SCIENTIFIC SUBMISSION FORM B

CALL FOR PROPOSALS

2010

Acronym of the project	**ICON**
Titre du projet en français	Information COmmunications et Nanotechnologies
Project title in English	Information COmmunications and Nanotechnologies
Coordinator of the project	Nom / Name : Alain CAPPY Etablissement / PRES Université Lille Nord de France/Lille1 Laboratoire / Laboratory : IEMN Numéro d'unité/Unit number : UMR 8520
Requested funding	
Disciplinary field	☐ Health, well-being, nutrition and biotechnologies ☐ Environnemental urgency, ecotechnologies **X Information, communication and nanotechnologies** ☐ Social sciences ☐ Other disciplinary scope
scientific areas	Nanoelectronics, photonics, computer science
Participation in an « Initiatives d'excellence » project	X oui ☐ non

Organisation of the coordinating partner

Laboratoire(s)/Etablissement(s) Laboratory/Institution(s)	Numéro(s) d'unité/ Unit number	Tutelle(s) /Research Organisation reference
PRES Université Lille Nord de France (ULNF)		

Organization of the partners

Laboratoire(s)/Etablissement(s) Laboratory/Institution(s)	Numéro(s) d'unité/ Unit number	Tutelle(s)/Research Organisation reference
IEMN	UMR 8520	Université Lille1, CNRS, UVHC, ISEN
INRIA-Lille	NA	INRIA
LIFL	UMR 8022	Université Lille1, CNRS
CRIL	UMR 8188	Université d'Artois, CNRS
PhLAM	UMR 8523	Université Lille1, CNRS
PAINLEVE	UMR-8524	Université Lille1, CNRS
LAGIS	FRE 3303	Ecole Centrale Lille, Université Lille1, CNRS
IRCICA	USR 3380	CNRS, université Lille1

1. SUMMARY

A well-structured network of cutting-edge research laboratories and infrastructures has been set up in the Northern France Lille region, focusing on *Information and Communication Sciences and Technologies* (ICT). It has built on 20 years of a proactive focused strategy by all relevant French research authorities (including the Ministry of Higher Education and Research, CNRS, INRIA, the Nord/Pas-de-Calais Regional Council) benefiting among other things from the European Community FEDER boosting programs. It gathers cutting-edge projects by the most internationally renowned teams coming from eight research units and centres, all very well-ranked by the French AERES independent research evaluation agency (namely, IEMN, INRIA-Lille, LIFL, CRIL, PhLAM, Painlevé, LAGIS and IRCICA). Actually, this consortium appears to one of the largest French public research workforces in ICT.

The ICON Labex (ICON for '**I**nformation and **CO**mmunications and **N**anotechnologies') proposal is intended to be one of the research flagships of the Northern France Region Region in which all regional higher-education institutions and universities have combined their research and research training efforts in a 'Research and Higher-Education Regional Pole' ('Pôle Régional de Recherche et d'Enseignement Supérieur (PRES)'), called 'Université de Lille/Nord de France (ULNF)'. The ULNF aims to increase international visibility, to achieve savings of scale in scientific investment and sharing infrastructures and services.
The ICON proposal is the result of a very severe selection process of both the involved teams and scientific projects. In addition to the obvious necessary condition of exhibiting ICT research activities and projects, candidate teams to ICON had to fulfil the strict conditions of being ranked A+ (as a global mark or at least with respect to their scientific production) by the AERES agency, and to agree to participate in the ICON focused project organization. The research groups fulfilling all these conditions constitute the base core of the ICON research workforce on which the ICON scientific program is based. Moreover, the scientific program of ICON will not support all scientific activities of these selected research groups but consists of a set of well-defined and structured best-level research projects (7 for the first years) which were proposed by the ICON partner laboratories and selected for their cutting-edge level, innovative (and sometimes high-risks) contents/goals, high potential for results both in basic knowledge and applications and potential leadership in the international scene.
The 7 ICON research projects entitled *Artificial Materials: a nursery of breakthrough (ARM), From Flexible to Vegetal Electronics (FOREVER), Molecular 3D computer(MOL-3D-COMPUTER), Everlasting numerical sphere(EVENS), Mining and Optimizing large-scale networks (MOLN), Artificial Intelligence (AI), Simulation Algorithms and Models for Bio And Medicine (SAMBAM)* lie on the domains of excellence of the partner units. In addition to covering a wide range of research fields hardware, software and systems with internationally renowned research groups in all three domains, one outstanding feature of ICON lies in its support of multidisciplinary research projects at the interface between hardware and software. This feature has been developed for years within the consortium and is quite unique in the French research landscape.

A second salient feature of ICT research in Lille is its state-of-the-art research facilities and platforms across the whole scientific ICON spectrum which matches the best international standards. In the hardware domains, this includes nanotechnology clean room facilities and an optical fibre drawing platform; in the software fields, this ranges from sensor networks to virtual reality platforms.

ICON promotes research excellence within domains where a strong local research workforce exists (*e.g.* in nanotechnologies, or in ambient and artificial intelligence) or can be developed. In addition to being one of the agents of the ICT revolution by itself, ICON fully matches the 'National Strategy for Research and Innovation' ('Stratégie Nationale de la Recherche et de l'Innovation' (SNRI)) as defined by the French Ministry of Higher Education and Research. In this respect, ICON aims to strengthen the French position and strategic interests in the continuum of ICT innovation, especially by promoting 'goal-oriented basic research' and complete value chains from early new concepts to the fabrication of demonstrators and prototypes. To this end, ICON will focus on the application of its scientific results for the benefit of society and economy in tight interaction with large companies and local SMEs, and with the help of the PRES knowledge transfer tools. A specific focus of the ICON strategy to exploitation of results for industrial and societal needs will concern three main application domains that are other strategic sectors for the Nord/Pas-de-Calais Region:

namely, health and environment, mobility and transport, and services. ICON includes specific proactive measures towards these sectors, favouring a rapid transfer of early new concepts and demonstrators to applications, as well as increased ICON scientists' awareness of ICT-industrial challenges in these domains.

In addition to its scientific and knowledge transfer programs, ICON will also innovate graduate research training in ICT development, at the Master and PhD levels. In particular, ICON will develop an attractive ICT master in its areas of excellence, with specific incentive measures to attract the best qualified students from abroad. Specific measures are included to attract outstanding foreign senior scientists, postdocs and students (at both the master and PhD degrees). Actually, much of the costs of ICON concern human resources, with flexible tools that are innovative in the French context to attract the best personnel, with internationally competitive conditions basis. ICON will also sustain training and career development programs at all phases of progression, from undergraduate trainees up to experienced professionals.

ICON will also coordinate and boost current educational efforts by its members to increase the pool of students interested in ICT. It is critical to infuse a new generation of scientists with the knowledge, skills, creativity, versatility and sense of wonder needed for ICT research excellence. More generally, ICON intends to enhance the scientific culture of the local general public. This remains a high priority challenge, especially for the ICT community, because ICT involves so many captivating, and often everyday phenomena that are of great general interest.

In order to exert a pull effect on other ICT research groups within the PRES, ICON will organize educational and innovation projects in which all ICT groups will collaborate which are expected to be funded by local authorities for the non-ICON teams. The latter are liable to join the ICON research workforce and structure when their future evaluation results by the AERES agency reach the highest standards that are required by the ICON rules of excellence.

By creating ICON, the partnering laboratories and research centres strive to facilitate a 'team' spirit between research groups of different scientific communities, and to create new opportunities for training, research and outreach activities. By focusing significant resources on selected specific research, educational, and innovation projects, ICON aims to reinforce long-term mutually beneficial partnerships between ICON scientists and their international partners, develop

collaborations and share expertise in promising innovative ICT domains where ICON already plays a role in the international scene, or is well-positioned to do so in the near future.

ICON will be organized around a project-oriented structure open to regional, national and international interactions and cooperations with other ICT scientists, scientists from other disciplines, industry, but also with undergraduate and secondary schools and more generally with society.

ICON proposal is organized as follows. The submission form B describes the project according to the plan and the number of pages proposed by ANR. Appendix 1 describes ICON facilities and platforms, appendix 2 presents the scientific project in details, appendix 3 presents the educational project and appendix 4 gives the personnel affiliated to ICON for each research unit.

2. APPLICATION TO THE ACTIONS OF THE PROGRAMME « INVESTISSEMENTS D'AVENIR »

Nom de l'action	*Acronyme du projet (préciser si le projet est déposé ou envisagé)*	*Nom du coordinateur*	*Consortium /partenariat impliqué*
IDEX		C. Sergheraert	PRES Université Lille Nord de France
EQUIPEX	MIND	A. Cappy	CNRS/CEA/ universities
EQUIPEX	MISMIC	G. Dambrine	CNRS/CEA/universities
EQUIPEX	GRIFON	J.M. Blondy	CNRS/universities
EQUIPEX	FIT	S. Fdida	INRIA/CNRS/ universities
EQUIPEX	AMIQUAL	J. Crowley	INRIA/CNRS/ universities
EQUIPEX	GRID 5000	D. Margery	INRIA/CNRS/ universties
EQUIPEX	LIGAN	P. Froguel	CNRS/INRIA
EQUIPEX	INGEVISU	F. Blaise	Universities
EQUIPEX	EFG	V. Breton	CNRS/CEA/INRA/CEMAGREF/Universities
EQUIPEX	REFIMEVE	C. Chardonnet	CNRS/ Universities/CNES
EQUIPEX	META	H. Leroux	CNRS/ Universities
INFRASTUCTURES	ReNaBI-IFB	JF Gibrat	INRA, CNRS, Institut Pasteur, universities
IHU	NEXIMED	P. Amouyel	Pasteur/CHRU/INSERM/CNRS/INRIA/Lille2

3. MANAGEMENT OF THE PARTNERSHIP

3.1. COMPOSITION OF THE PARTNERSHIP

The ICON Labex proposal is intended to be one of the research flagships of the Northern France Lille Region. It gathers cutting-edge projects by the most internationally renowned teams coming from eight research units and centres, all very well-ranked by the French AERES independent research evaluation agency (namely, IEMN, INRIA-Lille, LIFL, CRIL, PhLAM, Painlevé, LAGIS and IRCICA).

The ICON proposal is the result of a very severe selection process of both the involved teams and scientific projects. In addition to the obvious necessary condition of exhibiting ICT research activities and projects, candidate teams to ICON had to fulfil the strict conditions of being ranked A+ (as a global mark or at least with respect to their scientific production) by the AERES agency, and to agree to participate in the ICON larger project aims and organization. The research groups fulfilling all these conditions constitute the base core of the ICON research workforce on which the ICON scientific program is based. But ICON will not support all the scientific activities of these research groups. Instead, the scientific program of ICON is made up of a selection of well-defined and structured best-level research projects (7 for the first years) proposed by the ICON partner laboratories but involving a subpart of the ICON research workforce only. These projects were selected for their cutting-edge level, innovative (and sometimes high-risks) contents/goals, potential leadership in the international scene, and their high potential for results both in basic knowledge and applications.

Using these criteria, ICON will gather about 177 'equivalent full-time' scientists[1], 54 engineers and about 200 PhD students. About 68 % of the ICON scientists will be involved in the ICON research projects.

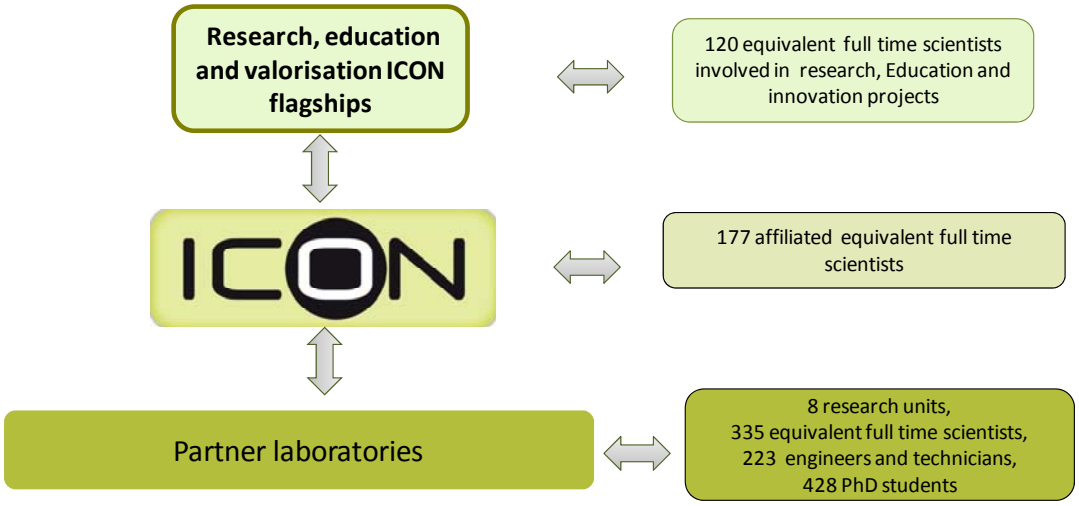
The following table lists the ICON-involved permanent research personnel (thus, not including PhD master students, postdocs, *etc*.) according to their specific laboratory.

Partner name	Affiliation	Prof. and Ass. Prof.	Researchers (CNRS/INRIA)	Engineers (CNRS,INRIA) Universities)
IEMN	CNRS/Lille1/UVHC/ISEN	64	40	25
INRIA-Lille	INRIA	0	26	19
LIFL	CNRS/Lille1/Lille3	45	2	0
CRIL	CNRS/ Université d'Artois	25	2	2
PhLAM	CNRS/Lille1	24	3	0
PAINLEVE	CNRS/Lille1	27	4	2
LAGIS	Ecole Centrale de Lille/CNRS/Lille1	7	4	0
IRCICA	CNRS/Lille1	1	0	6
TOTAL		193	81	54

The figure below details the ICON workforce. 'Full-time' means 'Equivalent full-time' (French professors and associate professors are expected to teach half-time and conduct research half-time). 'Full-time scientists' are mainly either professors/associate professors or permanent CNRS/INRIA researchers. 120 equivalent full-time permanent scientists are directly involved in the 7 ICON research projects, while, all together, 177 permanent research scientists from the partner laboratories and research centres are actually affiliated members of ICON.

[1] *Number of equivalent full time scientists = number of researcher (CNRS+INRIA) +0.5xnumber of professors/associate-professors*

ICON - structures



* Number of equivalent full time scientists= Number of researchers (CNRS or INRIA)+0.5 x number of professors/Associate professors

ICON will exert a pull effect on other ICT research groups within the PRES through a range of collaborative research, educational and knowledge transfer projects for all ICT groups, which are expected to be funded by local authorities for the non-ICON teams. These ICT groups are eligible to join the ICON research workforce and structure when their future evaluation results by the AERES agency will reach the highest standards as required by the ICON rules of excellence.

By creating ICON, the partnering laboratories and research centres strive to build a 'team' spirit between research groups of different scientific communities, and to create new opportunities for training, research and outreach activities. By focusing significant resources on selected specific research, educational, and innovation projects, ICON aims to reinforce long-term mutually beneficial partnerships between ICON scientists and its national and international partners, develop collaborations and share expertise in promising innovative ICT domains where ICON already plays a role in the international scene, or is well-positioned to do so.

3.2. RELEVANT EXPERIENCE OF THE PROJECT COORDINATOR

The partners have chosen Prof. Alain Cappy as project coordinator, based on his specific experience in the coordination and management of technical projects.
Alain CAPPY joined the University of Lille, France, in 1977. He received the 'Docteur es Sciences' degree in 1986 for his work on the modeling and electrical characterization of semiconductor devices. He is Professor of Electronics an Electrical Engineering at the University of Lille1, France. He is author or co-author of about 100 papers in international journals, 90 communications in international workshops and conferences and he gave 25 invited talks. Alain Cappy's papers have led to 2460 citations with one paper having more than 500 citations and 3 papers more than100. It should be noted that these highly cited papers reported works carried out in different scientific fields of micro and nanoelectronics (device modeling, device fabrication and device electrical characterization). From 2002 to 2009, he was director of the **I**nstitute of **E**lectronics, **M**icroelectronics and **N**anotechnology (**IEMN**, www.iemn.fr) a large institute gathering about 450 persons. IEMN has large technological facilities and its scientific activities cover a large domain going from the physics of materials and nanostructures to applications and instrumentation in acoustics and microwaves, with strong activity in nanoscience, nanoelectronics, nanosystems and

telecommunications. This institute was evaluated A+ (highest mark) by the national agency of research and higher education (AERES) in 2009. Alain Cappy participated in many technical committees of conferences and he is reviewer of several international journals (APL, JAP, various IEEE journals). He was the principal investigator in a number of national and European research contacts and coordinator of the FP6 project 'NanoTera'. He is presently member of the 'Scientific Community Council' of the European Technological Platform 'ENIAC', scientific advisor at AERES (The French agency for the evaluation of research and higher education). He is also CNRS coordinator of the national network RENATECH, a network that gathers the six largest academic micro and nanotechnology facilities created to optimize the national investment policy and to share a common technological roadmap. At regional level, he is coordinator of the 'Ambient Intelligence Campus' a leading-edge project of the State Region Project Contract (CPER) gathering almost all the ICON partner laboratories.

The Project Coordinator is responsible for the overall management of the project and has the capacity to represent the partners in the framework of the ANR contract.
In detail, the project co-ordinator:

- is responsible for the overall technical co-ordination and management of the project,
- follows up the overall performance and progress of the project against the project objectives,
- is responsible for the administration of the project finances,
- is responsible for the preparation and delivery of the technical and management project reports,
- is responsible for communications and interactions between ANR and the partners,
- provides the ANR with cost and progress reports and collects all information required for co-ordination.

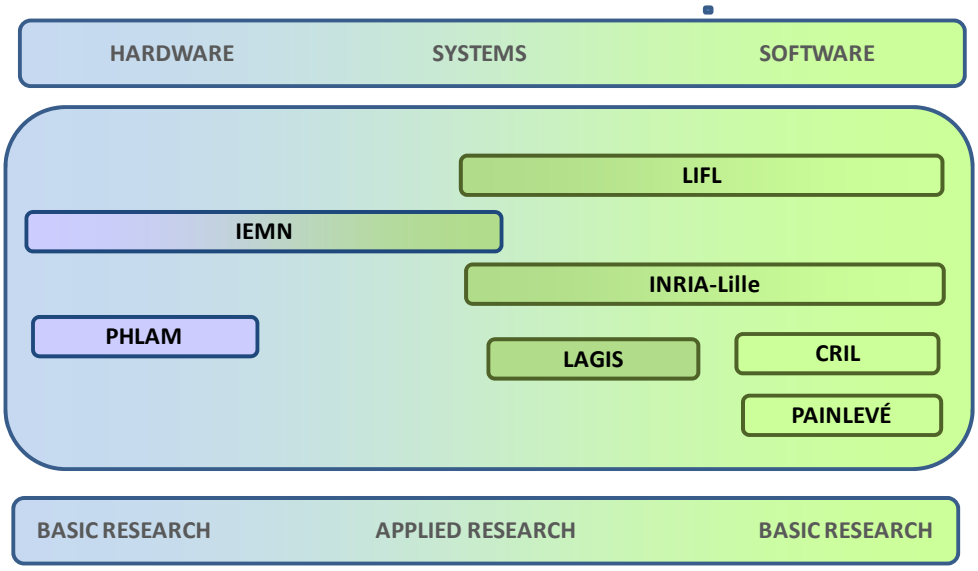
Actually, it is proposed to establish a 'Scientific Cooperation Foundation (FCS)' to manage ICON. Its director will then be in charge of all those requirements.

4. DESCRIPTION OF THE CURRENT SITUATION

Thanks to 20 years of a proactive focused strategy by all relevant French research authorities (including the Ministry of Higher Education and Research, CNRS, INRIA, the Nord/Pas-de-Calais Regional Council and benefiting among other things from the European Community FEDER boosting programs, a well-structured network of cutting-edge research laboratories and infrastructures has been set up in the Northern France Lille region, focusing on *Information and Communication Sciences and Technologies* (ICT).

The main characteristics of this ICT research infrastructure is not only to cover studies on hardware, software and systems with internationally renowned research groups in the three domains, but also to support multidisciplinary research projects at the interface between hardware and software. A second feature of the ICT research infrastructure in Lille is to be based on a set of research facilities and platforms matching the best international state-of-the art, covering the whole scientific ICON spectrum. In the hardware-related domains, this includes nanotechnology clean room facilities and optical fibre drawing platform. In the software-related one, this includes *e.g.* sensors networks and a virtual reality platform.

ICON PARTNER SCIENTIFIC DOMAINS



4.1. PRESENTATION OF THE PARTNERS

4.1.1 PARTNER 1: PRES UNIVERSITE LILLE NORD DE FRANCE

'Lille Nord de France University - Research and Higher Education Cluster' (later named *PRES ULNF*) was founded in January 2009 in order to increase regional academic potential, promote its visibility and enhance its international standing. With 17 higher education institutions (Universities and 'Grandes Ecoles'), 130 000 students, 4 600 researchers and research fellows, 3 000 doctoral students in 6 doctoral schools, Lille Nord de France University focuses largely on public research in the Nord/Pas-de-Calais region. It also incites the academic community to work in close collaboration with national research organizations, business and techno-clusters. Its activities aim the regional research and higher-education development.

4.1.2 PARTNER 2: IEMN

Research and Innovation

IEMN (Institut d'Electronique, de Microélectronique et de Nanotechnologie) UMR 8520, created in 1992, is a research laboratory located at Villeneuve d'Ascq that is affiliated with the CNRS, the University Lille1, the University of Valenciennes Hainaut Cambrésis and ISEN-Lille. The main objective is to gather, in a unique research structure, disciplines contributing to the progress of electronics, acoustics and their applications. Hence, such an organization is likely to facilitate interdisciplinary research on a wide spectrum of activities ranging from theoretical physics to telecommunication. Today, nearly 500 people work together in a scientific field ranging from information and communication technologies to micro and nano technologies. The scientific policy of the laboratory is determined within research groups and emerging activities are promoted by five research departments. Middle-term joint programs with industrial partners or other national institutions and long-term research initiatives stimulate the resourcing of our research projects. As a member of the Basic Technological Research Network with four other CNRS laboratories involved in micro and nano fabrication, IEMN offers to the scientific community a technical platform ranking among the best in Europe. Our scientific policy not only contributes to carry out research capable of advancing knowledge but also to bring social, cultural, and economic benefits for society through many collaborations with industry.

IEMN gathers 500 members. The permanent research staff of IEMN is made of 121 professors and associate professors, 42 CNRS senior and junior researchers, 90 engineers and technicians. More than 160 Ph.D., 38 Post-Docs, invited professors and temporary research staff also take part in IEMN.

IEMN is composed of 19 research group affiliated to 5 scientific departments:

- Materials and Nanostructures
- Micro and Nano Systems
- Micro Nano and Optoelectronics
- Telecommunication Circuits and Systems
- Acoustics

Each of those five departments is involved in four internal self-supported projects:

- Nano characterization
- Microsource of energy
- Flexible electronics
- Nanodevices and THz

IEMN is participating to four projects in the LABEX ICON project. However, it should be outlined that only one third of the IEMN faculties and researchers are directly involved as well as members of the technical staff enabling the use of facilities.

"Materials and Nanostructures" department activities concern studies of thin layers, heterostructures and nanostructures of materials of high interest for electronics, optoelectronics and nanotechnologies. Indeed, IEMN has a long tradition on the study of conduction properties of materials and notably those observed in semiconductors. Four groups of this department are involved at least in three sub-projects of the LABEX ICON project, some of them being coordinators: Physics; NCM; EPHONY and EPIPHY. As an example, NCM group leader will coordinate the "3D Mol computing" sub-project.

Research in the "Micro and Nano Systems" department has become a federating subject involving several groups widely covering topics such as sensors and actuators finding application in information and communication fields. In tight coordination with 4 research groups from the "Micro Nano and Optpelectronics" department, a groundbreaking research topic will be investigated for the first time ever by NAM6, BioMEMS, MAMINA, that is "Vegetronics". "Vegetronics" refers to the convergence of flexible electronics, vegetal and micro nano systems and fluidics.

"Micro- Nano- and optoelectronics" Department research deals with III-V, silicon and advanced molecular devices modeling and fabrication. DOME group will coordinate the research on

metamaterial where EPHONI, ACOUSTIQUE and AIMAN-FILMS groups will also play a key role in "Artificial Materials" sub-project. ANODE, SILICON MICROELECTRONICS groups and CARBON team are involved in projects of the LABEX ICON. "Flexible Electronics and Vegetronics" sub-project will be coordinated by SILICON MICROELECTRONICS and NAM6 group leaders.
"Telecommunication Corcuits and systems" department activities focused on autonomous wireless microsensors networks. It is part of the "Everlasting numerical sphere" sub-project where interaction between software and hardware will be strongly promoted. CSAM group is a key player in this field with the ability to tackle numerous challenges that arise from the complexity of the device.
IEMN strategy consisting in the initial commitment of its best groups leaves room for the future participation of other top-ranking groups of the Institute provided that their research activity is relevant in any of the LABEX ICON sub-project.

Indicators of excellence

IEMN is the unique place in France where researchers from five different horizons can merge their knowledge for the benefit of interdisciplinary research.
As an outcome of the last research assessment exercise carried out by the independent evaluation agency AERES, IEMN received the A+ score, the highest possible mark. The evaluation report authored by the AERES committee is available online from the IEMN web portal.

Hereafter are distinguished IEMN researchers during the last four years.

- Prix Ancel 2007 de la Société Française de Physique : Christophe Delerue
- Médaille de bronze CNRS 2008 : Arnaud Devos
- Prix Chavasse 2008: Bertrand Dubus
- ERC Starting Grant 2008: Bernard Legrand
- Grand Prix de l'Electronique « Général Férrié » 2008 : Martine Liénard

Research Contracts

IEMN is involved in 15 European Union projects, amidst which one being funded through the highly selective European Research Council (ERC) Starting Grant call for proposal; 42 ANR (National Research Agency) projects and 16 DGA (French Defense Agency) projects. Over the last four years, IEMN has been engaged in more than 400 contractual actions, whatever their nature. More than 110 were involving private companies and 87 were purely academic, the rest being short-term actions or service.

Exploitation of Results

At least, until 2011, IEMN has been awarded the Carnot Institute label for its commitment in collaborative projects involving industrial partners. Over the last four years, IEMN, through its trustees, holds a portfolio of 55 priority patents and 210 extensions.
Since 2003, IEMN and STMicroelectronics form a joint laboratory dedicated to the future directions of microelectronics ; grapheme-based devices, timing, software radio, HF devices, 3D integration are among research topics currently under investigation. Other research programs supported by the French Defense Agency (Délégation Générale pour l'Armement – DGA) deal with optoelectronics for defense application or MEMS for aerodynamics.
Strong connection and support of start-up companies such as DELFMEMS SAS and MENAPIC are also part of IEMN policy with the intention to foster the transfer of know-how, technology and methods to small and medium enterprise.

Higher Education

State-of-the-art research requires strong support through related teaching activities and research projects where students participate actively. IEMN has placed major emphasis on developing educational programs in electronics, microelectronics and nanotechnology that take advantage of its existing partnerships with the University of Lille 1, the research and educational institutions of the Region of Northern France, as well, national and international industry laboratories and top ranked universities around the world.
The University of Lille1 proposes a specific Master in Science and Technology, called "Microelectronics, Nanotechnologies and Telecommunications", as well as related doctoral

education. This graduate program is strongly linked to other worldwide known programs in the field that offer the possibility to students of participating in courses or research projects offered by our top ranked international partners. Examples of them include the University of Michigan, University of Illinois in Urbana Champaign, Georgia Institute of Technology and University of California in Irvine (USA) and Technische Universität Darmstadt, Germany, Imperial College London, UK. The establishment of these programs was possible following intensive interactions and research collaborations between faculty and researchers. They were also proposed to the European Union (Education, Audiovisual and Culture Executive Agency – EACEA/ Erasmus Mundus and External Cooperation) and the US Department of Education (Fund for Improvement of Postsecondary Education – FIPSE) and were funded following rigorous international review. Examples of them are:

►EC – US Cooperation Program: The "Fund for the Improvement of Postsecondary Education" (FIPSE) of the Department of Education in the US and the "Directorate General for Education and Culture" (DG EAC) of the European Commission awarded the IEMN/USTL a four year (2004-2008) long program called "EC-US Graduate Curriculum on Electronic Devices and Micro-Electro-Mechanical Systems for Biological/Biomedical Applications".

►Establishment of a double Masters degree ("Dual Degree Masters in Nanotechnology") together with the Georgia Institute of Technology supported through a Memorandum of Understanding (MOU) and definition of the appropriate course paths, recognized hours of credit, faculty and research exchanges.

►Funding of a three year program through the FACE (French American Cultural Exchange) Foundation for developing a "Dual Degree Masters in Nanotechnology" as well as, joint international program with the university of California in Irvine (UCI) in the area of carbon nanotubes and nano-components.

► Funding in September 2009 of a four year long Atlantis Program through the European Union and the US Department of Education for developing a Dual Masters Degree in Micro- and Nano-technology with the University of California in Irvine and in cooperation with the Technische Universität Darmstadt.

The above described programs set up a strong basis for graduate education at both the Masters and Doctoral level. This is best served by the simultaneous presence and interactions of researchers and faculty involved in Labex.

Organization

IEMN is composed of 19 research groups affiliated to 5 scientific departments:

- Materials and Nanostructures
- Micro and Nano Systems
- Micro Nano and Optoelectronics
- Telecommunication Circuits and Systems
- Acoustics

Each Department Head is member of the executive board of IEMN with the Director, the Deputy Director, the Administrative and Financial Department Head, the Technical Department Head and the representatives of the trustees.

Three or four times a year, elected and nominated members of the laboratory council meet mainly for collecting and exchanging information and upon request a vote is organized for important decision involving the future of the laboratory.

As far as financial aspects are concerned, IEMN is mainly funded by the CNRS and the Ministry of Higher Education and Research. Depending on the affiliation of the principal investigator, each project budget is managed by the corresponding institution. That is, for the sake of flexibility, IEMN's will was not to delegate to a unique institution the management rights and duties.

Existing Collaborations

Within the framework of the CPER CIA (Contrat de Projet Etat Région Campus Intelligence Ambiante), IEMN has been collaborating for more than four years with numerous partners of the present LABEX ICON project. IEMN has established an international joint laboratory (LIA)

called LEMAC with the Russian Academy of Science involving staff from the Ecole Centrale de Lille and Lille1 University.

Participation in other 'Investissement d'Avenir' Programs

IEMN participates to four EQUIPEX projects, two of them committing a large number of groups and facilities in connection with the present LABEX project. Within the framework of the EQUIPEX MIND project, IEMN has requested for a laser ablation equipment which is of major interest for flexible electronics processing. Besides the processing, very high frequency measurement is the objective of the EQUIPEX MISMIC project. Both are in collaboration with key national players of these fields.

4.1.3 PARTNER 3: INRIA-LILLE- NORD EUROPE RESEARCH CENTER

Research and innovation

INRIA is a public research establishment entirely dedicated to information and communication sciences. For more than 40 years, it has supported the economic and social transformations linked with the dissemination of digital technologies. As such, together with its academic and industrial partners, it conducts at the highest international level an increasingly infuential activity in fundamental research and technology development. The knowledge produced at INRIA has become essential in medicine, biology and many other sciences. It enriches our everyday lives (communication, safety, Internet usages) and sheds light on the issues of sustainable development and energy conservation.. INRIA Lille – Nord Europe is one of the eight research centers of INRIA. Created in 2008 with Bordeaux and Saclay, following an incubation period of six years within the INRIA Futurs unit, the INRIA Lille - Nord Europe Research Center employs 112 people (scientists, engineers, technicians and administrative staff). It financially supports more than 200 scientists in its 14 project-teams which were formed through partnerships with the Lille University of science and technology (Lille 1), the Charles-de-Gaulle University (Lille 3), the Ecole Centrale de Lille and the CNRS. There are nine project-teams common with the LIFL, two with the LAGIS, and two with the Paul-Painlevé laboratory. The INRIA Lille – Nord Europe research center hosts the first INRIA's team created abroad with the CWI in Amsterdam.
The competitiveness clusters (I-Trans for land-based transportation and particularly the Trade Industries cluster) and the research campus for interdisciplinary research and technological innovation studying ambient intelligence under the supervision of the CPER offer together a golden opportunity for scientific development and partnerships with businesses. The center is focused on high-priority scientific areas involving software infrastructures for ambient intelligence, modeling and interactivity with living systems, as well as modeling and simulation for complex systems.

Research groups involved in the LabEx. *For sack of clarity, and to avoid redundancy, the research groups of the research center which are part of the presented LabEx are described in the respective sections of our partners.* They correspond to the A+ criteria in term of scientific production at best international level: For the last four years, these research groups produced many publications in international peer-reviewed journals and communications in international peer-reviewed conferences. Eleven research groups are involved in the scientific project of the LabEx:

- Project-teams with LIFL: ADAM, DOLPHIN, MOSTRARE, POPS, RMOD, SEQUOIA2 and SHAMAN,
- Project-teams with LAGIS: ALIEN and SEQUEL (also in common with LIFL),
- Project-teams with Paul-Painlevé laboratory: MODAL and SIMPAF.

Experimental platforms

The research center contributes two national platforms led by INRIA: (i) Grid'5000 which is a research effort developing a large scale nation-wide infrastructure for large scale parallel and distributed computing research; (ii) SensLab which is a very large scale open wireless sensor network platform. The Grid'5000 node in Lille is managed by DOLPHIN project-team and the SensLab node in Lille is managed by POPS project-team.

Large initiative actions. The INRIA Lille – Nord Europe research center also participates to three large initiative actions from INRIA: (i) the SHAMAN project-team is involved in the SOFA-INTERMEDS action which aims to develop algorithms dedicated to medical simulation and to prototyping of such simulators – Stéphane Cotin, INRIA senior research and head of SHAMAN is national coordinator of this national action; (ii) the SIMPAF project-team is involved in the FUSION action which gathers mathematicians and computer scientists with the goal of developing tools and methods for the simulation of nuclear fusion; (iii) the last born large initiative action, named HEMERA, is dedicated to grid computing experimentation and is strongly linked to Grid'5000 platform.

Research contracts

The project-teams are implied in numerous funded projects:

- ANR: Flex-eWare, ITEmIS, SALTY, CHOC, DOCK, Lampada, Codex, Enumeration, RISC, SensLab, SFINCS, WINGS, F-Labs, Bin That Thinks, RESCUE, CoCoGen, Co-Adapt, Explora
- Competitiveness clusters: CAPPUCINO, ICOM, MIND, DECARTE, VVU
- FP7: SOA4All, WASP, ASPIRE, ProSense, SecureChange, PASSPORT, Pascal-2, Pump Priming, Complacs
- Others: Transduce (ICT Australia), QuiXProc (industrial contract), Intelligent Data Center (IPER)

Half of these projects are managed by the INRIA Lille – Nord Europe research center. Half of the contract managed by INRIA involves companies and they represent 60% of the external funds of the INRIA research center.

Organization

The heart of our activity is the project-team. An INRIA project-team is a focused research group with a limited lifespan (no more than 12 years) which is evaluated at the creation and each four years. The a priori evaluation is done by external reviewers which valid the appropriateness of the proposal.

Participation in other 'Investissement d'avenir' program

LABEX

- AMIQUAL (Ambient Intelligence for Quality of Life) whose goal is to provide a national distributed research facility for the sustainable development of Ambient Intelligence and its application to societal problems.
- FIT (Future Internet of Things) which consists in establishing the different sites with a set of competitive testbeds including wireless and wired technologies, with a strong emphasis on sensors, networked and embedded objects, multihop and cognitive radio, mobility and overlays.
- Alladin which aims to ensure the availability of a scientific instrument for experiment-driven research in the fields of large-scale parallel and distributed systems.

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IHU NEXIMED

NEXIMED goal is to place France amongst the leading countries for research, evaluation and dissemination of Personalized Medicine. In its new approach to medicine, NEXIMED expects to develop individualized treatments and prevention plans that are adapted to each individual's physiology, age, genomics, phenotypes and other personal characteristics. The question of data acquisition, storage, mining and access will be crucial. A specific platform (Information Technology Management for Personalised Medicine: IT4-Me) will be created, INRIA Lille – Nord Europe is one of the leading teams of the project.

4.1.4 PARTNER 4: LIFL

Research and innovation

LIFL (Laboratory of Informatique Fondamentale de Lille -Lille Computer Science Research Center- UMR CNRS 8022) is a joint research unit between the University of Lille 1, CNRS and the University of Lille 3. In addition, LIFL and INRIA have set up a strong partnership, and ten LIFL research teams are associated with the INRIA-Lille Nord Europe research centre. Created in 1983, LIFL hosts now roughly 250 members, including more than 100 full-time academic staff, research engineers, support staff, and more than 90 PhD students. LIFL is the largest French Computer Science Laboratory north of Paris.

Research activities undertaken at LIFL contribute to the advancement of new challenges for ambient intelligence such as adaptive software infrastructures, cloud computing, new interaction modes, data mining and content retrieval. Research is structured into seventeen teams around three main domains:Software Infrastructures and Embedded Systems; Interaction, Cooperation, Images and Models, Algorithms, Computing. Furthermore, several cross cutting actions enhance interactions around computational biology, model driven engineering, high-performance computing, machine learning and the interaction, virtual reality and image platform.

LIFL teams involved in ICON

Nine LIFL teams are significantly involved in three ICON research projects.

LIFL has developed a strong expertise in software infrastructures for ambient intelligence and embedded systems, and three teams contribute to the project 'Everlasting numerical sphere':

ADAM (Adaptive Distributed Applications and Middleware) , joint team with INRIA Lille, aims to provide a set of paradigms, approaches and frameworks based on advanced software engineering techniques such as CBSE (Component-Based Software Engineering), AOSD (Aspect-Oriented Software Development) or CAC (Context-Aware Computing) to build distributed adaptive software systems involving multi-scale environments and to take into account the adaptation all along the software life-cycle. ADAM follows two main research directions: The definition of adaptable component frameworks for middleware and the design of distributed applications for adaptive platforms. Since 2007, ADAM has published 16 communications in selective international journals and 16 communications in selective international conferences. The group develops and distributes several software platforms like FraSCAti, Spoon and is at the origin of the creation of the start-up Ubinnov.

POPS (Portable Objects Proved to be Safe), joint team with INRIA Lille, investigates solutions to enhance programmability, adaptability and reachability of objects designated by POPS -small devices like smart cards, RFID tags or personal digital assistant - which are characterized by limited resources, high mobility and high security level in spite of untrusted environment. Pops is managed by David Simplot-Ryl, member of the Institut Universitaire de France (2009 campaign). Since 2007, the team has published more than 60 international publications and several books. The team is involved in numerous national or international projects and is in charge of Lille's site for the SensLAB project.

RMOD, joint team with INRIA Lille, focuses on dynamically typed languages and software evolution of large object-oriented applications. In the past, Traits (designed with the software composition group of Bern) are now used in Perl6, Fortress (SUN Microsystem), Pharo, Squeak, and libraries are available for Javascript, Ruby. RMOD starts to work on security concerns in reflective languages. In addition it continues the development of the open-source software analysis platform MOOSE. It develops a language inspired from Smalltalk named Pharo which is used by several research groups, universities and companies worldwide. It is the development platform for Seaside an open-source framework to develop dynamic web applications. Since 2007, have been published 3 books, 14 communications in international journals and 38 communications in international conferences. The book Dynamic Web development in Seaside won the best book 2010 ESUG award.

LIFL teams gather complementary strong expertises in Data Mining and Optimisation, combining different approaches for extraction information of diverse data -3D data, video, structured data, multisource data -. Four teams are strongly involved in the LSN-MinOpt project:

DOLPHIN (Discrete multi-objective Optimization for Large scale Problems with Hybrid dIstributed techNiques) joint team with INRIA Lille aims to solve large multi-criteria combinatorial problems using parallel and distributed hybrid techniques. Particularly, DOLPHIN considers algorithms which generate the whole Pareto set of a given Multi-Objective Problem (MOP). Since 2007, have been published 39 communications in selective international journals (TCS, Computers & OR, EJOR, J. Heuristics, Operations Research Letters, Parallel Computing) 37 communications in selective international conferences (PODC, DISC, GECCO, IPDPS) and several books. Clarisse Dhaenens has been awarded by the Research Excellencia Prize in 2008.

FOX-MIIRE (FOuille de données compleXes, Multimedia, Image, Indexation, REcognition - Complex Data Mining Multimedia Image, Indexation, Recognition) develops new mathematical and algorithmic solutions for extraction of information from videos and statistical 3D shape analysis combining several domains of expertise such as geometry, computational topology, statistics, machine learning, computer graphics and computer vision. Results are applied in a wide range of fields such as segmentation, matching, 3D object retrieval, human behavior understanding and predicting … Since 2007, have been published 16 papers in major international peer reviewed journals such as IEEE Transactions on Pattern Analysis and Machine Intelligence, International Journal of Computer Vision, IEEE Transactions On Multimedia, 59 in international conferences such as ACM Multimedia, and several books.

MOSTRARE (MOdeling tree STRuctures, mAchine leaRning, information Extraction), joint team with INRIA Lille, focuses on XML database theory and structured machine learning for the study of streams of structured data and the definition of learning algorithms over trees and graphs. The team develops adaptive information extraction tools for Web documents integrating tree structures and emerging machine learning techniques Since 2007, Mostrare has published 23 communications in selective international journals including Machine Learning and 27 communications in selective international conferences including PODS (2007, 2010), CADE. An implementation of XPROC relying on theoretical results by the group on efficient streaming evaluation of XML queries is undertaken in collaboration with Innovimax.

SEQUEL, joint team with INRIA Lille Nord Europe in collaboration with LAGIS, focuses on all aspects of sequential learning, with the sequential decision problem at its core. Scientific activities range from foundations, to the design of new algorithms, proof of their performance, and applications/transfer/valorization.Since 2007, the group has published 24 communications in highly selective international journals (JMLR, TCS, Applied Mathematics Letters) and more than 60 communications in highly selective international conferences: 4 papers in ICML'10, 12 papers in NIPS since 2007, a best student paper award in COLT'09. Besides its significant number of publications in the main journals and conferences mostly in the major Machine Learning (and recently Data Mining) Conferences, the group is involved in software development: e.g. it develops CrazySone, the award-winning Go software. The group is also at the origin of the start-up Vekia

Computational Biology is a crosscutting action of the laboratory and biology is an application domain for several teams. Sequoia team directed by Hélène Touzet that pioneered bioinformatics in Lille is strongly involved in the project "Simulation, Algorithms and Models for Biology and Medecine" in interaction with three other LIFL's teams (Dolphin, Calfor, BioComputing).

SEQUOIA, joint team with INRIA Lille has a strong background in computational biology and bioinformatics. Its main goal is to define combinatorial models and efficient algorithms for large-scale sequence analysis in molecular biology. This includes the following research topics: genome annotation, next generation sequencing, sequence homoloy search, noncoding RNAs, non ribosomal peptides, genome rearrangements, high-performance computing. The team has also a good experience in developing and disseminating bioinformatics software : a web server dedicated to software receives several thousands of connections per month, Sequoia participates to a national project for an open-source RNA annotation platform that was awarded by the life science IBISA label, and maintains the Norine database, that is the official wwPDB international database for genes that are not encoded in genomes. Most of the research projects are carried out in close collaboration with biologists. Since 2007, Sequoia has published 26 communications in selective international bio-informatic journals with high impact factor -BMC Bioinformatics, Nucleic Acids Research, Journal of Computational Biology, Bioinformatics BMC Genomics,- and 15 communications in selective international conferences.

SHAMAN, joint team with INRIA Lille, is a newly created group whose scientific activities are essentially related to medical simulation. A common element among its different objectives is the notion of interaction, requiring that the simulations are computed in real (or near real) time, and that the presence of a user in the loop is accounted for (through the use of dedicated hardware

devices, haptic feedback and robust algorithms). This requires to develop accurate models, coupled with fast and robust computational strategies. The research directions essentially aim at improving the realism of interactive simulations of medical procedures. This increase in realism will permit to address new clinical applications, in particular preoperative planning and per-operative guidance, that currently rely on imaging techniques, but could greatly benefit from simulation techniques, thus enabling what we call "simulation-guided therapy". To reach these clinical objectives the group is addressing key research areas which lie at the intersection between several scientific domains. Since 2007, SHAMAN has published 25 publications in selective international journals and conferences including SIGGRAPH and MICCAI. SHAMAN is also leader of a Large Scale Initiative, a collaborative research project on Medical Simulation using the SOFA framework (www.sofa-framework.org, 80000 downloads) as a common platform for research, integration and validation of new algorithms.

Platforms

- *Grid 5000/Aladdin* is a French platform distributed in 9 sites around France, for research in large-scale parallel and distributed systems. LIFL teams have been the instigator of Lille's site since the beginning of the project in 2003 and Dolphin team is strongly involved in the management of this platform.
- *SensLAB* project deploys a very large scale open access wireless sensor network platform for enhancing research on wireless sensor networks. Lille's site consists in 256 sensors, including 32 mobile ones, deployed on INRIA platform at Euratechnologies.
- *PIRVI*, "Plateforme Interactions-Réalité Virtuelle-Images" is a framework initiated by LIFL in 2009 to enhance researches in the field of Computer Human Interaction, Virtual Reality and Images as well as to facilitate collaborations with industry. PIRVI participates strongly to the dissemination of team expertises, while demonstrating new results to potential industrial partners and globally to civil society

Research contracts

Over the last 4 years, the LIFL teams participated or are currently participating to 10 European funded projects in the FP7 program (with IP, STREP, or NoE), and the ITEA2 cluster. Among the 10, 6 were undertaken by joint project-teams with INRIA.
Numerous ANR funded projects have been set up by LIFL teams- 27 in the last 4 years, including 20 by joint project-teams with INRIA -in many ANR programs: International (with Japan and China), Jeune chercheur, VERSO, ARPEGE, CONTINT, Blanc …
At the national and regional level, LIFL teams have attracted funding from the FUI with competitive clusters (Pôles de compétitivité) labeled projects: 13 in the last 4 for years, including 10 by joint project-teams with INRIA. The major clusters in which LIFL teams are participating are PICOM (Industries du commerce), Systematic (Paris region system & ICT), and Minalogic (micro, nanotechnologies, and embedded systems.)
This funded activity leads to a vast ecosystem of academic and industrial partners with which LIFL teams are collaborating: more 150 in the last 4 years with top level partners such as Thales, CEA, Telefonica, Orange, Total, EADS, MAPLE, Telecom, Schneider Electric, NXP Semiconductor, Atos Origin, Nokia, VTT, or Imperial College London, just to name a few.

Exploitation of results

The exploitation of research results by LIFL teams is conducted in deep interaction with their various partners, Université Lille 1, CNRS, INRIA, and also the local incubating structures (CreInnov, MITI, CIEL.) One startup company has been created, Vekia, in collaboration with Lagis and INRIA-Lille - and two other ones are in the process of being created, Ubinnov and Softo sapiens. Patents are also deposited (3 in the last four years.)
Another important main vector for disseminating and exploiting the results in the computer science domain is through the distribution of software packages, libraries, and platforms. On the last 4 years, more than 40 such software packages were produced and distributed by LIFL teams, most of them under the terms of an open-source license. Some of them have been integrated in commercial software systems, like the library Blad in Maple, or Crazystone on which a commercial Go game program will rely.

Higher education

Members of LIFL are strongly involved in education programs in Computer Science. Bachelor and

Master Degrees in Computer Science and Bachelor and Master programs in Information Systems (MIAGE) of University of Lille, as well as computer science tracks in engineering schools Polytech'Lille and Telecom Lille1 rely mainly on our department and specialization tracks of Graduate degrees in Computer Science are strongly connected to our research domains.
The laboratory supports also strongly interdisciplinary programs as the new specialization track of the Master of Computer Science on « Interaction, Vision, Images » developed in cooperation with LAGIS laboratory, the specialization track « Advanced Scientific Computing" of the Master degree in Mathematical co-developed by Painlevé Laboratory, LIFL and other labs. Members of LIFL teach bioinformatics in Biology Master Programs. In Lille University of Human Sciences, LIFL supports the master "mathematics and computer science for human sciences" in collaboration with laboratories of philosophy, psychology and economy.
Training of young researchers is of course one of our main objectives. To grow the interest of students in faculty-led research, members of LIFL have developed new initiatives (see section Education). They also supervise numerous projects and internships, as well for undergraduate students as for graduate ones. Since 2007, 69 PhD theses and 10 "habilitations" have been defended at LIFL. Around 90 doctoral students are working in the different research teams of LIFL. LIFL belongs to the Doctoral school "Ecole Doctorale SPI (Sciences pour l'Ingénieur)" of Northern France and participates actively to the school (lectures in PhD program, management) organization of EuroDocInfo2008. Members of LIFL organize regularly National or International Schools, like Machine Learning Summer School in 2008.

Organization

LIFL is structured with 17 teams organized around three main domains, among them are 10 joint INRIA project teams. Cross-fertilization and emerging research are strongly supported by the laboratory e.g. via financial support for specific actions.

Existing collaborations

As said before, interaction and collaboration between LIFL teams is strong. E.g. Machine Learning gathers several teams and is central for two ones, Mostrare and Sequel who are used to work together and to have common seminars. Biology is one of our main application domains and teams involved in computational biology are used to meet frequently and to organize common meetings with biologists. Teams involved in software design interact e.g. by organizing common events, like Model Driven Architecture Days. Teams who work around "Interactions, Cooperation, Images", share equipments and development projects and meet regularly to define common strategy.

LIFL has developed strong interactions with ICON partners. The laboratory has a long-standing collaboration with IEMN which is emphasized in the IRCICA institute specially around Hardware/software Infrastructure design for self-organized smart objects and sensors where our expertises are complementary. Collaboration with LAGIS is already well established and has been concretized by common projects and PhDs; Common research projects are emerging, particularly around computational biology, machine learning, data mining.

Interdisciplinary research is encouraged. Particularly, Helene Touzet (LIFL) leads an action supported by University of Lille which gathers LIFL and biology laboratories around BioInformatics. Besides, LIFL participates to the Interdisciplinary Research Institute which hosts one LIFL team. Collaborations with social and human scientists have been developed, mainly recently around interaction and visual studies.

Participation in other 'Investissement d'avenir' program

LIFL participates to several national EquipEx projects

- AMIQUAL , FIT, Alladin : see partner 2, INRIA Lille – Nord Europe.
- France Grilles which aims: to further deploy a sustainable national production grid offering a high level of service to all scientific communities, especially those structured around Very Large Research Infrastructures (TGIR) in France and European Research Infrastructures (ESFRI), to support the emergence of regional initiatives around PRES, universities or "Initiatives d'excellence" by integrating them into a national framework and to integrate academic clouds in the production grid. Noureddine Melab, member of LIFL, has in charge Lille's node.

LIFL participates to the regional 'INgeVisu' EQUIPEX project of an innovative interdisciplinary platform around contents production, combining human sciences and technology. Teams working around image synthesis and virtual reality and platform PIRVI are strongly involved in this project.

4.1.5 PARTNER 5: CRIL

Research and Innovation

CRIL (*Centre de Recherche en Informatique de Lens - Lens Computing Science Research Centre*) UMR CNRS 8188 is a research laboratory located at Lens that is affiliated with both the University of Artois and the CNRS.

CRIL gathers more than 50 members. The permanent research staff of CRIL is made of 6 Professors, 19 "Maîtres de conferences" (tenured "Associate professors"), 1 CNRS Director of Research, 1 holder of a CNRS Chair of Excellence in Artificial Intelligence research and several engineers and administrative staff affiliated with either the University of Artois or the CNRS. More than 15 PhD students, postdocs and temporary research staff also take part in CRIL.

CRIL is directed by Eric Grégoire. Focusing on symbolic Artificial Intelligence (A.I.), it is organized around two closely cooperating axes:

- Handling of imperfect, incomplete, context-sensitive, time-sensitive and multi-source knowledge (with an emphasis on logic-based related approaches). This axis is directed by Pierre Marquis and Salem Benferhat.
- Inference and decision process (with an emphasis on discrete CSP (Constraints Solving Problems) techniques and SAT-solving technologies and their extensions). This axis is directed by Lakhdar Saïs.

The url of CRIL is http://www.cril.univ-artois.fr

CRIL is proposing one project in this Labex, involving its best and most internationally visible people, on a cutting-edge innovative and extremely ambitious project in the A.I. domain.

Indicators of excellence

CRIL is unique in the computing-research university landscape in France in that it specifically focuses on the Artificial Intelligence domain and has concentrated all its resources to build a significant critical mass on it, with the aim at reaching the excellence level.

Some indicators of excellence

- Since its creation in 1994, CRIL has repeatedly received the best possible assessments from the successive French official national evaluation taskforces: MST, MSTP and most recently by the AERES independent agency, which ranked CRIL as an A+ laboratory (the highest possible mark). The last evaluation report by the AERES is available from the CRIL main web portal and from the AERES website.

- A very significant indicator is the number of communications from CRIL in the prestigious and extremely selective (i.e. with a very low acceptance rate based on full-length papers submissions) main major international conferences in the A.I. and the CSP domains:
  - 14 papers at IJCAI'05 and IJCAI'07 main tracks;
  - 15 papers at ECAI'06 and ECAI'08 main tracks;
  - 11 papers at CP'05, CP'06 and CP'07 main tracks;
  - 8 papers at KR'06 and KR'08 main tracks

  authored by 33 different CRIL members. Refining these numbers to the IJCAI and ECAI conferences only, 20 different permanent members of CRIL (thus not even taking PhD students into account) have authored 29 contributions in these occurrences of these prestigious scientific events. With respect to the most recent occurrences of these conferences, the presence of CRIL remains as strong: 7 papers at ECAI'10, 4 papers at KR'10 and 3 papers at IJCAI'09 main tracks. Such a strong presence of CRIL can also be

found in the most prestigious A.I. journals: for example, in 2010 (actually, until September 2010), 4 papers were co-authored by CRIL members in the highly reputed *Artificial Intelligence* Journal. We believe that this clearly shows that CRIL is one of the major players in the cutting-edge Artificial Intelligence research community at the international level.

- From 2007 to 2010, CRIL has authored more than 300 publications and communications: more than 200 of them at the international level (i.e. with a truly international editorial board and audience, a selection process based on full papers and widely available proceedings/journals (ISSN or ISBN)). This list is available from the CRIL website. A list limited to the current permanent members of the project in this proposal is given in appendix 4.

- Some major recent awards at the international level:
  - Pierre Marquis has been awarded the "IJCAII-JAIR best paper award 2006" (after having received the "Ray Reiter award" together with Sylvie Coste-Marquis)
  - Christophe Lecoutre, Stéphane Cardon and Julien Vion's "Conservative Dual Consistency" article was an "AAAI'07 distinguished paper".
  - Salem Benferhat and Karim Tabia were awarded the best student paper at Secrypt'2008 (International Conference on Security and Cryptography)
  - Saïd Jabbour and Lakdhar Saïs were recipient of the best paper award at the 21th IEEE ICTAI conference that was held in 2009.
  - CRIL has also often been a successful competitor in the international solvers competitions in both the SAT and CSP domains. For example, Lakhdar Saïs and Saïd Jabbour's manySAT solver, developed in cooperation with Microsoft Research Cambridge, was the winner of the parallel SAT-race 2008 competition.

Research contracts

During the 2005-2008 period, CRIL has taken part to 4 ACI (« Actions Concertées Incitatives » from the Ministry of Higher Education and Research), to 4 ANR projects and to many contracted international cooperation actions (PAI, PHC, CMEP, CMCU, bilateral international CNRS actions, COST programs, etc.). On September 20 2010, CRIL was involved in 4 ongoing other ANR contracts (COMSOC, PLACID, UNLOC and DAG projects).

Exploitation of results

Although the main concern of CRIL is basic and fundamental research, the laboratory has contracted with a diverse range of companies and institutions, from local SMEs (e.g. Onyme) to large national (e.g. RATP, SNCF) and international ones (e.g. NASA Jet Propulsion Laboratory, Microsoft Research Cambridge, IBM Rational).

Noticeably, CRIL has now a long tradition of developing many efficient original solvers according to the open-source philosophy. They are described and downloadable from the CRIL website. For example, the Eclipse software development platform is making use of CRIL Daniel Le Berre's SAT4J, an open-source Java platform for SAT solving, and is downloaded about 13 million times per year.

Higher-education

CRIL is the home research laboratory of all computing science professors and "maîtres de conferences" in Lens. All of them are also deeply involved in both teaching and managing the university education system and programs. In particular, they play a key role in the IUT de Lens, where they e.g. hold the head of the computing science department and several education programs. They are also strongly involved in the Faculty of Sciences, where they take care of all computing-related programs and teaching units. Noticeably, they organize the computing science degrees ("Licence" and "Master d'informatique"), which were ranked A+ and A by the AERES in 2009, respectively. The Master is divided into two tracks that are truly unique and not redundant in

Northern France: one of them is oriented towards multi-tiers architectures and Java/JEE (Master "Ingénierie logicielle pour l'internet ILI") whereas the second one is focusing on intelligent systems and their applications (Master "Systèmes Intelligent and Applications SIA").
From the doctoral-level perspective, like all the other involved laboratories in this Labex project, CRIL is part of the Doctoral school "Ecole Doctorale SPI (Sciences pour l'Ingénieur)" of Northern France. CRIL strongly supports the project of creating one "Ecole Doctorale" in IT in the Northern France. In the last four years, 12 PhD theses and 4 habilitations have been defended at CRIL.

Organization

Due to the small size of the laboratory and its very focused research domain, each CRIL member has the expertise to possibly cooperate with any other CRIL member. Accordingly, the laboratory has organized itself under the form of two closely-related and interdependent axes, allowing for maximal cross-fertilizations and the dynamical emergence of open-ended and evolving working teams. One strength of the laboratory that we fully exploit relies on the potential combinatorial number of exchanges and collaborations between the various members of the laboratory who are thus all involved in similar research issues.

It is worth noting that the University of Artois and the CNRS have agreed on the following strategic decision taking effect on January 1st 2011. The University of Artois will delegate all its management rights and duties about CRIL to the CNRS ("Délégation générale de gestion DGG") and CNRS will pay a rent to the University. This unusual decision was not only motivated by administrative-related efficiency reasons: this is clearly a strategic move from the CNRS with respect to its involvement in CRIL, and more generally in the IT research domain in Northern France.

Existing collaborations

Built from scratch in the mid 90ties, CRIL has been carefully created to complement the scope of the other Northern France computing science laboratories, carefully avoiding any significant overlap. Not surprisingly, the main outside scientific collaborations of CRIL members are thus outside Northern France. However, collaborations between all computing science researchers in Northern France are strong within the shared Ecole Doctorale and CRIL members do have some one-off collaborations with the other laboratories involved in this Labex project (mainly with researchers involved in data mining, operational research and optimization from INRIA and LIFL). This Labex will be an opportunity to reinforce those local collaborations as well.
In France, the main academic partners of CRIL in terms of co-authored publications and shared research contracts are the IRIT (Toulouse), LAMSADE (Paris) and LSIS (Marseille) laboratories.
From an international perspective, these last years CRIL has pursued active contractual links with Portugal (PHC Pessoa and CPU-funded projects), the UK (CNRS-Royal Society actions), Ireland (PHC Ulysses), Thailand (PHC project), Holland (PAI Project) and conducts active PhDs co-graduations with institutions from Algeria, Morocco, Tunisia and Cameroun. Also due to the nature of research activities on formal logic-based issues, a significant part of the international activities of the laboratory lies on personal, one to one, non-contractual links, leading to co-authored publications.

Obviously enough, most permanent CRIL members exhibit significant editorial activities at the international level. These can be found in their personal webpages. CRIL also plays a key role in the scientific animation in the A.I. domain, both at the national and international levels. For example, Eric Grégoire is the Program Chair of the 22nd IEEE ICTAI conference (ICTAI'10), which will only take place in Europe for the third time in more than 20 years. It will be hosted in Northern France by CRIL in October 2010.

Participation in other "Programme d'Investissement d'Avenir PIA" programs

CRIL does not participate to any other PIA project (Equipex, etc.) except the IDEX call to which the ULNF PRES will submit a proposal.

4.1.6 PARTNER 6: PHLAM

Research and innovation

The « Laboratoire de Physique des Lasers, Atomes et Molécules » (PhLAM) is a joint unit from University Lille 1 and CNRS (UMR 8523), ranked A+ by AERES in 2009. The total number of laboratory members is around 120: 80 permanent staff, 40 PhD students and post-docs. The scientific activity of the lab is related to the interaction between light and matter, explored both by experimental and theoretical ways. We have mainly 5 research groups: Photonics, Non linear optics and dynamics, Atomic physics, Molecular spectroscopy and applications and Theoretical molecular physics. Although each group has its own research program, collaborations are currently effective between these 5 groups. Except one team in atomic physics, all the research groups have also been ranked A+ by AERES.

The groups associated to this project are mainly the Photonics group, the Non linear optics groups, part of the atomic physics group and some members of the Spectroscopy group involved in THz technology and material studies.
The Photonics group is designing new optical fibres (including fibres for telecommunication applications) and also producing these new fibres in our technological platform (based in the IRCICA building). This platform is one of the most important academic platforms in Europe, including OVD and MCVD processes. A strong effort is also developed for the design of new materials (inclusion of metallic or semiconductor nanoparticles into silica via various processes, original development of the sol-gel technique). Theoretical modelling of the optical properties of the produced fibres is also supported and a specific computational effort has been initiated to design the new fibres.
The new fibres produced in the group are also used to develop new light sources for various applications (telecoms, cryptography, medical diagnosis, new imaging techniques). Special efforts are concentrated on the development of supercontinuum sources, both in continuous and pulsed regimes.

The Non linear optics group is mainly interested in the propagation of light in micro and nano-structured optical fibres, the development of solitonic structures and the link with the evidence for optical rogue waves, a hot topic for the last two years. One goal of the study of the soliton solution for propagation is to optimize the transmission of information at a very high rate.
Another topic developed by this group is linked to the quantum limit of super-resolution of optical images, and also to the teleportation or telecloning of optical images.
Nonlinear dynamics has also been recently applied to the modelling of living cells, for instance the elucidation of the circadian clock in simple organisms like Ostreococcus tauri or the dynamics of the development of Physarum Polycephalum

The development of THz technology is important for telecommunications and the corresponding technical developments can also be applied to other fields like molecular spectroscopy where the THz domain is really challenging. PhLAM has a long tradition in the development of millimetre and submillimetre spectrometers and is currently evolving to the THz region. This evolution will take advantage of the availability of new devices in this frequency range.

The available equipments available at PhLAM include the technical platform for the production of photonic crystal fibres, the OVD, MCVD and sol-gel processes for the doping of silica, a low-temperature fibre “tower”. Many continuous and pulsed light sources are available at PhLAM , including high power lasers, for the optical characterization of the fibres and “preforms”. A femtosecond laser with tunable pulse width and various characterization devices (auto-correlator, streak camera, FROG) is a common facility for all the teams of PhLAM.

More than 140 papers have been published in international journals by the teams participating to this project. The list of these journals includes Phys. Rev. Lett., Opt. Lett., Opt. Express, JOSAB, Phys. Rev., Appl. Phys. Lett., J. Chem. Phys., as the highest impact factor journals.

Research contracts

At the European level, we are currently implied in the HiDEaS network (High Dimensional Entangled Systems, FP7-ICT-221906), the ACTINET network and the Interreg IV : Plasmobio program (development of innovative SPR biosensors).
At the national level 8 projects implying the different teams participating to this LABEX are currently funded by the national agency for research (ANR). We are also currently funded by CNRS within several national programs.

Exploitation of results

The lab doesn't have any internal structure dedicated to the exploitation of results, but utilizes the corresponding structures existing at CNRS or at University Lille 1 for patent registration. During the last years, several patents have been deposited, mainly by the photonics group.

Higher education

Many members of PhLAM have implications at the Master level: general responsibility of the Master of Physics, co-responsibility of the option Physics for biology, responsibility of the option Optics and Lasers.
We are implied at the teaching level in the Master of Physics, the Master of scientific computing, the Master dedicated to the future physics teachers.
Up to 2010 we were responsible of the doctorate program « Sciences de la matière et du rayonnement ».
Every year we have about 10 Master 2 students spending a semester in one of our research groups and 8-10 PhD students beginning their thesis.
We are also implied in the doctoral school Metamorphose from ULB (Brussels).

Organisation

The lab is organized into 5 research groups. The head of each group belong to the first circle around the director, and is consulted regularly for important decisions. The laboratory council represents the diversity of the members of the lab (researchers and technical and administrative staff, PhD students) and meets every 2-3 weeks.
The director, responsible for the scientific evolution of the lab, is helped by an administrative officer, in charge of the administrative and financial problems.

Existing collaborations

The lab is present in more than 10 GDR (Groupement de recherches CNRS , research network funded by CNRS), including the responsibility of one of these, dedicated to non linear photonics. From 2002 to 2009, the lab has also participated to the LEA HIRES (Laboratoire Européen Associé) in the field of High Resolution Spectroscopy, together with german and belgian labs (Brussels, Namur, Cologne).
We are also member of the GRIFON network (Groupement de recherche et d'innovation pour les fibres optiques de nouvelle génération) together with two other french labs: XLIM (UMR 6172, Limoges) and LPMC (UMR 6622, Nice). This research collaborative group has been created for an optimal collaboration between the french academic centres working in the production of new optical fibres. This network has also close collaboration with industrial partners. Among the industrial partners, Draka-Comteq represents one of the most important, this company being the number 2 in the world for the production of optical fibres. Other partners are 3S Photonics, Alcatel-Lucent and Osyris, a company created by a former member of the lab and developing new lasers for medical applications.

Close collaborations exist between PhLAM and IEMN groups within the IRCICA institute, due to the complementarity of the available equipments in these two labs: photonic crystal fibres production and expertise in optics for PhLAM, micro and nanosciences technological centre and expertise in electronics for IEMN. Among the collaborative projects we can quote the development of development of innovative SPR biosensors, the development of optoelectronic ultrastable oscillators, the study of THz transmitting devices, the investigation of new photovoltaic materials,

…This collaboration is also funded within the program "Campus Intelligence Ambiante" for the period 2007-2013.
Some collaborative work has also been done between PhLAM and LIFL in the field of computational biology, on the modelling of regulation networks in living cells.

Participation in other 'Investissement d'avenir' program

EQUIPEX :
PhLAM is participating to two "EQUIPEX" projects: Grifon (Groupement de recherche et d'innovation pour les fibres optiques de nouvelle génération- Research and innovation group for next generation of optical fibres) and Refimeve (Réseau Fibré métrologique à Vocation Européenne- Metrological Fiber Network with European Vocation)

4.1.7 PARTNER 7: LABORATOIRE PAINLEVE

Research and innovation

The Laboratory Paul Painlevé -- research unit associated to CNRS (UMR 8524) and Lille 1 -- is one of the largest laboratories of mathematics in France. With a permanent faculty of 48 full professors, 63 assistant professors, 2 CNRS Senior Researchers, 9 CNRS Junior Researchers, 1 INRIA Senior Researcher, 3 INRIA Junior Researchers, it covers a wide spectrum of pure and applied mathematics. The laboratory also comprises 11 administrative and technical staff and about 50 PhD students and PostDocs. As leading member of the « Fédération de Recherches en Mathématiques du Nord-Pas de Calais », the laboratory enjoys close partnerships with the other laboratories of mathematics of the region. Through its many research seminars, work groups, conferences and visiting professorships, the laboratory welcomes many foreign researchers on a regular basis. The members of the laboratory closely collaborate with mathematicians from all over the world and are regular visitors to universities in USA, UK, Germany, Canada, Poland, Romania and many other countries. The laboratory is strengthened by many international accords like GDRE, European networks, INTAS networks, Tournesol, Gilibert, Procope, EGIDE programs and PICS. The main tool of the laboratory is the « Bibliothèque Régionale de Recherche en Mathématiques » library which houses 16000 books and 360 international journals with more than 200 active subscriptions. This library is open to every mathematicians of the region as well as to the members of LIFL laboratory and INRIA Lille Nord Europe faculty.

ICON Teams

Probability and Statistics team

The Probability and Statistics (PS) team includes 28 permanent members, 2 emeritus Professors, 1 post-doc and 9 Ph.D. students. There are 3 main thematics:

- model-based statistics,
- stochastic geometry,
- stochastic processes, systems of particles and PDE.

The scientific life is structured around one general weekly seminar and several working groups gathering between 4 and 12 members.

Since January 2007, the members of the team have published more than 175 papers in international journals. Scientific cooperation in activity involve around 60 external collaborators from 18 countries. There are 8 research contracts, 9 participations in various ANR, 8 international cooperation agreements.

The PS team is involved in the Labex ICON through the project "applications of information technology to human health and medicine". In this project, managing high dimensional data sets and dealing with complex data (typically heterogeneous variables) is a scientific key point for exploring genomic data (GWAS). In particular, model-based clustering methods are very relevant

for performing this fundamental data mining step since they allow to develop in a well defined probabilistic context, but "friendly user" context, row partitioning in high dimension, variable selection feature and simultaneous row/column partitioning (bi-clustering). These methods can also have a deep impact in data visualization by designing some relevant subspaces and also in multiple testing problems by identifying correlated variables (a central problem in RNA-seq studies).

Some statistician members of the PS team joined recently their scientific forces in the INRIA team "MODAL"2 (Lille Nord-Europe center) designed for model-based clustering and visualization of complex data (heterogenous and high dimensional data) around its scientific leader C. Biernacki. Their individual research topics are in agreement with the statistical research topic of the Labex ICON, project "applications of information technology to human health and medicine":

- Model-based clustering of complex data (C. Biernacki, J. Jacques, C. Preda);
- Data visualization of complex data (S. Iovleff);
- Multiple testing problems (A. Celisse).

The main application domain of the methodological-focused team MODAL is identified as biology, in particular genomic data.

The PS team is experienced and involved in genomic data analysis. First, two contracts in pharmacogenetics with the biotech UK company PGXiS (2008-2010) are engaged about multivariate analysis of large SNPs datasets and involved C. Biernacki, S. Iovleff, J. Jacques and C. Preda. Second, two PhD theses are starting in October 2010: The first one is co-supervised by J. Jacques with the student J. Hammon and the company Genes Diffusion (collaboration with INRIA team DOLPHIN) and is entitled « Regression on SNPs to predict quantitative feature for genetic animal selection by combining statistical and combinatorial optimization approaches »; The second thesis is co-supervised by C. Biernacki and J. Jacques with the student L. Yengo and the Institut de Biologie de Lille and is entitled « Variable selection and classification in regression on SNPs for the genetic etiology of disease ». Finally, two other PS members (P. Heinrich and J. Kahn) collaborate with the Biophotonics plateform of the Interdisciplanary Research Institute (IRI) of Lille about the study of protein-protein interaction in living cells and aim at improving the statistical analysis of fluorescence technique images.

Numerical Analysis and Partial Differential Equations team

Although it is not yet involved in any proposed Labex projects, the Numerical Analysis and Partial Differential Equations (NAPDE) Team of the laboratory could easily interact with the research topics of the Labex ICON.

The NAPDE permanent faculty is composed of 6 Professors, 1 INRIA senior Research Scientist, 7 assistant Professors, 1 CNRS junior Research Scientist, 3 INRIA junior Research Scientists and 1 CNRS Research Engineer. It also comprises of many PhD-Students and PostDocs (in 2010, 9 PhD-Students and 3 PostDocs).

The research activities of the NAPDE team are devoted to the following topics :

- Approximation theory (rational approximation, orthogonal polynomials, asymptotic analysis, Riemann-Hilbert problems),
- Numerical matrix algebra (Lanczos-type projection methods, Ritz values, matrix functions, Interaction with the logarithmic potential theory, preconditionning methods),
- Partial differential equations (models of fluid mechanics, kinetic equations, fluid-particles interaction, non linear Schrödinger equation),
- Modeling and scientific computing (plasma physics, radiative transfer, biology, molecular dynamics, finite volume and finite element methods, boundary conditions influence),
- Statistical and Mathematical physics (quantum and classical open systems, semi-classical and spectrum analysis, Schrödinger equation and operators, multi-scale analysis, homogenization).

Some research axes clearly identified as natural interaction points with Labex Icon are :

2 http://www.inria.fr/recherche/equipes/modal.fr.html

- The study of numerical schemes for the solution of PDEs (Christophe Besse, Caterina Calgaro, Claire Chainais, Emmanuel Creusé, Thierry Goudon, Pauline Lafitte),
- The modeling of metamaterials (Christophe Besse, Claire Chainais),
- Mathematical biology (Thierry Goudon, Pauline Lafitte),
- Nonlinear dynamics (Stephan De Bièvre).

The NAPDE team is very active and publishes twenty-five papers on average per year in international rank A journals. The team manages three ANR contracts (Intocs, Iodissee and Microwave), one CNRS GDR (GDR 3274 Dynamique Quantique – S. De Bièvre) and different research contracts with institutional and industrial partners (French Nuclear Agency, Thalès, Andra, EDF).

Research contracts

The laboratory manages many ANR contracts :

- ANR GROUPES (Leonid Potyagailo),
- ANR DYNOP (Sophie Grivaux),
- ANR VIROSCOPY (Viet Chi Tran),
- ANR INTOCS (Jean - François Coulombel),
- ANR VHSMOD (Dimitri Markouchevitch),
- ANR MICROWAVE (Christophe Besse),
- ANR IODISSEE (Christophe Besse),
- ANR OBTH (Benoit Fresse),
- ANR GGAA (Cornelia Drutu),
- ANR Q-DIFF (Stéphane Malek).

It also organizes the European network GTEM (Pierre Dèbes).

Higher education

The laboratory is involved in four different Master programs giving the opportunity to students to work in various sectors like public or private research laboratories or careers in teaching. The preparation of a doctoral thesis in a research laboratory or in the industry can also be considered.

Master degree in Applied Mathematics

The Master degree in Mathematics, with specialization in Applied Mathematics is a top rate international training year in various fields of mathematics and its use in applied sciences. It delivers a specialization in numerical analysis, partial differential equations, probabilities and statistics. The faculty in charge of the program is composed of distinguished Researchers and Professors from the mathematical laboratories of the universities of the Region Nord Pas de Calais.

Master degree in Pure Mathematics

The Master degree in Mathematics, with specialization in Pure Mathematics is a top rate international training year with an introduction to mathematical research and different courses in analysis, algebra and geometry. This diploma prepares students for career in public or private research laboratories and for teaching professions. The faculty in charge of the program is composed of distinguished Researchers and Professors from the mathematical laboratories of the universities of the Region Nord Pas de Calais.

Both master degrees in Applied and Pure Mathematics take part in an exchange program with Belgian universities.

Master degree in Mathematical Engineering (Advanced Scientific Computing)

This Master degree in Mathematical Engineering, specialized in advanced scientific computing, from Lille University of Science and Technology (Lille 1) offers a top rate international interdisciplinary training year in applied scientific computing. It is available to postgraduate students who wish to specialize in modeling, numerical simulation and supercomputing.
The faculty in charge is composed of distinguished Researchers and Professors from 8 research laboratories and research institutions (CNRS, INRIA, ...) located on Lille 1 campus and we also welcome lecturers from Business and Industry.
Students have free access to computer facilities dedicated to high performing scientific computing and the latest computational tools such as the massively parallel IBM Blue Gene/L with 2048 computing cores and 5 Tera Flops and the pluridisciplinary European production EGEE grid.

This master leads to Fully qualified engineers or research and development engineers in various sectors such as car industry, aeronautics, space research, nuclear energy, environment, fossil and renewable energy or a doctoral thesis in a research laboratory or in the industry.

Master degree in Statistical and Numerical Engineering.

With an experience of over twenty years, this master degree provides practical knowledge in statistics (simulation, prediction, reliability, quality control, data analysis, credit-scoring, discriminant analysis, segmentation) but also in scientific computing (Operations research, numerical methods), computer science (Database, Office) and marketing.
The academic staff in charge is composed of distinguished Researchers and Professors from laboratory Paul Painlevé and also guest lecturers from Business and Industry. Graduates from this program are often hired as consultants, executives and managers.

Organization

The director Christophe Besse, professor at the Université Lille 1 Sciences et technologies, has been appointed in 2010 for a four years period. To direct the institute, he has support of an administrative support team, direction committee and an elected laboratory committee.

Scientific organization

The Laboratory Paul Painlevé is composed of 5 research teams:

Analysis
Numerical Analysis and Partial Differential Equations (see the description above)
Arithmetic and Algebraic Geometry
Geometry and Topology
Probabilities and Statistics (see the description above)

The Analysis team organizes its research around harmonic analysis, complex analysis and geometry, functional analysis and operator theory.

The Arithmetic and Algebraic Geometry group is concern with number theory, arithmetic geometry and algebraic geometry.

The Geometry and Topology team deals with dynamical systems, geometric group theory, algebraic topology, singularity theory, differential geometry and mathematical physics.

Existing collaborations
The team Probability and Statistics and the team and the Numerical Analysis and Partial Differential Equations (NAPDE) Team have common projects with INRIA Lille (SIMPAF and MODAL), and working groups with IEMN and PhLam on modeling of electronic and electromagnetic problems.

More specifically, the PS team collaborates with some partners in complementary topics to its research areas:

- Collaboration with the DOLPHIN INRIA team designed for large and complex optimization problems since many statistical methods, like clustering, lead to optimize some criteria in

complex structures. In particular, a PhD thesis started in 2010 between DOLPHIN and the PS team.

- Collaboration with the CERIM team of University Lille 2 designed for biostatistics since the PS team is involved in some applications in genomic data. In particular, the Assistant Professor G. Marot has been recruited in 2010 at the CERIM team and is also member of the INRIA MODAL team in which is highly involved the PS team.

Participation in other 'Investissement d'avenir' program

CAMASC project in the Inex Lille Nord de France. CAMASC (Center for Applied Mathematics And Scientific Computing). The goal is to built a world-class interdisciplinary research

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4.1.8 PARTNER 8: LAGIS

Research and innovation

The objective of the research activity of the LAGIS is the development of theoretical and applied activities in the area of information processing: Signal processing, image processing, statistical information processing, and system engineering: Automatic control, integrated design of controlled dynamic system, identification, fault detection and isolation, diagnosis and fault-tolerant control.
Five research teams contribute to this objective:
The MOCIS team contributes to the development of methods and tools for integrated design of controlled dynamic systems. It concerns all the different aspects of the problem which are modeling, model analysis and simplification, control and monitoring. The bond graph tool has been chosen for its abilities for modeling multienergy and multiphysics systems with a great physical insight and under a unified graphical way. Because of its graphical structure and the explicit showing up of the causality properties, the bond graph model is a very performing tool for our purpose.
The OSL team focuses on the research and best practices in the supply chain systems (the health-care engineering and health-care technology assessment, production systems, multimodal transport network and crisis management systems). This team works and develops current research results in the area of the modeling distributed systems, simulation, optimization and technology assessment management, especially taking into account the modern information and communication technologies.
The SI team develops its research activity in the area of statistical information processing for multisensor systems, including sensor networks. The non linear non gaussian dynamical systems frame is considered for this research, the problem tackled in this frame is the system state estimate. We aim at developing signal processing methods jointly with measurement devices in the area of polarimetric imagery. Signal processing methods are developed from information geometry which allows developing algorithm coherent with the underlying data varieties. We also focus on the physical interpretations of such methods. Concerning the device specifications, we aim to focus on improving methods to take into account the components temperature shift. We also plan to use our skills in light polarization to propose new polarization-based light coding. This could be applied to 3D visualization.
The STF team main aims are the contribution to the design of systems of automation while integrating on the one hand, the approach reliability for the definition of the architecture of the system, and on the other hand, while developing and by establishing the algorithms in process supervision based on advanced fault detection and isolation (FDI) and fault tolerant control (FTC), using functional and structural models. The systems concerned are the continuous (linear or non linear, and/or discrete systems (dynamic hybrids)) and distributed architectures. Others areas of researches of the SI team are color imagery and brain computer interface (BCI).
The SyNeR team mainly develops theoretical and applied methods for control of nonlinear, time delayed and hybrid dynamical systems, numerical differentiation of noisy signal and on-line

algorithms for identification (parameters, delays), estimation (non measured variables, abrupt changes) and network control.

LAGIS research activities involved in ICON

The research activities of the team SyNeR are mainly concerned with problems related to the identification, the control and the observation of nonlinear dynamical systems. The research encompasses theoretical problems as well as applications (in robotics, in networked control, and in electrical engineering).
Theoretical fields of interest are:
The robust control of nonlinear, time delayed and hybrid (with switching, impacts) dynamical systems. The used techniques are based on Lyapunov stability techniques as well as on the variable structure system theory (sliding modes), linear parameter varying models and homogeneity-based techniques.
The design of on-line algorithms for finite-time estimation (INRIA project ALIEN) for numerical differentiation of noisy signals, identification (of parameters or delays) and estimation (unmeasured variables, abrupt changes).
Those fundamental studies are oriented towards challenging application fields: Network control systems and collaborative robotics, which constitute two components of wireless sensor and robot networks.
Network control systems (NCS): It is a question here of taking into account temporal constraints arising in networked, real-time systems, by using models with delays or with switches. For instance, the quality of service (QoS) can be taken into account in the controller in order to guaranty the best performances. Applications have already illustrated or motivated these researches: Control of the master/slave type through Internet, thus with strongly variable delays. A concrete application was implemented, where the slave is a car-like robot connected to a distant observer/predictor (40 km). This work continues today in a context of remote force feedback. The aim is to guarantee stability and transparency of the haptic system despite the presence of the network between the operator and the robot manipulator. This theme is supported by the platform "Networked Control" of the LAGIS (constituted of processes and controllers connected by Wifi, Zigbee, *etc*). Applications can also be found in problems related to wireless sensor and robot networks (WSRN, see below).
Collaborative robotics: This field concerns the self deployment of autonomous swarms of mobile (car-like) robots. This implies geolocalization (via estimation algorithms), path planning and robust control problems. Several algorithms have already been applied to the control of formation of mobile robots (an illustrative platform is currently developed at EuraTechnologie within the framework of the INRIA project ALIEN) and are now extended to wheelchairs (in collaboration with partners from local hospital settings).
Wireless sensor and robot networks constitute a ground-breaking application of both NCS and collaborative robotics. WSRN can be dedicated to the surveillance of environmental sensible zones, the exploration of hostile areas, the supervision of large scale sensor networks, the people' assistance... The main idea here is to integrate autonomous mobile nodes (the robots) within the sensor networks, so to overcome the defection of some critical sensors, to maintain the connectivity of the network or to extend the coverage area during a random deployment. This involves consideration about mobile actuators within a mobile network of sensors as well as control networks (wireless) with strong constraints on the possibilities of communication in a noisy and nonhomogeneous environment. Such challenges need a joint research linking control sciences and computer sciences: This is why these activities will be developed jointly with the team POPS (LIFL and INRIA).

A group of researchers belonging to the SI team is mainly concerned with problems related to statistical information processing for multisensor systems (including sensor networks). Sensors networks or more generally multisensor systems evolve in changing environment and their own characteristics might vary according to time or surrounding environment. The sensed system itself may have several functioning modes and the measurement noises may also change.
These practical considerations lead to non linear non gaussian dynamical systems the state of which must be estimated in a robust way along with the systems' modes, measurements' modes and noise characteristics (mainly the probability density function). We propose solutions in the frame on non parametric bayes methods, therefore assuming that the unknown parameters belong to an infinite space. From such a modelling, it develops sequential Monte Carlo (SMC) based

algorithm allowing a system state estimate based on the best parameters estimation. They focus on on line probability density function estimation jointly to state estimation and on time varying hyperparameters of random measures.
The goal is to develop on-line algorithm allowing to self-adapt to a time-varying environment. But robust "estimation" is not the only challenge of information processing in multisensor systems or networks. Sensors have parameters that can be control to adapt to surrounding conditions or to operational purpose. We then face to a sensor management problem. Such a problem could be summarized in few questions: Which sensors, with which parameters values and during how much time. We develop sensor management algorithms for tracking purposes (in the frame of civil security for instance) based on random finite sets.
Another field of research developed is mainly focused on the development of data-hiding methods to secure the information. The current activities are about robust data-hiding (a.k.a. watermarking), undetectable data-hiding (a.k.a. steganography) and the security analysis of data-hiding methods leading to steganalysis and watermarking attacks. The development of secure data-hiding methods involves accurate statistical modeling of the host content (which are usually images, videos, sound or text) combined with side-informed coding. The development of security attacks implies the use of feature extractions, blind source separations and machine learning techniques.

For the activity identification, control and observation of nonlinear dynamical systems, the number of journal papers (referenced in international data bases) is 41.
For the activity statistical information processing for multisensor systems (including sensor networks), the number of journal papers (referenced in international data bases) is 25.

Platforms

The LAGIS laboratory develops cooperation with some teams of the LIFL in the framework of the “Plate-forme Interactions-Réalité Virtuelle-Images” (PIRVI). This platform has been initiated by the LIFL in 2009.

Research contracts

Over the last 4 years, the whole LAGIS participated or are currently participating to ANR projects (7), INTEREG project (1), European Network of Excellence (1). The LAGIS has obtained funding from “Pôles de compétitivité” labeled projects (4). The LAGIS participates to several “Pôles de compétitivité”: (i-TRANS), "Le ferroviaire au coeur des systèmes de transport innovants", PICOM (industries du commerce), "Véhicules du futur", (co-région Alsace/Franche Comté), ASTech, (aerospace, Paris-Ile de France).

Exploitation of results

The exploitation of LAGIS research results is conducted in deep interaction with its academic/research partners, Ecole Centrale de Lille, University Lille 1, CNRS and INRIA. The startup Vekia (http://www.vekia.fr/) has been created by a junior researcher (CNRS) from the LAGIS, in cooperation with the LIFL. This startup has exploited the results obtain at LAGIS in the area of on line probability density function of noise estimation jointly to state estimation.

Higher education

Members of LAGIS are strongly involved in education programs at Bachelor and Master degrees in engineering schools: Ecole Centrale de Lille, Polytech’Lille, Telecom Lille1 and at the University Lille 1.
LAGIS is particularly involved in Master degree programmes: SMaRT (Systèmes, Machines autonomes et Réseaux de Terrain). The SMART programme covers various research topics in robotics, automatic control and signal processing.
Ecole Centrale de Lille students have a specialization that they can choose among a choice of eight possibilities. Among these last, the "Information and decisional system", created in September 2010, gives the opportunity to the students do deepen their knowledge in the following areas: Statistical signal processing, machine learning, automatic control and robotic.

The new specialization track of the Master of Computer Science, supported by the LIFL laboratory, on "Interaction, Vision, Images" has been developed in cooperation with LIFL. Some members of LAGIS participate to this Master program.

Organization

LAGIS is a laboratory of 156 persons including 56 professors and associate-professors, 4 CNRS junior researchers, 13 technical and administrative staff and 83 PhD students and postdocs. LAGIS is structured with 5 teams which cover the main domains of the laboratory, systems and information processing.
The laboratory is directed by Philippe Vanheeghe (director, professor at Ecole Centrale de Lille) and Olivier Colot (assistant director, professor at Univertity Lille 1). The laboratory council is composed of 15 members including the director and the assistant director. The council acts as a governing authority for laboratory internal affairs and scientific orientation of LAGIS. Most of the time the team leaders are invited to the council meetings.

Existing collaborations

Collaboration with LIFL is already well established and has been concretized by common projects and PhDs. The project of the INRIA Lille-Nord Europe research center, SequeL (sequential learning) combines LIFL's expertise in machine learning and LAGIS's expertise in signal processing. The collaboration between these two laboratories around image and vision has led to the development of the new Master track IVI.
Collaborations with the mathematics laboratory Painlevé has been developed in the frame of co-supervised PhD.
LAGIS is involved in the INRIA project ALIEN, the main objective of this project is the design of new real-time estimation algorithms. The ALIEN project is a project of the INRIA Lille-Nord Europe research center and the INRIA Saclay - Ile-de-France research center.

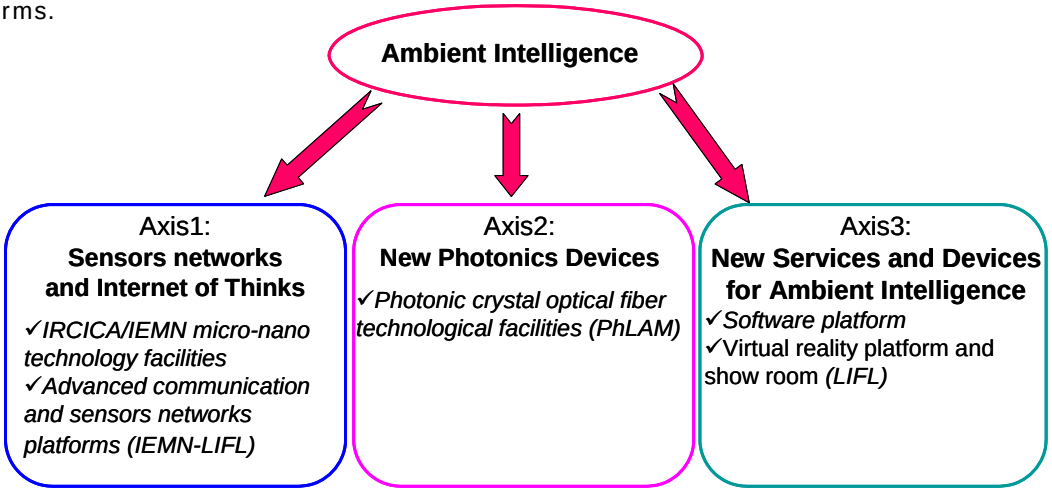
4.1.9 PARNER 9 : IRCICA

IRCICA was created in the framework of the program of reinforcement of the research in the Nord Pas-de-Calais Region launched by the Ministry of Research in 2001. 3 regional laboratories, IEMN, LIFL and PhLAM have joined their efforts to build a project and a scientific program focused on hardware and software components for information and advanced communication which corresponded to a scientific field in which the three laboratories had recognized knowledge and competences and in which many challenges and breakthroughs had to be addressed before industrial applications. The scientific work of the institute really started in 2002 with the strong willing to promote multidisciplinary works at the hardware/software interface or quite exploratory studies taking into account the national and international context and to achieve state of the art results.
.One of the major result of the creation of IRCICA was the synergies established between the researchers of the partner laboratories mainly at the hardware-software interface in the smart Objects Communication project. The scientific results were presented at two International Scientific Committee (ISC) meetings held on September 2003 and February 2006 and the evaluation on the scientific quality and on the pertinence of the work achieved was quite positive with fruitful recommendations. To support the scientific projects, three advanced technological platforms were developed:

- Telecommunication platform (IEMN)
- Photonic optical fiber platform (PhLAM)
- Virtual reality platform (LIFL)

These platforms were setting up in new IRCICA building that was delivered at the end of 2006. With the delivery of the building, it appeared important to better organize the research works around these technological platforms to favor multidisciplinary projects.

So, the IRCICA researchers, coming from the partner laboratories IEMN, PHLAM and LIFL have focused their activity for the 2007-2010 period on three main axis based on the three technological platforms.



This program aimed at the development of researches on electronic and/or photonic components to provide new miniaturized and low power devices able to establish self- organized communication with the environment and researches on new basic softwares and middlewares able to sustain new systems and services or self-organized ubiquitous information. These studies also include research at the hardware/software interface (IRCICA was a pionner for such multidisciplinary research) and it is intended to explore new areas concerning hardware-software co-design, telecommunication vs software systems and sensors networks vs spontaneous organizations.

The main topics proposed for each domain are summerized below with the corresponding man-power:

Domain 1: Sensors Networks and Internet of Things
25 researchers, 25 PhD students and Post-Doc

- Miniaturized ultra low power millimeter wave radio interfaces (60 and 140 GHz)
  - Cross optimization of the physical, MAC and network layers
  - New hardware architectures and new low voltage antimony based mm.wave devices
  - Software/hardware infrastructure for ad hoc and mixed networks including 60 GHz radio over fiber communication.
- New sensors and microsources of energy (emerging projects)
  - Microbatteries and photovoltaic energy scavenging for autonomous sensors networks.
  - Silicon nanowires for bio-sensors
- Molecular electronics to prepare break-throughs (beyond CMOS)

Domain 2: New photonic devices
- *20 researchers, 20 PhD students and Post-Doc*

- Advanced studies in the field of photonic crystal fibers
- Photonic stabilization of optoelectronic oscillators
- Left handed effects in microstructured materials
- Quantum communication in complex environments

Domain 3: New services and devices for ambient intelligence
- *28 researchers, 20 PhD Students and Post-Doc*

- Advanced studies on software modelization
- New models for large scale reasoning
- Haptic tactile feedback
- Interaction between users and 3 D models and interfaces
- Computing grids for large scale execution platforms

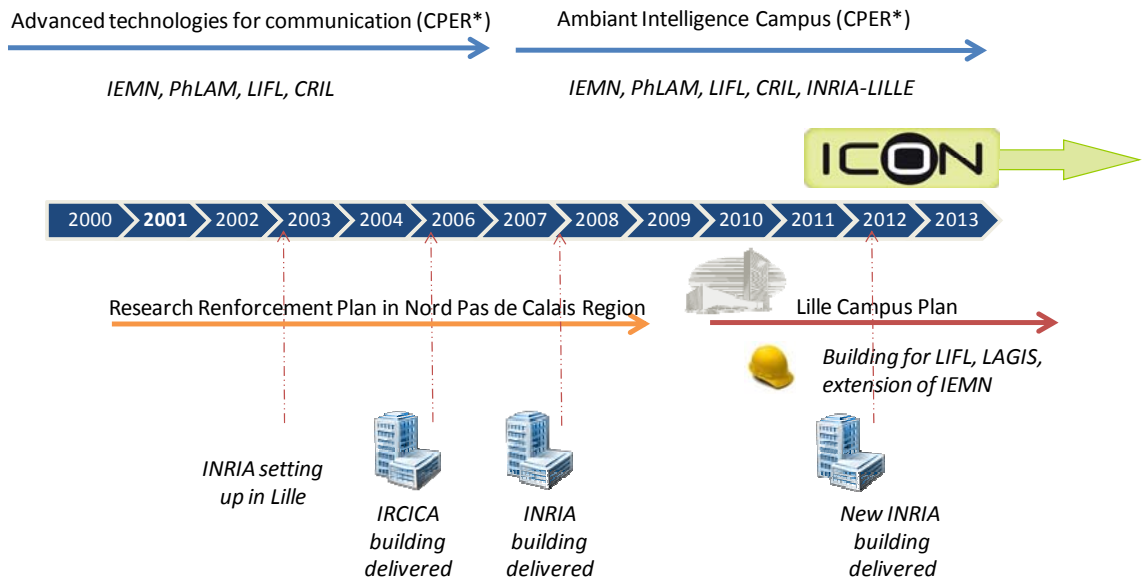
Management and organization:

Since January 2010, IRCICA is a Research and Service Unit (USR) with CNRS and University Lille1 as parent organization. All the IRCICA researchers that are welcome in the IRCICA building remain attached to their lab.

As USR, IRCICA is a light structure with a director and three platform managers. In the future, the objective is to receive the 'Project Hotel' label which is given to structures developing multidisciplinary research activities. With its platforms and scientific program, it is clear that IRCICA is at the heart of the ICON project.

4.1.10 EXISTING COLLABORATIONS

ICON : A result of 10 years of investment in ICTs in Lille



** CPER = State Region Project Contract*

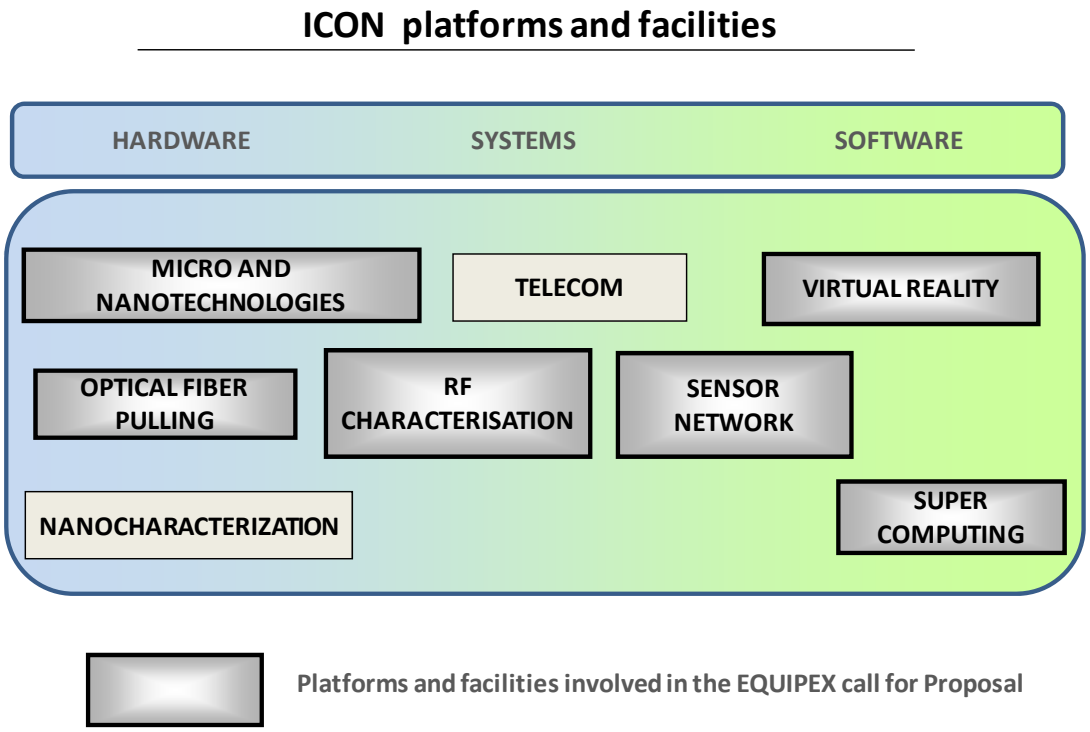
The ICON partners are involved in common projects for almost 10 years. The first significant common scientific programme was 'Advanced Technologies for Communications (TAC) ' that was a part of the 2000-2006 Contract between the Nord/Pas-de-Calais Region and the French State (CPER). The TAC budget was about 15 M€ for the partners IEMN, PhLAM, CRIL and LIFL for the whole period 2000-2006. Two main collaboration domains were developed in TAC, the photonic devices between IEMN and PhLAM and the 'mobiles communicating objects' between IEMN and LIFL. In 2001 the Minister of research launched a specific plan for the development of research activities in the Nord/ Pas-de-Calais Region. The 'reinforcing research plan (PRR)' has led to the creation of an INRIA unit in Lille with a building of 4000 m^2 (8000 m^2 soon) and the construction of a new building (4500 m^2) especially devoted to interdisciplinary projects between scientists from IEMN, PhLAM, LIFL and INRIA. This new building hosts a specific unit called IRCICA (Research Institute in Devices for information and advanced communications) having for objective to launch federative projects and to support the development of three advanced technological platforms fully integrated in ICON:

- Telecommunication platform (IEMN)
- Photonic optical fiber platform (PhLAM)
- Virtual reality platform (LIFL)

For 2010, IRCICA has clearly a role of 'interdisciplinary project hotel' by welcoming scientists and research groups to work on projects needing the use of the technological platforms.
IEMN, LIFL and PhLAM have continued to develop common project in the 2007-2013 'Region State project Contract' (CPER) through a research project called 'Ambient Intelligence Campus'
The multidisciplinary Ambient Intelligence Campus (AIC) aims is to become one of the leading centers for research and innovation in Ambient Intelligence, a scientific field which is at the interface between information and communication science and technology (ICT), physical and mathematical sciences, chemistry but also life sciences. This project is supported by the expertise of local research units, the strong involvement of national research institutions like CNRS (the French National Centre for Scientific Research) and INRIA (the French National Institute for Research in Computer Science and Automatic Control), the Lille University, as well as the concerned competitiveness clusters, in particular ' Trade Industry', 'Material and Applications for Sustainable Use' and 'Transportation of the Future' in its communication and embedded systems dimensions.
The activity of the Ambient Intelligence campus is structured around three complementary research themes: (i) micro and nanodevices, (ii) ubiquitous computing, (iii) photonics. The links between the AIC and ICON is obvious since it gathers the same partners, use the same experimental platforms and facilities and share some common scientific objectives. With the creation of ICON, the scientific policy of the AIC will be slightly reconsidered and a clear division between ICON and AIC projects will be done.

4.2. ICON PLATFORMS AND FACILITIES

A specificity of ICON is to support the research activities with a complete and up-to-date set of experimental platforms and facilities. **All the platforms and facilities are described in detail in Appendix 1**. Several ICON facilities and platforms (micro and nanotechnology, optical fiber pulling, super computing) are nodes of national infrastructure networks while most ICON facilities and platforms have participated to the 'equipment of excellence (EQUIPEX)' call for proposal.



Nanocharacterization and scanning probe microscopy platform

The creation of this platform coincides with the emergence of the new domains of Nanoscience and Nanotechnology in the beginning of the 2000's years. With 9 microscopes, 250m² of laboratories and nearly 25 regular users, the platform is certainly one of the most important in France. It relies on two techniques that are the Scanning tunnelling microscopy (STM) and Atomic Force Microscopy (AFM) working under ambient or ultra high vacuum (UHV) conditions. A new UHV system, unique in France, called 'Nanoprobe' gathers 4 STMs and a Scanning electron microscope (SEM) in the same chamber. It was designed to make in-situ fabrication, nanoscale imaging and transport measurement of 1D and 2D nanostructures

Nanotechnology cleanroom facilities

The ICON micro and technological clean room (1600 m2 located at IEMN, 25 M€ equipments) is an academic research infrastructure of high performance processing and characterization tools. ICON technological facilities are organised in four technological resources: material, lithography, deposition and etching, process control and assembly. Each resource is constituted by a coherent set of equipment devoted to specific process steps. The ICON micro and nanotechnology facilities are one of the six large national technological facilities. Its mission is to support academic and industrials technological projects oriented towards long term and high-risk investigations mainly. The domains of applications cover information and communication of course but also health, transport, energy and environment

Optical fiber facilities

The Optical Fiber Techno-Center of ICON, installed in January 2007 in the IRCICA building, concentrate several original equipments devoted to the studies, modeling and fabrications of new optical fibres: photonic crystal fibers (PCFs) and internal total reflection fibre. These facilities are split into three parts: the modeling and characterizations lab, the drawing research lab and the glass synthesis lab. These three labs have the following missions: develop new processes, realize new fibres for scientific demonstrations and applications, and collaborate with academics and industrials partners.

RF characterization facilities

In this characterization center we group the common IEMN facilities for measuring the main electrical parameters of devices over a wide frequency and temperature range. In grouping specific high level equipment which cost of around 3M€, it is unquestionably unique in France and amongst the two or three best microwave characterization academic centers in Europe. Moreover, its expertise in ultra-high frequency device characterization is internationally recognized and allows an important role in the joint laboratories between the IEMN and several industrial firms, but also to collaborate with great foreign research centers for developing new techniques of characterization (Agilent Technologies, Rohde&Schwarz, STMicroelectronics and THALES).

TELECOM platform

This unique academic platform, one of the best in Europe, offers a large set of advanced scientific equipments for the development of new radio modules and communication systems, up to the millimeter wave range, particularly suited for wireless ad hoc or mixed radio-fiber networks for smart objects and sensors, towards an ambient intelligence. It provides large facilities for the design and for the temporal, frequential or vectorial analysis and characterisation of innovative analog or digital communication sub systems and systems up to 110 GHz. It is fully complementary to the ICON electrical characterization facilities which deals with device and circuit characterisation while the telecom platform aims at the generation and analysis of complex signals (UWB, OFDM, CDMA, QAM, etc.) and standards to demonstrate new concepts for wireless communication links including radio channel sounding. In addition, it includes a hardware-software interface sub-platform which enables the implementation of communication middleware and routing algorithms together with the programming of reconfigurable MAC layers thanks to advanced development tools.

Sensor network platform

The wireless sensor network platform in Lille is double. On one hand, it is composed of a node of the ANR TLCOM SensLab platform and on the other hand this platform is composed of

heterogeneous hardware devices for ad hoc developments.The former aspect of the platform is composed of 256 double WSN430 nodes among which 32 are mobile, together with the servers and injectors for the platform functioning. Sensors are composed of MSP430 and 2.4GHz. This platform is totally automatic in the meaning that a user willing to test an algorithm just needs to upload its code on the sensors selected beforehand through a web interface. This platform is totally open and can be used by any person studying wireless sensor networks. The latter aspect of the platform is composed of heterogeneous sensors that are connected for the ad hoc experimentations needs that can be interconnected.

Vitual Reality platform

The *Plateforme Interactions-Réalité Virtuelle-Images (PIRVI)* is a framework initiated in 2009 to highlight researches in the field of Computer Human Interaction, Virtual Reality and Images as well as to facilitate collaborations with industry. Six teams from the Lille's Computer Science Laboratory (LIFL) are part of the PIRVI. The teams are sharing and operating several mid-size research equipments. The PIRVI framework also have a strong activity in the dissemination of team expertises, this includes demonstrating new results to potential industrial partners (small and medium enterprises), political figures and, globally, to civil society. Several other virtual reality centers exists in france. The PIRVI equipment can be considered as on-pair with others Virtual Reality setups featuring state-of-the-art equipments that are regularly updated. What's make PIRVI unique in France is the very wide spectrum and versatility of its equipment allowing to build complex setup containing Immersive display, Motion tracking systems, Vision based systems, various multi-touch surface and haptics devices.

Supercomputing platform

LIFL labs. (Laboratoire d'Informatique Fondamentale de Lille) has been selected in 2004 as a partner of the Grid'5000 national joint project (ACI Grid) (https://www.grid5000.fr). The objective of such project was to acquire and install by 2007 a nation-wide grid infrastructure composed of 5000 computing units distributed over 9 sites (among them Lille) and interconnected by the French 10Gbps Renater academic network. The originality of Grid'5000 is to offer a controlled and highly reconfigurable environment allowing to perform experiments from parallel and/or distributed applications on a single cluster to large scale and multi-site experiments in grid or cloud mode. In 2008, Grid'5000 has been labeled "Très Grand Instrument de Recherche" (TGIR) of high priority, which illustrates the strategic importance of such infrastructure. In 2009, the University of Lille has been selected to join another grid infrastructure which is European-wide, called Enabling Grids for E-sciencE (EGEE) (http://www.eu-egee.org). Unlike Grid'5000, which is dedicated to develop and promote research in grid/cloud computing, EGEE is a production grid dedicated to validate scientific results in different application fields such as biology, earth science, high energy physics, etc.

5. TECHNICAL AND SCIENTIFIC DESCRIPTION OF THE PROJECT

5.1. STATE OF THE ART

These last years, Information and Communication Sciences/Technologies (ICT) have been a key enabler of globalization and its resulting intensified economic competition and development. ICT are now considered as being mature research fields by themselves and are dramatically business driven. Tools such as the 'web 2.0', very high-speed networks, 'ambient intelligence' and the ever-increasingly need to model, simulate, store and process large amounts of data and knowledge remain and will stay major challenging research topics. The increasing performance required in memory and processing, the agility required for ubiquitous communication, the mandatory energy-consumption reduction in all nomadic applications not only demand even more scaling and density but also more diversification in materials and in architectures, as well as innovative software-related concepts and tools.

For the next years, we can also foresee many new opportunities for ICT not only for being an innovation world per se, but also for being one key evolution driver in other domains like e.g. energy, environment, mobility/transportation, services and health, and, more generally, to contribute to the wellbeing of tomorrow society. For example, in the energy domains and sectors, novel ICT-based applications are needed to realize energy saving and energy harvesting. These same energy and environment sectors also ask for new co-design and new software to develop

networks of sensors for example. As another example, ICT also becomes more and more ubiquitous in the mobility sector -with the need to provide the nomadic user with e-services, or in addressing keys issues in the mobility sector itself like multi-modal transportation optimization and security issues. In the health domain, in addition to e-health issues, we are at the beginning of a revolution regarding personalized medicine, drug design, micro and nano-systems for diagnosis and therapeutic applications, all heavily depending on ICT specific innovations.

One of the great forces behind the ICT industrial revolution has been miniaturization, the repeated shrinking in size and price, of the devices that process, store, and communicate information. More devices per circuit and ever more affordable functions have enabled the industry to expand its products from giant mainframe computers, to incredible quantity of consumer products. Virtually every electronic product contains at least one microprocessor and e.g. game machines now pack the computational power of supercomputers from just a few years ago. However, the conventional technologies (CMOS) reach their limits for processing, storing, and communicating information. Moreover, industrial laboratories (especially French ones) have greatly reduced the focus on hardware research. As a consequence, hardware-related breakthroughs resulting from long-term research must increasingly come from universities, national laboratories, and/or industry-universities consortia.

To extend the ICT revolution, ICT scientists will be challenged to invent new devices for processing, storing, and communicating information will have to be invented. These will very likely be based on new and sometimes artificial materials and exploit physical principles that physicists and engineers are just beginning to explore. New molecular-scale structural elements such as carbon nanotubes, semiconductor nanowires and nanocrystals are also of great interest for the realization of new devices. What technology will allow information to be processed faster and cheaper than the silicon CMOS? In fact, replacing CMOS with devices that can be smaller and cheaper while dissipating less power is a huge challenge, but there are no scientific reasons to believe that this challenge cannot be met and one ICON objective is to participate in taking it up. ICON is particularly well positioned to address these challenges since it combines expertise and suited infrastructures for nanodevice research.

ICON will be particularly well placed to address issues related to software and interface between software and hardware. The repeated price and size shrinking of hardware components together with the ubiquitous use of computer-based systems whose applications have been exponentially expanded both in scope and use, leads to the emergence of a kind of global digital system (or 'sphere'). This system acquires properties that somewhat metaphorically resemble those of a living system: It is multi-scale both in terms of structure and contents, with many transversal interactions. It is the object of fast diverse evolutions. Universal standards are emerging (a kind of system 'DNA') although not as fast and systematic as it might be sometimes necessary. It closely interacts with its environment (be it human or e.g. though the 'internet of things', 'ambient intelligence' or sensors networks). It becomes vitally permanent: interrupt Internet one day and this will disrupt the planet and might cause deaths. This digital world fails, adapts, evolves and grows continuously. Mastering this complexity and its uncertainty requires new models and both novel hardware and software infrastructures, concepts and tools, which ICON will adress in its projects 'EVErlasting Numerical Sphere' ICON project) while innovative content processing techniques will be developedin its projects 'Mining and Optimization algorithms for Large scale Networks' and 'Artificial Intelligence'.

Instead of providing a detailed actual state-of-the art of ICT for which there is no place here, each of the ICON scientific projects will be presented in appendix 2, the document describing the ICON scientific projects in details, with respect to the state-of-the-art and its international competitive position.

However, in the following section, ICON is positioned with respect to the French National Research and Innovation priorities.

5.2. OBJECTIVES OF THE PROJECT COMPARED TO THE STATE OF THE ART AND IN RELATION TO THE SNRI

The French research and innovation priorities have been defined by the Higher Education and Research Ministry through its so-called SNRI report, which emphasizes top priorities. ICON pertains to and matches many of them.

First, the 'Information, communication and nanotechnology' SNRI priority is clearly the central ICON research area, which associates hardware and software approaches and studies. Especially, ICON will contribute to 'prepare the Internet of the future' sub-priority by increasing and improving the performance of Information and Communication systems by combining optical and electronic functions on the same wafer, and developing appropriate software concepts and tools. It will also contribute to designing new tools to master its complexity, both from hardware and software perspectives. ICON will also participate to the development of 'Intelligent and communicating objects' sub-priority since e.g. their fabrication is based on heterogeneous 3D integration.

ICON will also contribute to the 'durable and sustainable development of nanotechnologies in France' SNRI priority and to 'develop the software industry' one. Let us stress that ICON will not only meet this latter priority through its software research projects but also through its valorisation and educational actions. In the software field, innovation often comes from or through SMBs, which can be highly flexible and reactive. ICON valorisation policy for software-related results aims at promoting French ICT SMBs. Also, one goal of ICON is to actively work on goal-oriented basic research, that is to create advance knowledge able to generate innovative products and to interact with societal and economics needs.

With respect to the 'Environmental urgency and eco-technology' SNRI priority, ICON results will not only be used in the photovoltaic cells development but also in 'intelligent buildings' and 'vehicle of the future', which requires a huge number of 'intelligent sensors' fabricated through 3D heterogeneous integration.

With respect to the 'Health, care, nutrition and biotechnology' SNRI priority, ICON will contribute to the development of high-speed analysis techniques through the integration of sensors, microfluidics and electronic devices (lab-on-chip) and through the technologies for the autonomy assistance for disabled or old people. One of the ICON scientific projects, called 'Simulation Algo and Models for Bio And Medicine', gathers computer scientists, mathematicians and physicists, and collaborates with biologists and clinicians. It is devoted to processing and analysing high throughput sequencing data, deciphering and modelling dynamic interactions in molecular networks and simulation-guided therapy.

Amongst the SNRI priorities, ICON will also contribute to the transversal 'To build a high-performance and competitive innovation ecosystem' priority since among its several scientific objectives the ICON structure will allow to reinforce the continuum from early concept demonstration to integration in products.

5.2.1 SCIENTIFIC PROGRAMME

One important particularity of ICON scientific programme is that it covers 'niches of excellence' issues within a large ICT scientific spectrum. It includes research activities on hardware, software and systems, focusing on building blocks for future information and communication systems (artificial materials, molecular computer, everlasting software, artificial intelligence). In addition to fostering research activities on hardware, software and systems in each of these domains on their own, one salient feature of ICON lies in its support of multidisciplinary research projects at the interface between hardware and software (like wireless communication and sensors networks issues at this interface). This feature that has been developed for years within the consortium is quite unique in the French research landscape. Noticeably, ICON already benefits from international-level platforms and facilities covering its whole scientific spectra. In the hardware domains, this includes nanotechnology clean room facilities and an optical fibre drawing platform; in the software fields, this ranges from sensor networks to virtual reality platforms.

More precisely, ICON scientific programme is constituted by 7 innovative research projects that lie on the domains of excellence of the partner units.

- Artificial Materials: a nursery of breakthrough (ARM): *M. Douay* (PHLAM)*
- From Flexible to Vegetal Electronics (FOREVER): *E Dubois* (IEMN)*
- Molecular 3D computer(MOL-3D-COMPUTER): *D. Vuillaume* (IEMN)*
- Everlasting numerical sphere(EVENS): *D. Simplot* , PA Rolland*, S. Ducasse* (LIFL, IEMN, INRIA)*
- Mining and Optimizing large-scale networks (MOLN): *R. Gilleron* (LIFL)*
- Artificial Intelligence (AI) : *E. Gregoire* (CRIL)*
- Simulation Algorithms and Models for Bio And Medicine (SAMBAM): *H. Touzet* (LIFL)*

* Coordinators of the project working group.

All these projects will intensively use the technological platforms and facilities described earlier. **The ICON projects are described in detail in appendix 2**. In the following part, the abstracts of the 7 ICON projets are given:

Artificial Materials: a nursery of breakthrough (ARM)

Biotechnology, environment, optics, chemistry, photonics, health, robotics, electronics, there are many areas where the nano-world has been successfully introduced. The nano-world begins in the material by structuring at the scale of a few nanometers giving amazing properties to the initial material: this structured material can be called artificial material. This project is focused on the impact of the nanoworld in the optical and acoustic–properties of artificial materials for the realisation of scientific and technological breakthroughs. Nanoworld includes nanoparticules, nanorings, nanotube, nanobridge that can be combined with ferroic properties into the materials. This combination allows the artificial material to gain more functionality. Moreover, nanostructures can be realized with periodic or random scheme in homogenous or composite materials. These new artificial materials will be able to guide, to confine, or to radiate light or sound in useful and previously unimaginable ways mixing optical and sound waves, optics with electronics, physics of critical states and the nanoscale. Applications of these artificial materials can be in solar cells, thermoelectric materials, nanoscale lasers, metamaterials, optical photonic crystal fires, elasto-multiferroic nanostructures devoted to micro-magneto-electro mechanical systems, ultrasonic imaging, magnetronics, therapeutic and theragnostic systems. This research project will focussed first on the deep understanding (theoretical and experimental aspects) of the interactions between nano-objects. This is the key for the elaboration of new nanostructured artificial materials proposed in the three–applications oriented studies: elasto-multiferroic nanostrutures, metamaterials and photonic crystal fibres.

The first step of this project will be focussed on the theoretical and experimental research to study interactions between nano-objets, to predict how they can be at the origin of new properties, and to identify hybrid excitations (phonons / electrons / photons / plasmons) which are strongly enhanced in these systems. On the experimental side, charge transport in nanostructured (& strained) materials will be probed directly at the nanoscale using revolutionary near-field microscopy approaches, i.e. a multiprobe scanning tunnelling microscope and an AFM/STM apparatus based on ultra-stiff sensors. Coupling of light, plasmon and acoustic waves in artificial crystals will be studied using ultrafast laser spectroscopy. Intraband transitions and mechanical vibrations of coupled nanostructures will be probed by THz spectroscopy. On the theoretical side, modelling of properties of artificial materials will be done using a unique combination of methods: molecular dynamics, ab initio and semi-empirical electronic structure calculations, electromagnetic and phononic simulations.

The research dedicated to elasto-multiferroic nanostructures and active materials combines the physics of critical states and nanotechnologies for new artificial materials in order to provide totally specific properties non-available in already known active materials. The research will address the extraordinary fundamental properties of the magnetic and/or electric sub-systems coupled to elasticity in the vicinity of the critical states, the technological strategies dedicated to the tailoring of the critical states and properties of the nanostructures and active materials, and to the development of innovative applications for Micro-Magneto-Electro-Mechanical Systems (MMEMS), multifunctional electronic components and magnetronics, and innovative nonlinear ultrasonic imaging, therapeutic and theragnostic systems.

Metamaterial represents an important type of artificial materials studies included in this project. The main target of this research will be unprecedented electromagnetic and acoustic waves controlling. Toward this goal, we will took advantage of the so-called space transformation

techniques aimed at controlling wave propagation by using effective parameters gradients, in the framework of effective medium theory. Contrary to conventional controlling techniques making use of interfaces via reflection and refraction effects or taking benefit of diffraction, new paradigms will be developed, via mirage, super-scattering and cloaking effects to mention a few. The use of metamaterial technology will allow the practical implementing in anisotropic (channeling) or isotropic (all angle) approaches depending on the specific applications. The breakthroughs from the application side will concern (i) breaking of the so-called diffraction limit (Raleigh limit) notably in far field by using hyperlens concepts, (ii) Full 3-D optical flat lens integrating metal and dielectric isotropic inclusion and (iii) cloaking of a scatterer so that it becomes invisible for electromagnetic and acoustic waves .The end uses are numerous covering a very broad spectrum involving CEM or smart miniaturized devices in the long wavelengths or imaging systems in the short ranges.

The advent of Photonic Crystal Fibers (PCF) is based on the creation of a microstructured cladding distributed around a core of silica (solid) or a hollow core. This artificial material allows better controlled conditions of light propagation and finds already applications and market. The maturity of the manufacturing processes of micro-structured fibers makes possible the transition to the nanoscale. Although extremely rich and extensively studied during this last decade, the optical characteristics of PCF suffer from a lack of possibilities in the dispersion management of this artificial material. Moreover, exchanging information between optoelectronics devices and optical fibre is still a bottleneck because of the need of bulky systems to connect optical field into the fibre. In order to go beyond these limitations, this project proposes to introduce the nanoworld into the photonic crystal fibre (i.e. the nanostructuration into the microstructuration of the fibres). In order to illustrated the tremendous capacity of introducing the nanoworld into optical fibres; this project is developed under 4 tasks like building electronic functions in the fibres by processing silicon wires in optical fibre, long-haul optical telecommunication systems covering distances between 100 km to more than 6 000 km using multimode fibres, optical nonlinear fibre will be more efficient than bulk nonlinear crystal, random fibre lasers leading to fundamental scientific results and applications.

In conclusion, nanoworld introduced in artificial materials allows the possibilities new amazing scientific results, paradigms and applications through disruptive approaches. New theoretical models and experiments (linear and nonlinear), simulation software, algorithms, fabrication processes, system design rules are needed for these disruptive approaches.

From Flexible to Vegetal Electronics (FOREVER)

From Flexible… Foldable, thin, light-weight, stackable, heterogeneous – that's the promise that flexible electronics holds today. As recently reported in the last edition of the International Technology Roadmap for Semiconductors (ITRS'09), *'Flexible electronics is projected to grow into a multibillion-dollar industry over the next decade and will revolutionize our view of electronics. […] It will enable a broad range of devices and applications not possible today.*' To illustrate this statement, it is easy to understand that flexible systems-in-foil (SiF) are particularly well suited to the development of nomadic and space-weight-and-power (SWAP) constrained applications. Smart systems featuring ubiquitous intelligence such as wireless sensor networks (WSN), micro-aerial vehicles, embedded defense, security and biomedicine chips, environment monitoring and smart textiles are all applications that flexible electronics would make take off. Beyond this enthusiastic perspective, one has to recognize that flexible electronics is quasi-exclusively synonymous with organic and printed electronics. Although devices such as flexible OLEDs (flat panel display and solid-state lighting) are progressively penetrating the consumer electronic market, many other applications requiring mechanical flexibility, conformability, ultra-thinness and large frequency bandwidth struggle to come up because of poor carriers' mobility in organic semiconductors and/or limited resolution of low cost printing techniques. In that context, **a first overall objective is to considerably improve the current state-of-the-art through the development multi-GHz flexible electronics**. To realize this intermediate goal, three complementary workpackages covering i) material engineering (WP1), ii) heterogeneous integration of high-frequency devices/circuits (WP2) and iii) flexible sensors/actuators (WP3) have been set up to enable the demonstration of flexible electronics for smart wireless technology. Based on a well established expertise, recognized know-how and collaboration network, our firm conviction is that millimeter waves (mmW) applications on flexible substrates can be developed in this project over a 4 years time frame.

To Vegetal electronics But the project ambition goes well beyond the sole scope of conventional solid-state approaches by considering **-inspiration from, -interaction with and -transposition to … the vegetal world**. At first glance, electronics and plants have very little to share. Nonetheless, properties of flexibility, stretchability and torsion resistance that are highly desirable in smart electronics applications constitute a trademark of the vegetal world. It is therefore the long term objective of this project to combine the properties and functionalities of 'sister plant' and 'brother electronics'. For that sake, a progressive approach that hierarchically introduces complexity is proposed to mitigate risk and maximize dividends. In that spirit, a first straightforward route that combines both electronics and plants is to reproduce basic vegetal construction patterns to considerably enhance the compliance and robustness of flexible circuits and systems (WP4). A second step will be to introduce the concept of collaborative hybridization between plants and miniaturized wireless solid-state systems that would render possible information sensing and energy harvesting from vegetal bodies (WP5). Last but not least, **the ultimate goal of this project is to develop the concept of vegetronics, a vegetal-inspired new paradigm for signal processing** (WP6).

In terms of scientific and technological results, it is the ambition of the medium term research developed in the first three workpackages to boost the development of flexible, ultra-thin, light-weight, heterogeneous and high-frequency integrated systems from the exploratory to the maturity stage. WP1 will significantly facilitate access to high-frequency performance through the adaptation of industrial semiconductor technologies to a highly flexible ultra-thin regime or through the implementation of exploratory nanostructured materials (e.g. graphene, CNT, NWs). Based on the development of four flex-compliant complementary semiconductor flavors, WP2 is projected to push low frequency performance and lowly integrated flexible applications into the multi-GHz and high density regime. In WP3, the heterogeneous integration of signal processing and sensor functional blocks holds the promise to leverage the development of smart, autonomous and mobile systems that can sense and transmit information wirelessly.
At longer term, the program on vegetal electronics proposes a sound approach to hierarchically combine the benefits of electronics and vegetal worlds. First, understanding and mimicking vegetal micro and nano-structured designs are expected to help clearing locks of highly flexible circuits and implementing default-tolerant architectures (WP4). The two last workpackages lead to a more intimate mixing between electronics and vegetal worlds. Electrical, mechanical, chemical and fluidic interconnections at microscale are obviously technological key points, and acquiring, processing and interpreting the corresponding vegetal signals are challenges at the frontier of the current scientific knowledge (WP5). At longer term, a major breakthrough is foreseen and consists in building a new paradigm for signal processing circuits that leave aside today's solid-state approach. Not only vegetal based substrates and materials will be combined to produce such circuits, but operating biomechanisms will also be used as new schemes for signal processing, thus enabling the development of novel circuits and systems with extraordinary new properties (WP6).
From an economic and societal perspective, the potential to exploit high-frequency flexible is enormous and contribute at its own scale to the SNRI (National Strategy for Research and Innovation) policy in terms of competitiveness and attractiveness, health, security and sustainable energy. In the long term, it is anticipated that coupling electronics to the vegetal world will also pave the way for unprecedented, environment-friendly, low cost and virtuous applications such as environmental monitoring, ephemeral biodegradable electronics, home and city climate management using controlled and actuated vegetal bodies.

Molecular-based 3D neuromorphic computers (MOL-3D-COMPUTER)

Summary

Molecule-based devices are envisioned to complement silicon devices by providing new functions or already existing functions at a simpler process level and at a lower cost by virtue of their self-organization capabilities. Moreover, they are not bound to von Neuman architecture and this feature may open the way to other architectural paradigms. Neuromorphic electronics is one of them. This challenge for the development of a new generation of computers has induced a lot of efforts in neuroscience computation activities and the framework for the spatiotemporal processing of information seems to be theoretically achievable. As the human brain contain more synapses than neurons (~ 10^4), it is mandatory to develop a nano-scale, low power, synapse-like device if

we want to scale neuromorphic circuits towards the human brain level. This feature has recently prompted the research for nano-scale synaptic devices. We recently demonstrated that a nanoparticle organic memory field effect transistor (NOMFET), a single organic device including the function of both a transistor and a memory, can exhibit the main behavior of a biological spiking synapse, i.e. short-term plasticity (STP) for dynamical processing of spikes. We call such type of devices a ***synaptor*** (synapse-transistor).

Objective 1. *In this project, we will explore the behaviors and functioning of 2D arrays of SYNAPTOR for use in neuromorphic circuits. Also, beyond the NOMFET concept, we will investigate a new type of synaptor. The Optically-gated Nanoparticle Organic Memory FET (OG-NOMFET) will overcome some limitations of the NOMFET and add new functionalities to program and teach neuromorphic circuits based on 2D arrays of such synaptors.*

At a more molecular-scale, molecular switches and memories have attracted a great interest. Molecules are quantum object by nature and their properties can be tailored by chemistry opening avenues for new experiments. Moreover, molecule-based devices are envisioned to complement silicon devices by providing new functions or already existing functions at a simpler process level and at a lower cost by virtue of their self-organization capabilities. Molecular switches and memories were suggested at the early stage of the molecular electronics history. However, these molecular devices alone are nor able to reproduce the neuromorphic properties such as STP and learning.

Recently, Wendin and co-workers (Chalmers University) theoretically demonstrated that functional molecules (i.e. molecules bearing some non linearities of their current-voltage curves) linking a 2D arrays of metal nanoparticles can be programmed (or learned) post-fabrication. The ground breaking new results was a demonstration, by programming by the edges without direct external access to individual links (i.e. molecules), how to configure the untrained "nanocell" after fabrication to become a specific type of circuits.

Objective 2. *The aim of this project is to implement such a molecule-NP network in both 2D and 3D, establish multi-level electrical connexions on them and to demonstrate a functional neuro-inspired behavior in such systems.*

The Mol-3D-Computer project work program represents challenging research at the leading edge of field of nanosciences, physics, chemistry and information computing. This is, by definition, high-risk with a concomitant very high level of potential return. The development of molecular-scale ICT devices and systems is an issue that affects the future of global nanoelectronics and of industries related to it. By going well beyond an incremental improvement of existing knowledge, the objectives of this project aim at sustaining long-term growth in all these areas, and contributing to the development of new knowledges as well.

Everlasting numerical sphere (EVENS)

Future Internet, includes numerous potential applications and scientific challenges, ranging from smart dusts or wireless sensor networks to large-scale distributed and autonomous systems such as cloud computing or Internet of physical world. The advent of Future Internet requires being able to achieve everlasting software systems as well as efficient ICT components with properties like energy-efficiency. To respond to these challenges we propose three original projects in the hardware and software domain.

Autonomous wireless sensor & ID nodes for green monitoring (AWSN). To be deployed to monitor and protect environment for long periods of time, wireless sensor network nodes need a power source together with an ultra low power design. Such intelligent and autonomous nodes should be miniaturized ($<1cm^3$) using heterogeneous integration. In addition, in millimeter-wave (mm.wave) impulse radio ultra-wideband ad hoc networks, classical models are not valid anymore for capacity and performance evaluation. New models based on the α-stable random variables and processes will be used to study and define optimal receivers in this context.

Future Internet, Internet of things. Wireless sensor and robot networks (WSRN) are the next step to provide new applications in the Internet of the physical world. These networks combine sensing, processing, and wireless communications in one small, low-power sensing node.

While wireless sensor networks (WSN) have already been well studied, they still suffer from the lack of experimentations and scalability, and do not consider realistic physical layer which requires hardware-software optimization. We will study both efficient data communications for WSRN as well as coordination and collaborative robotics.

Everlasting dynamic secure software. Software must evolve on large and multi-scale alive environments. In large-scale software systems, it is recognized that 80 % of the statement cost lays in maintenance and evolution. This project aims at providing mechanisms and frameworks which guarantee the agility of complex systems. In such systems, we are confronted with two main issues: evolution and dynamicity of applications as well as doing that in a secure manner.

Mining and Optimizing large-scale networks (MOLN)

Key words: knowledge extraction, data mining, machine learning, optimization, streams, multimedia data, large-scale networks, multi-objective analysis.

In our society, large scale networks problems are pervasive as witnessed by our dependency on physical networks that provide goods, energy, and information. Moreover, a large number of systems can be modeled using logical networks, as in social, biological or information networks. The project is two-fold: extract knowledge from information networks; define optimization algorithms for large-scale networks.

Mining large volumes of multi-source data on the stream for information networks

Information is currently available through large scale networks of entities. For instance, consider social networks where entities are users connected to each other by their social affinity, or also the Internet of interconnected computer networks, sensors, smart phones or servers. All these networks can be modeled as graphs of nodes, corresponding to the entities, and edges, corresponding to the relations or links between those entities. Further than this, these network graphs are not simple structures: they are characterized by being dynamic and evolving in time, by gathering large volumes of data and by being remarkably heterogeneous in content. Typically, entities in networks exchange and produce disparate types of data in large volumes, such as log files, texts, documents, audio files, images or videos among many others; this large scale data comes from multiple sources and therefore, it has to be traded and processed in a streaming fashion across the network.

These complex graphs pose crucial research challenges. One of them concerns the *extraction of knowledge* from the network in order to make the information usable by humans or agents. This constitutes the main goal of the data-mining field, in which efficient algorithms for information extraction are enhanced with statistics and machine learning techniques. The prime objective of this project is *learning, mining and analyzing large volumes of heterogeneous, multi-source, streaming data in networks*. The challenges we will face are: data and streams of data are heterogeneous; data is large scale; data is structured in a network; data is dynamic; data comes from multiple sources (text, documents, images, videos,...); multimedia data is variable. We will study and define mining algorithms and learning algorithms adapted to these challenges. We will put the emphasis on Web documents (XML documents), images (two dimensional and three dimensional) and videos. The applications we will consider are in the context of the World Wide Web and of social networks, and of camera networks. The main targeted applications are human behavior understanding, recommendation systems and social networking; the application domains are e-commerce and Web technologies.

Resulting from the project, we will deliver software corresponding to the main technical contributions of the project. As a common parcel for these software contributions we propose to develop a prototype platform for visual media-based social network, that is an adaptive social network built out of Internet multimedia contents: relations between users are inferred from contents and these relations evolve over time. Our platform will provide the common ground for testing the algorithms developed in this project and will be used as our benchmark application. We expect that our platform will suggest new social networks concepts and technologies.

In order to meet our objectives and confront the associated challenges, we will combine and cross fertilize competences of four research groups: **Sequel**, world-famous in reinforcement learning and sequential learning for defining adaptive algorithms on data streams; **Mostrare**, leader in XML database theory and structured machine learning for the study of streams of

structured data and the definition of learning algorithms over trees and graphs; **Fox** and **Miire**, leaders on multimedia mining and indexation of 3D-images for indexing, mining and analyzing image repositories and video streams. It should be noted that very promising young researchers have been recently recruited in the four groups.

Optimization of large-scale networks

Networks provide a common and general framework for modeling and analyzing problems that often have wider applicability than their originating context. Those large scale models give rise to very difficult optimization problems of constantly increasing size and complexity due to both the growth of network size and increasing concerns about sustainability, reliability, and robustness.

Moreover, a large part of real life network problems are subject to multiple criteria and uncertainties due to, noisy, approximated or unknown objective functions, data and environment parameters. Dealing with uncertainty and multiple objectives is essential to make a more realistic modelling of real conditions. For instance in transportation networks, vehicle routing problems (VRPs) are classical problems where the aim is to determine a set of routes that one or more vehicles should undertake to collect, deliver or transport goods and/or people. VRPs are particularly concerned by the presence of multiple objective (e.g. cost, quality of service, environment impact) and uncertainty in their data; e.g. stochastic travel time of the vehicles caused by the presence of traffic jams and/or atmospheric conditions (snow, pollution restriction speed), stochastic demands and customers, and risk nature of the goods.

The main goal of this project is the *multi-objective modeling and analysis of large scale network problems under uncertainty*, *the design of robust and scalable optimization algorithms*, and innovative case studies of real-life network applications in logistics/transportation, energy and communication networks.

Optimization on networks is a classical subject in combinatorial optimization. However our proposal aims to tackle several scientific challenges which have not been addressed according to the best of our knowledge. First the problems considered will be defined on large scale networks but will also be characterized by either a multi-objective function, or a bi-level structure or some uncertainty in the parameters. This will lead us to tackle a variety of relevant problems with complex combinatorial structure which have hardly been addressed in the literature. Second we will define some generic optimization frameworks based on the hybridization of different approaches. Indeed our objective is not to tune a specific algorithm for a given problem but to propose a flexible approach providing high quality solutions to various variants of the same problem. Last, due to the large scale feature, devised frameworks will have to be implemented on some high performance architecture to provide solutions in a reasonable amount of time. The research group is **Dolphin** which is a leader in multi-objective optimization and parallel optimization methods.

Artificial Intelligence (AI)

« What about the human contact in all that? »
« Get your elbow out of my keyboard! »
(Ph. Geluck. «Le Chat», Casterman)

This project will be conducted by the most internationally visible members of the CRIL laboratory. As explained above, CRIL already exhibits a strong critical mass and a high international presence in the symbolic Artificial Intelligence (A.I.) research field.

From a strategic point of view, this project aims at helping the involved team to increase its leadership in the international scene with respect to two major sub-fields of A.I. The more global goal is to reinforce the CRIL position as a major centre of excellence in symbolic A.I. and as a key player in the global competition in this domain.

From a scientific point of view, this project addresses two main advanced challenges that are considered « hot » topics by the A.I. research community and that are currently the object of an intense international research competition in which the CRIL team already exhibits very good results records.

The two challenges are:

1. push the envelope of the best current techniques to solve significantly larger and harder real-life instances of NP-hard A.I. reasoning-related paradigms;
2. design systems that are able to take decisions and reason in the presence of various complex preferences.

These two challenges are addressed through two closely interdependent Workpackages (WP) that will form a central project within the CRIL research program for the next five years.

The principal investigators of the A.I. project are: Eric Grégoire (Project leader), Pierre Marquis, Salem Benferhat and Lakhdar Saïs (all WPs co-leaders), accompanied by other CRIL researchers exhibiting excellent research results records in the targeted fields. The full lists of involved permanent researchers are given after the summary of each WP. The whole project is described in details in the Annex.

Simulation Algorithms and Models for Bio And Medecine (SAMBAM)

Molecular computational biology is a rich and diversified research field that has always been accompanying advances in the understanding of cellular mechanisms. In this picture, genomics

plays a central role as the alphabet of life. Sequencing technologies already permitted the completion of hundreds of genome projects. This phenomenon is dramatically amplified by the recent proliferation of Next Generation Sequencing (NGS) that outperforms conventional sequencing methods and allows to address a broad range of applications in genomics, transcriptomics, epigenetics. NGS and soon to come third-generation single molecule sequencing promise to open the way to personal genomics. A number of disease-oriented human resequencing projects that include large cohorts of patients are already underway. These projects should help us to enhance our understanding of the complexity of the genotype-phenotype relationship and accelerate drug and diagnostics development. Within the next decade, we also expect that having individual sequence and expression data will become a reality and will enable the prescription of specific treatments. This novel situation raises a number of exciting computational challenges and difficult questions to make sense out of this huge amount of data and infer biological knowledge from it.

Processing and analysing high throughput sequencing data. A single sequencer generates terabytes of data per run. At the first step, there is a critical need for efficient and accurate algorithms to process the raw sequences. Existing mapping software still needs several days of CPU time to handle eukaryotic genomes such as the human genome and tends to lack of sensitivity. This is a bottleneck for large resequencing projects. We will tackle these issues using advanced techniques coming from string algorithms, compressed dynamic indexes, high-performance computing and statistics. Once sequence data is mapped, the main problem is to mine it and find relevant and significant variations to identify mutations in disease pathways. Knowledge discovery in such data requires deep expertise in classification, machine learning, statistics and combinatorial optimization. We will address these problems both at the genomic level with Genome Wide Association Studies and transcriptome level, with analysis of expression data. In this line of research, gene expression analysis should also be greatly enhanced by incorporating heterogeneous sources of information coming from known interactions, such as protein-protein interaction networks or gene regulation networks.

Deciphering and modeling dynamic interactions in molecular networks. Beyond sequences and individual genes, it is now recognized that network-level approaches are key to many forthcoming medical advances, both for diagnosis and therapy. Major diseases like cancer are linked to disruptions of the regulatory networks and signaling pathways controlling cell division and proliferation. Understanding how the cell harnesses the dynamics of its networks is a central aim of computational systems biology, which requires tools from complex systems. We intend to study the dynamical ingredients of cellular network robustness in a few test cases featuring cell cycle control, signaling cascades, transcriptional regulation, and biological clocks. Furthermore, modeling and simulation are now reaching the required maturity to tackle the design of small artificial networks or to predict the effects of modifications of natural networks. They are becoming increasingly relevant to synthetic biology. The field is very young and has attracted a lot of interests within the last two years. We will use approaches coming from simulation, formal verification and reinforcement learning techniques to model interactions and deal with lacking system parameters. As a concrete case study, we are specifically interested in artificially enhancing the synthesis of nonribosomal peptides, which have not been tackled by modeling and simulation so far and are of significant interest for drug development and discovery (antibacterial, antifungal, antiviral, immunosuppressant, and anticancer).

A fully-interdisciplinary environment. This research program gathers scientists in computer sciences, applied mathematics and theoretical physics who are well-identified and have complementary expertise in their scientific field. The SEQUOIA team has a strong background in discrete algorithms and models for computational biology with applications to genomic sequences and nonribosomal peptides. The MODAL team is specialized in model-based classification and data visualization, with main applications in biology. BIOCOMPUTING and NON LINEAR DYNAMICS are experts in systems biology. DOLPHIN brings its competency in modelization and resolution of large multi-criteria combinatorial problems. SEQUOIA and DOPLHIN also share a common expertise into high-performance computing. Importantly, our research will be conducted in close interaction with leading research groups in biology at the local level, among them Neximed, the Institute for personalized medicine in Lille that includes an ambitious genomic workpackage for the study of Alzheimer's disease and multifactorial diseases (diabetes, obesity), as well as the sequencing platform of the CHR of University Lille 2 for cancers. We expect significant methodological

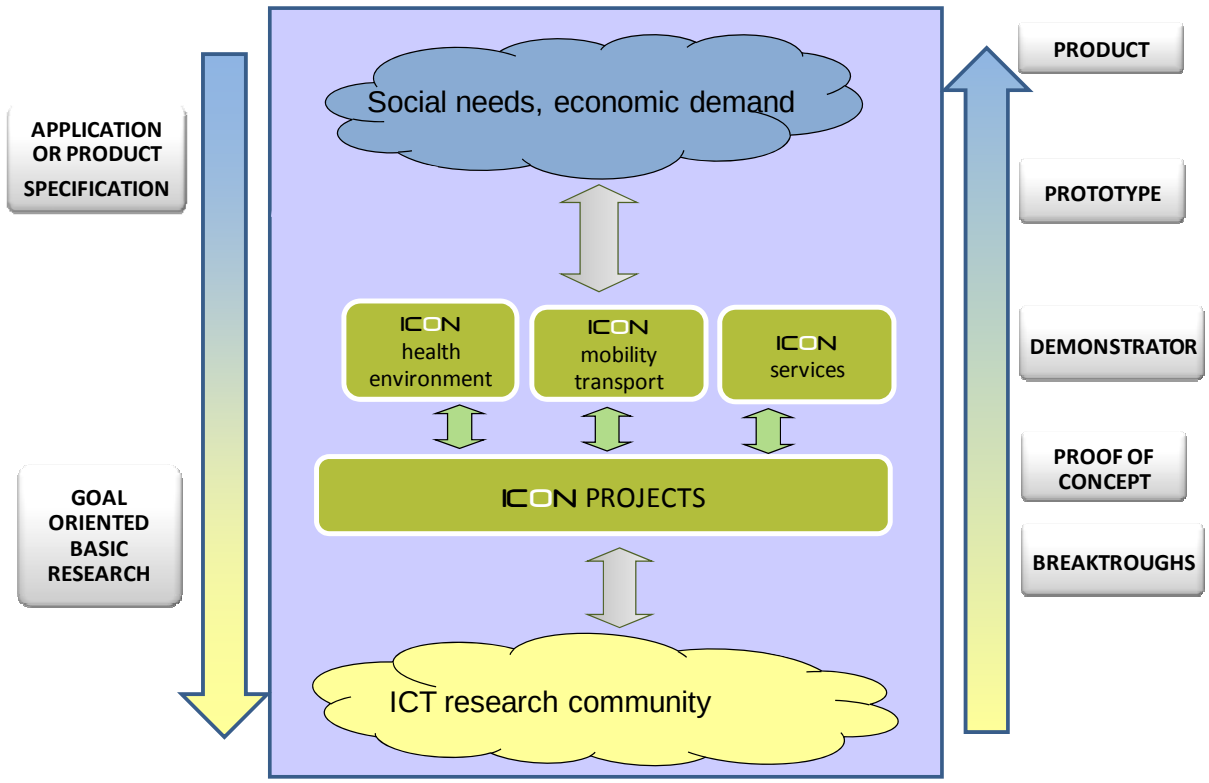
contributions from this project. A key success factor wil be the development and the diffusion of effective software that will be made freely available to the biology community with the help of the Lille RENABI bioinformatics platform.

Simulation guided therapy Simulation-Guided Therapy The variety and complexity of Medicine, as well as its ethical importance in today's society, have been a strong motivation in many scientific and technical disciplines. The medical field has already been a domain of application for computer science and several tools, such as image processing, are now an integral part of modern medicine. Yet, there is no question that the integration of new technologies in Medicine will continue to rise in the future. In this context, the simulation of medical procedures, whether it is targeted at training, planning of interventions, or even guidance during procedures, will be a major element of the Medicine of the twenty-first century. The potential impact of medical simulation on the medical field are enormous and we probably only imagine a small subset of the possibilities it offers. Ten years ago, when some of the first scientific breakthrough were made in the field, only a handful of people imagined that today, physicians around the world would rely on simulation in various aspects of their training, or that the Food and Drug Administration in the USA would mandate the use of simulation prior to the access of a new medical device for carotid stenting. This rapid evolution resembles the one taken by medical imaging, and we can only imagine what the combination of imaging and simulation will lead to, in a decade or two.
In this context, what we propose is not only to further improve the realism of current simulations for better, more immersive training, but to extend the use of simulation beyond training, so that it becomes an element of planning and guidance during interventions. This will require several breakthroughs, in various areas of the multidisciplinary field of computer-based medical simulation. Starting from a strong background in this field, we propose to extend our research in several key areas, such as anatomical modeling, biomechanical modeling, parallel and GPU computing, physiological modeling, and interaction models. To pursue these directions we have assembled a team with a multidisciplinary background, and more importantly we have established key collaborations with academic and clinical partners. Among these collaborations is a network of researchers at INRIA and in other institutions which are part of a large scale initiative on Medical Simulation that we are leading. Through this collaboration we have already made important progress, for instance in the area of biomechanical modeling of the liver, in the field of complex interactions between medical devices and anatomical structures, or for describing complex blood flow patterns near aneurysms. This collaborative network also benefits from the development of the SOFA framework, which is also led by our group.
A common element among the objectives and challenges of this research program is the notion of interaction. It implies that the simulations we develop are computed in real (or near real) time, and that the presence of a user in the loop is accounted for (through the use of dedicated hardware devices, haptic feedback and robust algorithms). This requires to develop accurate models, coupled with fast and robust computational strategies. The research directions we propose to follow essentially aim at improving the realism and fidelity of interactive simulations of medical procedures. This increase in realism will permit to address new clinical applications, in particular pre-operative planning and per-operative guidance, that currently rely on imaging techniques, but could greatly benefit from simulation techniques, thus enabling what we could call "simulation-guided therapy". To reach these clinical objectives (without forgetting training) we have identified several key areas where important improvements remain necessary. Most of these research areas are at the intersection between several scientific domains. They include real-time biophysical models (to define new models describing soft tissue deformation or physiological phenomena, and to develop computational strategies to enable real-time computation even with the increase in complexity of future models), models of therapy (to describe the action of medical devices on the anatomy whether this action is mechanical, electrical or chemical), and interaction models (to account for a variety of constraints between anatomical structures as well as tissue-tool interactions). The SOFA framework (www.sofa-framework.org) will be used to synthesize our various contributions and integrate them in a series of prototypes. These prototypes will span across several clinical areas and will serve as a basis for transitioning from training to planning to guidance.
If we succeed in this research, key aspects of Medicine will change forever: training will no longer put patients at risk, physicians will be able to maintain and assess their credentials, and interventions will be personalized, for safer and more effective therapy.

5.2.2 DISSEMINATION AND TRANSFER OF RESULTS AND EXPERTISE

Beyond its aims in research, ICON has set itself ambitious goals with respect to communication and innovation in the wider community which it seeks to serve. In addition to disseminating information about the project, its objectives, the approaches and results, ICON aims to:

- To facilitate collaboration and information exchanges between ICON partners;
- To create a communication channel with academic communities and industry for disseminating the project deliverables and conclusions;
- To promote the use of developed technologies amongst the academic research community and industry;
- To ensure that the products of the project live on in a commercial context, in the research community and in the Open Source community;
- To create viable technology transfer to industry.



The dissemination of knowledge to the external world will include a large variety of academic and industrial players and will interact closely with all technical activities. IN order to disseminate its research results

- An ICON website will be activated for the project with restricted pages reserved for the ICON partners. This site will permit easy communications between partners and the on-line form will allow the dissemination of information in a timely and cost efficient fashion to a wide audience. The website will display public information about the project and will be linked with other relevant web pages (Lille1, CNRS, INRIA, etc.). The web site will also be used as a resource for internal and external information dissemination. All project documentation draft and final versions, including presentations made at consortium meetings, will be held on a secure section of the site.
- The ICON partners will promote the results obtained in the project via the normal routes such as refereed journals, selective international conferences and patents.
- The ICON results will be also presented during national workshops such as the ‘annual ICON partner meeting’.

Dissemination of the work will create awareness among academic and industrial players. It intends to create a viable technology transfer and exploitation plan.

Technology transfer

Licensing agreements with existing companies, creation of spin-off companies are typical modes of exploitation of research results that the ICON partners will consider in the most appropriate ways. Among the exploitation activities that could be carried by the consortium, the partners will particularly lead the following actions:

- The partners will identify and maintain a list of the (inter)national companies that could be interested in exploiting the technologies developed in ICON.
- Creation of three working groups: ICON health, ICON transport and ICON e-service leaded by industrial representatives focusing on applications.

In addition, all the partners will try to use their know-how to transfer successfully the results of the project to companies, in particular SMEs with the help of the PRES valorization 'Valo Centre' service. This PRES service already carries out the following tasks and missions, which will thus be made available to ICON.

- Awareness raising: training and information for researchers
- Detection of research results with applied economic potential, and transferable to economic actors (all kinds of companies, either already in existence or being created). This identification work includes assement of scientific, legal, technical and economic factors, well beyond just active monitoring of research.
- Help in project development: scientific evaluation, identification of stepping stones to cross/obstacles to clear, with means available to attain the goals;
- Protection, exploitation of viable results to include, effective industrial protection;
- Research of opportunities, markets and industrial operators likely to follow up research results, and to develop, exploit and commercialize them through key innovation strategies;
- Negotiation of research partnerships, of transfer and concession of rights on inventions and innovative know-how transferred to industry, plus the actual drafting of appropriated contracts and agreements;
- Incubation, creation, financial support mechanisms and monitoring of start-ups and spin-offs, promotion of research work within the PRES ULNF.

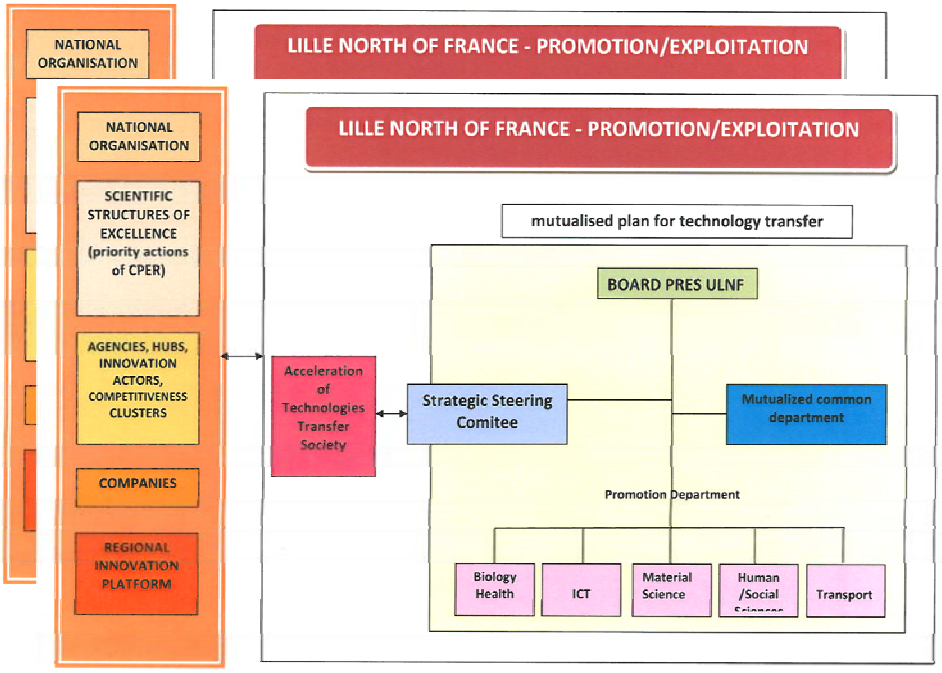
These development activities and procedures have been organized at regional level which is the right scale for high level skills to be mobilized and optimized. The PRES ULNF has decided to group together the existing development structures in a 'SATT' ('Acceleration of Technology Transfer Company') named 'Nord de France Valo'. The organization of the Lille Nord de France Valo Centre provides every researcher in the Nord- Pas de Calais with quality service in terms of project engineering, help in drafting projects, the handling on intellectual property, mediation with addressing economic conditions, undertaking market research, and also with contracts or negotiating.

Considering the research areas of the future SATT, the PRES ULNF and its partners have devised their project with the nine competitiveness clusters of our inter-regional area, including: *ITRANS* (Transport), *NSL – Nutrition Santé Longévité* (Biology / Health), *PICOM* (ICT and Retailing of the future), *MAUD* and *UP-TEX* (Chemistry and Materials), *IAR* (Agro-resources), *TEAM* ² (Energies) and *AQUIMER* (Halieutics).
The SATT, as a unique service centre for researchers and companies, will become a privileged interlocutor for the competitiveness clusters in terms of the identification of innovative projects and collaborative partnerships.
It will integrate the incubation activities, project engineers (promotion, R&D, business) from specific regional actions, and a part of the activity of an ADER (regional economic development agency), etc.
The organization of the SATT will be based on the strengths of its activities and competences. A first strand will gather the legal, economic, fiscal, and strategic competences in relation to the intellectual property issues (management and exploitation of the patent portfolio) in a specific cross-disciplinary department. A second strand, the financial department (heart of the SAS –

Simplified Stock Company) will be in charge of the financial and funding strategy as well as the recruitment policy. A third strand will cover the management and the follow up of projects such as industrial contracts (collaborative contracts and service agreements), European and international contracts, and national contracts (including the contracts with the ANR, the French *national research agency*). A fourth strand will be organized around both top-down and bottom-up activities of economic promotion including marketing research, economic benchmarking, and industrial prospecting for technology transfer.
Finally, a disciplinary interface unit will be organized around 7 thematic departments on Biology and Health, ICT, Materials science, Transport, Human and Social Sciences, Environment and Agro-resources. Follow-up committees will be set up for each thematic department to ensure their smooth functioning and to coordinate promotion activities with full respect to the rules of confidentiality and the code of ethics.

The SATT activities will comprise raising awareness, detection, maturation, protection and management of the intellectual property, contracts and project management, transfer and incubation, and finally business engineering.

The software economy differs from the classical model of technology transfer. In particular the importance of patents is not decisive. For this, the French institutions provide for the establishment of a CVT devoted to sofware (Consortium for Thematic Valorization). The SATT and the CVT will be contractually articulated for optimum efficiency of the entire device.



5.2.3 HIGHER EDUCATION, INTEGRATION INTO THE WORKPLACE

The ICON educational program aims to answer two questions

How to infuse the students with the knowledge, skills and creativity needed by ICT?

Regarding the education of the next generation of ICT researchers, the research community perceives that significant changes have occurred in the field during the past decade and that these changes have had, and will continue to have implications for the education of this next generation. The growing interdisciplinarity is evident in all of the ICT scientific challenges, including the nanoworld, and the evolution of the information age. This interdisciplinarity is manifested as a broadening of the interface between ICT and other areas such as physics, chemistry, biology,

Mathematics. More exposure to these fields is therefore needed in the undergraduate and graduate educational programs of students who might be seeking careers in ICT. Such interdisciplinary education should inc1ude both formal course work and hands-on exposure to how research is done in these fields, as well as an introduction to the vocabulary and culture of these diverse fields as they are now practiced in their interface with ICT. This new emphasis is believed to be essential for working at the cutting edge of ICT in the coming decade and beyond. The great challenge which faces the academic community thus is to create curricula that balance the need for breadth against the depth of the traditional mathematics and physics culture, from which the community draws its strength. Innovative and experimental approaches to this problem will be proposed by ICON partners at least to transmit a part of the ICT intellectual style to students. The implementation of these new educational directions for students, without increasing the length of undergraduate, graduate and doctoral programs, is a significant challenge and an exciting way for ICON faculties.

How to increase the ICT culture of the general public?

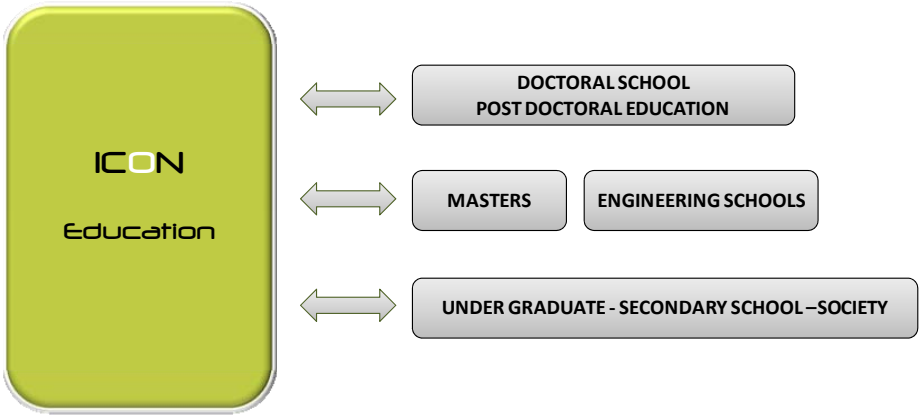
Increasing the scientific culture of the general public in ICT is the fourth ICON priority. This constitutes a challenge because ICT involves many captivating phenomena that are of great general interest, but the general public is largely unaware that ICT is the science behind many of the technological marvels that they use every days. Introducing interesting ICT phenomena at all levels of science teaching, from talks in the local public library to science classes in elementary school and the undergraduate lecture hall, is an opportunity that the ICON community will not miss.

To try to answer these questions, ICON partners have defined an educational program that is described in details in appendix 3

This program aim is to provide ideal environments for advanced studies by faculty and students working together to extend the boundaries of knowledge in the fields defined in the research part of the proposal. ICON will also play an important role in the definition of new Master and PhD programs, the objective being to give students the ability to adapt to the challenges imposed by the rapid research evolution in ICT in particular, the increasing place of multidisciplinarity. To respond to this challenge, a new Master degree program is under development ('Communication INformation Nanotechnology' – CINN Master Degree).

Significant efforts have also been made to successfully increase the number of educational partnerships with renowned international universities for the benefits of both the students and faculty. Efforts will be made to attract the best scientific talents. ICON will also support measures that may contribute to the integration of issues related to gender balance in the research community.Particular attention will be also paid to develop courses offered in the framework of continuing education programs in ICT.

ICON - EDUCATION



1. Master degree programs, Engineering Schools and Doctoral studies

ICON members are strongly involved in education programs related to their research. Several Master Degrees and Curricula of Engineering schools rely mainly on ICON members (academic and researchers) and more than 400 students per year get a Master Degree or an Engineering School Degree strongly related to ICON activities.

- The Master degree programs, in the fields addressed by ICON, that have been accredited by the Ministry of Higher Education and Research for 2010-2013 are:

►Master MINT (Microelectronics, Nanotechnologies and Telecommunications)
►Master SMaRT (Robotics, Automatic control and Signal processing)
►Several Master degrees in Computer Science (both in Lille and Lens)
►Master degree in Computer Science and Information Systems – Master Miage
►Master degree IVI "Image, Vision and Interaction"
►Master degree in Advanced Scientific Computing.

Besides, ICON contributes significantly to several interdisciplinary tracks of other masters, e.g. in Biology, in Financial Mathematics or in Mathematics and Computer Science for Human Sciences.

- Engineering Schools, Ecole Centrale de Lille, Institut Supérieur d'Electronique et du Numérique (ISEN), Polytech'Lille, Telecom Lille1 and ICAM are strong partners of the ICON in the field of education.

- The laboratories that take part in the ICON are all (with the exception of PHLAM) attached to the Doctoral School 'Sciences pour l'Ingénieur Université Lille Nord de France' (ED-SPI, **http://edspi.univ-lille1.fr/**) and roughly 65 PhDs related to ICON topics are defended per year in these laboratories. ED-SPI is organised around on six scientific domains (about 800 PhD students in total), Computer Engineering (20% of the total number of PhD students), Micro and Nanotechnologies, Acoustics and Telecommunications (18%), Automation, Signal Processing and Image (18%), Electrical Engineering (7%), Pure and Applied Mathematics (9%), Mechanical Engineering and Civil Engineering (28%). The PhD students that have earned their degree from one of the different Institutions attached to the Ed-SPI School represent 45% of the total number, 30% are coming from other French Institutions and 25% from foreign universities. The representation of students of diverse backgrounds and of different nationalities (60% of the PhD students are foreign students) contributes to the richness of ICON. Women represent one quarter of the PhD students. Industry-based collaborative research is developed in particular through 'Cifre' PhDs (10% of the total number of students). The professional insertion of the PhD students of ED-SPI is very good. About 25% of them are enrolled in research careers (University position or research centres), 40% are recruited in the industry, 20% are involved in post-doctoral studies, a small percentage of them find positions as engineers in research centres or in universities. [3]

Graduate success survey show that the transition to the labour market works smoothly for graduates of ICT programs. The occupational situation is systematically studied by OFIP (Observatoire des Formations et de l'Insertion Professionnelle, Observatory of educational programs and professional integration). The integration into the professional world is also fostered through integrated internships which form part of all our degree programs and are generally 14-16 week long.

2. Research, Innovation and Corporate Relations

ICON scientists are strongly involved in education programs, which are based on the most recent research and development in the area. We intend to convey a comprehensive view of the Information and Communication Technology (ICT) and Micro and NanoTechnologies (MNT) areas that will be useful in work life as well as in research. A LifeLong Learning (LLL) course will be

[3] Detailed Information concerning integration into the world of work for PhD alumni of University of Lille can be found on OFIP's site

offered to help the students to become lifelong learners. Introducing research, but also innovation and entrepreneurship in education programs is one of our main objectives. To grow the student interests in faculty-led research, incentives have been recently created.

►Introduction to research in the bachelor's degree: We participate strongly to the track 'Introduction to research' developed in Lille 1 University for undergraduates to get involved in research.
►Research as a specialization track in engineering school
►*Research, Innovation and Creativity* in Computer Science and Information Systems Master Program (Lille 1)
►Corporate Relations. All our degree programs contain at least one internship, generally 14-16 week long

Professional Integration is very good, as proved by the different survey results. E.g. for the Master of University of Lille and of the University of Artois, employement status and level, as well as forms of professions, of former students are systematically studied by OFIP (Observatoire des Formations et de l'Insertion Professionnelle, Observatory of educational programs and professional integration).

3. International relations

Developping and boosting international effective relationships in the ICT education field with foreign renowned international universities are very important ICON objectives. Various schemes, ranging from seminars to the development of dual degrees have already been established by ICON actors. Amongst the last years, the following actions have led to successful international programs and partnerships:

►Funding of a program of graduate level fellowships for transatlantic exchanges of students (consortium of 6 top-ranked Universities: Georgia Institute of Technology, University of Illinois in Urbana Champaign, the University of Michigan, Imperial College, U.K., the Technische Universität Darmstadt, Université de Lille1).
► Establishment of a double Masters degree ("Dual Degree Masters in Nanotechnology") together with the Georgia Institute of Technology.
► Funding of a three year program through the Foundation FACE (French American Cultural Exchange) for putting in place the program of "Dual Masters Degree in Nanotechnology."
► Funding of a three year program through the PUF (Partner University Fund) program for putting in place the program of " Doctoral Research and Teaching in Micro- and Nano-technology: High Frequency Nanotube printed circuits."
► Funding in September 2009 of a four year long Atlantis Program through the European Union and the US Department of Education for developing a Dual Masters Degree in Micro- and Nano-technology with the University of California in Irvine and in cooperation with the Technische Universität Darmstadt.
►Collaboration with Belgian Universities at different levels are numerous. As example, since 2008, EurodocInfo brings together PhD students in computer science and informatics from Belgium and North of France.
►Joint master between Lille University and Imperial College of London (project managed by S. Cotin and G. Casiez). The main objective of this master program will be to offer an international training in Computer Graphics dedicated to Medicine. The teaching program will include the fields of excellence of both partners in their respective research domain, such as Medical Imaging, Biomechanics or Interactive Simulation. The two-year training will offer high-level academic teaching (one year at Lille1 University, one year at ICL) but also extensive research experience. This master program will rely on a network of public and private organisms and will provide career opportunities in various research fields related to biomedical simulation.

4. Future developments

Graduate education at ICON places special emphasis on the relevance of science and technology to the complex society problems. Such problems frequently require an interdisciplinary approach

involving expertise in several different departments or laboratories. In the framework of the basic engineering curriculum (Bachelor and Master degrees) and in particular in case of multidisciplinary studies, it is nearly impossible to cover all the needed fields in detail up to the state-of-the-art level. Two paths are therefore identified for improvement.

a) ICON PhD Program and Doctoral School

First, doctoral training programs have to be created for allowing PhD students to select a set of advanced courses that fit their needs for their PhD thesis. This aims primarily at improving the offer of training proposed to the PhD students to fulfil the new requirements imposed to PhD students by the new emerging fields (inter, multidisciplinary). The global objective is to create first a platform for supporting the Doctoral School related to the ICON. The courses will respect specific organization criteria (short, intensive one-week modules) that will make them very flexible, accessible and attractive as well for high-level continuous education of engineers from industry. The idea is to move towards the creation of a doctoral school whose perimeter would be ICTS (Information and Communication Technologies and Sciences). The establishment of this new doctoral school would bring two major advantages. First the mother school would find a more human scale, reducing the size will enable optimal organization and more efficient monitoring of doctoral programs. The second main benefit is that all the ICON activity would be included in a single doctoral school.

It is very clear that international doctoral collaboration can yield to great benefits but it often faces to complex financial issues. The prospect of constructive innovation through international collaboration with high-level research institution will be supported by grants allocated to the ICON PhD students for a stay (1 to 6 months) in the partner institution. This financial support being subject to the quality of the mobility project, the proposal has to be structured, conducted and evaluated according to a process previously defined by ICON. ICON will also encourage internships in leading industrial labs.

Finally, ICON will also benefit from the experience gained by Lille 1 University and the University of Artois through their participation to the European Doctoral College 'Collège Doctoral Lille Nord de France' (http://www.univ-lille1.fr/recherche/Formation-Doctorale/CDE) and through its involvement in different other Doctoral Colleges (http://www.univ-lille1.fr/international/Programmes-doctoraux/Colleges_doctoraux) to develop PhD program aiming to be a reference for high quality and excellence in education.

In particular these networks are a good way to attract high quality faculty for seminars or longer visits. It also contributes to enhance our ability to attract the most promising students to ICON.

b) ICON Master degree Program

The second initiative to fulfil the lack of multidisciplinary courses at the Master degree level in accordance with the fields developed in the ICON is undertaken through the proposal of a new Master degree program proposed for accreditation to the Ministry of Higher Education and Research. This Master degree (CINN Master Degree) aims to provide a program that will prepare the students to new developments in a multidisciplinary context. It will be organised around courses in Physics, Electrical and Computer Engineering and built on a five years basis. The general architecture will be the following: Electrical and Computer Engineering (50%), Basis in Mathematics and Physics (20%), Opening multidisciplinary (10%), Humanities and Social Sciences (20%). A period of study abroad will be included in the program (one semester or the training period). All the Master students recruited by ICON for a research-based internship will be recipients of a grant. In case of a training period abroad option, under an ICON partnership, a financial support will be offered through scholarship delivery.

Initiative for the development of "Scientific and Technical Culture" in schools and high schools.

Several experiences rely on ICON laboratories to promote 'Scientific and Technical Culture' in schools and high schools. A first one relies primarily on the IEMN activities ('Nano-école', 'nano-school'). Another one is the partnership between University of Lille, INRIA Lille-North Europe and Lille's Academy for promoting science in schools and high schools, especially Mathematics and Computer Science. More generally, members of our laboratories participate frequently to

exhibitions, demos and interactive experiments, e.g. during the annual "Fête de la Science" or at "Palais de la Découverte". We intend to generalize the concept to address all the fields concerned by ICON. In the longer term, implementation of an ICON showroom will allow a visibility at the regional, national and international level of its excellence in research. The showroom would also be an effective means of communication with industry. More details are provided in the 5.2.5. 'Attraction' section.

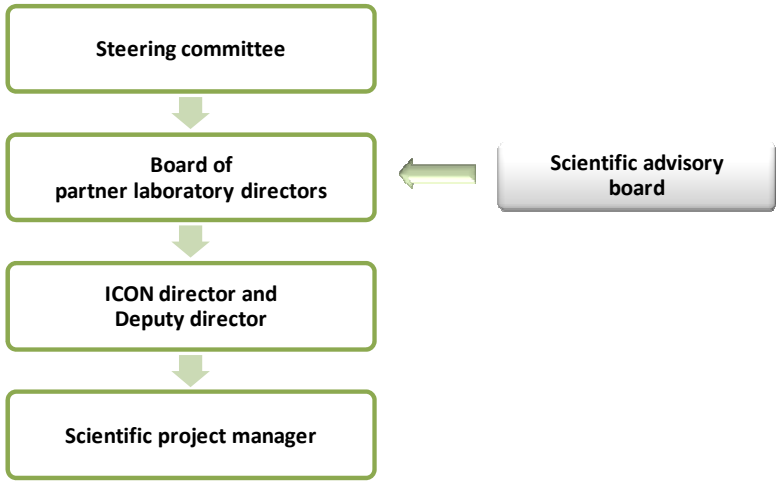
Excellence Chairs
In the 5.2.5 'Attraction' section, the planned 'Excellence Chair' mechanism is described and budgeted. One of them will be devoted to the software/hardware interface and will be called the ADA-Excellence Chair, in reference to Ada Byron. The outstanding scientist who will be the recipient of this invitation will be given the possibility of spending 2 to 3 month per year in ICON labs on a pluri-annual basis, while ensuring the continuity of interactions from his (her) home institution throughout the year thanks to electronic and visio-conferences exchanges. This framework will permit ICON to attract an excellent scientist who will not perhaps otherwise consider visiting or joining ICON due to her (his) other commitments at her (his) home institution. The graduate student of the part-time pluri-annual Chair will be given the opportunity to spend 2-3 months within the original institution of the host senior scientist, bringing the student cross-fertilization benefits, as well as for the ICON projects themselves.

Development of a strong continuing education program
LifeLong Learning (LLL) is essential in ICON fields where knowledge and technology are perpetually evolving. ICON opens most of its education program for long life learners and Lille1 University has a long and internationally recognized experience in the establishment of continuing education programs. ICON will benefit from this pioneering wealth of experience in its development of courses that respect specific criteria such as intensive one-week modules and industry-oriented modules, ICON "engineer in residence" program for professionals and researchers from industry interested in short trainings (3-5 days) on very specialized equipment (experiences already exist at IEMN, for example for training on Atomic Force Microscope). In particular, a LLL course will be offered to help the student to acquire lifelong learning skills.
Based on successful practice, very specialized seminars will also be developed and proposed to engineers from industry together with a collaborative virtual platform to exchange information. Newsletters could also contribute to the information exchange between ICON and the social-economic world.

5.2.4 GOVERNANCE

Strong, clear and continuous coordination is essential to the smooth and effective advancement of the ICON objectives. It is also of prime importance that the management structure of the consortium remains both simple and efficient and avoids creating any bureaucratic difficulties for the ICON scientists. This is especially true for ICON, which gathers many scientists and several partners (labs and their various institutional authorities together with their specific financial/administrative systems) while sharing interconnected scientific, educational and valorization objectives at the same time. The management structure has therefore been conceived in such a way as to promote the coordination, efficiency and effectiveness of the technical structure of the project. Taking all that into account, ICON is a 'project-oriented structure' that will not compete with the management of the partner research units. To this end, a 'Scientific Cooperation Foundation (FCS)' will be established, which appears to be the best French tool to fulfil these requirements.

ICON - MANAGEMENT



The FCS management will be carried out through three committees.

- The **Steering Committee** gathers representatives of the universities (Lille1, Lille3, Artois, and Valenciennes), Engineering schools (Ecole Centrale de Lille) and organisms (CNRS, INRIA) that are parent organizations of the ICON partner laboratories. The number of representatives will be defined within the FCS agreement and specified in the ICON consortium agreement (CA) that will be signed by these institutional partners. The Steering Committee is the institutional coordinating and supervisory body for the ICON project. Its primary function is to take responsibility for achievement of ICON outcomes in providing the necessary resources (especially in delegating the human resources to ICON) as well as controlling that the targets are met. Other responsibilities and powers will be specified in the consortium and FCS agreements according to the possible requests of the involved institutional authorities. The provisions of the CA and the FCS agreement will define how decisions can be taken by the Steering Committee. They will define how participants can leave or join the ICON consortium and/or the FCS itself. On most matters, decisions will require a simple majority of those present in the meeting. However, some specific questions will require an increased majority, especially decisions about the acceptance of new partners in the FCS and ICON. The number of votes of each participanting institution will also be specified in the consortium and FCS agreements. The Steering Committee will meet at least once a year or whenever deemed necessary.

- The **Board of directors** gathers the directors of the 8 ICON partner laboratories and research units. The Board of directors is appointed to act to be the chief executive group responsible for ICON strategy and its implementation. Its key purpose is to ensure ICON success by collectively directing and coordinating the partner laboratories participation. In compliance with instructions from the Steering Committee, the Board of directors responsibilities include:

    - Review and evaluate present and future opportunities, threats and risks in the external environment and current and future strengths, weaknesses and risks relating to ICON projects. Adapt the projects accordingly.
    - Determine strategic scientific options, select those to be pursued, and decide how the available means should be used to implement and support them.
    - Launch annual calls for the additional collaborative regional projects involving research teams outside the ICON circle, select the beneficiaries and assign the corresponding part of the ICON budget to the involved ICON partners.

  The above three roles will benefit from advisories from the ICON Scientific Council.

- Make sure that the ICON organisational structure and capability are appropriate for implementing the chosen strategies, and suggest adequate countermeasures to the Steering Committee when necessary.
- Ensure that communications both to and from the whole ICON scientific community are effective.

- The **ICON director and deputy director** are working closely with the Board of directors. They are appointed on a four years basis by the Steering Committee. To ensure the best representation and understanding of each scientific community involved in ICON, one of them will come from the hardware research community, while the other one will belong to the software one. They are responsible for the overall day-to-day management of ICON, including:
  - Manage day-to-day FCS budget, ICON general and scientific affairs, according to the policies and decisions adopted by the Steering Committee and the Board of directors. Take relevant necessary actions, and submit consequent countermeasures to the Board of directors and Steering Committee.
  - Establish annual budget reports and plans to be submitted for approval to the Board of directors and then to the Steering Committee.
  - Represent the FCS and ICON in external instances.
  - Co-ordinate exchanges between partners, especially ensure good information exchanges in the inside and on the outside about the projects evolution.
  - Organize and control the on-time delivery planning of the scientific and financial reports.
  - Enable and promote dissemination of results and knowledge transfer activities.
  - Establish administrative procedures and policies in accordance with the ANR rules.

- The **Scientific Council** will exhibit an advisory role. It will assess whether ICON supports the relevant best possible research and will suggest research policies accordingly. On request by the Board of directors and the Steering Committee, it will also review project proposals and provide funding recommendations. The Scientific Council will consist of 8 internationally renowned scientists coming from both academia and industry. They will be invited on the basis of their outstanding scientific achievements, as well as demonstrated significant accomplishments in the organization and management of research. The Scientific Council members are proposed by the Board of directors and are appointed by the Steering Committee, on a four years basis. They will meet at least once a year and exchange with the ICON instances by electronic ways as much as needed. Members of the Scientific Council will be remunerated for their expertise contributions.

- **Scientific Project Managers** are the scientific leaders of the ICON scientific projects.

5.2.5 ATTRACTION

Attracting top level talent to ICT is identified as another significant challenge for ICON. Transforming the graduate and doctoral education to be more interdisciplinary and more flexible, while emphasizing educational achievement and research leadership at the highest levels, is expected to help attract high level talent to ICON. Emphasis on rewarding hands-on research experiences at the undergraduate level is regarded as a critical component in exposing young people to the excitement and intellectual rewards of ICON research. Finding more pathways for rewarding careers for young people in the changing landscape of ICT related careers in industry, national laboratories, and in other sectors remains a challenge for our community. Enhancing the degree to which ICT researchers can work on the topics they are genuinely most interested in, as opposed to those most in fashion with the funding agency is identified as another goal of ICON. This will made academic ICT careers more attractive and more scientifically productive.

Specific measures to attract the best scientists will comprise:

1/ An annual *ICON colloquium*.

The purpose is to invite potential foreign candidates for research positions in ICON for a few-days visit. These scientists will be suggested by ICON scientific projects leaders, according to their preliminary promising contacts. The scientific part of this colloquium will be devoted to the presentation of ICON and its projects. Two days will be devoted to discovering the Euroregion and presenting both the facilities and the help they would receive for their installation, as well as the projects and teams that could hire and host them. It will be organized in the fall, before the researchers recruitment campaigns in the French calendar.

2/ Chairs. Two kinds of ICON Chairs will be created.

- *ICON Excellence Chairs* will be devoted to invite outstanding world-level scientists in the areas of the ICON projects. An attractive package will be associated to each position (including an attractive salary and associated PhD and Postdoc positions). These chairs will first be instantiated within the "Everlasting Numerical Sphere" and "Mining and Optimization algorithms for large scale networks" ICON projects. Their costs are included in the budgets of these projects. In addition to hosting internationally renowned scientists for long or short periods, pluri-annual invitations will be launched. The outstanding scientists who will be recipients of these invitations will be given the possibility of spending 2 to 3 month per year in ICON labs on a pluri-annual basis, while ensuring the continuity of interactions from their home institutions throughout the year thanks to electronic and visio-conferences exchanges. This framework will permit ICON to attract excellent scientists who will not otherwise consider visiting or joining ICON due to their other commitments at their home institution. The graduate students of the part-time pluri-annual Chairs will be given the opportunity to spend 2-3 months within the original institution of the guest senior scientist, bringing the students cross-fertilization benefits, as well as for the ICON projects themselves.

- A *Societal challenge Chair* will be associated with each of the three main ICON societal challenges (see 5.4). Consequently, an 'ICON, services and retail' Chair, an 'ICON and transportation' Chair and an 'ICON and health' Chair will be created. This second kind of chairs will be progressively set up starting from 2012. These ICON chairs will not necessarily be associated to single individuals; they will foremost consist of a set of tutorials and international-audience meetings on the involved topics. It is expected that each Chair will be supported in part by one or several private partners. Co-funding by the Northern France Regional authorities will be also asked for since these authorities have launched funding programs in these domains, as they have classified them as belonging to their highest research priorities (together with the ICON domains).

Additional measures to attract the best PhD candidates and to increase top level promising talents

ICON PhD candidates (i.e., PhD students working within some ICON project) will be hired purely based on criteria of excellence. Recruitment will be conducted at any time of the year depending on opportunities (current rigidities of most regular French sources for hiring students prevent the recruitment of excellent international students who are highly mobile). For this, we will combine the usual French recruitment campaigns and the flexible ICON framework for hiring the best promising PhD students. Additionally, as an attractive measure for potential PhD students and as a positive measure for the projects themselves, ICON will make available to its PhD students a set of 6 months bursaries covering all costs for research stays in the best laboratories abroad. Each such bursary will amount to about 15000€, the actual cost depending on the specific visited country.

Measures to attract the best students in ICON ICT master degrees

ICON laboratories organize programs and events for promoting research competences among master students. For example, the program called 'Research Innovation and Creativity' gathered

300 students this year. Also, ICON scientists are taking part in the annual 'Fêtes de la Science' which are intended for a large public audience. For example, the Artificial Intelligence project team regularly organizes very well-attended competitions between 'Artificial Intelligence' enhanced systems and prospective students on various strategy games. These actions will be amplified but are currently limited to local students. We also intend to attract the best French and international students at the master level in the hope that they will pursue doctoral studies in ICON. Especially, we will offer master students bursaries to conduct their final 6-months master degree internships within ICON projects. Bursaries will amount to 1000 € per month, and the selection of student benefiting from them will be made based on the excellence of their academic results. Importantly, these bursaries will be open both to local students and students outside the ICON IT master degrees.

Measures for the development of 'ICON Scientific and Technological Culture' in schools and high schools. Many regional initiatives rely on ICON laboratories to promote 'Scientific and Technological Culture' in schools and high-schools. A first one relies primarily on the IEMN activities ('Nano-école', i.e. 'nano-school'). Young people and teachers have access to educational tools and demonstrators through the nano-school website. To reach a maximum audience, nano-school will be included in the national UNISCIEL ('University of Science Online') project, which offers digital learning resources for teachers and students. We intend to generalize this concept to address all the fields concerned by ICON. In the longer term, implementation of an ICON showroom will allow a visibility of ICON research excellence at the regional, national and international level excellence in research. The showroom will also be an effective means of communication with industry and business actors. Another exemplar initiative is the partnership between the University of Lille, INRIA Lille-North Europe and Lille Academy for promoting science in schools and high-schools, especially Mathematics and Computer Science. More generally, members of ICON teams participate very frequently to exhibitions, demos and interactive large-audience experiments, e.g. during the annual 'Fête de la Science' or at the 'Palais de la Découverte'. Obviously, we intend to pursue and reinforce those activities.

5.3. STRATEGY OF THE SUPERVISING INSTITUTION

ICON research, education and innovation programs are in complete agreement with the stategy of the supervising institutions, not only the PRES Lille Nord de France, but also national organisms like CNRS and INRIA.

The scientific strategy of the PRES "Université Lille Nord de France"

The Establishments of Research and Higher Education supporting the LABEX project have a common research strategy within the PRES University Lille Nord de France (PRES – ULNF)». Through this strategy, the PRES-ULNF aims to be an international leader in research/training in certain scientific fields of high socio-economic impact with a domino effect to other fields with high research potential. It also aims to drive the territorial and socio-economic development through innovation. The roadmap for this strategy includes the following priorities:

- Organization of research around excellent scientific clusters
- Increasing the international attractiveness of research and training programs.
- Enhancing the education and lifelong training programs.
- Reinforcement of the research impact on the territorial and socio-economic development through innovation

Organization of the research around excellent scientific clusters

The scientific strategy of the University Lille Nord de France consists in the structuring of the research around excellent clusters having already a strong international recognition with a domino effect for sectors with high research potential. The scientific programs of these clusters correspond to the priorities of the 7th Framework Program for Research and Technological Development (FP7)

in particular, Health, Information and Communication Technologies; Nanosciences, Nanotechnologies; Materials and new Production Technologies, Environment (including climate change), Transport and Socio-economic Sciences and Humanities. They also correspond to the three priorities of the National Strategy of Research and Innovation (SNRI):

- Health, food and Biotechnologies;
- Environment urgency and Ecotechnology;
- Information, communication and nanotechnologies.

For each cluster, the partners' strategy is based on the creation of six LABEX around the research groups A+ enhanced by some research groups A presenting a high scientific potential. Within the framework of the PIA, the research perimeter of excellence is based on the following projects:

- A Labex in the field of Science and Technology of Communication and Information "Information COmmunications and Nanotechnologies"
- Three LABEX in the field of Biology/Health:
  - Title 1
  - Title 2
  - Title 3
- A LABEX in the field of the Environment "Physico-Chemistry of the Atmosphere"
- A LABEX in the field of Materials Science "Materials under complex Environment"
- A LABEX in the field of the Human Social Sciences "Argumentation"

Each LABEX is created on the basis of a scientific project with a flexible structure in charge of supporting management by project, multidisciplinary research and emergence of new projects on challenging issues. A particular attention is paid to the emergence of scientific leaders recognized by international, European and national evaluation. A logistic support will be devoted for the preparation and management of both ANR and European projects. Clusters have to intensify the international partnership through various forms of research association (LEA, LIA GDRI,...). In addition to the European space, they should reinforce their partnership with countries with high scientific capacity, such as North America, China, India, South Korea, Brazil and Russia.

Cluster are expected to develop multidisciplinary research within each cluster (hard /soft in ICT; physics and chemistry in Materials Science and Environment; biology, chemistry and imaging in Biology and Health, ...) and between clusters such as SHS with ICT; physics with all sectors; biology with chemistry, ICT, computer science and mathematics.

The scientific equipment constitutes also a priority. It concerns the reinforcement of the capacity of scientific facilities through an ambitious investment policy and the allocation of human resources. The objective is the positioning of the scientific facilities at the international standards. Particular interest is given to the access of these facilities to the scientific community by encouraging various forms of hosting and the establishment of "Project Hotel". PRES – ULNF provided a support for EQUIPEX projects related to excellent clusters. The management of these projects will be conducted in synergy with LABEX through an integrated management.

Enhancing the internal attractiveness

The attractiveness is a fundamental part of the scientific policy of the University Lille Nord de France. The development of clusters of excellence is subjected to the ability of these clusters to attract both highly talented researchers and students to the master and PhD degrees. A proactive policy of attractiveness will be implemented with the support of Local Authorities. This policy will be based on the allocation of specific resources to attract and keep talented researchers. These means include both the scientific environment (scientific equipment, logistic support, scientific position, research grants post-doc, high-level training for masters and doctoral programs,..), and the establishment of attractive careers. Attractiveness will be developed through tracking actions and the implementation of various procedures such the PRES international Chair and an extensive use

of the local, national and European opportunities such as the chairs of excellence of the Region, the ANR program (Chair of Excellence program and post-return, ..) and the PEOPLE / Marie Curie FP7 program.

Enhancing the education and life-long training programs

Clusters already rely on a large base of training programs (masters, engineering schools and doctoral schools). The objective of the PRES -ULNF is to emerge international training programs to attract talent candidates and to train students in an open international environment. This action aims to establishing a recruitment pool of doctoral students and to train executive graduates to creative and scientific approach. Specific resources will be devoted to these training programs to reinforce their national and international attractiveness.

The life-long raining constitutes also a priority for the clusters policy. This training beneficiates of the great achievement and expertise in this field of the PRES-ULNF members. The doctoral program will be re-organized by the creation of a doctoral school for each cluster. Doctoral Schools will focus on providing doctoral students with an additional high-level scientific training, interdisciplinary openness and an awareness of intellectual property and societal and international issues. They should also widely implement the international mobility and the doctoral attractiveness program.

Enhancing the research impact on the territorial and socio-economic development through innovation

Innovation is a key element for both the promotion of research and for the economic and social development. Both the innovation and technology transfer activity constitute a high priority of the PRES-ULNF. Substantial support will be given to the establishment of an innovation ecosystem in partnership with the support of the Local Authorities, the State and economic partners. Priority is given to establishing strategic relation with leading companies, to support small and medium companies and to reinforce the partnership with the competitiveness clusters. A particular attention is paid to the territorial development through the involvement in the competitiveness clusters in the Region (I-Trans, NSL, PICOM, MAUD, UPTEX, AQUIMER, TEAM2), the Economic Excellence Clusters created within the framework “Regional Scheme for Economic Development (SRDE) and the park of technology: EURASANTE (Health/Biology), Haute Borne (Technology), Euratechnologies (IT) and Plain Image (image creation).

The development of the innovation/transfer activity will be enhanced by the establishment of a SATT (Society for the acceleration of the transfer and technology) comprising members of the PRES-ULNF and the Universities of Amiens and Reims. The SATT will be in charge of the maturation of innovative projects, management of intellectual property and technology transfer. It will also provide a high level of expertise in legal, financial and management of partnership projects with the industry.

Supporting letters from CNRS, INRIA, university Lille1 and University d’Artois

CS

PRES Université Lille Nord de France
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Paris, le 27 octobre 2010

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Objet : Lettre de soutien pour les dossiers LABEX des investissements d'avenir

Monsieur le Président,

Le Comité de Direction du CNRS a examiné avec beaucoup d'intérêt les projets de LABEX qui lui ont été adressés. Il apporte son soutien aux projets qui remplissent les trois critères suivants :

- L'excellence scientifique, le caractère innovant et la plus-value par rapport à l'existant, ainsi que la cohérence avec les orientations stratégiques du CNRS sur le site;
- La pertinence du projet dans la politique du site ;
- L'assurance d'une gouvernance en « mode projet », respectant la structuration des unités de recherche.

Le projet «Information Communication Nanotechnologie» (ICON) remplit ces trois conditions et reçoit ainsi le soutien complet du CNRS. En cas de succès de ce projet, le CNRS s'engage à maintenir ses ressources sur le périmètre du projet de LABEX et à entamer des discussions avec ses partenaires pour envisager la façon de mettre en place une programmation pluri-annuelle concertée des ressources futures.

Nous vous remercions d'avance de bien vouloir nous adresser dès que possible une copie de l'intégralité du dossier final que vous déposerez.

Nous vous prions de croire, Monsieur le Président, en notre parfaite considération.

Le Directeur scientifique référent
Jacques MARTINO

Le directeur de l'INSIS
Pierre GUILLON

INSTITUT NATIONAL
DE RECHERCHE
EN INFORMATIQUE
ET EN AUTOMATIQUE

INRIA

PRES LILLE NORD DE FRANCE
A l'attention de Christian SEGHERAERT
Président
1bis, rue Georges Lefèvre
59044 Lille cedex

Villeneuve d'Ascq, le 17 Novembre 2010

N/REF : LIL/DIR/2010/010/MD

Monsieur le Président,

Je vous confirme le grand intérêt de l'INRIA pour le projet de laboratoire d'excellence ICON que porte le PRES Lille - Nord de France. En effet, ce projet s'inscrit parfaitement dans les priorités du plan stratégique de l'INRIA et du développement de son centre Lille - Nord Europe. Nous sommes tout particulièrement intéressés par la dynamique générée par les initiatives d'excellence et en particulier ce projet que vous portez. Nous nous félicitons également de la mise en place de laboratoires d'excellence dont la qualité attendue et le caractère pérenne permettront à nos chercheurs en sciences informatiques et mathématiques de collaborer sur le long terme avec leurs collègues en particulier dans le cadre d'équipes-projets communes.

Une partie importante des équipes-projets du centre de recherche INRIA Lille - Nord de France est susceptible de collaborer dans le cadre de ce laboratoire d'excellence et le centre de recherche a donc vocation à être partenaire de votre projet.

En cas de labellisation de ce laboratoire d'excellence, l'INRIA est tout à fait disposé à contribuer à sa gouvernance tant scientifique qu'opérationnelle. J'ajoute que nous sommes particulièrement heureux de l'inscription de cette action dans le paysage scientifique du Nord-Pas de Calais, en cohérence forte avec l'accord cadre que nous avons signé avec l'Université de Lille1, l'Université de Lille 3 et l'Ecole Centrale de Lille.

Je vous prie de croire, Monsieur le Président, à l'expression de mes sentiments les meilleurs.

Michel COSNARD

Par délégation,

MAX DAUCHET
Directeur du Centre de Recherche INRIA
LILLE – NORD EUROPE

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Université Lille1
Sciences et Technologies

DIRVED
Direction de la Recherche,
de la Valorisation et
des Etudes Doctorales

Commitment of the Université Lille1 – Sciences et Technolgies for the Labex

"Information COmmunications and Nanotechnologies"

The scienific strategy of the Unversity Lille1 concrerning the LABEX is presented in section 5.3 of the proposal

Through the LABEX "Information COmmunications and Nanotechnologies », the university of Lille1 aims to become an international leader in the field of "Information and Communications Sciences and Technologies" and to actively participate in the territorial and socio-economic development through innovation.

This LABEX emanates from the major scientific field in the region with more than 1000 scientists, PhD students and administrative and technology staff. It also beneficiates of an exceptional scientific experimental equipment and platforms with nanotechnology clean room facilities and the optical fiber drawing platform in the hardware domain as well as the sensor network or the virtual reality platform for the software one.

Research groups of this Labex are very active in the training programs, innovation activity, international cooperation and collaborative research with the industry. They are also involved in multidisciplinary research programs with other scientific fields, in particular biology, health, material sciences and services.

We believe that the exceptional potential of this LABEX together with the high quality management and the strong support of partners through additional human resources and scientific facilities will present an attractive environment for talent scientists and students and for the development of promoting risky innovative research. This environment will be also conducive for student training, innovation and territorial and economic development.

The university Lille1 largely supports the ICON LABEX. In addition to the actual human resources, scientific equipment and building infrastructure, the university is committed to providing subnational additional support for this LABEX, in particular in Human resources support (15 faculty members, doctorate and post doc grants, positions for inviting talent international researchers for long period,..), building and scientific infrastructure as well as in administrative and logistic support and current expenses.

Friday, November 19, 2010

Professor Philippe Rollet

President of the Université Lille1 – Sciences et Technologies

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UNIVERSITÉ D'ARTOIS

Arras, le 16 novembre 2010

Service de la Recherche et
des Etudes Doctorales
Resp : Patrick BOIDIN
Tel. : 03.21.60.37.10

LETTRE DE SOUTIEN

Je, soussigné Christian Morzewski, atteste du soutien plein et entier de l'Université d'Artois au projet de Laboratoire d'Excellence ICON (« Informations COmmunications et Nanotechnologies »), dans lequel est partenaire le Centre de Recherches en Informatique de Lens (UMR CNRS 8188).

Le Président de l'Université,

Christian MORZEWSKI

BÉTHUNE DOUAI LENS LIÉVIN ARRAS UNIVERSITÉ D'ARTOIS

5.4. CONNECTIONS TO THE ECONOMIC WORLD

The knowledge transfer strategy which includes a whole range of different connections with the economic world has been described in 5.2.2

Regional context

ICON scientists participate very actively in the activities of regional clusters, most importantly as key drivers in the following three main priority areas.

Mobility and transport

The Region Nord Pas de Calais concentrates 4 million people on only 2.3% of French territory, and is a crossroads in the heart of a Euroregion which concentrates 100 million inhabitants within a radius of 300 km. On the other hand, the region has many manufacturers and suppliers in the automotive and railway industry (40 000 jobs in the Region). These two factors mean that transport is a priority for the region.
The i-Trans competitiveness cluster brings together industry leaders and key players in research and education relating to rail, automobiles, logistics and intelligent transport systems in the Nord-Pas de Calais and Picardy regions. Together, they aim to build international recognition for Northern France as a unique focus of excellence and innovation in terrestrial transport for design, construction, operation and maintenance of sustainable transport systems.

Services and retail industries

The digital-based economic development is the priority of the Nord/Pas-de-Calais Region, with an emphasis on services and retail industries.

The regional ICT sector consists of a dense network of more than 4,000 companies and involves more than 30,000 jobs, including a large number of new businesses in cutting-edge ICT fields such as 3D, e-commerce, mobility, etc. Over the last five years, ICT 'ecosystems' have been created, backed up with significant public and private financial support, such as PICOM ('Pôle de Compétitivité des Industries du Commerce': i.e., 'Trade Industries Cluster'). Lille is at the heart of a 300 km radius area of 100 million consumers. The headquarters and the logistic centers of a large number of several international dimension brands, as well as the second largest French logistics center are established in this Region. Other ICT-related clusters and intiatives illustrate the dynamics of ICT in the Nord/Pas-de-Calais area: the 'Pôle Régional Numérique (PRN), (i.e., 'Digital Regional Pole') comprises 250 SMEs. Also, the 'Euratechnologies' is an ICT ecosystem of companies that will cover 150 000 m² of cutting-edge economic activities. Let us also mention the newly 'Center for Innovation in Contact-Free Technologies (CITC-EURARFID)' and the 'IMAGE' pole dedicated to digital creation. The 'Ubiquitous Pole' aims to make Lille one of the premier 'ubiquitous' cities in Europe: it gathers together technological actors and users (businesses, communities, associations, citizens, consumers, etc) in that respect. In 2012, EuraLens (Lens is the city of the ICON Artificial Intelligence Project team) will open: it is dedicated to digital industrial developments for Cultural-based domains. It accompanies the dynamics of the creation of a 'Le Louvre-Lens' museum (which is a subsidiary of the world-famous Paris 'Le Louvre' museum) in Lens. ICON research units partners are involved and active in these frameworks: they are often located on their sites and are engaged in their governance. For instance, they are heavily involved in the PICOM cluster (both in its governance and activities: ICON research units partners are involved in many PICOM applied collaborative research projects together with private companies).

Health and care

Lille University Hospital is ranked fourth in France in terms of research activity (publications according to the SIGAPS) and third in terms of overall clinical research (the SIGREC classification). The Nutrition, Healthcare, Longevity Cluster aims to bring together actors in the agrifood sectors, biotech companies and research and academic institutions from the Nord-Pas de Calais Region to focus on innovative collaboration projects that generate jobs linked to nutrition and health. Since 2006, **105 R&D projects** have been approved, totalling **230 million euros** in investment. The Lille region is home to world-class research groups for Alzheimer's disease, diabetes &

cardiovascular risks and inflammatory bowel diseases, These groups are the founders of the university hospital institute project (IHU) NEXIMED for personalized medicine.

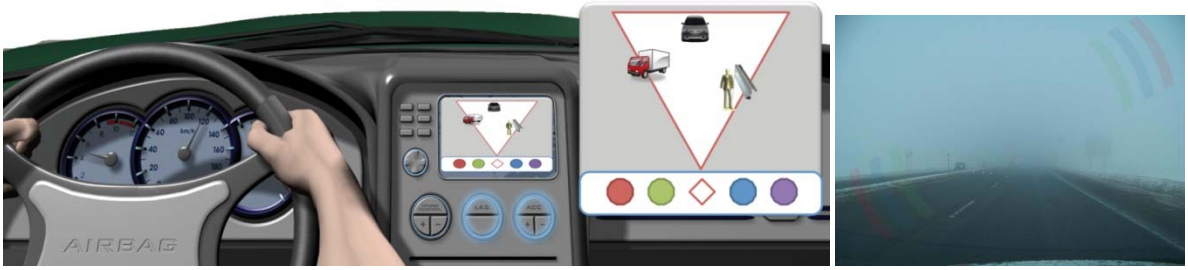
Opportunities for ICON of integrative or finalized research actions will be concentrated on these three priorities. A few exemple of current researches done by ICON partners are given below. Since all these application oriented works can be funded by existing research programs no funding is asked for these activities.

Mobility and transport

Next generation vehicle networks

Much research is conducted outside of ICON in the Valenciennes region in this area, including all aspects of mechanics, biomechanics, ergonomics. ICON is primarily concerned with the interfaces to nanotechnology, sensor networks, and services related to mobility in general.
For instance, wireless sensor networks (WSNs) have attracted a great deal of attention in the international research community [1]. In parallel, both Inter-Vehicle and Vehicle-Vehicle communication has gained significant importance in civilian and military research areas. Using sensors networks, communications will help create safer and more efficient highway systems, as part of the Intelligent Transportation System (ITS). Indeed, in the **Next Generation Vehicle Networks** scenario conception, vehicles are expected to become a part of the Internet, either as a terminal in a mobile network, as a network node, or as a moving sensor (providing environmental information, cars status, streaming video, etc.) or a combination of the three. However, such an ambitious idea comes with many challenges, including:

- *Radio Interface & Multi Access technique - Physical Layer (Code, adaptive modulation*
- The significant Doppler Shift between mobile communicating vehicles
- joint optimization and design of networking layers
- Design of intelligent transport systems dedicated to safety and driving advice.
-



Multi-criteria Traffic flow

ParadisEO (PARallel and DIStributed Evolving Objects) is a software framework dedicated to the flexible and reusable design of hybrid and parallel metaheuristics for single and multi-objective optimization. The software framework ParadisEO is distributed through the web site http://paradiseo.gforge.inria.fr under the CeCill licence. The ParadisEO software has great success in the academic and the industrial communities as evidenced by the following statistics. EDF, Thales, Eurodecision, KLS-Optim are among the users. One of the main applications is the distribution of traffic flow under dynamical constraints. Our objective is the industrialisation of the software under the cloud computing paradigm. Lower costs of application development and deployment, and superior return on investment will make cloud-based platforms the target of choice for both academics and industrials.

Services and retail industries

Data mining
We expect develop streaming algorithms and integrate them into the XML standard languages XProc and XSLT of the W3C. This will be done with the Innovimax Company. Along collaborations we will provide: algorithms for node graph classification with XRCE, algorithms for recommendation systems with the Orange company, algorithms for motion featuring from video streams with commercial companies in the context of the "pôle de compétitivité PICOM" (retail industries cluster) . We also expect to develop partnership with the Exalead company along the ICON project “Mining and Optimizing large-scale networks”.

Learning for trade
We expect to develop
- collaborations with local start-ups regarding the detection of new clients for a company.
- work with Oxylane and Becquet regarding the recommendation of products to potential buyers on their websites.
- collaboration with France Telecom/Orange Labs about the optimal selection of advertisements on web portals.

Sensor networks
Disseminate research results in sensor networks and RFID systems to local SME (EuraTechnologies, CITC-EuraRFID, PICOM) by transferring software systems like GOLIATH (Generic Optimized Lightweight communication stack for Ambient Technologies) and AspireRFID (wiki.aspire.ow2.org).

Retail innovation center
A technical and transfer center will be created with the cluster PICOM. II will be devoted to innovations for retail industries.

Wireless THz systems

High data rate wireless systems using THz waves becomes a hot topic in consumer and professional communications. An example concerns video transmission: non-compressed transmission of HDTV images needs more than 1 Gbit/s. Data compression is possible to reduce the rate but, in the case of compressed data, treatment is very difficult or impossible. Transmission of images between several professional users needs several compression/decompression sequences with dramatic loss of quality and limits real-time TV capability. To avoid these problems transmission of non-compressed images is done between fixed positions thanks to optical fibers. In the case of temporary needs like for sportive events high data rates wireless links are needed for HDTV. Other applications cover the transmission of HDTV between a fixed position and a car or a helicopter. The need for such high data rate / short distance wireless link will increase with the increase of the definition of HDTV and with the development of numerical movies/theatres.

On a longer time scale the main applications will be in the general public, they are numerous and can imagined as an extension of today Wi-Fi: hot-spots for instantaneous big file downloading (high resolution films: for example a single DVD of 5 GB is transferred in 40 seconds at 1 Gb/s a blu-ray disk of 30 GB is transferred in 6 seconds at 40 Gb/s), real-time teleconferences with high definition, video games etc

THz wireless transmission hot-spot

Health and care

Real-time medical simulation

SOFA is an Open Source framework primarily targeted at real-time simulation, with an emphasis on medical simulation. It has been in development for many years at INRIA and in particular the SHAMAN team in Lille. Based on advanced software architecture, it is particularly designed for the following application areas:

- Training: the use of simulation and virtual reality techniques can offer an additional support to traditional companionship learning methods:
- Planning of complex interventions: simulation can provide clinicians additional information, which will help determine the optimal strategy, thus reducing risks of complications and operating time. These “smart” simulations, based on patient-specific data, are intended to reveal the actual difficulties that may be faced during the actual procedure.

As an academic research development project, SOFA has become in a few years an essential actor in the medical simulation community. However, to meet the practical needs of industry and the technical needs of users, SOFA needs to evolve. To meet these increasing requests and also provide more professional solutions, we plan to create in 2011 a start-up company dedicated to 1) the development of the SOFA framework, and 2) professional solutions to address the needs of end users (hospitals, medical device companies,...) and companies developing applications based on simulation techniques. As such, this company will leverage its privileged position between researchers and industrial customers to offer state-of-the-art results and handle technology transfer as well as integration into commercial products.

Personalized medicine

We are strongly implied in the IHU NEXIMED project submitted to the French PIA initiative. It is an hospital-university institute devoted to personalized medicine. Complete analysis of an individual genome will become cheaper than a day of hospitalization. This genomic analysis opens the way for personalized and optimized cares and drugs. It is a revolution for medicine and for economy of health. A lot of new services will born around this concept. We will develop them with shareholder companies of NEXIMED project.

BioMEMS

BioMEMS devices are still in the early stages of development, but the long-term potential of the technology promises to enable many breakthroughs in medicine, chemistry, biology or environment monitoring. Recently, it has been recognized by the American Food and Drug Administration that there is a growing need for effective monitoring of the microorganisms and bioprocesses used in the sustainable production of fuels, chemicals and pharmaceuticals. The expanding number of tailor made production organisms and processes will necessitate better measurement and control of the processes in order to ensure the highest possible productivity. Improved bioprocess control, and faster organism development is driving a need for a device system which fulfils the following requirements: a) the ability to take rapid real-time measurements, b) a versatile analyte range, adjustable to measure various parameters and molecules, c) the ability to collect representative, low-volume samples from large and small scale cultures without endangering the integrity of the cultivation, d) reproducible performance throughout the duration of long cultivations, e) a compact size and a reasonable price - both for the infrastructure and the consumables. A BioMEMs measurement platform that is being studying within ICON could meet these requirements and it will constitute a significant improvement in terms of automation, analysis time and sensitivity.

Other ICON initiatives

ICON will implement initiatives, complementing both the Regional communities landscape and the ICON research efforts in a very useful and efficient cross-fertilization way. Specifically, the aim is to facilitate direct collaboration between research units and enterprises, especially SMEs. These initiatives involve not only the seven current projects ICON but all the core research groups of

ICON. They can also by pull effect involve the entire community ICT in the region. These initiatives are structured around the three regional priorities outlined above.

1. ICON Thematic Observatories For Innovation

These observatories are complementary to existing clusters. They aim to develop "creative communities" involving companies and researchers for the benefit of the research-based innovation.

Icon Mobility and Transport OFI
Chair person: Guy Joignaux, Director of the Lille Center or INRETS, the French National Institute for Transport and Safety Research

Icon Services and Retail Industries Mobility OFI
Chair person: Francoise Soulie Fogelman, VP Strategic Business Development of KXEN (The data mining automation company).

Icon Health and Care OFI
Chair person: David Delerue, Alicante CEO (SME Innovative software solutions for hospital)

2. Thematic ICON-Industries meetings. One-day meetings will be organized annually, alternating over the years between the major application themes. Each meeting will bring together ICON researchers and delegates from the corresponding economic/societal sector, with a specific emphasis from regional SMEs. The meetings will focus on practical demonstrations and tutorials about salient and cutting-edge relevant issues. The objective will be to foster real and cross-fertilization exchanges between all participants, both from the economic and academic sectors. These meetings will e.g. enable manufacturers to identify new technologies and opportunities for innovations. They will help researchers to better understand the needs of the involved companies, and foster or initiate future collaborations. The Program Committee for each of these meetings will mix academic and companies delegates.

3. ICON DEI (Development, Experimentation, Innovation) engineers.

A pool of engineers, integrated within the ICON laboratories, will play an interface function between Regional economic actors and ICON labs. Their role will be three-fold.

- Driving innovative ideas from the lab towards their valorization. They will concentrate on conducting feasibility experimentations and building prototypes based on ICON research results, testing their actual potential valorization value. In the 'hardware' ICON sector, they will be experts working within the ICON platforms teams.
- They will work with companies, mainly SMEs, by providing the labs expertise and technological aid to rapidly prototype or create feasibility demonstrators. The goal is to rapidly test and blue-print innovative promising ideas to fulfill technological needs of the companies.
- They will be the key ICON people to set up scientific and technological activities towards private companies events as described above, as well as demonstrations, knowledge dissemination and professional events, ICON-Industries meetings, etc.

These engineers will act in a reactive and flexible way according to the incoming needs of both the labs and the economic partners. They will not belong to an additional structure like e.g. a technological business center, since, among other things, they will remain assigned to their home ICON labs and research units. Interestingly, they will cover both pathways to innovation: from the lab to valorization and from the companies needs to research lab. Combining these two pathways should contribute to a virtuous circle of innovation: innovation driven by common practice and usage or companies needs, and innovation driven by research results.

It is expected that the fundings for these engineers will be 50 % supported by the Regional authorities, as this initiative matches their specific existing measures for job creation and

innovation facilitation in companies. These engineers will reinforce the teams of engineers already assigned by the research units to ICON, especially the valorization engineers already assigned by some labs.

5.5. PULL EFFECT

The ICON project pull-effect will be many-fold.

It has already been described how the project will closely interact with the local economy thanks to a dynamic valorisation strategy, especially within e.g. the transportation, E-activities and health/environment domains. Through all its aspects, ICON will take part in the regional strategy to reinforce these major sectors in Northern France.

Also, the international visibility and attractiveness of our higher education degrees in ICT will be reinforced thanks to both the attractive packages offered to PhD candidates and the new planned specific master in ICT and the specific measures described above. More generally, ICON is expected to be one of the major flagships of the University of Lille-Nord de France, reinforcing its outside visibility and reputation. On the inside of the University, ICON will play a role-model for other scientific sectors, inciting them to follow the same success-story through added-value through collaboration and research for excellence.

Additionally, the ICON project will have a pull-effect on the whole regional ICT research community thanks to the following additional measure. ICON concentrates on selected teams from the best ICT research groups from Northern France (especially, they must be A+ ranked by the French independent AERES agency). The ICON consortium will remain open to other local ICT research laboratories or teams when they reach this A+ level of excellence, endorsed by the AERES. To ensure a pull effect on both these laboratories and other research groups in other areas, ICON will launch yearly calls for Collaborative research proposals within Northern France, targeting either the scientific ICON domains in their own or their interactions with other research fields. Proposals that will be selected in these calls will make ICON related teams collaborate with these other laboratories or teams. The part of the costs related to ICON teams in these projects will be funded by ICON. We expect the remaining costs of the projects to be supported by the Northern France regional authorities through their usual instruments to fund collaborative and local research actions. Each year, ICON will devote 150 € to these collaborative actions. The local regional authorities are expected to (at least) double these funds in order to cover the costs relevant to non-ICON teams. Call for proposals will be done yearly. The duration of the accepted projects will range from one year to four years.

6. FINANCIAL AND SCIENTIFIC JUSTIFICATION FOR THE MOBILISATION OF THE RESOURCES

6.1. JUSTIFICATION FOR THE MOBILISATION OF THE RESOURCES

The budgets of the different ICON workpacakages were determined for a 4 years period. In the following sections, the budgets and financial requests are thus given for 4 years and extrapolated over 10 years that is the expected duration of ICON. For all projects, the following salary costs were fixed: PhD student 35 k€ per year, post-doc 47k€ per year and engineer 40 k€ per year. Two tables given at the end this document summarizes all the financial data.

ICON request summary (4 years)

Equipment (k€)	Excellence Chairs and teaching load decrease (K€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
850	**1500**	**3465**	**2726**	**1600**	**3021**	**785**	**13 947**

ICON: Total PIA funds requested for 10 years: 34 867 k€

6.1.1 RESEARCH PROJECT

The requested budget for the seven research projects is given below.

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
850	**1350**	**3465**	**2726**	**1120**	**2 721**	**245**	**12 477**

Total PIA funds requested for the seven research projects and for 10 years: 31 192 k€

Details by project. (the detail of the workpackges and sub-project contents are given in appendix 3 together with the scientific justification of the requested funds that is recalled here)

Artificial Materials: a nursery of breakthrough (ARM)

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
130	**300**	**455**	**940**	**160**	**912**	**115**	**3 012**

Artificial Materials: Total PIA funds requested for 10 years (k€) : 7 530

Scientific justification of the requested funds

SP1 - Interacting nano-objects: Towards artificial materials

Tasks 1.1 and 1.2 require important instrumental developments in near-field microscopy (UHV multiprobe STM & STM/AFM with atomic scale resolution): The recruitment of an engineer (4 years) is particularly needed. In task 1.3 (THz spectroscopy) permanent researchers will be mainly involved in the growth of nanowires and in low-T transport measurements: A post-doc (2 years) will help to design of the devices (THz resonator, plasmonic waveguide, integration of the nanostructures…). A post-doc is requested for 2 years in order to develop for the first time the spectroscopy of hybrid excitations using ultrafast acoustic techniques (Task 2.1). A PhD student will be in charge of realizing high efficiency solar cells using interacting nanoparticles (Task 2.3), and two others will be involved in the development of new theoretical methods to simulate thermal transport in nanostructured materials (Task 1.4) and hybrid excitations in artificial materials and nano-lasers [spasers] (Task 2.2).

SP2 - Elasto-multiferroic nanostructures and active materials for innovative imaging and information systems

Most part of the support solicited will be dedicated to the human power, since our group has already most of the required budget for necessary equipments.
The first part of support is for invitations of high level professors and senior researchers. This will be dedicated to well-known members of the LEMAC's russian and ukrainian colleagues who have identified and complementary skills necessary for the scientific program. This covers in particular the RF-characterization skills of our colleagues from Institute of Radio-Engineering and Electronics (RAS, Moscow, Russia) for the RF characterization of the magnetic nanostructures needed for MMEMS and magnetronics devices (Task 1), the technology of monocrystals and porous active conjugators synthetized by the ukrainian partner of Taurida University and their related characterization and applicative skills necessary in Task 2, and the skills of our colleagues from the Wave Research Center of General Physics Institute (RAS, Moscow, Russia) for wave phase conjugation adaptation to the high frequency range of ultrasound for the theragnostic applications with magnetic nanoparticles and micro-nano-bubbles.
The second part of the support is for postdocs. Two years of postdocs will be dedicated to settle the new activity towards MELRAMs and MEMRISTORS. This field is very competitive now and the development of our specific approach needs an increase of human power in the group. Two years of postdocs will be dedicated to the development of theragnostic systems. Here also, the theragnostic area is very competitive and like the previous point, an increase of human power is important to bring to life within a reasonable time our concepts.
The remaining budget is dedicated to attraction each year of new young researchers and to provide help to the running research activity, to improve our calculation possibilities for the simulations with multiprocessors, and upgrade of the characterization AFM equipment with MFM possibilities.

SP3 - Metamaterials

Four key research groups are involved in the aforementioned metamaterial project justifying the request of 4 years of postdoc which could be attributed to two post-doc candidates. These postdoc students will be employed for two years, sharing their time between various teams in order to promote collaborative works. A significant part of the project is also related to the training of PhD's students notably in the framework of Europmeta network devoted to the spreading of metamaterial

technology in Europe via the virtual institute METAMORPHOSE on metamaterial technologies. Also, a large part of the activity will concern promoting metamaterial activities through conferences and workshops at an international level which are complementary of the efforts carried out in the framework of GDR workshop notably the *Waves* GDR. At last, the research activity involves computing and fabrication of metamaterials justifying the budget for computer resources and running technological cost.

SP4 - Photonic crystal fibers: A nursery of optical breakthroughs

Missions are planned to make exchange and work meeting with other group in France and other research laboratories for instance for task 3, University of Southampton and Imperial College in UK. Task 1 is a new operation in the laboratory and requires support of post doc and running costs. This will help to define more rapidly the required processes (stack and draw technique versus vapor deposition of silane) to progress on this new field. Task 3 needs realizations of new fibre types, theirs characterizations and their use in non linear experiments. This is the reason of the asking of running cost and small optics as well as short period of master students (formations). Task 4 needs support of PhD students and small optics the building of new optical experiments on these new classes of fiber lasers.

From Flexible to Vegetal Electronics (FOrEVER)

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
230		**560**	**752**		**700**		**2 242**

From Flexible to Vegetal Electronics: Total PIA funds requested for 10 years (k€): 5 605

Scientific justification of the requested funds

This project technological project aims at developing several technological integration routes of flexible electronics that enable high-frequency applications. This scientific action naturally encompasses the assembly and interconnection of functional blocks to produce smart systems that can sense and transmit information wirelessly. For that sake, one essential technological prerequisite is to be able to heterogeneously integrate RF devices, circuits and propagation lines as well as sensors and actuators originating from markedly different and incompatible technological processes. The equipments needed for the projects are Spin-etch station, High speed thermal camera, Laser for microparticle image velocimetry. The working costs mainly cover micro and nanofabrication costs. The human resources (PhD and post doc) will be distributed among the 6 workpackages described in appendix 2

Molecular-based 3D neuromorphic computers (3D-mol-computer)

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
150		**140**	**188**		**240**		**718**

Molecular-based 3D neuromorphic computers: Total PIA funds requested for 10 years (k€) : 1 795

Scientific justification of the requested funds

Non-permanent staff.

From Y1 to Y3, one post-doc and one PhD student will be working together on the project. The PhD student will be on the theoretical side and the pots-doc on the experiments. The two last years (Y4-Y5), two post-doc will be working together on the experiments. Two post-docs for the 2 last years are required since this is the most "high-risk" part of the project, so not well suitable for PhD training.

Consumables: 50 k€/year.

- clean-room costs: 20 k€/y
- chemicals, fluids, gas for synthesis: 15 k€/y
- Si substrates, SPM tips, fluids and gas (LT measurements) for characterization: 10 k€/y
- Miscellanous (e.g. publication costs,…): 5 k€/y

Travel: 10k€/y

This cost corresponds to one int. conference and 1-2 nat. conferences per year for 2 people involved on the project, and few short-time missions (1-2 days) to discuss with external collaborations required for the project.

Equipement: 150k€

The PI's group at IEMN has a large experience in organic nanostructures fabrication by chemical routes and is equipped with a platform for "materials and organic devices" consisting of three glove-boxes with a controlled atmosphere, one coupled to vacuum evaporator, one integrating a spin-coater and the third dedicated to the electric characterization (8-tip prober). Physical characterizations (surface tension, FTIR, ellipsometry, AFM, XPS-UPS, UV-vis, …) and electrical characterizations at the macro and nano-scales (I-V 4K to 300K, C-V, STM, C-AFM, EFM, …) are available in the group or at IEMN common facilities.

However, this project requires acquiring a more specific and dedicated equipment:

- The opto-electrical characterization of the molecule-capped NPs in part 2 and part 3 requires up-grating our light excitation system (laser source, optical fiber,...) to be coupled with our SPM set-up.

Everlasting numerical sphere (EVENS)

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
190	**300**	**560**	**376**	**240**	**380**	**30**	**2 076**

Everlasting numerical sphere: Total PIA funds requested for 10 years (k€) : 5 190

Scientific justification of the requested funds

An Excellence Chair will be devoted to invite one full-time or several partial-time outstanding world-level scientists in this area. An attractive package will be associated to this position. The goal is to fecundate the interactions between the three packages and so to increase the cutting-edge level and innovative level of future developments of this project.

Workpackage1: Autonomous wireless sensor & ID nodes for green monitoting (AWSN)

- Equipment
  - Nano-material synthesis equipment : Mechanical milling system down to nanometric scale; Hydrothermal synthesis equipment 80 k€
  - Characterisation equipments : Measurement of the internal and external quantum efficiency of solar cells; Measurement of the internal and external quantum

efficiency of solar cells; Extension of the Hall measurement system towards low current Capabilities: 110 k€

- 1 PhD student to contribute to the development of the micro-battery mainly for the material science.
- 1 PhD student with a chemical back ground to work on the porous silica thin film super capacitor.
- 1 Post Doc to study and design new GaN based heterostructure for the photovoltaic micro-cell to harvest/scavenge the whole visible spectrum energy.
- 1 Post Doc to optimize the technological process for System In Package heterogeneous integration.
- 1 Post Doc to handle the energy management tool and to optimize the energy management unit.
- Working costs:
  - Support to the technological platforms (consumables such as sputtering target or probes for mm-wave measurements, technological run costs…..): 150 k€
  - Foundry of specific circuits to validate new concepts for the radio module ant the energy management module: 150 k€

Workpackage2: Future Internet, Internet of things

The efforts (2 PhD students, 3 one-year postdoctotal fellows and 1 engineer) will be focused to self-deployment schemes by using collaborative autonomous robots with two axes: (i) optimization of (communication) topology control and area coverage and (ii) detection and identification of parameters in cooperative multi-robots systems. We will consider the problem of deploying and controlling a fleet of mobile sensors which maximizes the area covered by all the sensors while keeping efficient multi-hop communication during the deployment. We target to propose a fully distributed algorithm suitable for wireless sensor networks, which is asynchronous, fault-tolerant and may take into account possible obstacles in the monitored field and realistic physical layer. Cooperative robotics systems concern several applications such as: moving a heavy or large load in a difficult or dangerous zone, global exploration of a large environment where it is not question for the moment to send men, etc… These systems can be characterized by oscillatory behavior and multi-goals activity. Such complex systems can be seen as a large scale system with time varying coupling. It will not be possible to analyze and estimate such a large scale system this is the reason why we should concentrate on a local analysis and estimation taking into account such time variability. The aim is to use, with our algebraic framework, some related idea of algebraic elimination to get information useful for online oscillatory behavior detection, parameter estimation and eventually observation of such complex system.

Workpackage3: Everlasting dynamic secure software

- Ph.D.1. Everlasting Software Product Lines. The goal of this Ph.D. is to work on how product lines can integrate during the design as well as in an unanticipated manner the need for applications to be highly reconfigurable and adapt to subsequent evolutions. The goal of this Ph.D thesis is to investigate composition orders and tracability in an unanticipated product line process.
- Ph.D.2. Object Isolated Spaces. Currently memory in a virtual machine like the one of mainstream languages is flat or not structured in compartmented. There is no way to control the fact that certain objects should not access to other parts of the systems via memory access primitives. This is clearly a lack of protection. The goal of this Ph.D. is to investigate the challenges in building such an infrastructure in terms with the interaction with message passing at the level of the language and garbage collectors at the level of the virtual machines. The solution should support the separation of co-existing groups of objects inside a same virtual machine.
- Engineer . Working on security for dynamic languages requires to have access and modify deeply the underlying execution engine of the language. Nowadays such execution engines are highly sophisticated virtual machines. We need to modify such virtual machines for two reasons: first some abstractions requires deep modifications that cannot be done solely at the language compiler level: for example introducing first class references that are invisible at the level of the language, second to get these new ideas reasonably fast. Indeed, we can accept 30% slowdown not 300%. Now virtual machines are difficult piece of software that may randomly crash after 20 minutes of normal execution, just because a specific memory

and process configuration is reached. Therefore there is a need for a deep engineering effort that should be supported by a full expert engineer.

- Post-Doc . Saas programming models for Large Cloud Computing. The main objective of this work will be an autonomic computing framework for large-scale service-oriented architectures and infrastructures. It will result in a coherent integration of models, tools and runtime systems to provide a first end-to-end support to the development of autonomic applications in the context of large-scale SOA in a model-driven way, including never-covered aspects such as the monitoring requirements, the analyse (or decisionmaking) model, and an adaptation model tackling large-scale underlying managed components.

Mining and Optimizing large-scale networks

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
	450	**525**	**188**	**240**	**100**	**25**	**1 528**

Mining and Optimizing large-scale networks:

Total PIA funds requested for 10 years (k€) : 3 820

Scientific justification of the requested funds

An Excellence Chair will be devoted to invite one full-time or several partial-time outstanding world-level scientists in this area. The candidate(s) will be experienced in large-scale data mining or stream mining. An attractive package will be associated to this position. The goal is to fecundate the interactions between the two packages and so to increase the cutting-edge level and innovative level of future developments of this project.

An Excellence Chair will be shared with the ICON project “Simulation Algorithms and Models for Biologie And Medicine”. We do not consider biological data in this project. But networks of structured data also exist in biology (regulation networks, protein networks,…). Genomics and medical data are a crucial instantiation of the general problem of mining large volumes of multi-source data. Therefore, we plan to develop a new research topic on mining and learning biological networks. The goal is to cross fertilize both projects.

SP 1 LSN-MINING

- We ask for fundings for 2 PhD positions linked to the excellence chair.
- We also ask for fundings for 2 PhD positions which will complete PhD positions obtained via other fundings. The subjects include: "link prediction in networks via sampling", "node classification in graph streams", "sequential learning for dynamic structured data", "similarity in 3D shape retrieval system", "context use for event detection". We ask for fundings for a post doctoral position.
- We propose to develop a prototype platform for visual media-based social network. The platform will provide the common ground for testing the algorithms developed in this project and will be used as our benchmark application. In order to complement existing resources, we ask for 2 engineers for developing the platform and for integration and maintenance of software developed in the project.

SP 2. Optimization of large scale networks

A Phd student and two-year post-doc are asked to carry out a research and development work on modelling the identified network problems into bi-level and multi-objective combinatorial optimization problems. They will be in charge of the design and implementation of generic metaheuristics and their validation. One additional task will be to design and implement parallel and hybrid algorithms to solve the target large scale network problems.

A.I. (Artificial Intelligence) project

Equipment (k€)	teaching load decrease (K€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
150	**150**	**595**	**188**		**239**	**50**	**1 372**

A.I. (Artificial Intelligence) project: Total PIA funds requested for 10 years (k€) : 3430

Scientific justification of the requested funds

- Permanent personnel. In France, each permanent professor or « maître de conférences » must spend 50 % of his (her) time in teaching duties. The requested funding will allow 9 members of the project to decrease their teaching load to only 20 % of their working time.
- 1 PhD will be hired every year with a three years contract, except the first three years of the project where two PhD students will be hired each year.
- 1 postdoc all year-long during the project (with contracts ranging from 6 months to 2 years) and two postdocs starting from the fifth year of the AI project.
- 5 (legally compulsory) gratifications for master students 6 months internships on the project: 30 months * 417.09 € = 12.5 k€/year
- update of the CRIL cluster devoted to the AI project: 150 k€ in 2013 and 169 k€ in 2017 (the CRIL cluster contains 150 Intel XEON 3 and 2.66 GHz bi and quadri-processors and nodes: It has been updated in 2009 and his maintenance is prepaid until 2012. It will be 100 % devoted to the heavy experimental studies about SAT and CSP and related issues of the AI project. The difference between the two planned budgets in 2013 and 2017 is due to the necessity to plan the update of the necessary air-conditioning system).
- "Fonctionnement" (mainly "missions" involving the participation to national and international conferences and meetings): 60 k€/year (59 k€ the first year) for each of the first four years, 70 k€/year after.

Simulation Algorithms and Models for Biologie And Medicine

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
	150	**630**	**94**	**480**	**150**	**25**	**1 529**

Simulation Algorithms and Models for Biologie And Medicine: Total PIA funds requested for 10 years (k€) : 3 823

Scientific justification of the requested funds

An Excellence Chair will be shared with the ICON project "Mining and Optimizing large-scale networks" (see this project)

SP 1. Molecular computational biology – In the heart of cells

4 PhD students (3 years each) working on the following topics :
- mapping algorithms for human genomes
- network-level genome analyses and systems biology
- statistical and combinatorial approaches to decipher signals in genomic and transcriptomic data
- synthetic biology for non ribosomal peptide synthesis

This project will provide unprecedented opportunity to initiate collaborations with cosupervised PhD theses between research teams within each sub workpackage.

- 3 software engineers (3 years each) : The computational developments associated to the outcomes of the subworkpackage *Processing and analysing high throughput sequencing data* require the participation of several software programmers. The first past of the work will consist in developing prototype software and carrying out experimental validations on benchmark data (provided by our biology partners). The second part of the work will consist in going in production and deploying a public release, available for the scientific community. This task will be achieved in close collaboration will the RENABI bioinformatics platform of Lille. Experience in computer programming in UNIX/Linux environments (including languages such as Java, C, C++, Python, R), applied mathematics and advanced algorithms is essential. Previous experience of working in a multidisciplinary environment is desirable.

SP 2 Interactive medical simulation

- PhD 1 "augmented reality and tracking of deformable structures": while the benefits and feasibility of augmented reality techniques with rigid objects has already been demonstrated, the problem is significantly more complex when dealing with soft objects. They are two main issues in this area. The first one is to develop new methods for tracking the motion of surface points on the deformable structure, in particular when the tacking has to be performed in a very constrained environment, such as a surgical unit. The second issue is to propose an accurate model of deformation, that can provide a volumetric deformation field based on partial surface information. The model also needs to be compatible with real-time computation.
- Ph.D 2 "radiotherapy planning system": radiotherapy is a growing therapeutical approach in oncology, and new applications areas are being discussed. Simulation techniques play an important role in the planning aspect of radiotherapy, by computing an optimal set of directions for the beams of electrons that are used to destroy tumor cells. The computation of these optimal directions depends on each patient, on the radiotherapy setup, and a very accurate computation of the particle transport through the different tissues of the body. The objective of this research is to 1) improve the accuracy of the transport and dose calculation methods using Monte Carlo techniques, and to optimize computation times using massively parallel computing on the GPU.
- An key element of our research is a continuous interaction with clinicians, for initial input but more importantly for validation of our results. This is only possible by actually developing prototypes of applications that can be deployed in a controlled clinical environment. This requires supervision of the work, both from a scientific standpoint, and a development standpoint. For this, we would like to recruit a postdoctoral fellow who would be at the interface between research and clinical applications. In addition, our experience has shown that developing such applications requires a significant amount of development time. For this we request one or two software engineers, for a combined duration of 3 years.

Pull effect

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
					300		**300**

Pull effect: (see 5.5) Total PIA funds requested for 10 years (k€): 750

This requested budget is a contribution of ICON, for the development of collaborative research projects with teams or individuals outside of ICON (mainly, but not only, within the PRES-ULNdF) to pull those teams and individuals towards excellence. This contribution will be completed with other financial resources (contracts, universities/organisms, Regional Council),

6.1.2 EDUCATIONAL PROJECT

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
	150					**540**	**690**

Educational project: Total PIA funds requested for 10 years (k€): 1 725

- Grants allocated to the ICON PhD students for a stay (1 to 6 months) in the partner institution (about 50 month per year).
- ADA Excellence Chair : 37,5 k€ per year for salary and accommodation of partial time position.

Other item of the educational projet (see 5.2.3) will be supported by partners and other founds.

6.1.3 VALORIZATION-EXPLOITATION OF RESULTS

Equipment (k€)	Excellence Chairs (k€)	Ph.D. students (k€)	Post-docs (k€)	Engineers (k€)	Working costs (k€)	Grants for students (k€)	**Total PIA funds requested for 4 years (k€)**
				480			**480**

Exploitation of results: Total PIA funds requested for 10 years (k€): 1 200

The exploitation of results will be pooled in large organizations, primarily the SATT (see 5.2.2). No PIA support is required for this action.

We mobilise PIA support for 50% of the cost of implementation of DEI Engineers (development, experimentation, innovation, see 5.4,"links with the world economy"). The supplementary financial support of this item and the support of other items of 5.4 will be achieved by ICON partners, businesses and local communities.

6.1.4 GOVERNANCE

The Governance of ICON will be done though a foundation. This foundation will be dedicated to ICON or will be a department of a larger foundation of the PRES ULNdF. In both cases, a high-level administrative staff will support ICON direction. The cost of this position will be supported by ICON partners as well as the running costs of the foundation (meetings of boards, councils). So, no request of funds is planned for ICON governance.

6.2. CONCLUSION

ICON research, educational and valorization projects gather about 120 equivalent full time scientists and 37 engineers working in the platforms or in research groups. For these activities, the requested fund is 34 867 k€ for ten years. Obviously, ten years is longer than the duration of the research projects. The business model we would like to implement is to use ICON as leverage on well defined projects. After an initial support given by, all the projects should find their own resources through usual funding agencies (ANR, EU…). This decrease of ICON support needed for running projects will be used to launch new projects that will be defined with the help of ICON scientific council. In that sense, ICON will mainly act at leverage on research, education and valorization in the Nord-Pas de Calais Region. The table 1 below gives a summary of the ICON requested funds. Obviously, ICON will support only a part of the full costs of the projects. The full costs of ICON projects are given in table 2

	Equipment	non permanent Personnel	Working costs-travel-subcontracting	Grants for students	Total for 4 years	Total 10 for years
Research projects						
ARM	130	1 855	912	115	3 012	7 530
FOREVER	230	1 312	700	0	2 242	5 605
3D- mol-com	150	328	240		718	1 795
EVENS	190	1 476	380	30	2 076	5 190
MOLN	0	1 403	100	25	1 528	3 820
AI	150	933	239	50	1 372	3 430
SAMBAM	0	1 354	150	25	1 529	3 823
Total research projects	850	8 661	2 721	245	12 477	31 193
Educational project		150	0	540	690	1 725
Exploitation of results/va		480	0		480	1 200
Pull effect		0	300		300	750
Grand Total	**850**	**9 291**	**3 021**	**785**	**13 947**	**34 867**

Table 1

	Total requested funds for 4 years	Total requested funds for 10 years	Equivalent full time permanent scientists (per year)	Equivalent full time permanent engineers (per year)	permanent scientist salaries (10 years)	permanent engineer salaries (10 years)	Project full costs
Research projects							
ARM	3 012	7 530	29	7	21 024	3 500	**32 054**
FOREVER	2 242	5 605	12	6	8 760	3 000	**17 365**
3D- mol-computer	718	1 795	2	3	1 460	1 500	**4 755**
EVENS	2 076	5 190	25	11	17 885	5 500	**28 575**
MOLN	1 528	3 820	19	4	13 505	2 000	**19 325**
AI	1 372	3 430	16	2	11 315	1 000	**15 745**
SAMBAM	1 529	3 823	19	4	13 505	2 000	**19 328**
Total research projects	12 477	31 193	120	35	87 454	17 500	**137 147**
					0		**0**
Educational project	790	1 725	48		35 040		**36 765**
					0		
Exploitation of results/valorization	480	1 200			0		**1 200**
					0		
Pull effect	300	750			0		**2 700**
					0		
Grand Total	**13 947**	**34 867**	**168**	**35**	**122 494**	**17 500**	**175 862**

Table 2

7. APPENDICES