216715 NEWCOM++
Deliverable DI2.1
WPI.2 - Higher Education in Wireless Communications

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Editor(s), (names and affiliations): Silvano Pupolin (CNIT)
Participating institutions: ISMB, Bilkent, NKUA-IASA, CNIT, UPC, CTTC, IST-TUL, CNRS, RWTH, UCL, PUT, Chalmers, AAU
Contributors: Silvano Pupolin (CNIT), Roberto Verdone (CNIT)
Internal Reviewer(s) (names and affiliations): Luis M. Correia (IST-TUL)
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Abstract: This WP deals with activities dedicated to the education of young researchers and PhD students participating to NEWCOM++. It is organised in six Tasks, working in parallel on separate aspects. An important goal addressed is related to the cooperation with the research Tasks, which was sought in order to support the integration actions for higher education in wireless communications. The following main outcomes have been achieved after the first year: organisation of some successful summer/winter schools and Emerging Topic Workshops, preparation of a schedule of PhD courses based on remote teaching tools, submission to EC of an application for grant to support mobility of researchers through the Marie Curie programme, and other achievements, detailed in the Deliverable.

According to the Technical Annex, this Deliverable should report on the PhD courses, summer/winter schools and workshops organised in the first year. However, it will also include a short description of the state of activities in the other Tasks, dealing with the other issues.

Keyword list: PhD Courses, PhD student mobility, Schools, Emerging topic workshop.

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SECTION 1 – INTRODUCTION

WPI.2 is split into six Tasks, each of them in charge of a specific action for higher education. The first three Tasks are mainly devoted to PhD students and they are also open to students enrolled at Universities which are not involved in NEWCOM++. The three Tasks are entitled: **Task TI.2.1** *PhD Courses by distance learning,* **Task TI.2.2** *PhD students mobility,* **Task TI2.3** *Co-tutored PhD title.*
Next two Tasks, **Task TI.2.4** *Emerging Topic Workshop,* **Task TI.2.5** *Summer/Winter Schools* are devoted to the organisation of events attracting young researchers and PhD students within NEWCOM++ and above; such events were structured as Summer/Winter Schools and an Emerging Topic Workshops. Finally, **Task TI.2.6** *Participation to other EC projects to support student mobility* is a push to increase PhD students and young researchers mobility within the research topics developed in NEWCOM++ by using different EC mobility support measures offered by the People programme of FP7.

According to the Technical Annex, this Deliverable should only report on Tasks TI.2.1, TI.2.4 and TI.2.5. However, as relevant actions have been taken in the first year of NEWCOM++ activity also in the context of TI.2.6, a paragraph is included dealing with such Task. The state of activities performed in TI.2.2 is also briefly reported. Finally, this Deliverable DI2.1 does not address Task TI.2.3 because, as expected, it requires one more year for its activation and to measure its performance in terms of PhD students involved in the mobility programme. However, a short description of the lines of activities foreseen for the second year is also included in the Deliverable.

This deliverable is structured in one main Section devoted to the activities performed during the first year. It analyses in deep detail what has been done compared to the Technical Annex. We report in separated paragraphs the outcome of five Tasks. The sixth paragraph is related to the preliminary activity done during the first year for Task TI.2.3 “Co-tutored PhD title”, which requires a lot of bureaucracy in order to be ready to begin the activity during the second year. Section 3 is devoted to the Conclusions and makes an accurate analysis of the efforts needed to complete the program.

SECTION 2 – ACTIVITY DONE DURING THE FIRST YEAR

In this period the organisation structure has been defined and specific actions have been taken. The kick-off meeting has been held in Bologna on January 28, 2008.

2.1 Task TI.2.1 PhD Courses by Distance Learning

The responsible of this Task was initially Krzysztof Wesolowski, PUT; in October he handed off for personal motivations to Roberto Verdone, CNIT. They were in charge of the definition of a set of courses to be delivered by using a distance learning approach.

General objectives – As general objective, the programme of PhD courses intends to cover the various thematic areas addressed by the WPRs, integrate and complement the programme of summer/winter schools organised within NEWCOM++ and offer to PhD students courses that they can select in order to complete the set of requirements defined at institution level, which often require that a given amount of hours of classes are followed during the years of the individual PhD programme. With this goal in mind, it was decided to define a programme of at least (possibly more than) 200 hours of remote teaching, delivered through courses of 10 or 20 hours each, covering the various disciplines from radio channel modelling, to signal processing and network issues. The course might be split in modules, of at least five hours each, with a coordinated program and with different instructors. The modules might be provided by lecturers either online (i.e. interactively, following a precise schedule for lectures), offline (i.e. recording lectures, leaving the students to choose when to listen to them, and being available during specific time schedules for receiving questions and interacting with students) or as a mix of the two options; the two options, left to the decision of the lecturers, were the result of a discussion held within WPI.2. In fact, previous experience in NEWCOM denoted a scarce participation of students to the courses offered, when classes are based on precise schedules which might compete with other businesses at the institution level. For this reason it was decided to try both options during the first year of the programme.

The software tool - Since Easymeeting is the software tool bought by the consortium and distributed to the institutions to allow virtual meetings in NEWCOM++, it was also decided to consider it as the platform for the specific purposes of the distance learning programme. However, the software tool, widely used within the WPRs to organise virtual meetings, showed some technical problems which made sometimes the use of PowerPoint presentations almost impossible, when the goal is a smooth fruition of contents provided by speakers. Then, it was decided to address the company that provided Easymeeting to require proper solution to the technical problems. This suggested to slightly delay the provision of the PhD courses, while keeping active the task of preparing the schedule of courses for 2009.

The contents offered - After two calls circulated within the NoE, five courses were offered as shown below (details can be found in Appendix A).

1. Roberto Verdone, Davide Dardari, Gianluca Mazzini, Andrea Conti, CNIT, “Wireless Sensor and Actuator Networks”, 20 hours.
2. Andreas J. Kassler, Karlstad University - Chalmers, “Principles and Practice of Wireless Mesh Networks”, 10 hours.
3. Gabriella Olmo, Enrico Magli, CNIT, “Multiple description coding for wireless video communications”, 10 hours.
4. Stefano Tomasin, Lorenzo Vangelista and Nevio Benvenuto, CNIT, “Key technologies for next generation digital video broadcasting standard”, 16 hours.
5. Lorenzo Vangelista, CNIT, “Embedded telecommunication wireless devices”, 14 hours.

After these offers were made, and some discussion with the instructors, the following schedule has been defined, assuming all problems with the software tool will be solved by the beginning of 2009.

February 2009 - “Wireless Sensor and Actuator Networks”, 20 hours (given by Roberto Verdone, Davide Dardari, Gianluca Mazzini, Andrea Conti, CNIT)

April 2009 - “Principles and Practice of Wireless Mesh Networks”, 10 hours (given by Andreas J. Kassler, Chalmers Univ.)

June 2009 - “Key technologies for next generation digital video broadcasting standard”, 20 hours (given by Stefano Tomasin, Lorenzo Vangelista and Nevio Benvenuto, CNIT)

October 2009 - “Embedded telecommunication wireless devices”, 10 hours (given by Lorenzo Vangelista, CNIT)

December 2009 – to be defined

The exact schedule of the lectures will be defined one month before the start of each course, distributed to all NEWCOM++ researchers through email and website. Participants will be asked to register to the course.

More detailed presentation of the course contents, and of the proponents, are given in Appendix A.

A new call for course proposals (with specification of the preferred thematic areas, uncovered by previously offered courses) will be issued in March 2009.

2.2 Task TI.2.2. PhD Students Mobility

The responsible of this Task is Dr. Mario Chiesa, ISMB. He is in charge of collecting the available positions to accept PhD students at each participating Institutions. Then, such positions are both circulated via the general mail reflector, and posted on the Project website.

NEWCOM++ devoted three prizes of 1500 Euro each, for supporting mobility of researchers among NEWCOM++ institutions. In particular, the aim of the mobility grants is to enhance the face to face research cooperation, promoting exchanges of researchers among different institutions. The first call for applications was issued for two positions with a deadline on October 30, 2008, and was posted in the website http://www.newcom-project.eu:8080/Plone/mobility/grants-for-mobility. The call set some specific requirements, like the inter-disciplinarity of the research goals, and this limited the number of applications. Two PhD students applied for the mobility prize, and after the evaluation of the proposals the committee decided to award them.

The winners are:

Adrian Kliks, Poznan University of Technology
He will spend 1 month at CNIT in Pisa (contact person:. Filippo Giannetti), Italy, to do research activities on: “Adaptive Modulation and Coding Algorithms for Non-Orthogonal Multicarrier Systems”.

Flavio Fabbri, CNIT, University of Bologna
He will spend three months at Dept. of Wireless Networks, RWTH Aachen University (contact person:. Petri Mahonen), Germany, to do research on: “Discovering Connectivity and MAC properties of Static and Mobile Wireless Sensor Networks: the Impact of Non-Poissonian Nodes Distributions and of Realistic Mobility Patterns on Network Throughput”.

2.3 Task TI.2.4: Emerging Topic Workshop

The responsible of this Task is Dr. Xavier Mestre, CTTC with the cooperation of. Erdal Panayirci, Bilkent. Two emerging topic workshops have been initially scheduled for 2008. One has been held on July 1-2, 2008 in Bressanone (Brixen) in Italy, jointly with the summer school and the second was initially scheduled in Aachen (Germany) for December 3-4, 2008. However, for technical reasons the second workshop has been postponed to February 2-3, 2009.

Summer Workshop 2008

The theme of the summer workshop was Wireless Sensor Networks. The organisation was done with the help of Roberto Verdone (CNIT), Mischa Dohler and Carles Anton (CTTC).

The workshop was attended by 52 students and 11 seniors, including the speakers, and it was held on July 1 and 2, 2008, in Bressanone, Italy, co-located with the Summer School on Wireless Sensor Networks. The following 19 talks were given, out of which 7 were offered by students not participating to NEWCOM++ activities:

- Flavio Fabbri, CNIT Bologna: Area Throughput for CSMA Based Wireless Sensor Networks
- Riccardo Masiero, CNIT Padova: Network Coding and Data Fusion for Data Collection in Wireless Networks
- Maria Rita Palattella, University of Bari: On the Energy Efficiency of the IEEE 802.15.4 MAC
- Francesco Zorzi, CNIT Padova: Sensor motes and applications
- Ermanna Conte, CNIT Padova: Channel Prediction and Quantisation Methods for MIMO-BC with Limited Feedback
- Giulio Dainelli, CNIT Pisa: A layered architecture for multicellular multi-carrier systems
- Davide Chiarotto, CNIT Padova: Cross-Layer Design of MIMO Ad Hoc Networks
- Francesco Renna, CNIT Padova: Time synchronisation and channel estimation for OFDM systems in very dispersive channels
- Stefano Rinauro, University of Rome “La Sapienza”: Gain Control Free Blind carrier frequency offset estimation for QAM constellations
- Lorenzo Rossi, University of Rome “La Sapienza”: Robust Interpolation for Video Error Concealment using Multiple Description Coding
- Anna Maria Vegni, University of Rome3: Introduction of DOA/TOA based Localisation Services Protocol
- Mohamed Laaraiedh, University of Rennes: Advanced Localisation Techniques: Application to 4G Networks and Ray Tracing Tools
- Roxana Burghelaa, University of Rennes: Ray Tracing based propagation channel simulator including realistic UWB antenna behaviour Applications to radio positioning and navigation in heterogeneous radio systems
- Stefano Tennina, University of L’Aquila: On the Positioning Estimation of WSNs in Dynamic Indoor Environments: Experimental Results
- Federico Librino, CNIT Padova: Cooperative techniques in wireless networks
- Veronica Palma, University of Rome3: A novel technique for an iris recognition system
- Nicola Caporusso, University of Lucca: Techniques for Vehicular Ad-hoc Networks
- Peter Dely, University of Karlstad: Previous, Current and Future Research Activities on Packet Aggregation for Voice over IP in Wireless Mesh Networks
- Jonas Karlsson, University of Karlstad: TCP Performance Enhancements in Wireless Mesh Networks Problems, ongoing work and future
- Marcello Caleffi, University of Naples “Federico II”: DHT Routing for Scalable Ad Hoc Networks

The Emerging Topic Workshop and Summer School 2008 website is available at http://www.dei.unipd.it/ssie, where all the presentations are available. A picture of the event is reported in Appendix C.

2.4 Task TI.2.5: Summer/Winter Schools

The responsible of this Task is Silvano Pupolin, CNIT. The Task organised two summer/winter schools, which were the outcome of a joint work done at several institutions. Furthermore, some schools organised by a single institution were also supported by NEWCOM++ and attended by NEWCOM++ students.

Summer School 2008

The first summer school was held in Bressanone, Italy on June 30 – July 2, 2008. It was hosted by the University of Padua within its summer site in Bressanone. The topic of the school was Wireless Sensor Networks, and the organisers were Roberto Verdone (CNIT), Mischa Dohler and Carles Anton (CTTC). The committee for discussion of the programme also included Xavi Mestre (CTTC) and Erdal Panajirci (Bilkent). The school was attended by 52 students and 11 seniors, including the speakers.

Students were very active during the School making it a real new experience. Many interesting questions have been presented to the speakers opening new possible research themes.

On the School website http://www.dei.unipd.it/ssie almost all the presentations are available.

The detailed program of the School is reported in the Appendix B and has been posted in the website: http://www.newcom-project.eu:8080/Plone/work-packages/integration/wpi.2-higher-education-in-wireless-communications/newcom-summer-school-2008.

The program of the Summer School was as follows:

Monday 30th June - Morning Session
1a 'Introduction/WSNs/applications' (1h30min) – R. Verdone, CNIT
COFFEE BREAK
1b 'Industrial Efforts/Standardisation' (1h30min) – M. Dohler, CTTC
Monday 30th June - Afternoon Session
2a 'Hardware & Experimentations' (1h30min) – M. Dohler, CTTC
COFFEE BREAK
2b 'Channel Modelling for WSNs' (1h30min) – C. Oestges, UCL
Tuesday 1st July - Morning Session
3a 'MAC, Routing and Data Aggregation' (3h) – M. Dohler, CTTC
Wednesday 2nd July - Morning Session
4a 'Network Coding' (1h30) – R. Koetter, LNT-TUM
COFFEE BREAK
4b 'Topology Control and Connectivity' (1h30min) – R. Verdone, CNIT
Thursday 3rd July - Morning Session
5a 'UWB for WSNs' (1h30min) – D. Dardari, CNIT
COFFEE BREAK
5b 'Localisation Techniques' (1h30min) – D. Dardari, CNIT
Friday 4rd July - Morning Session
6 'Distributed Data Estimation Protocols' (1h30min), C. Anton, CTTC

A picture of the event is reported in Appendix C.

After the school was held, a questionnaire was circulated among the participants asking for a feedback and a score (between zero and five) to the organisation, the programme and the quality of lectures. On all aspects, the average score was above 4.2 over 5 and a very positive feedback was achieved.

Winter School 2008

The first winter School devoted to "Flexible Radio and related technologies", was initially scheduled for being held in Aachen on December 2-5, 2008. Owing to technical problems, it was postponed to February 2009. The new dates for the event are: February 3-6, 2009.

The scope of the school is to cover all aspects related to Flexible Radio to the degree possible, including lectures on algorithmic, platform-centric and network-level flexibility, as outlined below.

The School, organised by Newcom++ partners NKUA-IASA (Andreas Polydoros) and RWTH (Heinrich Meyr), with active participation from many other partners, will be held in Aachen, Germany in UMIC Research Centre. It will occupy fully four days. During the School, a two-day workshop will also be held in the afternoon where the participants (researchers, doctoral students, etc.) will have the opportunity to present their own research work related to flexible radio and such networks.

The program of the winter school at the time of writing is as follows:

First Day - Morning Session
- Introduction to Flexible Radio (1 hour) (A. Polydoros)
- General AMC design procedure (1 hour) (A. Polydoros, A. Zalonis)
- COFFEE BREAK
- Flexible codes (1 hour) (A. Polydoros)
- Flexible multicarrier Waveforms (1 hour) (A. Polydoros, S. Stefanatos)

First Day - Afternoon Session
- Algorithmic Design and Architectures for MPSoC Wireless Communications (1 hour) (H. Meyr, K. Nikitopoulos)
- COFFEE BREAK
- Heterogeneous MPSoCs as the enabler of Software Defined Radios (2 hours) (Torsten Kempf)

Second Day - Morning Session
- NoC and MPSoC - programming and design (2 hours) (Fabien Clermidy)
- COFFEE BREAK
- ASIP-based MPSOC for channel decoding (2 hours) (Amer Baghdadi)

Second Day - Afternoon Session
- OpenAirInterface Simulation/Emulation demonstration (Raymond Knopp)

Third Day - Morning Session
- Power amplifiers and advanced transmitters for multistandard multiband applications (Renato Negra) (2 hours)
- COFFEE BREAK
- MPSoC platform design methodologies and tools (2 hours) (Leupers)

Fourth Day - Morning Session
- Introduction to Flexible Networks/Cognitive Radio (2 hours) (Petri Mahonen)
- COFFEE BREAK
- Adaptive RRM Techniques (2 hours) (Ramon Agusti)

Fourth Day - Afternoon Session
- Dynamic Spectrum Access (2 hours) (Ramon Agusti)
- COFFEE BREAK
- Game Theory approach to flexible RRM and spectrum sharing (2 hours) (Hanna Bogucka)

Summer School 2009

The organisation activities for summer school 2009 have been launched. The organisation is jointly performed with CIME. The organisers are Fabio Fagnani and Sandro Zampieri. It will be held next June 22-26, 2009 in Verres, Aosta, Italy.

The topic of the School is: "Mathematical Foundations of Complex Networked Information Systems". The tentative program is as follows:

- Bela Bollobas, University of Cambridge and University of Memphis, "Random graphs"
- Ralf Koetter, Technische Universitat Munchen, "Network Coding"
- P.R. Kumar, University of Illinois, "Mathematical foundations of wireless networks"
- Martin Wainwright, Berkeley, "Graphical models and distributed algorithms: Message-passing and relaxations"
- Riccardo Zecchina, Politecnico di Torino, "Statistical physics of constraint satisfaction networks"

Schools Organised by Single NEWCOM++ Institution

NEWCOM++ also supported courses on specific topics of interest organised by single institution. Two of them were supported during 2008, whose description is given below.

Course on "Wireless Physical Layer Security"

It was held at UCL (Louvain-la-Neuve, Belgium) on June 16 and 17th 2008.

The course has been co-organised by Luc Vanderdorpe (UCL) and Merouane Debbah (CNRS), and was attended by 40 people.

Speakers: H. V. Poor (Princeton, U.S.A.) and H. El Gamal (Ohio State University)
The course aimed to:
1. Introduce the basic principles of information theoretic security;
2. Cover recent research advances in wireless physical layer security;
3. Summarise the important contributions resulting from recent research efforts; and
4. Outline the outstanding open problems in the area.

The course programme was as follows:

1. The Classical Wiretap Channel (2 hours)
(a) Information theoretic versus computational based secrecy (HEG)
(b) Shannon's model (HEG)
(c) Wyner's wiretap channel (HVP)
(d) The Csiszár-Körner broadcast channel with confidential messages (HVP)

2. Recent Advances in the Wiretap Channel (HEG: 3 hours)
(a) Secrecy through public discussion
(b) The wiretap channel with feedback
(c) Opportunistic secrecy
(d) The MIMO wiretap channel
(e) The relay-eavesdropper channel
(f) Authentication over the wiretap channel

3. Multi-User Wireless Channels with Secrecy Constraints (HVP: 3 hours)
(a) The broadcast channel
(b) The multiple access channel
(c) The cognitive interference channel
(d) Scheduling of secure broadcast

4. Concluding Remarks (HEG & HVP: 1 hour)
(a) Lessons learned
(b) Open problems

Pictures of the event are reported in Appendix C.

Course on "Cooperative Communications"

The course was taught by Dr. Gerhard Kramer from Bell Laboratories, Alcatel-Lucent, Murray Hill, USA in the period Oct. 6-10 2008 at Aalborg University. The course was organised by Bernard Fleury (AAU) and was attended by 34 participants: 17 from Aalborg University and 17 from other NEWCOM++ partners.

All information about the course, including the course material, has been posted on the web-side: http://es.aau.dk/sections/navigation_and_communications_navcom/phd_course_cooperative_communications.

The list of participants is posted on
http://es.aau.dk/sections/navigation_and_communications_navcom/participants_list_phd

The course gave a background and overview of cooperative communication methods that are based on information theory principles. The course started by reviewing conventional networking models and developed models that are useful for analysing the capacities of wireless and wireline networks. The main part of the course concerned relaying strategies such as amplify-and-forward, compress-and-forward, decode-and-forward, network coding, and some of their variations. The course covered both ergodic (fast fading) and outage (slow fading) channel models and results. Code design was also treated. Finally, a brief overview of wireless networking protocols was given.

Syllabus:

- Day 1: Network Models
  - AM: Conventional Networks and Review of Communication Theory
  - PM: Wireline and Wireless Network Models
- Day 2: Cooperative Strategies and Rates
  - AM: Network Capacity and Wireline Strategies
  - PM: Wireless Strategies: Amplify-and-Forward, Compress-and-Forward, Decode-and-Forward
- Day 3: More Strategies and Codes
  - AM: Sophisticated Strategies
  - PM: Code Design
- Day 4: Cooperative Diversity
  - AM: Outage, Diversity, Multiplexing
  - PM: Strategies for High and Low SNR
- Day 5: Wireless Protocols
  - AM: Issues, Protocols and Comparisons

Teaching material: The course was based on the booklet “Cooperative Communications” by G. Kramer, I. Maric and R. Yates, Foundations and Trends in Networking, vol. 1, no. 3-4, 2006.

Pictures of the event are reported in Appendix C.

2.5 Task TI2.6: Participation to Other EU Projects to Support Students Mobility

The responsible of this Task is Silvano Pupolin, CNIT.

NEWCOM++ partners, together with COST2100 institutions, have set a program submitted to the Marie Curie action whose deadline was set at Sept. 2, 2008. The program has been named NEWCOST.

The proposal involved many NEWCOM++ partner institutions, namely: CNIT (leader), ISMB, CTTC, IST-TUL, EURECOM, RWTH, UCL, FTW, PUT, KAU as well as other partners not involved in NEWCOM++. The action foresees to recruit and train 24 Early Stage Researchers (ESRs); in all cases, the recruitment period is maximum, to achieve the highest level of scientific skill: 36 months. The number of ESRs involved within NEWCOM++ is 16.

After the first evaluation phase, NEWCOST received a very high mark (84.6 over 100, with 70 set as the minimum threshold). At the time of writing of this Deliverable, it is still not clear whether NEWCOST will be admitted to negotiations, as the expected acceptance rate is very low (around 10%).

2.6 Other Activities

Task TI2.3. Co-tutored PhD title

This Task expects to get some measurable outcome at the end of the second year since it involves several bureaucratic and complex activities due to the different rules governing the PhD studies in the Countries where the participating Universities are located. There are different options that could be applied.

1. Doctor Europaeus title. It is issued to a PhD student that has spent at least six months within a University of the EU. The thesis defence is done with a committee in which there are members from different European countries. The PhD title is issued by the University where the student has been enrolled. An annotation on his Diploma reports the Doctor Europaeus title.

2. “co-tutelle” program: a PhD student applies to this program following the rules defined by Governmental agreement between two states. Typically it is required that a student spends at least six months in a partner University. The thesis defence is done with a committee structured as stated in the Governmental agreement. The PhD title is issued by the University where the student has been enrolled. An annotation regarding the co-tutelle is also reported. It is also possible to agree among the two Universities to issue a double PhD title.

3. Double PhD title: in order to do this, a bilateral agreement between the two Universities involved is mandatory. This is complicated by the different rules governing the PhD program in different countries. In most Countries the minimum time spent to get the PhD is three years; in some other is four years. An example of what NEWCOM++ can do is the action promoted by the International association Top Industrial Managers Europe (T.I.M.E.) composed by 51 Faculties or School of Engineering which is promoting a double Engineering Degree. The rules to do this are reported in the association website: www.time-association.org. This association is looking for doing the same thing for the PhD program.

NEWCOM++ is working towards the achievement of all the above mentioned three levels of co-tutoring.

The bureaucratic documentation has been made available for the co-tutelle within the consortium. The co-tutelle agreement requires that a student be involved since the beginning of his PhD program. So, these activities could take place after the enrolment of new PhD students that has just been done in some Universities, while in some others it is still in progress and will be defined by the end of January 2009. Any action will be taken in order to let PhD students move within this framework. In any case this activity will start only in 2009.

SECTION 3 - CONCLUSIONS

Topics on higher education in Wireless Communications are on the move. Summer and Winter Schools began and the first one concluded was really successful. The winter school has been delayed for technical problems and we believe it will be successful too. The theme for the second Summer School has been defined and some lecturers have been also accepted the invitation. The themes that have been considered for these three Schools cover important research topics for the future of wireless communication systems, specifically: “Wireless Sensor Networks”, “Flexible Radio and Related Technologies”, and “Mathematical Foundations of Complex Networked Information Systems”. We also considered Schools organised by single partner of NEWCOM++ and we are encouraging all partners to share to other members the courses they are offering to PhD students or they plan to get at their own University. The two courses offered during 2008 were on “Wireless Physical Layer Security”, given at UCL and “Cooperative Communications” given at AAU. The emerging topic workshops have been organised jointly with the summer/winter schools. The one held last July was very interesting and attracted a lot of attention from the attendees. Several questions were raised and the possibility of activating joint research among the attendees are real. The organisation of PhD courses by distance learning took more time than expected, and it was further delayed because of the change of Task responsible in October 2008 due to personal reasons, and the problems encountered during the first year with the software tool to be used. The schedule for 2009 is now available, covering many topics.

Mobility of researchers within the NoE is another important activity. NEWCOM++ awarded two fellowships to PhD students to spend some months to perform research within a University different from the one were they are enrolled. A more challenging activity was to participate to a Marie Curie action in order to have a larger number of people that could move around. The project, called NEWCOST, received a high mark but it is not yet known if it will be admitted to negotiation.

The Task related to the Co-tutored PhD title need a deep knowledge of the laws governing these activities in all the member states involved in the NoE. An accurate analysis of the international agreements has also been done. Now we have a clear view of what is possible to do and the related bureaucracy and what need further analysis of the laws for their application.

To conclude, WPI.2 is going on in the right direction. Several actions have been started and are moving coherently with the final target to be reached: a common basic knowledge of young researchers working in the field of wireless communications.

APPENDIX A – LIST OF PHD COURSES BY DISTANCE LEARNING

NEWCOM++ Ph.D. course proposal	
Course title:	WIRELESS SENSOR AND ACTUATOR NETWORKS Technologies, Analysis and Design
Author's name:	Roberto Verdone, Davide Dardari, Gianluca Mazzini, Andrea Conti
Author's affiliation:	CNIT
Course abstract:	
When choosing the technology options to develop a wireless sensor network (WSN), it is vital that their performance levels can be assessed for the type of application intended. This course describes the different technology options – MAC protocols, routing protocols, localisation and data fusion techniques – and provides the means to numerically measure their performance, whether by simulation, mathematical models or experimental test beds. Case studies, based on direct experience of implementing wireless sensor networks, describe the design methodology and the type of measurements used, together with samples of the performance measurements attained.	
Course objectives:	
The course will enable you to answer vital questions such as: * How long will my network remain alive given the amount of sensing required of it? * For how long should I set the sleeping state of my motes? * How many sensors should I distribute to meet the expected requirements of the application? * What type of throughput should I expect as a function of the number of nodes deployed and the radio interface chosen (whether it be Bluetooth or Zigbee)? * How is the Packet Error Rate of my Zigbee motes affected by the selection of adjacent frequency sub bands in the ISM 2.4GHz band? * How is the localisation precision dependant on the number of nodes deployed in a corridor?	
Course outline:	
1. Introduction 1.1 Introduction 1.2 What is a WSAN? 1.3 Main Features of WSANs 1.4 Practical Issues of WSANs Related to Energy Management 1.5 Current and Future Research on WSANs **2. Applications of WSANs** 2.1 Application Areas and Scenarios 2.2 Event Detection and Spatial and Time Random Process Estimation 2.3 The Hybrid Hierarchical Architecture **3. Channel Modelling** 3.1 Introduction 3.2 Basics of Electro-Magnetic Propagation 3.3 Experimental Activities Aimed at Modelling the Wireless Channel at 2.4 GHz for WSANs **4. Connectivity and Coverage** 4.1 Introduction 4.2 Connectivity in Wireless Ad Hoc and Sensor Networks 4.3 Link Connectivity 4.4 Single-hop Link Connectivity in WSNs 4.5 Multi-hop Link Connectivity in WSNs 4.6 Characterisation of the Interference 4.7 Network Connectivity 4.8 Network Connectivity for WSANs 4.9 Alternate Models for Network Connectivity 4.10 Coverage vs. Energy Efficiency 4.11 Further Reading **5. Network Lifetime** 5.1 Definition of Node Lifetime 5.2 Definitions of Network Lifetime 5.3 Communication Protocols and Network Lifetime: How to Choose 5.4 Some Numerical Examples **6. Technologies for WSANs** 6.1 ZigBee Technology 6.2 Ultrawide Bandwidth Technology 6.3 Bluetooth Technology 6.4 Comparison Among Technologies **7. Communication Protocols for WSANs**	

NEWCOM++ Ph.D. course proposal	
Course title:	Principles and Practice of Wireless Mesh Networks
Author's name:	Andreas J. Kassler
Author's affiliation:	Karlstad University, Sweden

Course abstract:

Wireless Mesh Networks (WMN) are wireless multi-hop networks characterised by an infrastructure-based backbone and adaptive routing and radio resource management mechanisms that offer an economic alternative for providing broadband wireless internet connectivity. Realising such vision requires a paradigm shift from current internet architecture towards a totally decentralised, self-managed, scalable and adaptive wireless access network. The advantage of WMNs is the possibility of rapid and cheap provision of Internet access networks avoiding the expensive and time-consuming process of laying cables. The application potential of WMNs is enormous including scenarios like emergency communications, home networks, community and neighbourhood networking and services, or enterprise networks. The key challenges in WMN research are the development of MAC and routing protocols enabling a decentralised adaptive radio resource management. Cross-layer design in particular involving physical layer, MAC layer, and routing protocols is essential for an efficient operation. Delivering carrier-grade quality requires a proper planning and dimensioning of WMNs, resilient routing helps to increase the survivability of the network in case of failures. The tutorial will give a state of the art report on WMN research. Current trends in standardisation are illustrated and an overview of ongoing projects and testbed deployments is given. A general classification of WMNs will be introduced and put into relation with IEEE802.16 Mesh mode and 802.11s. We will identify key research challenges and solution proposals for hot topics such as multi-channel and multi-radio mesh networks, cross-layer issues, and adaptive resource control.

Tutorial objectives:

This PhD course provides a comprehensive overview on principles behind WMNs, practical solutions as developed by relevant industry, and standardisation issues. We first introduce the concepts of WMNs and give an overview on deployment scenarios and applications and services foreseen for such mesh networks. Different types of WMN technologies will be identified and classified according to their main functionality components like signalling, resource allocation, and routing. We will then systematically cover research issues and challenges associated with all layers in WMNs, especially in relation to the following topics: Capacity, Topology Control and Interference; Channel Selection and Management for Multi-Channel WMNs; Medium Access Control; Routing; Transport Layer; Interworking with other Networks; Congestion Control; Fairness and Cooperation; Quality of Service Provisioning; Cross-Layer Design; Security and Management; Peer-to-Peer services and multimedia delivery over mesh; which will have significant impact on the solution space. Furthermore, we will discuss planning and optimising issues in WMNs. Here the challenge arises how to plan a self-organising network. Special attention will be given to handle traffic dynamics in WMNs and adaptive cross-layer resource control. We then provide a detailed description of important architectural solution proposals from industry and academia that will capture the current state of the art in this area, including available testbeds. This will lead to a presentation and discussion of several open research challenges to foster the development of novel research ideas in the attendees. We finalise the tutorial by presenting current standardisation efforts. The main differences between the solutions and their usefulness for different application scenarios will be discussed. After attending this PhD course, attendees will have a clear understanding of basic principles behind Wireless Mesh Networking and open research issues. Therefore, participants will be able to evaluate future developments and trends in this area. Attendees will also have an overview on ongoing standardisation activities. The knowledge gained through this course will help researchers and engineers to build better algorithms, protocols and services for WMNs.

Course outline:

Introduction
Motivation and Use Cases
Overview of Wireless Mesh Networks
Terminology: A definition of Wireless Mesh Networks
Characteristics and underlying concepts

Classification of different approaches Key Research Issues and Challenges Capacity Multi-Channel Multi-Radio WMN Topology Control and Interference Medium Access Control Scheduling and quality of service Resource allocation mechanisms Routing Transport Layer Interworking with other Networks Multi-homed mesh networks Congestion Control, Fairness and Cooperation Radio resource management End-to-end Quality of Service Provisioning Quality of experience based resource allocation Cross-Layer Design Security and Management Peer-to-Peer services and multimedia delivery over mesh Route selection and frequency planning in multi-radio, multi-channel and multi-technology networks Mesh network planning: problem, tools and algorithms Standardisation Research testbeds and Products MIT Roofnet Freifunk Locustworld Motorola Mesh Networking Microsoft MCL Heraklion Mesh Future Directions
Proposed software tool:
Lecturnity

NEWCOM++ Ph.D. course proposal	
Course title:	Multiple description coding for wireless video communications
Author's name:	Gabriella Olmo, Enrico Magli
Author's affiliation:	Politecnico di Torino, Department of Electronics
Course outline:	
- Roadmap of video coding standards: H.264/AVC, SVC, MVC (2h) - Application layer error control (2h) - Priority encoding transmission (1h) - Basic MDC techniques (3h) - MDC techniques for video (2h)	

NEWCOM++ Ph.D. course proposal	
Course title:	Key technologies for next generation digital video broadcasting standard
Author's name:	Stefano Tomasin, Lorenzo Vangelista and Nevio Benvenuto
Author's affiliation:	Department of Information Engineering (DEI), University of Padova, Italy

Course abstract:

As the European Telecommunications Standard Institute is finalising the standardisation of the next generation digital video broadcasting standard (DVB-T2), this course aims at providing an overview of technologies that will play a key role in the future of video broadcasting. We will provide insights on orthogonal frequency division multiplexing (OFDM), advanced coding (low density parity check codes, LDPC), multiantenna (MIMO) systems applied to broadcast transmission over large areas and with a high spectral efficiency. Topics will include time/frequency synchronisation and channel estimation for OFDM, LDPC codes with decoding strategies, decoding of block space-time codes. The technologies will be investigated in the frame of DVB-T2 standard and an overview of the standard will be provided.

Course objectives:

Provide basic knowledge on key technologies in current telecommunication systems, with a focus on the next generation digital video broadcasting standard.

Course outline:

Topics:
- Transmission over dispersive channels
- DVB-T network and channel model
- Low density parity check codes
- OFDM, synchronisation, channel estimation
- space-time block codes: sphere decoder. Alamouti code.
- overview of DVB-T2 standard

NEWCOM++ Ph.D. course proposal	
Course title:	Embedded telecommunication wireless devices
Author's name:	Lorenzo Vangelista
Author's affiliation:	University of Padova (IT) - Department of Information Engineering

Course abstract:

Telecommunications systems success is more and more linked with availability of end-user devices at affordable price and acceptable usability (which includes weight, volume, and intuitive user interface to services). Along the course, for sake of simplicity, we take as reference the design of a GSM/GRS mobile phone. We will go through:
- the main overall architectures
- a review of the chipsets available on the market and their hardware/firmware(DSP)/software partitioning,
- the hard real time operating system choice (including open embedded systems such as embedded Linux and Android),
- the challenges for a low power low complexity implementation of the protocol stack (including completely handwritten C software and machine translation SDL to C),
- the alternatives for the user interface (including UML specification),
- software engineering for real time embedded systems,
- testing and debugging.

Course objectives:

The aim of the course is twofold: to give the PhD students a view of the real complexity of such a "simple" device like a GSM phone and stimulate them in taking into account in their research projects the complexity induced by some choices made in designing a system.

Course outline:

- Introduction to embedded systems
- Architectures for embedded wireless systems
- System partitioning: hardware / firmware(DSP) / software
- Example: chipsets for GSM mobile phones (the example will go through the all course)
- Operating systems for wireless embedded devices: requirements and examples (Linux embedded, Android, etc.)
- Protocol Stack implementation: challenges and tools (SDL, automatic translation SDL to C translation)
- User interfaces for wireless embedded devices: usability, specifications (e.g. using UML), implementations, frameworks
- Software Engineering for embedded wireless systems
- Testing and debugging

Proposed software tool:

Camtasia Studio 5.1

APPENDIX B – SUMMER SCHOOL 2008 – PROGRAM, WEBSITE, ETC.

The Summer School 2008 information is available at the websites: http://www.dei.unipd.it/ssie and http://www.newcom-project.eu:8080/Plone/work-packages/integration/wpi.2-higher-education-in-wireless-communications/newcom-summer-school-2008.

The Summer School poster with the final program is reported below.

Summer School in Wireless Sensor Networks
Bressanone, Alto Adige, Italy
June 30- July 4, 2008

Committee: CNIT, Italy: Roberto Verdone, Silvano Pupolin
CTTC, Spain: Carles Anton, Xavi Mestre, Mischa Dohler
K.H. Univ, Turkey: Erdal Panayırcı
SITE: University of Padova, Casa della Gioventù, Via Rio Bianco - Bressanone

PROGRAM

Monday June 30, 2008
9-12.30: *Introduction/WSNs/applications* (1h30min) – R. Verdone, CNIT-Bologna
COFFEE BREAK
Industrial Efforts/Standardization (1h30min) – M. Dohler, CTTC
14:00-17:30 *Hardware & Experimentations* (1h30min) – G. Chelius
COFFEE BREAK
Channel Modelling for WSNs (1h30min) – C. Oestges, UCL

Tuesday July 1, 2008
9-12.30: *MAC, Routing and Data Aggregation* (3h) – M. Dohler, CTTC
COFFEE BREAK served in the middle of lecture
14-17: Session on Emerging Topic Workshop
COFFEE BREAK served in the middle of Session

Wednesday July 2, 2008
9-12.30: *Network Coding* (1h30) – R. Koetter, LNT-TUM
COFFEE BREAK
Topology Control and Connectivity (1h30min) – R. Verdone, CNIT
14-17: Session on Emerging Topic Workshop
COFFEE BREAK served in the middle of Session

Thursday July 3, 2008
9-12.30: *UWB for WSNs* (1h30min) – D. Dardari, CNIT
COFFEE BREAK
Localisation Techniques (1h30min) – D. Dardari, CNIT

Friday July 4, 2008
9-12.30: *Distributed Data Estimation Protocols* (1h30min), C. Anton, CTTC
COFFEE BREAK
Final discussion (1h30min) – D. Dardari, CNIT

APPENDIX C – PICTURES FROM THE 2008 SCHOOLS AND WORKSHOP.

Picture from the Summer Workshop 2008, Bressanone, July 1 and 2, 2008

Picture from the Summer School 2008, Bressanone, June30 – July 4, 2008

Pictures of the Course on "Wireless Physical Layer Security", UCL (Louvain-la-Neuve, Belgium), June 16 and 17th 2008.

Pictures of the Course on "Cooperative Communications", Aalborg University, October 6-10, 2008

Pictures of the Course on "Cooperative Communications", Aalborg University, October 6-10, 2008