaying and Resource Allocation in Wireless Networks”; Task 1.1.3 “Capacity-reaching channel codes”. For each Task, specific JRAs have been identified that target to address some of the fundamental open issues in the respecting thematic areas. In order to avoid overlap between the various efforts and to enhance cooperation between partners a research harmonization and consolidation procedure was followed. The consolidation procedure resulted in the following 9 JRAs.
Task 1.1.1 “Theoretical Limits of Communications and Networks”
Task Leader: Marouane Debbah (Supelec)

- **JRA 1.1.1.1:** Performance limits of Sparse Bayesian Learning with application to wireless communication systems
  Leader of the JRA: Remy Boyer (CNRS)
  Main partners: Bernard-Henri Fleury (AAU), Pascal Larzabal and Mohammed Nabil El Korso (CNRS)

The objective of this JRA is to provide and analyze closed-form analytic expressions of the Bayesian lower Bound on the BMSE (Bayesian Mean Squared Error) for the estimation of a sparse vector. Thus, this JRA proposes new results on the ultimate estimation accuracy on a sparse vector. In particular, the oracle scenario where the support of the active sources is known is studied since this scenario is the gold-standard for assessing practical estimators.

Main Scientific Achievements of this JRA are:
- The Bayesian lower bound verifies a relation of order wrt. the sparsity parameter and a geometrical characterization is provided.
- The Bayesian lower bound for orthogonal square dictionaries and the link between the Van Trees’ lower bound and the Bayesian one based on the deterministic/Bayesian connection are also discussed.
- In a greedy philosophy, we study the impact the underestimation of the number of active sources on the Bayesian lower bound.
- Analytic expression of the Bayesian lower bound in case of erroneous assumptions on the support of the amplitude vector is provided.

- **JRA 1.1.1.2:** An Information-Theoretic Perspective of Cooperation and Secrecy in Multi-User Communications
  Leader of the JRA: Pablo Piantanida (CNRS-SUPELEC)
  Main partners: Meryem Benammar, Mari Kobayashi, Merouane Debbah, Gil Katz and Sheng Yang (CNRS-SUPELEC), Luc Vandendorpe (UCL), Shlomo Shamai (TECHNION)

The objective of this JRA proposal is to study the information-theoretic fundamentals and limits of multi-terminal communications. We shall focus on the study of three central research, which are described below:
- Secrecy in multi-user communications
  The research aims at demonstrating through simple models of sources and channels that secrecy can be achieved at no total rate cost at all. Indeed, current physical layer security theory indicates that securing all data traffic comes at a cost of a throughput loss, which is the price payed for security, given fixed resources, such as bandwidth, power, quality-of-service, etc. Not all wireless systems can afford a loss in the possible reliable rate, which with state-of-art technology approaches the theoretical capacity limits. We are planing to investigate the potential and ultimate limitations of securing part of the data to be transmitted (evidently the more sensitive part) via physical-layer techniques, while suffering minimal total rate loss.
  Another challenging goal is to study impact of partial channel state information is available to the transmitter (CSIT). Indeed, perfect secrecy cannot be established without CSIT unless the legitimate and the eavesdropper terminals observe asymmetrical channel statistics (e.g. better signal-to-noise (SNR), number of antennas), or at least partial CSIT. Due to the difficulty to obtain a complete characterization of the capacity, most recent contributions have focused on degrees of freedom which captures the behavior in the high SNR regime. We will pursue these theoretical directions on moderate SNR regimes.
- An information-estimation paradigm
  The connection between the most classical information-theoretic notion, the average mutual
information and the classical minimum means-square error (MMSE) was recently found via the notion of I-MMSE. This relation has attracted massive attention, and one of its classical application is in assessing the ultimate limits of communications in a variety of channels and processing constraints. Our research is aimed at harnessing this relation as to enhance our understanding and insights to the ultimate performance limits of multi-user wireless communication. Another goal of this undertaking will be focused on DoF studies, referring to other multi-terminal settings, e.g., the standard interference channel. We wish to better understand whether the combination of I-MMSE and multi-letter expressions for network problems, may yield further results and insights for different multi-terminal settings.

- Multi-user state-dependent channels, delay constraints and feedback

Information transfer over wireless networks with time-varying channels presents many challenges, essentially, due to the presence of uncertainty at the encoders about network topology, impact of interference at destination nodes and correlation between transmit signals. The encoder nodes typically extract some partial knowledge —or attempt to learn— about the time-varying channel characteristics via noisy feedback links. In the recent years, communications with channels controlled by random parameters —state— have been greatly developed. Information theory has not paid full attention yet to the subtleties of feedback in multi-terminal networks. Feedback was incorporated only in the form of side information at the transmitter, but not considered in the multi-terminal context of user cooperation, user coordination, key agreements, delayed CSI at the transmitters (CSIT), etc. The understanding of the different roles of feedback in multi-terminal networks opens up a wide array of research problems. We will pursue these theoretical directions.

- Cooperation in cellular architectures

The impact of cooperation on the performance of wireless cellular systems will be studied from an information-theoretic viewpoint, focusing on simple formulations typically referred to as Wyner-type models. Cooperation may be available at the base station (BS) level, which is also known as Multi-Cell Processing (MCP), network Multiple-Input Multiple-Output (MIMO), or Coordinated Multi-Point transmission/reception (CoMP). Another class of cooperative strategies allows cooperation in the form of relaying for conveying data between Mobile Stations (MSs) and BSs in either the uplink or the downlink. Relaying can be enabled by two possible architectures. The research aims at demonstrating through simple models including finite backhaul, possibly unreliable links that cooperation can be very useful in wireless cellular systems. We shall investigate networks aspects in cooperative wireless cellular systems, invoking: source-channel separation, random aspects in large cellular networks, oblivious and opportunistic relaying, the impact of structured coding and interference alignment in backhaul constrained cooperative cellular communications.

- JRA 1.1.1.3: Communications Performance of Large Dimensional Systems

| Leader: Romain Couillet (CNRS-SUPELEC) |
| Main partners: Pablo Piantanida, Merouane Debbah and Marco Di Renzo (CNRS-SUPELEC), Alessandro Guidotti and Giovanni Emanuele Corazza (CNIT-UniBO), Maxime Guillaud (VUT), Aris Moustakas (IASA) |

This JRA intends to develop tools for the analysis of large dimensional communication systems at large, i.e. having a specific large component, by confronting and merging the different recent methods used by the participants. Of main interest are those tools that turn large dimensional systems into infinite ones to help mathematical tractability and provide insightful results. Among those are: Random matrix theory, Stochastic geometry, Optimization methods.

Main Scientific Achievements of this JRA are:

- Performance of finite block-length communications in large MIMO systems. This work studies the second-order coding rate of the multiple-input multiple-output (MIMO) Rayleigh block-fading channel via statistical bounds from information spectrum methods and Gaussian tools from random matrix theory. Based on an asymptotic analysis of the information density
which considers the simultaneous growth of the block length $n$ and the number of transmit and receive antennas $K$ and $N$, respectively, closed-form upper and lower bounds on the optimal average error probability are derived when the code rate is within $O(1/\sqrt{nK})$ of the asymptotic capacity. A comparison to practical low-density parity-check (LDPC) codes reveals a striking similarity between the empirical and theoretical slopes of the error-probability curve, seen as functions of $n$ or the signal-to-noise ratio (SNR). This allows one to predict in practice by how much $n$ or the SNR must be increased to realize a desired error probability improvement.

- **Average Rate of Downlink Heterogeneous Cellular Networks over Generalized Fading Channels** – A Stochastic Geometry Approach

By exploiting the PPP–based abstraction model, a new mathematical methodology to compute the downlink average rate over general fading channels is proposed. In particular, a new analytical framework is proposed which, at the same time, reduces the number of integrals to be computed, and, similar to the Pcov–based approach, is flexible enough for application to arbitrary fading distributions (including correlated composite channel models). The framework leverages the application of recent results on the computation of the ergodic capacity in the presence of interference and noise. It avoids the computation of Pcov, and needs only the Moment Generating Function (MGF) of the aggregate interference at the probe mobile terminal. This framework is denoted by MGF–based approach. It is shown to be is applicable to multi–tier cellular networks with long–term averaged maximum biased–received–power tier association, and that either a single or a two–fold numerical integral need to be computed for arbitrary fading channels.

**Task 1.1.2 Relaying and Resource Allocation in Wireless Networks**

Task Leader: Savo Glisic (UOULU)

- JRA 1.1.2.1: Network Coding schemes for relay channels.
  
  Leader: Stephan Pfletschinger (CTTC)
  Main partners: Carmine Vitiello and Marco Luise (CNIT-UniPI), Stephan Pfletschinger and Monica Navarro (CTTC)

In this JRA, we consider the two-way relay channel (TWRC), in which two users exchange packets via a relay. This setting is one of the prime scenarios for physical-layer network coding and applies e.g. to satellite communication and to radio links which are connected via a relay, e.g. for the backhaul in cellular networks. In this scenario, two users send their packets to an intermediary relay, which then retransmits the information to the other user. The most efficient approach for this setting is given by the two slot protocol, which comprises the multiple-access and the broadcast phase:

- MAC (multiple-access) phase: Both users transmit their packets to the relay, which decodes both packets or a function of them.
- Broadcast phase: The relay broadcasts a combination of the packets to both users.

We consider different decoding options for the multiple-access phase which decode the messages of all users or only a function of the messages, which is used for transmitting in the broadcast phase. To this end, we consider individual decoding for the users' messages or for the network-coded combined message vs. Joint (vectorial) decoding of all messages. This latter approach has shown benefits for the joint decoding of binary LDPC codes with a decoder in GF(4) and for low code rates even outperforms the otherwise near-optimum approach based on lattice coding.

**Main Scientific Achievements**

- Application of trellis codes to physical layer network coding in the two-way relay channel: With trellis codes, we have developed a joint decoder which allows to decode combinations of different codes of possibly different rate in the multiple-access phase. The decoder applies the Viterbi algorithm on an extended trellis which combines both users' codes. This approach can be extended to turbo codes.
Joint vectorial decoding of non-binary LDPC codes. The belief-propagation decoder for non-binary LDPC codes has been extended to a joint decoder for multiple superimposed codewords, as they appear in the multiple-access phase of the two-way relay channel or in a more general sense in uncoordinated multiple-access schemes.

- JRA 1.1.2.2: Optimization approaches for heterogeneous networks
  Leader: Beatriz Lorenzo and Savo Glisic (OUULU)
  Main partners: Jordi Perez-Romero, Ramon Agusti (UPC), Luisa Caeiro, Sina Khatibi and Luis M. Correia (INOV)

The general framework for this JRA focuses on heterogeneous networks that can be comprised of multiple technologies such as cellular and wireless local area networks, etc. Moreover, multiple layers including both macrocells and small cells (e.g. microcells, picocells, femtocells, etc.) can also be present and relaying and multi-hop capabilities can be exploited. Under this framework, the objective of this JRA is the development of efficient resource allocation strategies with the general target to ensure the QoS requirements and the efficiency in the resource usage. Particular emphasis will be given to distributed approaches because they allow for a reduction in complexity and signalling overhead in comparison to centralized approaches, mainly when a high number of cells/access points/terminals is being considered. Among the considered scenarios, this activity will also pay attention to the case of radio resource management in a heterogeneous network composed by virtual radio access networks.

MainScientific Achievements of this JRA are:
- Formulation of an optimisation problem for the scenario in which several terminals can act as access points and relay traffic from other terminals to/from the infrastructure. Problem focuses on the association of users to APs and allocation of resources in the infrastructure. An initial solution for distributed AP selection has been proposed making use of Q-learning.

- The Dynamic Network Architecture (DNA) paradigm in wireless networks has been proposed, in which a certain class of terminals can be connected to the conventional internet service provider and act as an AP for other terminals, or they can be connected to the wireless operator as a simple terminal. The optimization of the topology and architecture has been carried out.

- JRA 1.1.2.3: Traffic dynamics - routing and topology reconfiguration
  Leader: Panayotis Mertikopoulos (CNRS)
  Main partners: Aris L. Moustakas (IASA)

The general framework of this JRA is to construct multi-path routing algorithms for wireless networks that achieve the optimum traffic distribution in the network while satisfying the following operational desiderata:
(1) Scalability: the algorithms' performance must scale well with the size of the networks up to the massively large network regime.
(2) Distributedness: the algorithms must not require a central control entity but only rely on locally available information.
(3) Robustness: the algorithms must retain their properties in the presence of operational volatilities - ranging from fluctuations in the link quality to more radical events (such as router failures).

Main scientific achievements of this JRA are:
We take an approach based on an "exponential learning" scheme which constructs a (discounted) aggregate score for each of the different paths available to an origin-destination pair based on the experienced latency along each path, and then assigns traffic proportionally to the exponentials of these scores. By so doing, the algorithm converges to the network's optimum (or equilibrial) traffic distribution exponentially fast; furthermore, with each origin/destination pair updating its own routing scheme, the algorithm's convergence...
speed scales well with the network's size.
On the other hand, a major challenge occurs when delays fluctuate unpredictably due to random, exogenous factors (packet drops, inaccurate RTT measurements, fluctuations in the link quality, etc.). Nonetheless, even in the presence of stochastic perturbations of this sort, the proposed routing scheme converges arbitrarily close to the optimum traffic distribution, and this convergence remains robust under measurement errors of arbitrary magnitude. Finally, the algorithm retains its convergence properties even when the latency feedback information is not up-to-date, and/or the network's users update their routing scheme in a completely asynchronous manner (i.e. independently of one another, in tune with our distributedness requirements).

Task 1.1.3 Capacity-reaching channel codes
Task Leader: Erdal Arikan (Bilkent)

- **JRA 1.1.3.1: Spatially Coupled Codes**
  Leader: Michael Lentmaier (ULUND)
  Main partners: Iryna Andriyanova (CNRS), Najeeb ul Hassan (TUD)

Spatial coupling is a method to improve the performance of Belief Propagation (BP) decoders for error correcting codes. The spatial coupling of the individual code structure has the effect of increasing the belief-propagation (BP) threshold of the new ensemble to its maximum possible value, namely the maximum-a-posteriori (MAP) threshold of the underlying ensemble. The threshold saturation phenomenon observed for spatially coupled codes provides new ways in the design of codes with capacity achieving performance. For example, the role of low-degree variable nodes is relaxed compared to conventional irregular Low Density Parity Check (LDPC) codes. Spatial coupling is not limited to binary LDPC codes but can be also used for non-binary transmission and more general classes of codes on graphs. The work under this JRA aims at:

- understanding and exploiting new degrees of freedom in the design of binary and non-binary spatially coupled codes,
- considering efficient window decoding of spatially coupled codes and the trade-offs between latency, complexity and performance in the waterfall and error floor region,
- investigating the performance of spatially-coupled codes over non-ergodic, channels and the trade-off between diversity and latency,
- as a longer term objective, investigating possibilities of combining spatial coupling with polar coding.

Main scientific achievements of this JRA are:

- New degrees of freedom in the design of spatially coupled codes have been investigated by considering non-binary LDPC codes
- An efficient window decoding method has been developed for spatially coupled codes
- Non-uniform decoding schedules for spatially coupled codes have been developed that reduce the number of messages passed and lower the decoding complexity without significantly increasing latency
- Performance of spatially coupled codes over non-ergodic transmission channels such as block fading channels has been studied which show that spatially coupled codes perform well over such channels when the window size for spatial coupling is chosen sufficiently large so as to span the length of block fades.

- **JRA 1.1.3.2: Non Binary Codes**
  Leader: Guido Montorsi (CNIT-PoliTO)
  Main partners: Guido Masera and Muhammad Awais (CNIT-PoliTO), David Declercq and Florence Alberge (CNRS)

Non-binary LDPC codes show improved performance over binary LDPC codes especially for
short-length frames. Even if more complex than the binary case, the decoding of non-binary LDPC codes remains tractable. The complexity of the iterative sum-product algorithm for decoding of non-binary LDPC codes can be reduced by using a version of Fast-Fourier-transform (FFT) in the decoding process. Message passing for decoding non-binary LDPC shares common features with extrinsic information passing used in turbo-codes. The intended work in this JRA is about the derivation of efficient decoding algorithm (message-passing) for non-binary LDPC codes by improving and refining existing techniques.

The main scientific achievements of this JRA are:

- Extrinsic Information Transfer (EXIT) chart methods have been developed for non-binary LDPC codes. Upper and lower bounds are given on the EXIT chart by a social welfare function derived from the Maximum Likelihood (ML) criterion.
- VLSI implementations of analog digital belief propagation decoders have been developed for non-binary LDPC codes which provide complexity independent of modulation alphabet size and promise the construction of systems with unbounded spectral efficiencies.
- A Trellis-based Extended Min-Sum (T-EMS) algorithm has been developed which provides low-complexity decoding for non-binary LDPC codes without compromising performance.
- A Multiple Votes Symbol Flipping (MV-SF) algorithm has been developed which leads to a favorable complexity-performance tradeoff for decoding of non-binary LDPC codes.

This JRA concerns construction of codes for multiterminal coding scenarios. There are three topics discussed in this section: i) Minimum Mean Square Error (MMSE) of ‘bad’ codes, ii) Polar codes for multiterminal scenarios, and iii) Combined coding and cooperation for wireless networks.

The main achievements of this JRA are:

- For codes on additive Gaussian noise channels, attaining a minimum required rate at some specific SNR, a tight lower bound on the MMSE has been found which is valid for any SNR. It is shown that the lower bound is attainable by superposition codebooks that are optimal for a specific degraded Gaussian broadcast channels. The significance of these results for code construction is multiterminal settings is discussed.
- Polar codes are developed that achieve the full capacity region in for Slepian-Wolf source coding problem and the multi-access channel coding problem. The polar code constructions achieve the capacity regions without using any time-sharing, unlike previous constructions.
- A near optimal joint network channel decoding algorithm (NOJNCD) has been developed that combines the redundancy of error correction codes employed at the physical layer of each transmitter with the redundancy provided at the network layer by relaying of messages. The combined code is seen as a “super code” and the distance spectrum of the super code is derived, leading to an upper bound on the Bit Error Rate (BER) for all sources. The results show that the diversity gain achieved by the system is equal to the minimum distance of the
channel code at the sources. These novel results are important to effectively design a cooperative system that can satisfy both diversity gain and coding gain constraints.

**Highlight of significant results from WP1.1**

Dirk Slock (CNRS/Eurecom) gave a tutorial entitled "Designing the MIMO Broadcast and Interference Channels" at the 19th European Wireless Conf. (EW2013), University of Surrey, Guildford, UK, April 15, 2013.

The First NEWCOM# Dissemination Event took place at Orange Labs, Paris, 17 June 2013. As far as WP1.1 is concerned, P. Duhamel (CNRS) and B. Lorenzo (OUULU) gave two presentations. There was also a demo-Poster held by K. Hamidouche (CNRS/Supelec)

A joint Phd supervision (candidate Gil Katz) is taking place between Technion (S. Shamai) and CNRS/Supelec (M. Debbah, R. Couillet and P. Piantanida)

M. Debbah and R. Couillet gave a tutorial at SPAWC 2013 in Darmsdat in June 2013 : “Random Matrices for Signal Processing Applications”

The following special issue was organized by C. Bader of CNRS/Supélec: Eurasip Journal on Signal Advances in Signal Processing: Advances in Flexible Multicarrier Waveforms for Future Wireless Communications.

Beatriz Lorenzo (OUULU) has been invited by Laura Galluccio (CNIT-UniCT) to be Co-chair of RAWNET workshop with N#, May 2014. Both are organizing a special session N# within that conference and planning to organized a special session N# within Eurasip journal for the most promising papers accepted for the workshop.

Savo Glisic (OUULU) is organizing CROWNCOM 2014 conference in Oulu in June 2014. He has applied for N# sponsor and he plans to organize a special session N# within this conference.

Marios Kountouris from CNRS is organizing SPASWIN 2014 (http://spaswin2014.tk/)

**WP1.2: Opportunistic and Cooperative Communications**

WP Leader: Sergio Palazzo (CNIT)

This WP addresses the many theoretical aspects related to the various emerging opportunistic and cooperative networking techniques, with the objective of assessing them, and finding the most suited to increase the capacity and/or the availability of wireless networks. In a cellular network scenario, attention is focused on the study of intra-cell relaying among nodes and inter-base station cooperation to achieve significant capacity and multiplexing gain, as well as to decrease the loss probability, and to improve timeliness in data delivery. In the context of “occasional” and sporadic communications, the WP investigates the techniques for distributed and cooperative resource allocation and routing in delay-tolerant networks, and those for medium access, routing and power-adaptation in Mobile Ad-hoc NETworks (MANETs, also in their special flavour of Mobile Clouds). Particular attention is finally devoted to the theme of the study and optimization of cooperative sensing in unstructured networks.

**A summary of WP1.2 progress towards objectives**

The WP is divided into three Tasks, each with specific scope and objectives: Task 1.2.1
"Cooperative multi-user communication"; Task 1.2.2 “Optimal design of opportunistic networks and mobile clouds”; Task 1.2.3 “Cooperative sensing”. For each Task, specific JRA’s have been identified that target to address some of the fundamental open issues in the respecting thematic areas. In order to avoid overlap between the various efforts and to enhance cooperation between partners, a research harmonization and consolidation procedure has been followed. From more than 20 initial proposals, the consolidation procedure resulted in the following 11 JRA’s, whose activities carried out in the first year are described in detail in the Deliverable D1.2.1.

**Task 1.2.1 Cooperative multi-user communication**
Task Leader: Ivan Stupia (UCL)

- JRA2 on Network coding for MARC  
  Leader: Mohieddine El Soussi (UCL)  
  Main partners: Mohieddine El Soussi and Luc Vandendorpe (UCL), Abdellatif Zaidi (CNRS)

This first JRA deals with network coding techniques in MARC environments in which two users communicate with a destination with the help of a half-duplex relay. Based on the compute-and-forward scheme, performance of coding has been studied evaluated. In this framework, instead of decoding the users’ information messages, the destination decodes two integer-valued linear combinations that relate the transmitted codewords. Two decoding schemes are considered. In the first one, the relay computes one of the linear combinations and then forwards it to the destination. The destination computes the other linear combination based on the direct transmissions. In the second one, accounting for the side information available at the destination through the direct links, the relay compresses what it gets using lattice-based Wyner-Ziv compression and conveys it to the destination. The destination then computes the two linear combinations, locally. For both coding schemes, the design criteria have been discussed, and the allowed symmetric-rate have been derived.

Next, the power allocation and the selection of the integer-valued coefficients to maximize the offered symmetric-rate have been addressed. In the first year the collaboration between UCL, CNRS/MLV, CNRS/SUPELEC and Bilkent led to the publication or submission of both individual and joint paper to international conferences and journals.

- JRA3 on Message-passing methods for distributed wireless network organization  
  Leader: Maxime Guillaud (VUT)  
  Main partners: Maxime Guillaud (VUT), Mihai Badiu and Carles Navarro Manchon (AAU)

The second JRA aims at designing distributed interference management schemes requiring only local information exchange at any given point of the network, while retaining the performance of centralized schemes. In fact, centralized interference management schemes are inapplicable to large networks, so that distributed solutions need to be sought. A distributed strategy is also supported by the fact that interference is localized, in the sense that in large systems a receiver is predominantly interfered by the transmitters which are geographically close to it - this property being naturally linked with the factorization at the core of the message-passing technique.

Specifically, research activities related to this JRA addressed distributed pre-coder design algorithms that rely on local CSI and involve local computations and information exchange with neighboring transmitters. Similarly, the distributed algorithms for cooperative receiver processing should require the receivers to locally share soft information (regarding, for instance, modulation symbols or bits). AAU and VUT collaborated on this JRA during the first year and a paper has been submitted for publication on an international conference.
JRA4 on Distributed learning schemes for interference management and signal optimization in large networks
Leader: Panayotis Mertikopoulos (CNRS)
Main partners: Panayotis Mertikopoulos (CNRS), Aris Moustakas (IASA), Maxime Guillaud (VUT)

The third JRA aims at providing distributed learning schemes for interference management and signal optimization in large networks. This JRA focuses on interference management in dynamic MIMO systems comprised of several wireless users who communicate over multiple channels (typically orthogonal frequency subcarriers), and are going online or offline based on their individual needs. One particular case that has been examined concerns the multiple access channel (MAC) model where the transmitters upload data to a single receiver. Adaptive full spectrum management policies have been also investigated. In the first year, research activities addressed design of a distributed learning scheme which performs at least as well as the best fixed transmission strategy, even though the latter cannot be anticipated by transmitters with only local information at their disposal. In this first year, CNRS and IASA collaborated and several research visits have been exchanged focused at properly planning research activities, while VUT is expected to be involved in research activities on learning schemes in the upcoming months. The collaboration between CNRS and IASA led to the publication of a joint paper that has been already presented.

JRA5 on Clusters organization for multi-hop cooperative communications
Leader: Stefan Mijovic (CNIT-BO)
Main partners: Riccardo Andreotti, Paolo Del Fiorentino, Vincenzo Lottici and Filippo Giannetti (CNIT-UniPI), Ivan Stupia, Luc Vandendorpe (UCL)

The fourth JRA is related to clusters organization for multi-hop cooperative communications. In this JRA, partners focused on two key distinctive aspects of systems employing cooperative beamforming: energy consumption and VAA formation (ECVF). ECVF refers to the decision of making available a certain amount of energy that will be shared, during a certain time, with the other nodes forming the VAA. ECVF problem is handled by making use of a non-cooperative game theoretical approach. Research activities have involved CNIT/PI, CNIT/BO and UCL. In this first year research activities among partners have specifically focused on the definition of a game in which the impact of selfish behavior of users on VAA formation and beamforming is investigated.

Task 1.2.2 Optimal design of opportunistic networks and mobile clouds
Task Leader: Laura Galluccio (CNIT-CT)

JRA1 on Opportunistic relaying and forwarding
Leader: Beatriz Lorenzo Veiga (UOULU)
Main partners: Beatriz Lorenzo Veiga and Savo Glisic (UOULU), Laura Galluccio(CNIT-CT)

The first JRA is a cross-Track JRA involving both Track 1 and Track 2. It deals with relaying and forwarding techniques in opportunistic networks, especially in Delay Tolerant Networks (DTNs). Classical ad hoc routing protocols rely on establishment of a complete end-to-end route from the source to the destination, thus are not suitable for DTNs applications. This is because information can be relayed from source to destination during the limited time two mobile nodes (e.g. people carrying a smartphone) spend in each other connectivity range or in the infostation proximity. This JRA has been splitted in two sub-activities. The first sub-activity involves CNIT/CT and CNIT/BO and aims at providing routing algorithms based on social behavior of users which will converge to experimental activities in WP2.2. The second sub-activity involves CNIT/CT and UOULU and has addressed a recovery technique in DTNs.
which is based on social groups. Research activities led to a joint paper publication involving CNIT/CT and UOULU.

- JRA2 on Game theoretic approach to timing channel communications
  Leader: Sergio Palazzo (CNIT-CT)
  Main partners: Salvatore D’Oro, Laura Galluccio and Giacomo Morabito (CNIT-CT), Fabio Martignon and Lin Chen (CNRS)

The second JRA aims at exploring timing channel communications which can be exploited to provide secure communications resilient to jamming attacks. Actually, jamming is a critical issue in wireless networks as it can totally or partially disrupt ongoing communications, and several anti-jamming techniques have been considered in the literature so far. In this JRA partners focused on timing channel communications that enable data transmission in silences between transmitted packets. More in detail, a game theoretic approach has been considered in which network users exploit the timing channel to counteract a reactive jammer which is able to simultaneously jam transmitted packets on different channels. During the first year, research activities have been carried out by CNIT/CT and CNRS/UPSUD and a joint paper have been submitted for publication. A PhD student has spent a visiting research period at UPSUD thanks to a Newcom# Mobility Grant for research activities strictly related to those performed within this JRA.

**Task 1.2.3 Cooperative sensing**

Aris L. Moustakas (IASA)

- JRA1 on Multiple source detection, localization, and transmit power
  Leader: Ioannis Dagres (IASA)
  Main partners: Andreas Polydoros (IASA), Adrian Kliks (PUT), George Arvanitakis (CNRS/EURECOM)

The goal of the first JRA is to focus on three fundamental aspects of source detection and localization in lognormal fading environments: a) Algorithmic design; b) Propagation model; c) Prior information. In this first year, research activities involved IASA and PUT and addressed the first two categories. More specifically: a) a Competitive Expectation Maximization (C-EM) algorithm has been considered which includes stages of EM iteration, split, merge and annihilation operations; b) a realistic scenario of shadow fading spatial correlation has been considered, and its implication on achievable performance is currently under investigation.

- JRA2 on Cooperative simultaneous localization and tracking
  Leader: Florian Meyer (VUT)
  Main partners: Burak Cakmak and Bernard-Henri Fleury (AAU), Franz Hlawatsch (VUT)

The second JRA aims at providing novel techniques for cooperative localization and tracking. Complexity issues of existing localization algorithms based on message passing have been addressed with the goal of making the algorithms feasible for large-scale localization scenarios with mobile nodes. CoSLAT algorithms have been developed by embedding a consensus or gossip algorithm in existing distributed cooperative localization algorithms to make them suitable for scenarios where part of the nodes to be localized are non-cooperative. During the this first year VUT and AAU have achieved a still ongoing cooperation.
JRA3 Source detection in the presence of interference and noise
Leader: Aris Moustakas (IASA)
Main partners: Erwin Riegler (VUT), Spyros Evangelatos (IASA)

The purpose of this JRA is to obtain analytic or semi-analytic results for the fundamental limits of multiple primary source detection by sensors in wireless networks. The tools used are based on the statistical physics of spin glasses.

JRA4 on Hybrid spectrum sensing architecture for cognitive radio: overcoming noise uncertainty
Leader: Aris Moustakas (IASA)
Main partners: Erwin Riegler (VUT), Spyros Evangelatos (IASA)

The fourth JRA addresses the study of non-cooperative systems where the spectrum sensor suffers from a minimum SNR below which it is impossible to reliably detect the primary user's signal. In this JRA, analysis and implementation of two low-complexity spectrum sensing schemes under noise uncertainty have been proposed. One is based on a combination of two well-known and complementary signal detection techniques: energy detection and cyclostationary feature detector called hybrid spectrum detector (HSD), and the other on sequential energy detector (SED). Both algorithms are going to be implemented using GNU Radio with Universal Software Radio Peripheral to verify their performances under noise uncertainty. Involved partners are CNRS and PUT which are currently working on a hardware demonstrator for hybrid spectrum sensing implemented on ESRP2 platforms.

JRA5 on Energy-efficient data collection and estimation in wireless sensor networks
Leader: Francesca Bassi (CNRS/UPSud)
Main partners: Enrico Magli, Sophie Fosson (CNIT-PoliTO), Davide Dardari and Gianni Pasolini (CNIT-UniBO), Michel Kieffer, (CNRS/UPSud), Carles Anton Haro and Javier Matamoros (CTTC), Adrian Kliks (PUT)

The fifth JRA is a cross-WP activity that refers to both WP 1.2 and WP 1.3. Therefore, for the sake of completeness, its definition and roadmap have been also included in D13.1. The goal of the JRA is to leverage the different experiences and expertises of the partners, already active in this research domain, in order to provide innovative solutions for energy-efficient data dissemination and collection in sensor networks. The participants, CNIT/TO and CTTC, have defined a common research framework and a joint paper have been submitted to an international conference.

Highlight of significant results from WP1.2

The structure of the WP, the selected JRAs, and some initial results were presented by the WP Leader, Sergio Palazzo (CNIT-CT), at the First NEWCOM# Dissemination Event at Orange Labs on June 17, 2013. In this event, Lin Chen (CNRS-UPSud) gave a presentation of the JRA on “Game theory applied to timing channel communications”.

Panayotis Mertikopoulos (CNRS) has been invited to the 1st International Workshop on Algorithms and Dynamics for Games and Optimization (ADGO 2013), Playa Blanca, Chile, Oct. 14-18, 2013. The invited talk was entitled “Hessian Riemannian gradient flows in semi-definite programming and applications to wireless communications” is an outcome of the JRA3 in Task 1.2.1.

L. Galluccio (CNIT-CT) and B. Lorenzo (OUULU) will be co-chairs of the next 2014 RAWNET (Resource Allocation in Wireless Networks) Workshop to be held jointly with WiOpt 2014, Hammamet, Tunisia, May 2014. Both are organizing a special session N# within that
conference and planning to organize a special issue of a journal inviting also the most promising papers accepted for the workshop.

Riccardo Andreotti has successfully defended his PhD Thesis. This thesis has been co-tutored by CNIT-PI and UCL.

**WP 1.3 Energy- and Bandwidth-Efficient Communications and Networking**

WP leader: Andreas Polydoros (IASA)

The amount and diversity of services provided by wireless systems and networks has increased drastically in the recent past. This has led to a rapid increase in the data-rate requirements (bits/sec/Hz/unit area) in the standardization of upcoming wireless systems, while at the same time spectrum remains scarce. In addition to this, the limitations of battery-powered mobile devices have become apparent. The objective of this WP is investigating those techniques at different layers which result in power- and energy-efficient networks and nodes (especially mobile devices). This also encompasses interference management (control/mitigation) techniques for coexisting networks (multi-tier networks within the same operator or multi-operator networks sharing a band). Particular attention is devoted to four research topics. The first is about power- and energy-efficient terminals, where the focus is on their energy savings. The second is about interference mitigation (co-channel as well as adjacent-channel) at the PHY layer. The third focuses on network resource allocation by taking into account simultaneously energy consumption and interference, while the fourth is devoted on ad-hoc network optimization under energy related metrics.

**A summary of WP1.3 progress towards objectives**

The WP is divided into three Tasks, each with specific scope and objectives. Task 1.3.1 “Techniques for power-efficient communications” deals with techniques for power efficiency and minimization at the transceiver and network level. Task 1.3.2 “Low-interference, low-emission, radio interfaces” deals with the handling of interference by appropriate low interference transmission techniques (e.g. beam-forming, MIMO, GMC). Task 1.3.3 “Resource Allocation for optimized radio access” is about Radio Resource Management (RRM) and Interference Management (IM) – for a given interference level – in selected scenarios, including Heterogeneous Networks (HetNets).

IASA as the WP leader, worked for the preparation of a template for JRA proposals along with a harmonization – consolidation procedure. The goal of that procedure was to enhance adherence of the JRAs to the Tasks’ scope and focus, harmonize the work between the various topics, and avoid overlapping. The template and the procedure were adopted by the NEWCOM# consortium.

For each Task, specific JRAs were created that target to address some of the fundamental open issues in the respecting thematic areas. In order to avoid overlap between the various efforts and to enhance cooperation between partners, a research harmonization and consolidation procedure was followed. From more than 20 initial proposals, the consolidation procedure resulted in the following 9 JRAs.

**Task 1.3.1: Techniques for power-efficient communications**

Task leader: Jesus Gomez (CTTC)

- JRA on Resource allocation and scheduling strategies for energy harvesting devices
  Partners: CTTC, UPC

The first JRA aims at studying energy harvesting wireless communication networks. These are networks in which wireless nodes harvest energy from nature to sustain their operation.
The introduction of such energy sources into the network model introduce new challenges in the terminals and network design: to find good statistical models of the energy harvesting process, identify hardware limitations and efficiencies, apply realistic models of energy consumption, and others. The focus on this JRA is to design resource allocation and scheduling strategies to recharge the batteries by means of passive or active harvesting techniques and, thus, to increase the lifetime of the network for energy harvesting devices. In the first year there was collaboration work between the UPC and CTTC. Based on this collaboration, some joint and individual papers have already been published or submitted to conferences and scientific journals.

- JRA on Energy-efficient data collection and estimation in wireless sensor networks
  Partners: CNRS, UPSud

The second JRA aims at optimizing data collection, estimation and communication techniques in Wireless Sensor Networks (WSNs) for energy efficiency. In particular it explores: (i) the newly proposed compressive sensing data acquisition technique, as well as, distributed source coding techniques that exploit the spatial and temporal correlation of the measured data, (ii) the emerging distributed estimation strategies based on a calibrated weighting and mixing of two previously employed estimation procedures: consensus and innovation, and (iii) the network coding communication strategies. The collaborating institutes are CNRS/UPS, CTTC, CNIT/UniBo, and CNIT/PoliTo. The cooperation between CNIT/PoliTo and CTTC resulted in a research visit focused on “distributed sparse signal estimation: new models and solutions”, in the organization of a seminar in CTTC and the submission of a joint paper. The cooperation between CNIT/UniBo and CNRS/UPS included a research visit in CNIT/UniBo.

- JRA on Joint Protocol channel decoding (JPCD)
  Partners: CNRS, CNIT

The third JRA aims at exploring the recently proposed protocol channel decoding techniques, also referred to as Joint source-channel decoding (JSCD), to improve the energy efficiency of receivers improving the synchronization and the channel decoding techniques, and thus, avoiding wasting energy due to packet retransmissions. The collaborating partners are CNRS, CNRS/UPS, and CNIT/UniBo. In the first year the joint work concentrated in the identification of open issues in joint protocol-channel decoding.

- JRA on Energy efficient probing in CSMA based multi-rate ad hoc networks
  Partners: Bilkent, UPSud

The fourth JRA aims at analyzing the energy efficiency of the CSMA protocol, as most of the MAC protocols for power-constrained devices employ non-persistent CSMA. The goal is to develop an energy efficiency model which can be applicable for CSMA-based standards in general. Bilkent and CNRS/UPS are collaborating on this topic. In the first year they analyzed the energy efficiency of CSMA network from a MAC layer perspective. On this subject, a paper has been accepted for publication which forms the basis of the proposed joint research task. A letter paper has also been submitted which investigates spatio-temporal effects on the throughput of a CSMA network.

Task 1.3.2: Low-interference, low-emission, radio interfaces
Task Leader: Adrian Kliks (PUT)

- JRA on Advanced MIMO techniques (virtual MIMO, MIMO-FBMC) for low-interference transmission
  Partners: INOV, UPC, PUT
In the first JRA two specific research topics have been defined, the analysis of the optimal precoding schemes for FBMC/GMC systems and application of link-adaptation techniques for the Wireless Body Area Network (WBAN) systems using virtual MIMO concept. Both problems address the idea of application of MIMO techniques for interference management. The joint work is realized between PUT, UPC and INOV. In the first year the work was concentrated in the simulation environment for both topics. Intensive simulations have been carried out and the results obtained there are subject to journal submission.

- JRA on Advanced filtering and adaptive signal processing (OOB, PAPR, SIC)
  Partners: INOV, UPC, PUT

The goal of the second JRA is the investigation of advanced filtering and signal processing algorithms for interference minimization in multicarrier systems, mainly focusing on Peak-to-Average Ratio minimization algorithms and Out-of-Band radiation reduction techniques. The joint work between SUPELEC and PUT started with the definition of the research scheme, i.e. the multicarrier modulation (OFDM) for which the joint PAPR and OOB reduction algorithm has been proposed. The aim of the developed solution was to take into account various hardware limitations. Simulations have been carried out and the obtained results have been presented in a joint paper at the GROWN conference.

**Task 1.3.3: Resource Allocation for optimized radio access**

Task Leader: Luca Sanguinetti (CNIT)

- JRA on Interference management techniques for heterogeneous networks
  Partners: UPC, IASA, PUT, UPSud

The first JRA deals with the interference management problem, which is known to represent a major issue in HetNets due to several aspects such as unplanned deployment, varying access to femtocells, power differences between nodes, etc. The collaborating partners are UPC, IASA, PUT, CNRS/LRI, and CNIT/Pisa. During the first year, the JRA has mainly focused on the identification of the research problems that will be addressed, in relation to the state-of-the-art. These research problems are: (i) Enhanced power adjustment strategies based on environmental/context knowledge, in which the users’ location and mobility knowledge will be used in the design of new power adjustment techniques to avoid interference to victim users, (ii) Optimized resource allocation in hetnets for inter-cell interference coordination, (iii) Strategies for allocating shared spectrum in HetNets. In the first year, two joint papers and one individual paper by UPC were submitted in conferences.

- JRA on Game-theoretic energy-efficient control and resource allocation algorithms in heterogeneous networks
  Partners: CNIT, CNRS, UCL

The second JRA aims at developing game-theoretic energy-efficient control and resource allocation algorithms able to approach the ideal cooperative gains of heterogeneous and multi-tier networks while relying on mostly local channel state information and user data. In particular the joint work is focused in: (i) developing game-theoretic inspired power allocation algorithms to improve the relay performance in interference limited cellular systems; (ii) finding game-theoretic inspired power allocation algorithms that allow improving the energy efficiency of a two-tier network in which a macro cell coexists with an irregular deployment of small cells cooperating among each other in a distributed manner; and (iii) derive distributed power allocation approaches, which optimize the energy efficiency of BICM-OFDM systems, accounting for pragmatic design issues such as the use of practical modulation and coding schemes, automatic repeat request mechanisms and packet-oriented transmissions. The collaborating partners are UCL, CNIT/Pisa, CNRS/ENSEA, and CNRS/SUPELEC. During
the first year a researcher from CNIT/Pisa visited SUPELEC for one month. Initial results of the joint activities were presented in one conference and submitted to another one, while there is also a submission of a joint paper at the IEEE Transactions on Signal Processing and a planned submission on IEEE Transactions on Wireless Communications.

- JRA on Self-configuration and Optimization of a Hybrid LTE Femto - M2M Network for Smart City Applications
  Partners: CNIT, CTTC

The third JRA aims at optimizing the use of the LTE network in a smart city scenario with a large presence of machine type communication (MTC) devices. The focus was on the uplink scheduling problem of MTC traffic over LTE network and in the identification of the simulation and analytical tools that will support the joint research. The collaborating partners are CTTC and CNIT/UniBo. The simulations will be performed with the LTE NS3 open source module developed at CTTC. In September 2013 a researcher from CNIT/UniBo visited CTTC for one month. During the visit a deep study of the simulator was possible and several issues from the implementation point of view were solved. Initial results and joint papers are expected at the beginning of 2014.

**Highlight of significant results from WP1.3**

Cooperation of CNRS-LRI (Univ. Paris-Sud) with a PHC-Sakura international cooperation project (between France and Japan) in the Eco-HetNet project: "Cross-layer Protocol Design for Eco-friendly Heterogeneous Wireless Networks". Participating partners: LRI (CNRS-Univ. Paris- Sud) / Graduate School of Informatics (Kyoto University).

The structure of the WP, the selected JRAs, and some initial results were presented by the WP Leader Prof. A. Polydoros, at the First NEWCOM# Dissemination Event at Orange Labs on 17th of June 2013. In this even, Miquel Payaro gave a presentation of the JRA on "resource allocation and scheduling strategies for energy harvesting devices".

A workshop for WCNC2014 is under preparation from WP1.3 members. Title: "Interference and design issues for Future Heterogeneous Networks (FutureHetNets’2014) Full-day Workshop": Organizers: Hanna Bogucka, Adrian Kliks, Jordi Perez Romero

Further details of the structure, organization, and partners’ involvement of the JRAs in Track 1 can be found in the relevant Deliverables D11.1,D12.1, and D13.1.

### 2.2.2 TRACK 2
Track Leader: Roberto Verdone (CNIT)

Track 2 is devoted to the “EUropean laboratory of WIreless communications for the future INternet” (EuWIn) that hosts researchers from within the network, from external Academic Institutions, and from European companies. EuWIn is organized as a collaborative effort of the constellation of all NEWCOM# partners orbiting around three different reference sites at three different NEWCOM# Institutions. Through its activity on themes like Radio Interfaces, Internet of Things, and Flexible Communication Terminals and Networks, the Lab allows the experimental verification of some of the results produced in Track 1. The hosting Institutions of the three EuWIn nodes offers facilities and personnel to host researchers performing the different cooperative research actions described later on in the Joint Program of Activities. EuWIn has the ambition of creating a permanent environment for cooperative research that survives the NoE with the contribution of the hosting Institutions.
WP 2.1 Radio interfaces for next-generation wireless systems
WP Leader: Miquel Payaro (CTTC)

This Work Package is devoted to set up, operate, and maintain the EuWIn facilities at the Centre Tecnològic de Telecomunicacions de Catalunya (EuWIN@CTTC). The general focus is on the implementation of radio interfaces with emphasis on low energy consumption, low emission, and high spectral efficiency, as well as on localization techniques in wireless communication terminals. In order to assess the performance of these radio interfaces in close-to-real-world situations, a set of realistic channel models is also developed within this WP.

The lab is open to all NEWCOM# partners for the possible implementation, experimental validation and performance assessment of research results from Track 1, especially Task 1.1.1 “Theoretical limits of communications and networks”, Task 1.1.3 “Capacity-reaching channel codes”, Task 1.3.1 “Techniques for ultra-power-efficient terminals”, and Task 1.3.2 “Low-interference, low-emission, radio interfaces”. Part of the results in this implementation-oriented WP is also fed back into the theory-oriented WPs in Track 1, so that the theoretical models and results can be further refined taking into account practical constraints.

The lab contributed specific EuWIn training sessions to the dissemination and training activities to be organized under WP3.2 ‘Education and Training’. In order to foster industry-academia cooperation, WP2.1 organizes activities such as lab visits and/or virtual tours to its premises. Besides, it reports on lab activities and results at some of the in-company dissemination events organized by NEWCOM#. Where appropriate, WP2.1 stimulates NEWCOM#’s Affiliate Partners (or other companies’) participation in its activities.

A summary of WP2.1 progress towards objectives

According to the DoW, the first six months of activity within Track 2 of Newcom# have been dedicated to the laboratory set-up. The outcome of such activity has been described in the three Deliverables released at M6. After that date, EuWIn started organizing the inaugural event, held in Bologna on July 8-10, 2013, whose structure and attendance is described in D21.2. During those days, Track 2 also organised an emerging topic workshop and a project meeting where the plan for future activities was discussed and many JRAs defined. Industry liaisons have been created, both during the days of the inaugural event in Bologna (participated by several industries) and on June 7 when the first Newcom# dissemination event at the premises of an industry was held, at Issy-Les-Moulineaux (France) in Orange Labs.

The list of consolidated JRAs of WP2.1 was agreed as follows.

Task 2.1.2 Low-energy-consumption and low-emission radio interfaces
Task Leader: Amor Nafkha (Supelec)

- JRA#A Enhanced NC-OFDM transmission with reduced spurious emission level

The aim of this JRA is the reduction of subcarrier spectrum sidelobes and intermodulations in the transmitter, which will allow for dynamic generation of signal well localized in frequency, i.e. with “clean” power spectrum density plot. Algorithms other than digital filtering are being considered as they can provide lower computational complexity and higher flexibility in comparison to typical digital filtering.

Researchers of this JRA have not obtained any scientific achievements, yet. This is due to the fact that the first months of activity have been devoted to the lab equipment set-up and test at one of the partners premises (PUT). The details of the equipment set-up and test can be found in Section 3.4.4 of D21.2.
Task 2.1.3 Hybrid localization techniques for wireless terminals
Task Leader: Carles Fernandez (CTTC)

- JRA#F Design and experimental validation of algorithms for active and passive indoor positioning

This JRA addresses different aspects and technologies for indoor location, namely: i) estimation and tracking algorithms for indoor UWB positioning. Theoretical bounds for UWB ranging will be also addressed, ii) other positioning schemes based on receiving power indicators of wireless communication networks such as WiFi and Bluetooth, in combination with inertial measurement units will be explored, building proof-of-concept prototypes based on COTS components and Bayesian filtering theory, and, finally, iii) the problem of multi-source localization will be addressed and tested via a simulation tool developed within this JRA.

Scientific achievement of this JRA has been that IASA has enriched its localization simulator with the new algorithms and performance bounds, obtained in WP1.1 (from Track 1). This is specially important since it links the activities in the two tracks. In addition to this, some preliminary work has been carried out on cooperative spectrum sensing and localization in cognitive radio systems using compressed sensing, on feasible set bounding in cooperative wireless network positioning and on TDOA-based positioning algorithms in harsh conditions (e.g., the presence of unknown clock skew).

Task 2.1.4 High spectrally-efficient radio interfaces
Task Leader: Guido Masera (CNIT)

- JRA#B Practical implementation of polar codes

Polar codes have proved to achieve capacity under specific conditions. Different algorithms have been proposed for decoding polar codes with different tradeoffs between decoding complexity and performance. This JRA will address the design of efficient hardware architectures for decoding polar codes. Among the algorithms that will be studied are belief propagation decoding and successive cancellation decoding.

Scientific achievements: The results of the work carried out by the researchers in this JRA have been mostly obtained in the field of receiver architectures to decode polar codes. For example, a VLSI implementation of a non-binary decoder based on belief propagation was designed and a two phase successive cancellation decoder architecture for polar codes was proposed (the described method has been disseminated to the industry and is being turned into a commercial product)

- JRA#H Impact of channel model in the performance evaluation of wireless systems

In this JRA, the performance of a wireless communications system (e.g., based on IEEE 802.16 or LTE) will be evaluated under different channel propagation conditions. The performance metric will be related to the quality of the received signal (e.g., in terms of BER or EVM). All the stages of the communication (signal generation, modulation, propagation, acquisition, channel estimation, demodulation, etc.) will be implemented in the GEDOMIS® platform. The channel propagation conditions will be uploaded in CTTC’s channel emulator and the models for the channel will be chosen from the different models that will be developed within JRAs C, D and/or E.

Scientific achievements: The initial scientific results of this JRA have been that an LTE-based PHY-layer has been implemented in the GEDOMIS® testbed, on top of which the impact of the channel model can be evaluated. Precisely, the developed system consists of a hardware-efficient implementation of a Femtocell/Macrocell interference-mitigation technique for LTE-based systems.
Task 2.1.5 Channel measurements, modelling and databases  
Task Leader: Troels Pedersen (AAU)

- **JRA#C Assessment and development of multi-link channel models**

This JRA’s ambition is to develop and experimentally validate accurate and computationally effective multi-link channel models applicable to cooperative and interference-limited networks. Indeed, the multi-dimensional radio channel remains central in interference-limited scenarios. Multiple antenna systems (MIMO), interference recognition and management as well as cooperation among separate network nodes are inherently multi-dimensional techniques and should always be designed with a proper knowledge not only of the channel, but also of the interference. Hence, a multi-dimensional description of the radio channel characteristics (joint modelling of space, time, frequency, polarization, interference, etc.) is required in order to exploit all these dimensions when designing transmission protocols. This JRA aims at exploring the multi-link aspects of radio channels, and to propose models for design and simulation.

Scientific achievements: The work performed within this JRA has not produced scientific achievements, yet.

- **JRA#D Channel models for cooperative positioning**

This JRA aims at exploring the multi-link aspects of radio channels for positioning purposes, and at proposing models for design and simulation.

Scientific achievements: The work performed within this JRA has not produced scientific achievements, yet.

- **JRA#E Compressive sensing for sparse propagation channel estimation**

Mainly due to the relative mobility of the transmitting and receiving equipments, the wireless propagation channel is time varying. Under the assumptions of linearity and time invariance during the measurements, the propagation channel is completely characterized by its Complex Impulse Response (CIR). In order to overcome this time varying property, the wireless telecommunication systems periodically estimate the CIRs. In this framework, we propose to use compressive sensing toward the estimation of the CIR.

Scientific achievements: Researchers of this JRA mainly worked on the channel sounding aspects: i) a previously collected data set of measured Complex Impulse Responses (CIR) is now available and can be shared with other Newcom# researchers. These CIRs had been collected in different indoor environments (shopping center, metro station, laboratory, university buildings), ii) a new channel sounder started to be built. The RF part is now under test. The digital part of the sounder needs now to be developed, and iii) the above mentioned CIR measurements will be now used to develop and test compressive sensing techniques for sparse propagation channel estimation, jointly by CNRS/SATIE, CNRS/UPS and AAU.

- **JRA#G Spectrum occupation measurements and database exploitation**

During the last years, and starting in NEWCOM++, UPC has built a semi-public database that contains spectrum occupancy measurements in different bands and locations in the area of Barcelona and neighborhoods. Measurements have been obtained by means of a handheld Anritsu MS2721B Spectrum Analyzer. Similarly, also PUT has performed some spectrum occupation measurement works in the area of Poznań. Based on the available information from measurements in these two sites, the purpose of this JRA is to update the current measurements with additional ones and to exploit them for the development of RRM strategies making use of flexible spectrum management.

Scientific achievements: Researchers in this JRA have conducted a comparative study of
spectrum occupancy in big cities (such as Barcelona and Poznań) by performing measurement campaigns. In addition, these same researchers have performed measurements of TV white spaces in indoor conditions to be used for the improved use of heterogeneous networks.

*Highlight of significant results from WP2.1*

AAU and Renesas Mobile Corporation (N# associate partner) jointly organized a workshop on advanced wireless receiver design on May 7 in Copenhagen, with the participation of staff members of the two institutions. The purpose of the workshop was to create a framework for the participants from industry and academia to present and discuss their recent developments, and exchange ideas in the area of algorithm design for wireless receivers enabling systems with high spectral efficiency. It was an opportunity for AAU to spread the results of its activities in WP21. The workshop consisted in several presentations from both institutions, followed by rounds of discussion. The topics of the presentations and discussions revolved around the challenges of and advanced techniques for designing receiver algorithms that improve spectral efficiency, such as: message-passing receiver design, sparse channel estimation, low-complexity channel estimation for LTE, challenges of interference in wireless (LTE) systems, LTE interference mitigation, and distributed receiver cooperation.

Members of CTTC involved in WP2.1 participated in the Newcom# Summer School on Interference Management for Tomorrow's Wireless Networks by giving two lectures describing some experimental results carried out at EuWin@CTTC premises. The school took place on 28 – 31 May, 2013.


AAU is organizing the "Seventh IEEE Workshop on Advanced Information Processing for Wireless Communication Systems", which will take place next week (14-15 November) at Aalborg University. More detailed information in the event's website: [http://www.es.aau.dk/sections/navigation-and-communications-navcom/events/7th-ieee-ws-aipwcs](http://www.es.aau.dk/sections/navigation-and-communications-navcom/events/7th-ieee-ws-aipwcs)

The event, which is sponsored among others by Intel Mobile Communications (Denmark), aims to bring together young academic researchers and professionals from the wireless communication industry, encouraging networking and interaction between academic and industrial peers.

On the industrial side, AAU has advertised the workshop to all important companies in the wireless communication business in Denmark and surrounding area, including: Intel Mobile Communications, Rohde & Schwarz, and Broadcom.

UCL, CNIT/Bologna, and CTTC are preparing a joint Newcom#/COST IC1004 training school on experimentation (Claude Oestges is the COST IC1004 chair of Radio Channel WP). The school will take place during 25 – 28 November 2013 and will be hosted by CTTC.
The title of the school will be “Beyond 4G Networks in Cities: from Theory to Experimentation and Back” and the detailed technical program can be found at [http://www.euracon.org/b4gc2013](http://www.euracon.org/b4gc2013).

Claude Oestges from UCL (representing WP2.1) and other researchers from other WPs provided inputs to the RAS White Paper on “High Capacity PHY for Future Radio Access and 5G”.

**WP 2.2 Networking technologies for the Internet of Things (IoT) with mobile clouds**

**WP Leader:** Davide Dardari (CNIT)

This Work Package aims to set up, operate, and maintain the EuWIn facility at the University of Bologna (EuWIn@CNIT/Bologna). The general focus is on networking technologies for the Internet of Things (IoT) with mobile clouds, with particular emphasis in Smart City as well as indoor applications. More specifically, activities revolve around the investigation and implementation of different routing protocols for large sensor networks, various schemes for delay-tolerant networking paradigms, and measurement and modeling of the mobility patterns of mobile clouds. Complementarily, the performance of distributed and cooperative (multi-terminal) localization schemes is experimentally assessed in close collaboration with EuWIn@CTTC.

The lab is open to all NEWCOM# partners for the possible implementation, experimental validation and performance assessment of research results from Track 1. To further facilitate this, the HW/SW platform is remotely accessible and over-the-air programming of all lab devices is enabled. Hence, project partners are allowed to upload their own algorithms, measure their performance, and download all key performance indicators. A particularly intensive collaboration is envisaged with the following tasks in Track 1: “optimal design of opportunistic and wireless networks with mobile clouds” (Tasks 1.1.2 and 1.2.2); and “resource allocation, energy efficient networks” (Tasks 1.3.1, 1.3.3). Feedback in terms of e.g. measured traffic patterns, performance assessment of specific protocols, or node connectivity realizations will be provided to Track 1.

The lab contributes specific EuWIn training sessions to the dissemination and training activities to be organized under WP3.2 “Education and Training”. In order to foster industry-academia cooperation, WP2.2 organizes activities such as lab visits and/or virtual tours to its premises. Besides, it reports on lab activities and results at some of the in-company dissemination events organized by NEWCOM#. Where appropriate, WP2.2 stimulates NEWCOM#’s Affiliate Partners (or other companies’) participation in its activities, with emphasis on those working in the fields of the mobile clouds and the Internet of Things.

**A summary of WP2.2 progress towards objectives**

According to the DoW, the first 6 months of activity within WP22 of Newcom# have been dedicated to the EUWin@CNIT-BO laboratory set-up. The outcome of such activity has been described in the Deliverable D22.1 released at M6 (April 2013).

The last 6 months have been focused on the finalization of the EUWin@CNIT-BO platforms and their functional validation. Preliminary tests performed on EUWin@CNIT-BO platforms as well as on external facilities offered by other partners are described in Deliverable D22.2. The EuWIn facilities have been officially presented during the inaugural event, organized by EUWin and held in Bologna on July 8-10, 2013, whose structure and attendance is described in Deliverable D22.2.

For what the JRAs are regarded, 5 JRAs have been defined and consolidated. Most of them are strictly linked to corresponding theoretical JRAs in Track 1 and will give the opportunity, during the 2nd and 3rd year of activity, to assess the performance through experimentation of the algorithms designed in Track 1.
Task 2.2.1 Lab set-up, maintenance and planning
Task Leader: Danilo Abrignani (CNIT)

Three different platforms have been designed and deployed at EuWin@UNIBO providing more than 200 wireless nodes implementing different types of radio interfaces: Flexible Topology Testbed (FLEXTOP), Data Sensing and Processing Testbed (DATASENS), and Localization Testbed (LOCTEST). Particular effort has been dedicated to software/firmware development and to implement over-the-air remote access (FLEXTOP). The purpose, the functional description as well as the user interfaces of each platform are detailed in Deliverable D22.1.

The activity carried out included also some preliminary tests on the experimental platforms to assess their correct functionality as described in Deliverable D22.2. Within this activity it has to be remarked that some preliminary tests have been carried out, with a down-scaled testbed developed using FLEXTOP, in order to compare the results with those obtained in a smart city real test bed deployed in a small town of Italy.

Although the main EuWin@UNIBO site is physically located at CNIT - University of Bologna - , for its use especially in wireless sensor networks and positioning experimentations, facilities made available by partners participating to intra- and inter-WP JRAs are being “federated” under the same hat of common research themes (lab of labs). These facilities include ultra-wide bandwidth devices, for active and passive localization, and software defined radios for dynamic spectrum selection schemes.

Task 2.2.2 Large-scale wireless sensor networks: routing protocols, network topologies and cooperative localization
Task Leader: Chiara Buratti (CNIT)

Four JRAs have been established, covering all the topics addressed by the Task and using the available facilities. Considering that the lab set up and validation ended in July 2013, these JRAs have just started. In addition, some JRAs are the experimental counterpart of theoretical JRAs in Track1 and will host the algorithms developed there. For this reason no significant results are available yet at the end of the first year, therefore in the following only a brief description of each of them is given.

- JRA#1 Design and experimental validation of algorithms for active and passive indoor positioning

The JRA deals with localization issues and will mainly use the LOCTEST platform at EuWin@CNIT-BO and the localization platform at EuWin@CTTC, with the purpose of implementing estimation and tracking algorithms for indoor positioning and radar applications. JRA#1 is an inter-WP JRA between WP2.1 and WP.2.2. Within this JRA a researcher mobility (from CNIT-BO to CTTC) started in Sept. 2013 to work on the design and test of a prototype for indoor positioning. So far, different devices (e.g., WiFi interface, IMU unit, etc,) have been integrated in a unique mobile node based on the Raspberry architecture. This node will constitute the starting point for future tracking algorithms implementation based on the fusion of measurements coming from heterogeneous devices. A PhD candidate at UCL is spending 6 months at CTTC (July 2013 – December 2013) doing research on Bayesian bounds for indoor location.

- JRA#3 Experimental activity on data sensing and fusion

This JRA is related to distributed signal processing techniques and it will exploit the DATASENS platform. The purpose is to assess the performance of energy-efficient data collection and estimation algorithms developed in Tasks 1.3.2 and 1.2.3 in realistic platforms and environments. This JRA involves CNIT-BO and CNRS. More specifically, consensus
algorithms applied to distributed estimation of a physical phenomenon will be tested using a large number of wireless nodes. Consensus convergence and estimation accuracy will be experimentally characterized and compared with the theoretical results obtained in Track 1.

- JRA#4 Reducing Traffic Congestion in Wireless Mesh Networks

This JRA is carried out by CNIT-UniBO and the LIMOS laboratory at CNRS. The aim is to design and test, on the EuWIn facilities at CNIT-Bologna, some solutions to improve the ZigBee routing protocol, targeting at reducing traffic congestion. This JRA activity is organized according to the following steps: 1) Design of new protocols aiming at reducing traffic congestion in Zigbee networks, and test their performance on the NS-2 simulator implemented at the CNRS, LIMOS laboratory; 2) Implement the more promising solutions on the EuWIn FLEXTOP platform and compare them with the Zigbee AODV-based reference protocol.

- JRA#6 Testing IP-based Wireless Sensor Networks for the Internet of Things

The main objectives of this JRA are the implementation and testing of different upper layers protocols for IEEE 802.15.4 networks and the comparison between two different paradigms for the Internet of Things. The JRA is organized in three phases:
1) Implementation of the 6LowPAN, the Zigbee/Zigbee-IP protocol stack, and SDWN on the FLEXTOP platform.
2) Comparison of the two paradigms, mainly in terms of delay needed to access a specific node in the network when passing or not through the Gateway.
3) Comparison of different solutions for the two paradigms in terms of energy consumption, traffic congestion and overhead, security features, and fragmentation.
The partners involved of this JRA are CNIT@UniBO and CNIT-UniCT.

Task 2.2.3 Experimental Activities on Opportunistic Networks with Mobile Clouds
Task Leader: Harri Saarnisaari (UOULU)

So far one JRA is active in this Task, but other JRAs are expected to start during the second year.

- JRA#5 "Socially-aware protocols for wireless mesh networks"

This JRA between CNIT-UniBO and CNIT-CT aims at experimentally evaluate the theoretical outcomes of the research performed in Task 1.2.2 on “Optimal design of opportunistic networks and mobile clouds” using the DATASENS platform. The idea is to realize a mesh network composed of at most 50 mobile nodes and 150 fixed nodes. The main objective of this JRA is to evaluate the impact of the social behaviour on the performance of a mesh network composed of mobile nodes (carried by people) and fixed nodes.

**Highlight of significant results from WP2.2**

The inaugural event of EuWin, which took place in Bologna at the premises of the EuWin@CNIT-BO site on July 8 2013, has been an extraordinary occasion of networking within Newcom# and outside Newcom#, in particular with industry. Within this event, all EuWin facilities have been presented to the public, both through talks and demos/posters. In the successive days, Track2 also organized an emerging topic workshop and a project meeting where the plan for future activities was discussed and many JRAs defined. Industry liaisons have been created, both during the days of the inaugural event in Bologna (participated by several industries) and on June 7 when the first Newcom# dissemination event at the premises of an industry was held, at Issy-Les-Moulineaux (FR) in Orange Labs.
WP 2.3 Flexible communication terminals and networks

WP Leader: Raymond Knopp (Eurecom)

This Work Package aims to set up and maintain the EuWIn facilities at Eurecom (EuWIN@CNRS/Eurecom). The general focus is on networked signal processing for collaborative communications, development methodologies for massive radio networks in support of the Internet of Things, and technical enablers for white-space exploitation in the presence of a primary communication system.

The lab is open to all NEWCOM# partners: it promotes the use of open-source tools for real-time deployment and in-lab experimentation of wireless communication devices and in particular make existing platforms and tools from the consortium available for widespread use (e.g. OpenAirInterface). This includes explicit training activities, software development support, and reproduction of hardware platforms. Collaboration is foreseen to be particularly intense with the following tasks in Track 1:

“cooperative multi-user communication” (Task 1.2.1), “resource allocation for optimized radio access” (Task 1.3.3), and “optimal design of MANETS and mobile clouds” (Task 1.2.3).

The lab contributes specific EuWIn training sessions to the dissemination and training activities to be organized under WP3.2 “Education and Training”. In order to foster industry-academia cooperation, WP2.3 organizes activities such as lab visits and/or virtual tours to its premises. Besides, it reports on lab activities and results at some of the in-company dissemination events organized by NEWCOM#. Where appropriate, WP2.3 stimulates NEWCOM#’s Affiliate Partners (or other companies) participation in its activities.

The WP is organised in four tasks:

Task 2.3.1 “Lab set-up, maintenance, and planning”
Task leader: Raymond Knopp (Eurecom)

Task 2.3.2 “Tools for embedded HW/SW architectures”
Task Leader: Carlo Condo (CNIT)

Task 2.3.3 “Experimentation in collaborative communications in multihop network topologies”
Task Leader: Florian Kaltenberger (Eurecom)

Task 2.3.4 “Large-scale emulation for the Internet of Things (IoT)”
Task Leader: Navid Nikaein (Eurecom)

A summary of WP2.2 progress towards objectives

Several JRAs are active and new topics have been defined in face-to-face and telephone meetings (EURECOM-CNIT-Torino, EURECOM-TUD,EURECOM-TUV). The active JRAs are described here.

- JRA 1.1 Cloud RAN (CRAN, 2.3.2.1)

This JRA is a joint effort between CNIT-Polito, CNRS-Eurecom, Bilkent, and Inov. Some industry collaboration notably with Alcatel-Lucent (France, Germany) and members of the Chinese C-RAN project (Agilent, Orange, IBM) should also be mentioned, although for the latter they are outside the scope of Newcom#, both the project and the external partners benefit from the development that is injected into OAI. The main motivation for this work is twofold. First to provide an experimental all software CRAN solution using only x86-based processing. The testbed will allow partners from Newcom# to experiment with centralized basestation processing algorithms for a small-scale network at EUWin-EURECOM using commercial 4G UEs (e.g. dongles connected to PCs). Secondly we provide a framework for...
studying the feasibility of using hardware accelerators for the channel decoders in software defined radios, with target architectures CRAN or basestation pooling applications. Channel decoding is by far the bottleneck in a CRAN application. In this regard, it is even worth investigating the true different in computation efficiency between existing 4G codes (i.e. Turbo codes) and recent competitors (LDPC, Polar), whether the actual implementation is software or hardware-based. In the case of a full hardware accelerator module, we are interested in assessing the gain (or loss) in an overall CRAN architecture, especially from the perspective of power consumption. Recent work reported in D23.2 on hardware architectures for polar codes and more general computing architectures for channel decoding was reported.

- **JRA 1.2 Cellular broadcasting (2.3.2.2)**

We are mainly interested in experimental aspects of broadcast transmission of multimedia content over cellular networks (e.g. LTE eMBMS) and have initiated a collaboration with the ICT-ACROPOLIS NoE. Under the lead of Kings College London, they have submitted an application to the English regulator OFCOM to use TVWS spectrum to trial cellular eMBMS. Several Nf partners have expressed interest in this trial (EURE, IASA, PUT). The hardware platform used will be Eurecom’s OpenAirInterface platform. Research issues include:

- Coexistence in TV White Space (e.g., TV White Space WiFi coexisting with TV White Space LTE, M2M and a range of others secondary systems that could potentially operate in such spectrum).

- Understanding of spatial dynamics in resulting signal levels based on our TV White Space transmissions. This it hoped to also include assessment of the potential effects on other legacy services, especially PMSE around King’s College London – noting that all trials will be run within the constraints of the draft ETSI Harmonised Standard as well as the power levels as returned by the geolocation database. Related to this, the trials will also aim to define and validate appropriate QoS parameters for low cost spectrum monitoring in the UHF band.

- The potential to aggregate resources, including aggregation of WiFi TV White Space channels (perhaps also with other WiFi channels outside of TV White Space), and aggregation of LTE resources in TV White Space. Aggregation of TV White Space resources/capacity among different systems (inside and outside of TV White Space) will also be studied. Further, the effects on the higher-layer (user-experienced) performance of such aggregation will be studied.

More specifically, the key systems/services and scenarios currently expected to be implemented and investigated include:

- LTE multicast/broadcast (eMBMS) service provision in TV White Space.

- Augmentation of this service through aggregation with another system in licensed or other license-exempt spectrum, e.g., WiFi or cellular 3G/4G. The aim is to demonstrate improved capacity and service provision through such aggregation. Such aggregation could demonstrate augmented broadcast, augmented data-carousel download provision, and “Cognitive Pilot Channel”-like capabilities, among many other possibilities.

- Testing/study of IEEE 802.11af draft in TVWS, including aggregation of multiple 802.11af channels. Perhaps testing of other systems in TVWS, particularly TD-LTE is seen as feasible, and also M2M type systems are potentially a possibility.

- Trials of a broadband network in TVWS for public safety (PPDR) scenarios. This network will likely use off-the-shelf TV White Space technology and combine LTE based picocells with broadband in TV White Space.

- Exploitation of the trials will begin jointly between NEWCOM# and @cropolis and continue within the context of NEWCOM# in 2014.
In order to alleviate the spectrum scarcity due to the high bandwidth demands from new devices and applications, cellular network operators may deploy a Dynamic Spectrum Access (DSA) overlay. In such a scenario, an operator opportunistically uses spectrum as a secondary user to augment its spectrum holding. While DSA for 4G systems (LTE and LTE advanced) is far from being standardized, first proposals for an architecture of DSA in 4G systems has been made, such as the introduction of an Spectrum Accountability Server (SAS) that manages spectrum access policies and monitors spectrum leases. To utilize the DSA capabilities, base stations (BS) and user equipment (UE) need to be enhanced by cognitive features in order to request spectrum lease and cooperative sensing information (cognitive BS) and be equipped with a spectrum agile radio (cognitive UE). While DSA is an important direction to increase the spectral efficiency, research for new waveforms is carried out for 5G systems. These waveforms address drawbacks for OFDM used in 4G LTE-based systems, such as OFDM’s need for orthogonality and synchronicity. One of the approaches for new waveforms is Generalized Frequency Division Multiplexing (GFDM) a digital multi-carrier transceiver concept that employs pulse shaping filters to provide control over the transmitted signal's spectral properties, a cyclic prefix that enables an efficient FFT-based frequency domain equalization scheme as well as tail biting as a way to make the prefix independent of the filter length. One specific GFDM feature is the ultra-low out-of-band radiation due adjustable Tx-filtering. This feature makes GFDM attractive to be used by the secondary user in a DSA overlay network, where the ultra-low out-of-band radiation minimizes the impact of the secondary system on the primary system. As such, DSA with the new waveform enables coexistence between 4G and 5G systems.

In the context of DSA and new waveforms for coexistence between 4G/5G networks, TUD and EURECOM plan joint experiments. Two options are considered. In option 1, the primary system is based on EURECOM’s OpenAirInterface system, the secondary system is equipped with TUD’s setup for GFDM transmission. In this option, synchronization and sensing might not be necessary if the primary system makes sure it leaves a hole in the UL resources. The objective of the experiments is to measure the co-channel interference reduction with respect to a classical 4G waveform such as SC-FDMA. In the other option, the secondary system is also based on EURECOM OpenAirInterface with the integration of the GFDM waveform. Both options are currently under discussion and further planning.

### JRA 1.4 OAI Lab setup for joint teaching activities (2.3.1.1)

IASA will receive OAI ExpressMIMO2 equipment in 2013 for joint research and teaching activities. Concerning teaching, EURECOM will provide specific training on OAI HW and SW modules over a few days of joint activity at either IASA or EURECOM once the cards have been delivered. EURECOM has already developed certain teaching modules reported in D23.2. IASA has furthermore committed to using OAI equipment for lab teaching sessions in Digital Communications. EURECOM will also provide OCTAVE / MATLAB based testbenches for different basic exercises. Specific preparatory sessions for preparing OAI environments for JRAs planned for 2014 will be transferred to IASA.

### JRA 1.5 Exploiting Channel Reciprocity in MIMO TDD channels (2.3.3.2)

The performance of MIMO systems relies to a great extent on the available channel state information at the transmitter (CSIT). In FDD systems, this CSIT is obtained by feedback and is therefore subject to low resolution and delay. In TDD systems, channel reciprocity can be exploited to infer CSIT from the uplink channel. Especially multi-user MIMO and massive MIMO systems rely to a great extent on the exploitation of channel reciprocity to gain CSIT. However, while the physical radio channel is reciprocal, the effects of the radio frequency circuits is not and must be calibrated. In this JRA several avenues of reciprocity are
investigated. In the first activity, which is mostly joint work between EURECOM and VUT, we investigate the estimation of channel reciprocity parameters in the presence of frequency offsets [3]. To this end, channel measurements have been collected using the OpenAirInterface EMOS platform, which stores channel measurements from the LTE real-time modem. These measurements are currently limited to 2x1 with a single user. In the second activity, which is mostly joint work between Eurecom and Linköping university, we investigate the effect of mutual coupling and cross-talk on the estimation of channel reciprocity compensation matrix [4]. For this work a new simplified methodology to acquire bidirectional channel measurements with a single ExpressMIMO2 card is used. This way 3x1 or 2x2 MIMO measurements can be done with the same card and thus avoiding frequency offsets. The measurements can be taken directly from the OAI octave interface. An extension of this setup to two or more ExpressMIMO2 boards is currently being developed. This will allow measurements of 4x4 MIMO or 4x2x2 MU-MIMO.

**Highlight of significant results from WP2.3**

A significant achievement was the training session on the new ExpressMIMO2 cards organized during the summer school on "Interference Management for Tomorrows' Wireless Networks" held at Eurecom, Sophia-Antipolis on May 28-31, 2013. Several Newcom# partners took advantage of this training.

EURECOM has an ongoing collaboration with Orange China (Beijing) who has developed hardware device drivers allowing interconnection of OpenAirInterface soft-modem software with a USRP N300 platform. This is a very popular platform used by many academic research labs in the world, and by several Newcom# partners. This development is now delivered as part of the publicly-available software package from the OAI website and SVN server. It allows real-time LTE transmission, but is currently operating at a non-standard 6.25 MS/s sampling rate. This achievement illustrates the validity of our Software Defined Radio approach in OAI since the code has been ported successfully on a totally different hardware target! To the best of our knowledge, it is the first time OAI has been used on a hardware other than those provided by EURECOM.

EURECOM has recently collaborated with Agilent China who uses the OAI ExpressMIMO2 platform as an LTE-eNB to perform interoperability tests with a commercial UE (Huawei E392U-12). Both FDD transmission and TDD Configuration 3 transmission have been tested successfully with a 5MHz channel. The attachment process is completed successfully and the UE can get IP address from the eNB and a high-throughput video service was validated. Agilent currently makes use of a commercial LTE-EPC (evolved packet core) interconnected with the OAI eNB in order to provide full layer 3 control services for the commercial UE. The work performed shows that the OAI platform is mature enough for industrial applications/deployment.

**2.2.3 TRACK 3**

Track Leader: Luis Correia (INOV)

The third track, in addition to the activities on training, human capital, and dissemination in the research community that is detailed later on, pays special attention to relations with European companies that participate to the NoE life as "Affiliate Partners", with the right to take part into events and technical meetings, and with the commitment of organizing and participating into periodic dissemination events in different countries. Some companies became Affiliates of NEWCOM# at the proposal phase of the project, others during this first year of activity.
WP 3.1 NEWCOM# Conferences, Workshops and Special Sessions
WP Leader: Claude Oestges (UCL)

Dissemination of research results produced within the NoE starts of course from the organization of dedicated events and from the participation in the major scientific events of the international research community. As a consequence, the main objectives of this work-package are the following:

- Organize an annual NEWCOM# conference with peer review and proceedings (in the second and third year).
- Interface with other EC projects and events and exploit possible synergies with the Future Network and Mobile Summit, concertation events, etc.
- Promote the involvement of NEWCOM# in the organization of major, already existing international conferences and workshops.
- Organize special sessions within the framework of NEWCOM# during major international conferences on the subject of wireless communications and related issues.

A summary of WP3.1 progress towards objectives

Activities in the workpackage have really taken off in April, but activities has been accelerated over the other months. In particular, a database in now being compiled with all NEWCOM# teams participating in other EC projects and/or in the organization of large conferences.

On October 1, 2013, the leadership of WP3.1 was taken over by UCL (C. Oestges).

Task 3.1.1 NEWCOM# annual conference
Task Leader: Roberto Verdone (CNIT)

In parallel with the change of WP leader, a number of amendments were made in the Description of Work relative to the Task 3.1.1 (NEWCOM# plenary conference). These amendments result in delaying the first scheduled annual event in order to align it with EuCNC14 (formerly FUNEMS, that now will be fully organized by NEWCOM# partners).

Task 3.1.2 EC concertation activities
Task Leader: Claude Oestges (UCL)

Regarding the EC concertation, Jossy Sayir (UCAM) presented NEWCOM#’s standardisation interests at the RAS cluster meeting in Lisbon (July 2013). In October, Claude Oestges (UCL) answered to the online survey compiled by CRS-i regarding all RAS projects’ standardisation interests. This survey was further discussed during the RAS workshop and EC concertation meeting which took place in Brussels on October 22-23, 2013. Several NEWCOM# partners were present at the meeting. Several NEWCOM# partners (Supelec, UCL, UCAM) also contributed to the RAS White Paper on “High Capacity PHY for Future Radio Access and 5G”. Further work on this action is to be expected, as agreed during the RAS cluster meeting. During that meeting, a first contact was established with Gerhard Wunder (HHI/TU Berlin) in view of developing contacts that may lead to his group joining NEWCOM# as an associate partner and also in view of fostering collaborations between NEWCOM# and 5GNOW. Finally, it was also agreed that C. Oestges would present EuWin to the RAS community (either by email and/or at the next RAS meeting).

Task 3.1.3 Conference workshops and special sessions
Task Leader: Giacomo Bacci (CNIT)

The WP and task leaders have been sending emails to gather the information and stimulate initiatives. These are summarized below.
NEWCOM# supported a workshop on Cognitive Radio Advances organised by CRAFT and held on the fringes of the VDE’s International Symposium on Wireless Communication Systems (ISWCS) in August 2013. One of the Workshop Chairs was from NEWCOM# (PUT). This workshop aimed at gathering researchers, engineers and practitioners both from academia and industry (universities, research centres, network operators, etc.), as well as end users which aim to inspire the analysis and development of new solutions and realizations of the cognitive radio concept, and to present advanced flexible transmission techniques, platforms, and CR applications. The main focus was on the practical implementation of the CR concept and the “shift-to-market” activity, including legal and economic aspects.

Furthermore, NEWCOM# also supported the Seventh IEEE Workshop on Advanced Information Processing for Wireless Communication Systems (Aalborg, Denmark, November 14-15, 2013), organized by AAU (NEWCOM# partner). The workshop aims to facilitate professional and scientific networking among young researchers, mainly from Northern and Central Europe, working in the field of signal and information processing in wireless communications. Several partners (VUT, SUPELEC, AAU) will be presenting their work. Note that the workshop is further organized under the patronage of the company Intel Mobile Communications Denmark, IEEE Denmark, the EU-FP7 Network of Excellence NEWCOM#, the EU-FP7 STREP WHERE2 and the EU COST Action IC1004.

Finally, several researchers from NEWCOM# are involved in the organisation of a NEWCOM# special session:
- at RAWNET 2014, to be held in May 2014 in Tunisia (the partners, CNIT-UoC, UOULU are also co-chairs of the conference),
- at WCNC 2014 (April 2014), in the form of a workshop on “Interference and Design Issues for Future Heterogeneous Networks” (CTTC),
- at CROWNCOM 2014 (UOULU, the partner is also general chair of the conference),
- at ICC 2014, as the 2nd IEEE International Workshop on Advances in Network Localization and Navigation (CNIT-UniBo).

**Highlight of significant results from WP3.1**

NEWCOM# provided the technical sponsorship to the IEEE Symposium on Information Theory (ISIT 2013) to be held this coming July in Istanbul, Turkey.

Several researchers from NEWCOM# were involved in the ISIT 2013: one of its two general chairs is Erdal Arikan from partner Bilkent, and two of its 4 TPC co-chairs are Jossy Sayir from partner UCAM and Igal Sason from partner Technion.

Among the accepted papers in ISIT 2013, 79 or 12% have co-authors from NEWCOM# partner institutions or co-authors named in the NEWCOM# technical annex. This is a considerable number for a conference with over 70% of papers submitted from countries outside the European research area.

NEWCOM# supported a workshop on Cognitive Radio Advances organised by CRAFT and held on the fringes of the VDE’s International Symposium on Wireless Communication Systems (ISWCS) in August 2013.

**Deviations from Annex-I in WP3.1**

In agreement with the Project Officer, the first scheduled annual event has been postponed to June 2014 in order to align it with EuCNC14 (formerly FUNEMS, that now will be fully organized by two NEWCOM# partners). The DoW has been amended accordingly.
WP 3.2 Education and Training
WP Leader: Gerald matz (VUT)

To achieve the general objective of excellence in research, a number of summer and winter schools are organized and additional training stages at the various sites of the newly established European Lab of Wireless Communications for the Future Internet (EuWIn) is offered. The seasonal schools typically lasts for one week and consist of short-courses and tutorials on advanced topics in wireless communications. These courses are given by leading international experts from within and outside NEWCOM# and are supplemented with discussion sessions that give PhD students the opportunity to exchange ideas with their peers and with senior experts.

In addition to seasonal schools, Emerging Topic Workshops (ETW) are held in order to foster the exchange of ideas regarding new trends in wireless communications research and to provide a platform for (early-stage and prospective) PhD students to identify suitable thesis topics that are practically relevant and scientifically challenging. The ETWs are also anticipated to be an ideal meeting point for interaction with the industry.

The theory-oriented seasonal schools and ETW are complemented with more practical training sessions at the EuWIn facilities, which allow the PhD students to gain hands-on experience regarding various wireless hardware platforms. Seasonal schools and training stages are open to NEWCOM# beneficiaries and to affiliate partners.

A summary of WP3.2 progress towards objectives

Task 3.2.1 Seasonal Schools
Task Leader: Roberto Verdone (CNIT)

During the first year of NEWCOM#, two Summer Schools, one Training Session, and one Emerging Topic Workshop have been organized by NEWCOM# researchers, with strong administrative support from the recently established European Association of Communications and Networking (EURACON). The details of these events are as follows:

- **Seasonal School; Eurecom, Sophia Antipolis (France); May 28-30, 2013; 60 attendees**
- **Seasonal School; Poznan Univ. Technology (Poland); Sept. 18–20, 2013; 48 attendees**

Task 3.2.2 EuWIn Training Sessions
Task Leader: Sylvain Azarian (Supelec)

- **Training Sessions; Eurecom, Sophia Antipolis (France); May 31, 2013, 60 attendees**

Task 3.2.3 Emerging Topics Workshops
Task Leader: Miquel Payaro (CTTC)

- **Emerging Topics Workshops; Univ. Bologna (Italy); July 8-10, 2013; 65 attendees. All events attracted a large number of attendees and have been a huge success with the participants due to the high quality of the technical programs. All WP3.2 milestones during year 1 have thus been achieved.**

Highlight of significant results from WP3.2

To improve the industry outreach of NEWCOM# schools, one of the speakers (Hoydis) of the first school had been invited from industry. With the second seasonal school there were two speakers from industry (Esnault and Y. Zhang). The Emerging Topics Workshop was
planned to have even stronger involvement of industry, (De Bonis, Peron, and Beker).
The combination of the workshop with the EuWin Inaugural Event (First Emerging Topics Workshop) and a NEWCOM# Track 2 Meeting ensured that the experimental activities within NEWCOM# were promoted and that the exchange with the theoretical work in Track 1 was further fostered.

WP 3.3 Journal special issues, books and book chapters
WP Leader: Luc Vandendorpe (UCL)

Journal special issues published by major international editors (IEEE, Springer, Wiley, etc.) represent an excellent instrument to enhance the visibility of research activities carried out into the NoE. The main objectives of this workpackage are related to the dissemination of the scientific results produced within the NoE, as well as to increase its recognition within the international reference research community. They can be basically summarized as follows:

- To foster the design and implementation of Journal Special Issues in international peer reviewed journals, dealing with the main research topics addressed in NEWCOM#.
- To stimulate the participation of NEWCOM# researchers as prospective authors in the journal special issues organized either by NEWCOM# or by third parties.
- To trigger and organize the writing of book chapters and books. Book chapters are devoted to the state-of-the-art and the recent advances of specific scientific and technological topics addressed by NEWCOM# researchers while books are reserved for the results of Track 1 of the project.

A summary of WP3.3 progress towards objectives

Task 3.3.1 Identification of topics for SIs, book chapters, books, journals, and monitoring of CIPs.
Task Leader: Luca Vandendorpe (UCL)

The first activity of the WP was the creation of the list and the description of journals (EURASIP, IEEE and others) which are of interest for special issues organized by NEWCOM# researchers, or to which NEWCOM# could contribute. A list of main book and book chapters publishers (e.g. Wiley, Springer, Cambridge University Press, etc.) was also created with the cooperation of which NEWCOM# authors could disseminate their production. Finally, a preliminary list of topics that have been identified as potential topics for special issues to be launched by NEWCOM# members as well as the associated WP/tasks was edited as well. Workpackage and task leaders have been regularly contacted to take initiative and have discussion in their respective WP/task in order to identify new topics or new opportunities for dissemination.

Task 3.3.2 Organization of SIs and writing of books and book chapters.
Task Leader: Claude Oesteges (UCL)

Researchers from within the NoE (spontaneously or after appropriate solicitation actions by the Task leader) took an active role in proposing and organizing special issues on journals, taking the initiative to publish books containing the results of the JRAs, both as a self-standing volume or as contributions to multi-author books. It has been ensured that NEWCOM# was properly acknowledged in the different special issues (e.g. by explicit mention of NEWCOM# in the CFP and/or the editorial, by inserting the NEWCOM# logo on the cover, by explicit mention of NEWCOM# in the title, etc.).

To date, the following journal special issues have been launched, and two of them are in the “manuscript submission” phase:
- Indoor Localization, Tracking, and Mapping with Heterogeneous Technology, to be published in IEEE Transactions on Vehicular Technologies;
- Special Issue on Signal Processing Techniques for Anywhere, Anytime Positioning, to be published in EURASIP Journal on Advances in Signal Processing.

This task also includes the edition of NEWCOM# White Book (in electronic format) which will summarize the main scientific outcomes of the project along with a number of open issues to be addressed in the years to come.

**Task 3.3.3 Promotion activities**

Task Leader: Adrian Kliks (PUT)

Activities aimed at adequately publicizing these Special Issues both within and outside the NEWCOM# community: to maintain e-mail reflectors, to ensure the widest possible circulation of the corresponding call for papers through e-mail reflectors, etc. One page of the NEWCOM# website, called “Journal special issues” is devoted and maintained with the related information (link to Call for Papers, editors, etc ..). The address of this page is: [http://www.newcom-project.eu/index.php?option=com_content&view=article&id=17&Itemid=110](http://www.newcom-project.eu/index.php?option=com_content&view=article&id=17&Itemid=110)

**Highlight of significant results from WP3.3**

During the first 12 months of NEWCOM#, one book and one book chapter inspired by NEWCOM# joint research activities have been edited and they are now ready for publication. The book chapter “Null-space precoder for dense 4G and beyond networks” included in the book entitled Resource Allocation and MIMO for 4G and Beyond will be published by Springer. The book “Machine-to-Machine (M2M) Communications, Architecture, Performance and Applications” will be published by Woodhead Publishing Ltd.

A special session was proposed and accepted for EUSIPCO 2013, Marrakech, about “Resource allocation for wireless communication systems”.

**WP 3.4 Industry Liaison and Dissemination**

WP Leader: Hikmet Sari (Supelec)

One of the main objectives of NEWCOM# is to improve dissemination of the research results produced by the NoE towards the European wireless communications industry. The general aim of the activity is to support and possibly drive to some extent the research performed at companies to help them innovate and maintain a strong position in the international competition. Dissemination is mainly carried out by organizing periodic dissemination events hosted by Affiliate Partners from industry. The rationale is that organization of such events at the premises of the Affiliates facilitates participation of their engineers, managers, and other employees without incurring any significant travel cost. Also, the dissemination events are advertised and are open especially to companies in the same country as the hosting Affiliate to maximize participation by reducing traveling costs. By organizing a sufficiently large number of events (2 in the first year, up to 4 in the second and third year) most countries and regions in Europe are covered. During the events, the Host and other interested Institutions are requested to highlight their needs and expectations in terms of R&D to possibly find a match of interests with the (mainly) academic research performed by NEWCOM#, and the NoE presents its experimental facilities at EuWIn to possibly foster cooperative research. The Dissemination Events also have the function of facilitating contacts between young
researchers in the NoE and representatives of European companies for possible recruiting opportunities. Prior to the organization of the Dissemination events, a survey was carried out to focus and steer in advance the dissemination program.

A summary of WP3.4 progress towards objectives

Task 3.4.1 Survey of the Research needs of European Companies
Task Leader: Hikmet Sari (Supelec)

Several Affiliate Partners and other industrial stakeholders in Europe were contacted in the first three months of the project to find out their expectations and need in terms of support to research in the mid-term to improve their competitiveness and help them keep the leadership on the global market. Availability to host/or participate in the dissemination events also was ascertained by the survey. The survey outcomes was used to set out the Dissemination Plan in terms of location and nature/subject of the events. Eleven Associate Partners from industry responded to the survey. This means that Associate Partners have significant interests in N# activities. Partners were also asked as to when they could host a future Dissemination Event: the first event was organized at the premises of Orange labs.

Task 3.4.2 Periodic Dissemination Events
Task Leader: Hikmet Sari (Supelec)

The first NEWCOM# Dissemination Event took place on 17 June 2013 at Orange Labs, Issy les Moulineaux, near Paris. The event was attended by 26 people, 13 of which from NEWCOM#, 12 from the host Orange Labs, and 1 from another industrial partner. All efforts to organize a second Dissemination Event in October 2013 have been unsuccessful, because none of the contacted associate partners committed to host such an event in that time period. But on the positive side, we now have commitments from two associate partners to host events in 2014, one in January and one in April. The first event is to be hosted by NEC Labs in Heidelberg, Germany, and the second by AVEA Labs in Istanbul, Turkey. There is also a possibility that Portugal Telecom will join NEWCOM# as an Associate partner and also host a Dissemination event in January 2014. If this happens, the event at NEC Labs in Heidelberg will be shifted to February 2014. Overall, after a slow start in the first year of the project, the second year looks bright in terms of dissemination toward European industry.

Deviations from Annex-I in WP3.4

In the DoW two events during the first year are planned. Actually only one event in Orange Labs (June 17th) was held. This was because none of the contacted associate partners committed to host such an event in that time period. The second event has been already planned and takes place in January 2014 hosted by NEC Labs in Heidelberg, Germany. It is in fact a postponed event of Year 1.

WP 3.5 Development and valorization of human capital
WP Leader: Pawel Kryszkiewicz (PUT)

This WP implements a number of actions to facilitate the development of personal skills and the growth of professional competence in research. The instruments to achieve this are special grants for PhD and early-stage researcher to spend research period at the NEWCOM# EuWin Lab, a number of awards for papers and in general achievements obtained within the NoE, and a set of gender actions to promote the
participation of female researchers. Communications of the outcomes of such actions are given with emphasis at the main NEWCOM#-related events and on the NEWCOM# newsletter and website to highlight at best their relevance in the context of a NoE.

A summary of WP3.5 progress towards objectives

Task 3.5.1 NEWCOM# mobility and “lab” grants
Task Leader: Simona Moschini (CNIT)

The call for mobility grant was open on the January 31, 2013 and deadline was on March 15, 2013. The notification on the results of the call was given on April 15, using The Newcom# webpage, mailing list and LinkedIn group.

There were 6 researchers funded in this call for mobility grants, namely,

- Mohsen Rezaeckheirabadi (VUT)
- Melchiorre Danilo Abrignani (CNIT-Bologna)
- Riccardo Andreotti (CNIT-Pisa)
- Salvatore D’Oro (CNIT-Catania)
- Sophie Fosson (CNIT-Torino)
- Vincenzo Zambianchi (CNIT-Bologna)

Four of them are PhD students and two are young researchers. In total, those researchers have spent/are spending 11 months in their hosting institutions with well defined research plans, it provides great potential for writing highly visible scientific papers. Further details on the visits, hosting institutions and research topics can be found here: [http://www.newcom-project.eu/index.php?option=com_content&view=article&id=16&Itemid=111](http://www.newcom-project.eu/index.php?option=com_content&view=article&id=16&Itemid=111)

Task 3.5.2 NEWCOM# awards
Task Leader: Marco Luise (CNIT)

There are three kinds of awards to be granted each year in order to promote excellence in research within NEWCOM#:

- The NEWCOM# Best Paper Award (BPA)
- The NEWCOM# Young Researcher Award (YRA)
- The NEWCOM# Distinguished Researcher Award (DRA).

In the first year the call was open on September 6, 2013. Submission deadline was on September 30 and final decisions by the Committee were made on October 25. The Awards Grants will be given during the annual NEWCOM# conference that will be co-located with the first year with EuCNC – European Conference on Networks and Communications in June 2014. The awardees are:

- BPA: Marco Di Renzo (SUPELEC), Alessandro Guidotti, and Giovanni E. Corazza (CNIT/UniBo).
- YRA: Maria Gregori and Miquel Payaro (CTTC)
- DRA: Radio Networks research group (CNIT-UniBo), led by Roberto Verdone.

Highlight of significant results from WP3.5

Five out of six persons that received mobility grants has already returned from they stays. Reports were collected and high visible publications are to arise in few months.
There was high interest in awards, i.e. high number of applications was collected. The awarded papers was published in the international journals of high impact. Moreover, the awards committee assessed all awarded paper as high quality.

**WP 3.6 The NEWCOM# Portal and related Web Presence Tools**  
WP Leader: Roberto Verdone (CNIT)

A fundamental and central instrument for dissemination, integration, and spreading of excellence is the NEWCOM# Portal that fosters communication among partners and with the NEWCOM# office, promotes a cooperative work environment, and showcase the life and achievements of the NoE. It will integrate as a heritage the Virtual Center of Excellence ViCE-WiCom tool which was developed in the framework of the NEWCOM++ project as an instrument to support knowledge sharing, and analysis of the relationships between content, people and activities into a knowledge map for the network. Besides, it also features dedicated sections on EuWiIn where lab-specific information such as measurement campaigns, events, manuals or materials are posted, and hosts periodic issues of the “NEWCOM# NewsLetter” reporting on the life and achievements of the NoE. A videoconferencing tool named SCOPIA, allowing for a cost-effective realization of the meetings of the various NEWCOM# bodies, or daily interaction of groups of researchers was made available through the portal, as well. The portal manages the relevant security issues when it comes to the protection of information, considering that the users of such tools are of many kinds, namely: the governing bodies of the NoE (some with unlimited access), the EC representatives (with dedicated areas), the NEWCOM# partners, the affiliate partners (with some restrictions), and the remaining interested parties from outside the NoE.

**A summary of WP3.6 progress towards objectives**

**Task 3.6.1 Development of the NEWCOM# Portal**  
Task Leader: Rosa Martinez (CTTC)

The N# portal (http://www.newcom-project.eu) was launched at the end of January. In February 2013 the centralized document repository was embedded into N#’s portal. The handover of the website from CTTC to CNIT took place in July 2013. Google Analytics was installed to monitor the usage of the portal’s tools. After the first test of the MPA in April 2013, some features for the File Repository were implemented.

A number of project mailing lists were created in November 2012:
- project_office@newcom-project.eu
- executive_board@newcom-project.eu
- sci_contacts@newcom-project.eu
- admin_contacts@newcom-project.eu
- all_newcom@newcom-project.eu
- wpXY@newcom-project.eu
- o wpleaders@newcom-project.eu
- associate_partners@newcom-project.eu

The videoconferencing tool (SCOPIA) was made available to all project partners.

**Task 3.6.2 The NEWCOM# NewsLetter and Social Networking**  
Task Leader: Adrian Kliks (PUT)

The LinkedIn Newcom# group was set up at the beginning of the project and, at the moment, consists of 62 members and it is not only restricted to Newcom# members. Besides, a NewsLetter, featuring the life and achievements of the NoE, has been published on a quarterly basis on the portal. To edit it, a collection of news and preparation of reports on the
activity of each WP has been carried out. The NewsLetter has been disseminated through the website and to the mailing list of NEWCOM#.

**Task 3.6.3. Maintenance and Support**  
Task Leader: Giorgia Bertozzi (CNIT)

In the second part of the year the contents of the portal (e.g. information on events, schools, uploading of documents) have been managed and continuously updated. Help has been offered to users and contributors in what concerns both content management and technical support about the usage of the NEWCOM# portal and of its features. There have been also made some upgrades of the portal itself to better serve the community.

In the second part of the year the second release of EuWIn website was implemented. Every features offered by both of the portals have been tested.

*Highlight of significant results from WP3.6*

The set of web tools have been implemented at the contractual date. All web related tools needed to support the networking and integration activities have largely facilitated a fruitful cooperation among scientists and the dissemination of project results.

A server hosting the NEWCOM# web tools directly managed at CTTC. The features currently implemented are:

- a special restricted section for Advisory Board
- a special restricted section for the MPA
- a news and events public area
- a public area to showcase the NoE, its activities and public results (most of the deliverables) to the external scientific community
- a 'Mobility Grant' section
- a restricted areas to exchange documents, data and materials within the NoE
- a N# papers section
- a Schools section
- an “Awards” section

A server hosting the videoconference solution SCOPIA is directly managed by CTTC, as well as a hosted solution for more than 40 mailing lists.

**2.2.4 TRACK 4 (WP 4.1)**  
**Track Leader:** Carles Anton-Haro (CTTC)

*In this Deliverable only WP 4.1 is reported, since the other WPs of this Track (WP 4.2 and WP 4.3) are reported in Deliverable D43.2.*

Broadly speaking, the management activities in a NoE, in addition to setting up and maintaining the legal basis for operation of the NoE, are instrumental to make sure that all partners follow the correct procedures in the administration of their own budget, and that prepare timely and accurate reports to the Coordinator and/or to the Commission where requested. In addition, the network management has also to implement due auditing actions to possibly identify spending unbalance issues among partners as well as possible non conformity of some partner’s activity to the work program of the NoE. In the case some non conformity (financial or scientific) is detected, proper corrective measures are proposed to the Executive Board of the NoE.
Complementarily, it also includes the yearly update and further refinement of the Joint Program of activities taking into account inputs from the Advisory Board and EC project review meetings.

Along with that, some dynamic allocation of NoE budget according to individual partners’ performance is also envisaged in NEWCOM#, in such a way that the potential of those having shown larger impact towards the project objectives can be increased.

Finally, another fundamental output of the management activities is a constantly updated review of the status of the NoE that will also allows evaluating its sustainability after the Commission funding is over. This is done by implementing specific actions about promotion of the NoE activity and by identifying the most promising aspects in the network (e.g., the EuWIn lab) that can be possibly turned into some form of self-sustaining business. The Management activities within NEWCOM# are organized into three WPs, each regarding one of the main aspects mentioned above.

**WP 4.1 Direction and quality assurance of scientific activities**

WP Leader: Marco Luise (CNIT)

This WP summarizes the most crucial steering and coordination functions of the Project Coordinator for the everyday proper working of the NoE; it is related to the proper implementation and management of the research WPs (Tracks 1 and 2) and training and dissemination WPs (Track 3). There are numerous tasks carried out within this WP, most importantly:

- assessing/enhancing with the help of the Advisory Board the quality of the results produced by the NoE in terms of scientific and technical innovation;
- assessing/monitoring the quality and timely delivery of documentation (deliverables).

Potential deviations and/or critical issues (in terms of scientific content and/or documentation quality) are identified in due time and reported to the Executive Board, that takes appropriate actions towards the WPs to solve the issue. Network promotion and sustainability aspects are also addressed in this Work Package, together with the fundamental issue of the access policy to EuWIn.

1. **A summary of progress towards objectives**

This WP deals specifically with all aspects related to the proper implementation and management of the research WPs. This includes the assessment and possibly the enhancement of the quality of the results obtained from the NoE in terms of scientific and technical innovation. The WP activities are split into 3 tasks: Task 4.1.1 “Scientific quality control”, Task 4.1.2 “Management of the Executive Board and the Advisory Board”, Task 4.1.3 “Network promotion and sustainability”.

**Task 4.1.1 Scientific quality control**

Task Leader: Marco Luise (CNIT)

One of the main, and more time-consuming activities of this WP has been the scientific quality control of the research deliverables. Each research deliverable first underwent an internal (to the specific research WP) review, then has been reviewed by the Track Leader and finally it has been duly reviewed by NEWCOM# Scientific Director (Track 1, 2 and 3) and by the A&M Director (Track 4). In this way the Scientific Director has had an overall visibility of the network scientific production, and could provide actions to coordinate the deliverables content to avoid duplications and increase synergies.

To accomplish this object, during year 1 deadlines of review process and methodology have been modified.

The WP activity has been mainly accomplished by NEWCOM# Scientific Director, in close
cooperation with the Managing Director and NEWCOM# Office. The EB members have been actively involved in network management and committed to its proper functioning.

**Task 4.1.2 Management of the Executive Board and the Advisory Board**

Task Leader: Marco Luise (CNIT)

As to the management of the Executive Board (EB), 7 meetings have been held:

<table>
<thead>
<tr>
<th>VENUE</th>
<th>DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>virtual</td>
<td>October 24, 2012</td>
</tr>
<tr>
<td>Pisa</td>
<td>November 21, 2012</td>
</tr>
<tr>
<td>virtual</td>
<td>January 14, 2013</td>
</tr>
<tr>
<td>Paris</td>
<td>March 7-8, 2013</td>
</tr>
<tr>
<td>virtual</td>
<td>May 13, 2013</td>
</tr>
<tr>
<td>Poznan</td>
<td>July 23, 2013</td>
</tr>
<tr>
<td></td>
<td>October 3-4, 2013</td>
</tr>
</tbody>
</table>

NEWCOM# Advisory Board (AB) is composed by:

- Sergio Benedetto, Politecnico di Torino, Italy
- Andrea Goldsmith, Stanford University, USA
- Georges Karam, Sequans, France
- Jorma Lilleberg, Renesas Mobile, Finland

The names speak for themselves, it is just worth mentioning that emphasis has been put on recruiting highly representative leaders from the wireless industry.

The first meeting of the Advisory Board took place on the 5th July (virtual meeting). The goal was to formally kick-off the activities of this body and, also, to inform the AB of the scientific activities of the network through the provision of the Annex I and all research deliverables. The second meeting of the Advisory Board took place on the 2nd October (virtual meeting). Here they have been asked to revise a set of deliverables: D11.1, D12.1, D13.1, D21.2, D23.2, D32.1. A proper folder in the file repository has been created for store documents available for the AB. Another meeting between the WP Leaders and the Advisory Board members took place on the 11th October (virtual meeting). The purpose was the preparation of review by the AB of a set of deliverables. The report on results of this review is in Annex II of this deliverable.

The remarks provided by the AB and reported in Annex II has been discussed at the EB level and will be taken into consideration in two respects: first, they will be used to re-organize and restructure the different activities, especially when it comes to the issue of fragmentation of Track 1 JRAs and of the definition of objectives of Track 2 JRAs; second, they will also be used to improve the organization of the set of Deliverables of Year 2. No action was taken
into Y1 in this respect, since the report of the Advisory Board was delivered at the end of October 2013 when most Deliverables had been already prepared for the final internal review.

**Task 4.1.3 Network promotion and sustainability**

Task Leader: Simona Moschini (CNIT)

This Task is discussed in detail in section 4 of this Deliverable.
3. Project publications during the reporting period

During the first year, a total of 101 journal and conference papers have been published or accepted for publication (a list can be found in Annex I). Out of them, 32 correspond to journal articles, as Figure 1 left illustrates. More importantly, 33 of those publications turn out to be joint ones. This evidences the high level of integration of research activities already attained in the first year of the project. Further details on the number of contributing institutions to those publications can be found in Figure 1 right. Unsurprisingly, joint publications where two partners collaborate are the most frequent ones.

<table>
<thead>
<tr>
<th>Publications Y1</th>
<th>Conference</th>
<th>Journal</th>
<th>Total</th>
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</thead>
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<tr>
<td>Joint</td>
<td>22</td>
<td>11</td>
<td>33</td>
</tr>
<tr>
<td>Individual</td>
<td>47</td>
<td>21</td>
<td>68</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td>32</td>
<td>101</td>
</tr>
</tbody>
</table>

**Figure 1**: Publications either accepted or published during the first year of the project. Details on conference/journal and joint/individual (left) distribution, and on the number of contributing institutions (right).

Figure 2 and Table 1 below show the breakdown of publications into workpackages. Clearly, the number of publications generated by Track 1 ('Theoretical') workpackages is substantially higher than that of Track 2 (EuWIN, ‘Experimental’). This stems from the fact that, quite often, the time needed to publish results based on experimental work is higher. Besides, Track 2 workpackages devoted most of their efforts in the first semester to the set up and organizational activities of the various EuWIN labs (see Gantt diagram in the DoW). This initial effort, indeed, had a negative impact in terms of scientific production which, we expect, will become less noticeable as project progresses.

![Figure 1: Number of joint and individual publications per workpackage.](image-url)
Table 2: Breakdown of publication type per workpackage.

<table>
<thead>
<tr>
<th></th>
<th>WP1.1</th>
<th>WP1.2</th>
<th>WP1.3</th>
<th>WP2.1</th>
<th>WP2.2</th>
<th>WP2.3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint</td>
<td>5</td>
<td>17</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>2 partners/1 country</td>
<td>0</td>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>2 partners/2 countries</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>3 partners</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>4 partners</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Individual</td>
<td>22</td>
<td>18</td>
<td>11</td>
<td>14</td>
<td>2</td>
<td>1</td>
<td>68</td>
</tr>
</tbody>
</table>

3.1 Other dissemination activities

NEWCOM# has been represented in several Radio Access and Spectrum (RAS) Cluster and Concertation meetings, where the project activities have been presented:

- Participation and presentation in the Concertation Meeting held in Brussels on February 28, 2013.
- Participation in the RAS Cluster Meeting held in Lisbon on July 4, 2013.
- Participation in the Concertation Meeting held in Brussels on October 23, 2013.
- Participation in the RAS Cluster Meeting held in Brussels on October 22, 2013.
4. Network promotion and sustainability

4.1 A Promotional strategy for the NoE

The first step in the promotional strategy during the first year of the project (Y1) has been the creation of communication material (leaflets, bookmarks, gadgets) to advertise the network. The promotional materials were circulated in the NEWCOM# schools, workshops and dissemination events held in the first year.

The second step, to be taken in Y2, consists in setting up an and putting into action an effective promotion campaign which highlights the benefits of keeping the network alive after the EC funding period. To that aim a questionnaire will be prepared, the circulation of which will initially be restricted to NEWCOM# partners and Affiliate Partners. It is aimed at identifying the benefits of the network on personal and organizational level, as well as possible critical deficiencies to be fixed.

The output from the questionnaire will then be used in Y3 to setup a path through which refine and reshape a first Promotional Strategy, that was already at the core of the first communication material (leaflets, bookmarks, pencils) advertising the network, as it will be prepared and circulated in the events held in the first year. In this latter respect, involvement of the EURACON association will be considered.

4.1.1 The NEWCOM# context

Establishing the Identity
The core concept is: NEWCOM# is a Network of Excellence (NoE) of a relatively large size, created for the purpose of scientifically addressing medium/long term, complex, interdisciplinary, fundamental research problems in the field of wireless networks, focused towards identifying, posing in the right modeling perspective, and at least partially characterizing the information-communication theoretical limits of such networks and the algorithmic solutions that make it possible to approach those limits. A distinctive feature of NEWCOM# is a careful mixture of theoretical and experimental research through the creation of the multi-site EuWIn laboratory. All of this has to conveyed by promotional material and initiatives.

Identifying the Target Audience
Inside and outside NEWCOM#: researchers in the wireless sector, partners, affiliate partners, industry.

Developing a Theme
Actually NEWCOM# has more than a single theme (research/education, theoretical/experimentation), and so it tries to address a relatively large target audience. The common characteristic for those different themes is the aim to represent – as a Network – a reference point for researchers’ activities and interests, “the” place where to go (for researchers, universities, enterprises, etc.) for the wireless research sector.

Establishing the Objectives
NEWCOM# has very well defined Spread-of-Excellence objectives, such as:

a) Enhance the already good cooperation level among research groups reached by NEWCOM++ and push it to a level where it will reach an irreversible, steady-state nature.

b) Shape a new generation of young European researchers fully free of any scientific provincialism and accustomed to common work under major scientific challenges.
c) Encourage a fair and vital competition among researchers via the NEWCOM# Awards.

d) Disseminate scientific results across the scientific community through jointly written papers, special session and journal issues, and offer to the European industry the benefit of longterm, fundamental research achievements through dedicated events and the tool of affiliate partners.

According to the Identity, the Target, the Theme, and the Objectives defined above, first of all, we defined and spread a definitive "NEWCOM# corporate image"; that needed some intermediate steps:

- the creation of a vectorial logo, with declared dimensions, proportions and guidelines, and specific colors, identified by their HEX codes;
- the production of vectorial and raster versions of the logo itself;
- the availability of those materials through the website for official usage;
- the concept and design leaflets, posters and other promotional material;
- the concept and design of gadgets and other promotional objects.

The simplest and most immediate way to publish the "NEWCOM# Corporate Image" was through the NEWCOM# Portal. A banner was created introducing for the first time the graphical "suite" and the representative colors. We decided that the main points of the Corporate Image had to be easy and attractive and we decided to use bright colors, to make an immediate impact on people. We choose two main colors: dark blue for the base of material and an intense orange as main color of NEWCOM# logo.

After that, we worked on the idea that the banner had to immediately convey: a glimpse of what NEWCOM# is. For this reason the following elements were used and combined together:

- NEWCOM# logo
- Europe map with a special focus on N# partners' States
- strips reminding of telecommunications links
- graphical background suggestive of algorithms and signals

![Fig. 3: NEWCOM# banner](image)

Once the logo and banner were designed, we used the graphical concept for all the material of the project.

Slides templates to be used for any kind of NEWCOM# presentation, were created using the Project Image and were made available to all the NEWCOM# partners in the file repository of the portal.
Fig. 4 NEWCOM# Power Point presentation model
A standard presentation of NEWCOM# for dissemination purpose has been edited and uploaded in the portal, so that all NEWCOM# partners can use it to present the project whenever it is needed. This presentation is the Annex IV of this deliverable.

Afterwards we designed a Leaflet for better information about the project, and advertisement material in the form of a bookmark and a pencil to be distributed during the NEWCOM# events.

For the leaflet and the bookmark we introduced for the first time a different idea of dissemination material, compared what was used by the predecessors NEWCOM and NEWCOM++: a simpler and more immediate way of communication.

The leaflet does is not the usual folding brochure; rather, it is a smaller A3 one-page card in heavy glossy paper. In this way it has to contain essential information, very easy to read and digest.
To that aim, the crucial point was to insert the most “attractive” highlights of the project, just to tempt people to visit the website to get into the project. A special wording was studied for the purpose.

We decided to give great evidence to what makes NEWCOM# special among all of the other projects in the ICT area founded by the EC: it has been the only one founded for 3 times. For this reason we invented the “NEWCOM SAGA”, highlighting facts and figure of these 10 years of the project.
NEWCOM# pursues long-term, interdisciplinary research on the most advanced aspects of wireless communications like Finding the Ultimate Limits of Communication Networks, Opportunistic and Cooperative Communications, or Energy and Bandwidth-Efficient Communications and Networking.

14 partners in 14 different countries integrating their competences and resources to:
- produce medium to long term results in the area of design and performance evaluation of wireless networks
- foster industry-academia cooperation, dissemination, and liaison by making academic research closer to industrial needs and interests
- provide a unique training environment for a new generation of researchers both in theoretical and experimental research
- create a permanent environment for cooperative research

400 researchers involved, 20 grants and awards to young researchers

NEWCOM# is a Network of Excellence within the European Commission challenge FP7-ICT-2011-8 1.1, "Future Networks"

**Excellence within Excellence: 10 years of NEWCOMs**

The NEWCOM "Sagia" started in 2004 under FP6 with the first Network of Excellence NEWCOM, continued under the FP7 with NEWCOM++ in 2008, and NEWCOM# in 2012. NEWCOM is quite unique in the rich panorama of European NoEs since it is one of the very few (and the only one in ICT) that has been granted support, in a modified form but with the same spirit, for the third time.

It was started by a Consortium of 80 European partners (both at the academic and industrial level) representing the most renowned experts in Europe, it was down-selected to 17 in NEWCOM++, and 14 in NEWCOM#.

The NEWCOM# Consortium is now an ecosystem for research featuring excellent researchers with an inherent attitude to work in line with the NoE philosophy: cooperation, interaction, integration.

In 10 years NEWCOM has nurtured a new generation of Researchers and a new generation of Institutions.

<table>
<thead>
<tr>
<th>Facts and figures:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• The European Laboratory of the Future Wireless Internet</td>
</tr>
<tr>
<td>• Resources: 23 millions euros</td>
</tr>
<tr>
<td>• 1200 Researchers involved</td>
</tr>
<tr>
<td>• 200 Joint Publications</td>
</tr>
<tr>
<td>• 50 Awards and mobility grants</td>
</tr>
<tr>
<td>• 20 Summer/Winter schools</td>
</tr>
</tbody>
</table>

**PARTNERS:**
- CNIT (IT), Aalborg University (DK), Bilkent University (TK), CNRS (FR), CTTC (ES), IASA (GR), INOV (P), Poznan University of Technology (PL), Technion (IL), Technische Universität Dresden (D), University of Cambridge (UK), Université de Louvain (BE), Oulu University (FIN), Technische Universität Wien (A)

**CONTACTS:**
- Project Coordinator: CNIT (Italy) Marco Luise marco.luise@cnit.it
- A&M Director: CTTC (Spain) Carles Anton-Haro carles.anton@cttc.es
- Project Office: Simona Moschini & Rosa Martinez project_office@newcom-project.eu

**Fig.5: NEWCOM# leaflet**
The bookmark was to further enhances the “effect” of the leaflet: having something small, nice and useful, so that people would like to get it and use it, and sooner or later they will have the curiosity to get into the NEWCOM# portal.

Being the bookmark smaller than the leaflet, different highlights with another wording were created. This was the most critical point of the dissemination material, because representing an entire project in few lines, and tempting people to get into it, was a real challenge.

Fig. 6: NEWCOM# bookmark

In addition, we designed a NEWCOM# pencil. This is just a nice and attractive gadget, made in two colors, blue and orange, made for the purpose to attract people in our stand or desk during technical demonstration sessions, so that they can have the occasion to get information about the project.

Fig. 7: NEWCOM# pencils
Finally, we designed business cards for people in the Project Office, with the distinctive NEWCOM# graphical theme.

Fig. 8: NEWCOM# business card

As mentioned earlier in this document, experimental research is perhaps the main novelty into NEWCOM#, and the creation of the EuWIn laboratory represents the key point in this respect. EuWIn has got potential of becoming a permanent and self-sustainable activity to be spun off from NEWCOM#. For this reason we decided to devote special attention not only to communication of the NEWCOM# identity/activity, but to concentrate on EuWIn as well. We choose a similar “Corporate Image”, so that was immediately clear that EuWIN is a “Newcom# Product” even if with its own life.

Fig.9: EuWIn banner
Fig. 10: EuWIn Power Point presentation model
4.1.2 A first run: EuWin inaugural event in Bologna

We presented for the first time leaflet, bookmark and pencils during the EuWin inaugural event in Bologna. The purpose was to collect feedback from visitors and used them to modify the materials for future activities.

We had definitely good feedback, having lots of people taking specially bookmarks and pencils, as expected. Hence, we kept the original design and ordered more units. We also decided to use that material not only for the dissemination events but also for all the schools and workshops.

4.2 The questionnaire

As stated before, at the end of Y1 we will prepare and distribute the questionnaire, in order for the partners to better evaluate the life and achievements of the NoE.

The aim of the questionnaire is to identify the benefits of the network on personal and organizational level, as well as possible critical deficiencies to be removed. Its first issue has already been created in a draft version. Once finalized it will be circulated and uploaded on the N# website under the restricted area, were it will be accessible to all the partners and affiliate partners.

4.2.1 Target audience and setup

The questionnaire will be delivered to all the NEWCOM# WP Leaders and affiliate partners at the beginning of year 2. Its purpose is to understand better the researchers’ activities and interests. It will be submitted through the Google Forms facility, that allows users to create simple questionnaires, send them by email, and collect data results directly in a Google Excel file and in a Google Report, with charts and lists.

The questionnaire will be sent by mail, with this introduction:

“The aim of the questionnaire is to collect information to identify benefits of the NEWCOM# network on personal and organizational level, as well as possible critical deficiencies to be removed in the second and third year. The information you will provide with this questionnaire will be used as feedback of the experience carried out within the first year of the Newcom# project by you and your organisation.

The evaluation will represent an useful source of input for the Project/Network’s promotional strategy and its sustainability.

4.2.2 Questions

Fifteen questions organized in three main blocks:

Questions 1. - 5. about researcher and their behaviors
Questions 6. - 10. about the evaluation of current NEWCOM# internet tools and their usage
Questions 11. - 15. about possible evolutions of the network

The draft version of the questionnaire is in the Annex III of this deliverable.

4.2.3 Next Steps

Following is a short list of next steps, according to the previous guidelines:
1. Feedback from the visitors at the next events and in particular at the NEWCOM# Dissemination Day 2014: was the message appropriate and interesting enough? What to change and what to leave ‘as is’.
2. The concept and design of possible future gadgets and other promotional objects
3. Evaluation and new definition of the other basic elements for the promotional strategy
4. Define the events and the situations (workshops, sessions, websites, press, etc.) where to ‘push’ (according to the push paradigm) the NEWCOM# presence
5. In the Web 2.0 paradigms, define and develop the elements (widgets, buttons, etc.) and the situations (partners’ and researchers’ web pages, other institutions’ web pages, like IEEE, ACM, EU websites) where to ‘pull’ (according to the pull paradigm) the NEWCOM# presence
## Annex I: Workplan

### MILESTONES

<table>
<thead>
<tr>
<th>Milestone no.</th>
<th>Milestone Name</th>
<th>Work package no</th>
<th>Lead beneficiary</th>
<th>Delivery date from Annex I</th>
<th>Achieved</th>
<th>Actual achievement date</th>
<th>Comments</th>
</tr>
</thead>
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<tr>
<td>MS3 51</td>
<td>First call for mobility grants</td>
<td>35</td>
<td>1-CNIT</td>
<td>M3</td>
<td>YES</td>
<td>31/01/2013</td>
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<tr>
<td>MS3 61</td>
<td>First release of the N# Portal</td>
<td>36</td>
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<td>YES</td>
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<tr>
<td>MS3 21</td>
<td>NEWCOM# Seasonal School n.1</td>
<td>32</td>
<td>14-VUT</td>
<td>M6</td>
<td>YES</td>
<td>28/05/2013</td>
<td>1 month shift due to logistics but dates in the DoW were tentative.</td>
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<tr>
<td>MS3 52</td>
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<td>35</td>
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<td>MS4 21</td>
<td>Implementation of tools for the collection of MPA data</td>
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<td>None</td>
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<td>MS3 22</td>
<td>NEWCOM# Emerging Topic Workshop n.1</td>
<td>32</td>
<td>14-VUT</td>
<td>M9</td>
<td>YES</td>
<td>08/07/13</td>
<td>Date set according to AB availability. Two additional meetings held in subsequent months for increased coordination.</td>
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<tr>
<td>MS4 11</td>
<td>First meeting of the advisory board</td>
<td>41</td>
<td>1-CNIT</td>
<td>M6</td>
<td>YES</td>
<td>05/07/13</td>
<td>The awards committee made the decision on the date indicated. Awards to be delivered at the first N# annual event (EuCNC July’14) for increased visibility.</td>
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<tr>
<td>MS3 53</td>
<td>First series of awards</td>
<td>35</td>
<td>1-CNIT</td>
<td>M12</td>
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<td>25/10/2013</td>
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<tr>
<td>MS3 23</td>
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<td>YES</td>
<td>18/09/2013</td>
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<td>Delivery date from Annex I (proj month)</td>
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<td>Actual delivery date</td>
<td>Comments</td>
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<td>D42.1</td>
<td>Definition of the MPA Procedure</td>
<td>4.2</td>
<td>1- CNIT</td>
<td>M3</td>
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<td>D43.1</td>
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<td>5- CTTC</td>
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<tr>
<td>D34.1</td>
<td>Survey on Research Expectations of European Companies</td>
<td>3.4</td>
<td>4- CNRS</td>
<td>M3</td>
<td>YES</td>
<td>31/01/2013</td>
<td></td>
</tr>
<tr>
<td>D21.1</td>
<td>Description of EuWIn@CTTC technical facilities and interfaces, and preliminary plan of activities</td>
<td>2.1</td>
<td>5- CTTC</td>
<td>M6</td>
<td>YES</td>
<td>08/05/2013</td>
<td>Slight deadline extension agreed with project officer.</td>
</tr>
<tr>
<td>D22.1</td>
<td>Definition of EuWIn@CNIT/Bologna tested interfaces and preliminary plan of activities</td>
<td>2.2</td>
<td>1- CNIT</td>
<td>M6</td>
<td>YES</td>
<td>08/05/2013</td>
<td>Slight deadline extension agreed with project officer.</td>
</tr>
<tr>
<td>D23.1</td>
<td>Open Lab access and experimental setups EuWIn@CNRS/Eurecom and preliminary plan of activities</td>
<td>2.3</td>
<td>4- CNRS</td>
<td>M6</td>
<td>YES</td>
<td>08/05/2013</td>
<td>Slight deadline extension agreed with project officer.</td>
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<tr>
<td>D33.1</td>
<td>Report on relevant journals, editors, topics and main contributors</td>
<td>3.3</td>
<td>12- UCL</td>
<td>M6</td>
<td>YES</td>
<td>08/05/2013</td>
<td>Slight deadline extension agreed with project officer.</td>
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<tr>
<td>D36.1</td>
<td>Software Description Document</td>
<td>3.4</td>
<td>1- CNIT</td>
<td>M6</td>
<td>YES</td>
<td>08/05/2013</td>
<td>Slight deadline extension agreed with project officer.</td>
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<td>D11.1</td>
<td>Fundamental issues on the performance of wireless networks and related results</td>
<td>1.1</td>
<td>4- CNRS</td>
<td>M12</td>
<td>YES</td>
<td>16/11/2013</td>
<td></td>
</tr>
<tr>
<td>D12.1</td>
<td>Fundamental issues and preliminary results of N#JRAs on opportunistic and cooperative communications</td>
<td>1.2</td>
<td>1- CNIT</td>
<td>M12</td>
<td>YES</td>
<td>16/11/2013</td>
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<tr>
<td>D13.1</td>
<td>Fundamental issues on energy- and bandwidth- efficient communications and networking</td>
<td>1.3</td>
<td>6- IASA</td>
<td>M12</td>
<td>YES</td>
<td>16/11/2013</td>
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<tr>
<td>D21.1</td>
<td>Lab equipment and infrastructure functionality tests</td>
<td>2.1</td>
<td>5- CTTC</td>
<td>M12</td>
<td>YES</td>
<td>16/11/2013</td>
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<td>D22.2</td>
<td>Preliminary tests over the lab infrastructures</td>
<td>2.2</td>
<td>1- CNIT</td>
<td>M12</td>
<td>YES</td>
<td>16/11/2013</td>
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<td>D23.2</td>
<td>First report on tools and their integration on the experimental setups</td>
<td>2.3</td>
<td>4- CNRS</td>
<td>12</td>
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<td>16/11/2013</td>
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<td>Task</td>
<td>QC</td>
<td>Status</td>
<td>Date</td>
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<td>D31.1</td>
<td>First year workshops and conferences activity report and CD ROM of the 1st N# Annual Conference</td>
<td>3.1</td>
<td>11-UCAM</td>
<td>M12</td>
<td>NO</td>
<td>Postponed to YEAR2, Amendment in DoW made</td>
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<tr>
<td>D31.2</td>
<td>Report on education and training activities during year 1</td>
<td>3.1</td>
<td>14-VUT</td>
<td>M12</td>
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<td>16/11/2013</td>
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<tr>
<td>D33.1</td>
<td>First report on planned launched journal special issues, book chapters and books</td>
<td>3.3</td>
<td>12-UCL</td>
<td>M12</td>
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<td>16/11/2013</td>
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<tr>
<td>D34.1</td>
<td>First dissemination report</td>
<td>3.4</td>
<td>4-CNRS</td>
<td>12</td>
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<td>16/11/2013</td>
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<tr>
<td>D35.1</td>
<td>Report on first-year mobility and awards</td>
<td>3.5</td>
<td>1-CNIT</td>
<td>M12</td>
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<td>16/11/2013</td>
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<tr>
<td>D36.2</td>
<td>First report on Web Tools usage</td>
<td>3.6</td>
<td>1-CNIT</td>
<td>M12</td>
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<td>D41.1</td>
<td>First yearly report on scientific management and network promotion plan</td>
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<td>1-CNIT</td>
<td>M12</td>
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<td>16/11/2013</td>
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<td>D41.2</td>
<td>Policy for Open Access to EuWin</td>
<td>4.1</td>
<td>1-CNIT</td>
<td>M12</td>
<td>YES</td>
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<td>D43.2</td>
<td>Management Report for the 1st annual Commission Review</td>
<td>4.3</td>
<td>5-CTTC</td>
<td>M12</td>
<td>YES</td>
<td>16/11/2013</td>
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5.2 Annex II: Advisory Board comments on Deliverables

Comments on Report D13.1 of WP1.1
Performance Limits of Wireless Communications

The work within this WP falls within 3 broad categories: Theoretical Limits of Communications and Networks; Relaying and Resource Allocation in Wireless Networks; and Capacity-reaching channel codes.

In the area of theoretical limits, several areas were investigated: performance limits of sparse learning, cooperation and secrecy in multi-user communications, and performance of large dimensional systems. There is a large body of work on sparse learning and, while the reported work did make a nice contribution to the state-of-the-art in this area, I didn’t find the connection of the reported work to be particularly aligned with the Description of Work or with wireless networks in general. While application of the derived results to channel estimation was mentioned in passing, this did not seem to be a primary focus of the ongoing research. I would suggest that the work on sparse learning move closer towards the goals of the Description of Work, particularly focused on the exploration of the capacity limits of large networks under imperfect information about channels and interferers. The work on cooperation and secrecy in multiuser communications was broad, deep, highly novel, and well aligned with both the Description of Work. In particular, this work has advanced the state-of-the-art in secrecy, delay constraints and feedback, information-estimation, and clustered cooperation in cellular systems. Continuing the excellent progress in these research directions is strongly encouraged. It does seem that Shamai is the primary contributor to this body of work and it would be good to see more contributions from and collaborations with other Newcom researchers on these important topics. The last topic investigated under theoretical limits was that of large dimensional systems. The work under this topic on finite blocklength communications in MIMO fading channels as well as the use of stochastic geometry to characterize downlink rates in cellular HetNets were impressive analytically and for their novel approach to solving these challenging problems. These research results align well with the Description of Work and the described extensions appear very promising.

All of the work in the area of Relaying and Resource Allocation in Wireless Networks is well aligned with the Description of Work. Within this broad area of investigation, work is reported in the area of network coding for the two-way channel, where the authors propose some novel ideas and evaluate their performance. This work seemed to be a solid contribution, but somewhat incremental compared to prior work. The researchers are encouraged to describe their contribution beyond current state-of-the-art more clearly, and perhaps try out some bolder ideas that are “outside the box”. In terms of Hetnet resource allocation optimization, the problem formulation seemed rather standard, as did the solution approach. It also seemed a bit odd to assume a WiFi AP as a relay, as this is not standard behavior for WiFi APs, and hence the formulation seemed a bit artificial. The assumption that the APs operate in different WiFi frequencies so they do not interfere mutually is also highly artificial given the prevalence of interference in the WiFi band. Overall I found this problem formulation to be highly constrained and rather artificial. I would encourage the researchers to either make the problem broader (i.e. not focus on LTE/WiFi Hetnets) or solve the problem under realistic assumptions for these two deployed networks. The proposed work on dynamic network architectures was more creative and novel, and the proposed solution techniques to the optimization appear promising. The description of research on Radio Resource Management for a Virtual Radio Access Network was too preliminary to evaluate. The proposed work on multipath routing seems very promising with potentially high impact. The researchers appear to have some good preliminary results and this research direction should be strongly
The work on capacity achieving codes falls into three broad and challenging areas: Spatially Coupled Codes; Non-binary encoders and decoders; and Coding for Multiterminal Communication Systems. Coding is not my area of expertise so I am not the best person to evaluate the work. That said, I was impressed with the level of scholarly detail in the description and the extensive and impressive numerical results. It appears that the researchers have made significant advances in coding in all three of these areas and have many new promising directions to pursue as well. This area of investigation is well aligned with the project and, indeed, will advance the state of the art in coding both in theory and in practice. The researchers are strongly encouraged to continue their work in this direction.
Comments on Report D13.1 of WP1.3
Energy-and bandwidth-efficient communications and networking

The work package in pills

Work Package (WP) 1.3 is divided into 3 tasks in the statement of work:

- Task 1.3.1: Techniques for power-efficient communications
- Task 1.3.2: Low-interference, low-emission, radio interfaces
- Task 1.3.3: Resource Allocation for optimized radio access.

The first task broadly deals with the optimization of energy efficient communications from a terminal and network point of view. As for terminals, it involves algorithmic as well as hardware aspects in order to trade battery lifetime and performance. At the network level, an optimization of network level functions (e.g., routing) and the whole system centered on energy consumption minimization are also analyzed, focusing on the design of network architectures and routing protocols.

The second task has the goal of investigating and developing various PHY layer techniques for interference mitigation, such as adaptive spectrum shaping techniques, with particular emphasis on beamforming for low-interference communication, reduction of out-of-band radiation, enhanced filtering, advanced MIMO techniques and adaptive signal processing, reduction of the effects of nonlinear elements in the transceiver chain.

The third task analyzes resource allocation techniques to minimize energy consumption and interference in various selected scenarios of interest, including relaying nodes, stationary and mobile nodes, femto-cells, picocells and heterogeneous networks. It will also assess the suitability of context awareness on radio resource management and study techniques that exploit such information. The main analysis and design tools are network control, game theory and distributed algorithm design.

The Report description

The first report (D13.1) includes three kinds of material for each of the three tasks: a survey of the main literature, a concise description of open issues as potential areas of investigations and some preliminary results.

The deliverable reviews the State of the Art (SoA) in the thematic areas and highlights the fundamental open issues for further investigation. For each Task, 9 specific Joint Research Activities (IRAs) are proposed that address some of the fundamental research open issues previously described. For each activity the Report presents its description, the relevance to the identified fundamental open issues, a short presentation of the initial output/results, and a roadmap for the joint research work in the following years.

The Report is well organized and written, all its parts are structured in a uniform way so as to facilitate the reader in finding the topics of interest.

Comments on the reports

The Report is rich of information and, as mentioned, it shows clear signs of coordination among the contributors. Perhaps its main shortcoming is its pervasiveness and abundance of data and information. The literature on “green” communications is huge and varied, and the survey of some aspects of it in the Report is well done; however, an effort would have been appreciated to
highlight the main (pillar) contributions from the incremental ones. As it is done in the Report, there is a serious risk for a non-specialist to get lost in the overwhelming number of citations.

A similar comment applies to the enumeration of the “open issues” in the various tasks. They are too many, and range from fundamental to minor ones. Sometimes, abundance should not be pursued as an objective in itself, since it reveals the lack of deepening in trying to identify THE crucial tasks. It is suggested to try to make this distinction, which would also help in understanding the JRA choices among the many candidates initially proposed: are they related to the group competences/interests, or stem they from the identification of the major open issues?

I refrain from commenting the initial research results since they are very preliminary. However, it appears that some of them have been obtained as outcome of activities developed before the starting of the project, as it is testified by the dates of publications. An effort should be made to clearly distinguish the results attributable to the project from those obtained by researchers of the network in different contexts.
Comments on Report D13.1 of WP1.2
Opportunistic and cooperative communications

I am limiting my advises and comments to the collaborative multiuser relaying case only.

1. The general problem in wireless multihop networks is how to best utilize the available resources to let multiple information flows between a number of sources and destinations to take place at the same time. This is a very difficult problem since very little is known about the general case. That is why it is understandable that topologies that people have studied have only a few nodes and flows.

The problem is interesting and important to study since the star topology used in cellular networks is not efficient enough solution for ever increasing wireless capacity need. The current work is dealing with two sources and one destination. The sources are connected to the destination directly and via a relay. All the evaluations are based on the assumption that full CSI is known at every node. Is this a realistic assumption in a large network? More discussion is needed when the assumptions is realistic.

The new relaying approach that is described in the report is very complex but its improvement to the achievable rate compared to the already existing and know approaches is minor (about 10-15% according to the Figures 3-2, 3-3) so is it really useful to extend the study to multiple flows using the same principal idea?

Would it be more useful to extend the problem to practical solutions and develop practical coding and modulations and show how close we are able to get to the calculated theoretical limits or select some other problem.

Is there any guarantee that the optimization approaches used in the solutions find the global and not only the local solutions. And if the same principle is extended to more complex topologies how about then?

The NEWCOM# project started November 1, 2012, but the results presented in D12.1 according to the reference [277] were already available at that time. It looks like Figures 3-2 and 3-3 are already in the paper and that the paper was submitted for publication on Sept. 2012. Can you explain this?
Comments on Report D21.1 on WP2.1
Radio interfaces for next generation wireless systems and D23.1 of WP2.2 Flexible communication terminals and networks

The two deliverables (D21.2 and D23.2) summarize the activities carried out in the EuWin Labs at CTTC and Eurecom, respectively. Both present the results of some preliminary experimentations obtained in the last twelve months and both focus on PHY measurement. For this purpose two MIMO system are implemented; one based on the WiMAX standard (CTTC) and one on LTE (Eurecom). In addition, at CTTC, some experimentation for indoor location have been carried out. Finally, both reports present the EuWin Inauguration event that has been organized in Bologna on July 2013, the Joint Research Activities and the plans of activities for Year 2 of the project.

At this phase of the project, the most important objective of these deliverables is to prove that the Labs in place are ready and can be used in the coming years to implement and experiment the outcome of the theoretical research. I believe this goal is achieved, through the description of some preliminary tests. We have 2 MIMO systems with software defined radio capability enabling the implementation of various PHY algorithms that can be tested in the future. At CTTC, we have also a platform that can be used for all research around indoor location system. So in summary, the deliverables are consistent with the description of work and the platforms built correspond to the state-of-art of MIMO system and indoor location.

My recommendations for the future are:

i) Reduce some of the redundancy between the deliverables, specifically those regarding the description of the EuWin event. This can be covered in one deliverable and have all other deliverables referring to it.

ii) For future experimentation, it is very important to state clearly the objective of the experiments to run and recall the theoretical outcome we are trying to prove in real world. This will enhance the presentation and the quality of the experimentations results.
Comments on Report D13.1 of WP3.2
Education and Training

WP3.2 deals the organization of a program of a number of summer and winter schools and additional training stages at the various sites of the newly established European Lab of Wireless Communications for the Future Internet (EuWIn). It is foreseen that the schools will typically last for one week and consist of short-courses and tutorials on advanced topics in wireless communications.

The first Report provides the details of the two Summer Schools, one Training Session, and one Emerging Topic Workshop that have been organized by NEWCOM# researchers during the first year of activity, with the administrative support from the recently established European Association of Communications and Networking (EURACON).

The program of the events shows that the choice of the speakers has been done accurately, inviting well known researchers also from outside the network researchers.

In terms of number of attendees, the events have been a significant success, and the evaluation forms filled by the attendees show a great appreciation for contents and quality of speakers.

It seems then that all WP3.2 milestones during year 1 have been achieved.
5.3 Annex III: The draft Questionnaire

QUESTIONNAIRE

1. Name and organization

2. Which of the following communication tools are you using in your usual activities?
   - Phone Conferences
   - Mailing lists/Reflectors
   - RSS feeds reader
   - Text chat tools
   - Video chat tools
   - Blogs (as an editor)
   - Other

3. Which of the following popular web 2.0 services are you subscribed to?
   - LinkedIn
   - Facebook
   - iGoogle
   - Googlegroups
   - Myspace

4. Most important feature you need in your daily research activity
   Please write, one per line, a brief description of the feature (few words), possibly with the URL of a good example you are currently satisfied with

5. NEWCOM# WPs in which your organization is involved in
   List the workpackages (WPs) in which your organization is involved in.

6. NEWCOM# website evaluation
   Please, evaluate the importance and effectiveness of the tool within NEWCOM#
   - Essential
   - Useful
   - Average
   - Poor
   - Useless
   - Never used, sorry
   - Other

7. NEWCOM# mailing lists evaluation
   Please, evaluate the importance and effectiveness of the NEWCOM# mailing lists
   - Essential
   - Useful
   - Average
   - Poor
   - Useless
   - Never used, sorry
   - Other
8. NEWCOM# videoconference evaluation
Please, evaluate the importance and effectiveness of the tool within NEWCOM#

Essential
Useful
Average
Poor
Useless
Never used, sorry
Other

9. Encountered problems and solutions to improve the network
Is there something that you would like to improve within the network? What would be the solution(s)?
The answers (in a free-form input text)

10. Which of the following features you consider essential for your research activities?
RSS feeds from other projects’ websites
RSS feeds from IEEE and ACM (for Cfp, etc.)
NEWCOM# group in Linkedin
Other

11. Comments about new features/tools to implement NOW within NEWCOM#
If you check some options in the previous question, please provide more details about your needs
The answers (in a free-form input text)

All the answers above will be part of further activities in order to shape better the Promotional Strategy of the Network.

12. Which of the following do you consider a worthwhile kind of tool to keep "alive" after the end of the project?
A website with a N# restricted area
A website with thematic public forum
A multi-user videoconference system (like SCOPIA system)
A simpler communicator system (like skype, google, live messenger…)
Mailing lists
Other

13. At your organisation level, would you consider devoting a part of your EU funding to maintain these tools alive?
NO
Yes, but more than 1K/year per partner
Yes, between 1 and 3K/year per partner

14. Free space for comments
The answers (in a free-form input text)
5.4 Annex IV: Presentation for dissemination

“The” Network of Excellence in Wireless Communications

“The Networks of Excellence (NoE) funding scheme is designed for research organisations willing to combine and functionally integrate a substantial part of their activities and capacities in a given field, with a view to creating in this field a European virtual centre of research”!
NEWCOM: 2004-2007, 60 partners!
NEWCOM++: 2008-2010, 17 partners!
NEWCOM#: 2012-2014, 14 partners!
Overall financing by the European Commission close to 16 Million Euro!
Overall effort of 3400 person-month!

NEWCOM# Objectives!
- To produce medium to long term results in the area of design and performance evaluation of wireless networks;
- To strengthen the integration of partners’ research activities and agendas, both at the theoretical and experimental levels;
- To foster Industry-Academia cooperation and, by doing so, make academic research closer to industrial interests;
- To train a new generation of researchers in the field of wireless communications with solid theoretical and experimental skills;
- To contribute to the long-term sustainability of the NoE by creating a permanent environment for cooperative research: the EuWIn lab!
FACTS and FIGURES!

- Total NoE duration: 36 months!
- 14 partners from 14 different countries!
- 16 Work Packages organized in 4 Tracks!
  - ≈3 WPs on theoretical research (234 pm’s)!
  - ≈3 WPs on the EuWin (187 pm’s)!
  - ≈6 WPs on dissemination and training (141 pm’s)!
  - ≈3 WPs on management and NoE sustainability (34 pm’s)!
- Overall effort: 596 person-months!
- Total Cost: 5.551 M€!
- EC contribution: 2.846 M€!
- 16 Affiliate companies!
- (More than) 300 researchers involved!

NEWCOM# Partners!

1. CNIT – Italy (Coordinator)!
2. AALBORG UNIVERSITET - Denmark!
3. BILKENT UNIVERSITESI - Turkey!
4. CNRS Paris - France!
5. CTTC Castelldefels - Spain!
6. IASA Athens - Greece!
7. INOV Lisbon - Portugal!
8. POZNAN UNIVERSITY OF TECHNOLOGY - Poland!
9. TECHNION Tel Aviv - Israel!
10. TECHNISCHE UNIVERSITAET DRESDEN - Germany!
11. UNIVERSITY OF CAMBRIDGE - UK!
12. UNIVERSITE CATHOLIQUE DE LOUVAIN - Belgium!
13. OULUN YLIOPISTO - Finland!
14. TECHNISCHE UNIVERSITAET WIEN - Austria!

FACTS and FIGURES!
TRACK 1 – Theoretical Research Issues (3 WPs)!
TRACK 2 – EuWin: The European Lab of Wireless Communications for the Future Internet (3 WPs)!
TRACK 3 – Training, Dissemination and Human Capital (6 WPs)!
TRACK 4 – Management (3 WPs)!

GOVERNANCE!

European Commission

Advisory Board

NEWCOM P.I. & Scientific Director

NEWCOM Administration & Management Director

Executive Board

Research

Training, Dissemination

Management

General Assembly

JP4

NEWCOM Partners

NEWCOM Affiliate Partners

Wireless Research Community

European Commission

GOVERNANCE!
Track 1 (theoretical)!

- Performance Limits of Communication Networks (including channel codes, relaying, and resource allocation)!
- Opportunistic and Cooperative Communications (including delay-tolerant networks, mobile clouds, cooperative sensing)!
- Energy- and Bandwidth-Efficient Communications and Networking (including low-power terminals and network optimization)!

Track 2 (experimental)!

- Radio interfaces for next-generation wireless systems!
- Networking technologies for the Internet of Things (IoT) with mobile clouds!
- Flexible communication terminals and networks!

Track 3 (dissemination and training)!

- Annual NEWCOM# conference, workshops and special sessions!
- Education and Training: schools and workshops!
- Journal special issues, books and book chapters!
- Industry liaison and dissemination!
- Development and valorization of human capital!
- The NEWCOM# Portal and related Web Presence Tools!
The EuWIn Lab!

Other Institutions
- CNIT
- IOV
- PUT
- AAI
- UNBO
- Eurecom
- CNIT Administration
- TECHNION UCAM
- UDOUL
- IUU
- IASA
- UCL
- ONS
- VUT
- BIXENT

Associate Partners
- EUWIn Director
- CNIT

The EuWIn Lab!

The EuWIn Lab!
is a non-profit registered association established to facilitate research and disseminate culture in the fields of communications and networking science and technology at the European level. The association is establishing national PoP in EU countries, and is liaising with similar entities at the National and International level (SEE, VDE, IEE, AICT/GTTI, FICTE, IEEE, …) to come to a Continental harmonization of the different initiatives in the field.
## 5.5 Annex V: Publications

### Journal Papers - Joint

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<th>Title</th>
<th>Journal</th>
<th>Pages</th>
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<tr>
<td>1.1</td>
<td>S. Yang, P. Plantanida, M. Kobayashi, S. Shamai (Shitz), &quot;Secrecy Degrees of Freedom of MIMO Broadcast Channels with Delayed CSIT,&quot;</td>
<td>IEEE Trans. on Information Theory</td>
<td>vol. 59, no. 9, pp. 5244-5256</td>
<td>September 2013</td>
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<tr>
<td>1.2</td>
<td>M. El Soussi, A. Zaidi and L. Vandendorpe, &quot;Compute-and-Forward on a Multiaccess Relay Channel- Coding and Symmetric-Rate Optimization&quot;,</td>
<td>IEEE Trans. on Wireless Communications</td>
<td>accep</td>
<td>for publication with minor revision, 2013</td>
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### Conference Papers - Joint

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<th>Title</th>
<th>Conference</th>
<th>Date</th>
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<tr>
<td>1.2</td>
<td>M. El Soussi, A. Zaidi, L. Vandendorpe, &quot;Compress-and-forward on a multiaccess relay channel with computation at the receiver,&quot;</td>
<td>Communications (ICC), 2013 IEEE International Conference on</td>
<td>9-13 June 2013</td>
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<tr>
<td>1.2</td>
<td>A. Zaidi, S. Shamai (Shitz), &quot;On Cooperative Multiple Access Channels with Delayed CSI at Transmitters&quot;,</td>
<td>accepted at SPAWC 2013</td>
<td></td>
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<tr>
<td>Author(s)</td>
<td>Title</td>
<td>Conference/Proceedings</td>
<td>Year</td>
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<tr>
<td>A. Zaidi, S. Shamai</td>
<td>&quot;On Multiple Access Channels with Delayed CSI at Transmitters,&quot;</td>
<td>IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC 2013), Darmstadt, Germany</td>
<td>2013</td>
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<td>P. Closas, A. Guillamon</td>
<td>&quot;Sequential estimation of gating variables from voltage traces in single-neuron models by particle filtering&quot;,</td>
<td>in Proc. of IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2013), 26-31 May 2013, Vancouver (Canada)</td>
<td>2013</td>
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<tr>
<td>P. de Kerret, M. Guillaud, D. Gesbert</td>
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