Activity Report 2011

Section Partnerships and Cooperations
# DISTRIBUTED SYSTEMS AND SERVICES

1. ACES Project-Team (section vide) ................................................................. 5
2. ADAM Project-Team .................................................................................. 6
3. AMAZONES Team ...................................................................................... 12
4. ARLES Project-Team .................................................................................. 16
5. ASAP Project-Team ..................................................................................... 23
6. ASCOLA Project-Team .............................................................................. 26
7. ATLANMOD Team ...................................................................................... 30
8. CIDRE Project-Team .................................................................................. 33
9. FOCUS Project-Team .................................................................................. 37
10. INDES Project-Team ............................................................................... 40
11. MYRIADS Team ....................................................................................... 41
12. OASIS Project-Team ............................................................................... 48
13. PHOENIX Project-Team ............................................................................ 52
14. POPS Project-Team ................................................................................... 54
15. REGAL Project-Team ............................................................................... 60
16. RMOD Project-Team ............................................................................... 65
17. SARDIES Project-Team ............................................................................ 68
18. SCORE Team ............................................................................................. 72
19. TRISKELL Project-Team .......................................................................... 75

# DISTRIBUTED AND HIGH PERFORMANCE COMPUTING

20. ALGORILLE Project-Team ......................................................................... 83
21. CEPAGE Project-Team ............................................................................ 86
22. GRAAL Project-Team ............................................................................... 91
23. GRAND-LARGE Project-Team ................................................................. 97
24. HIEPACS Project-Team ........................................................................... 99
25. KERDATA Team ..................................................................................... 104
26. MESCAL Project-Team ............................................................................ 106
27. MOAIS Project-Team ............................................................................. 113
28. RUNTIME Project-Team ........................................................................ 116

# NETWORKS AND TELEcommunications

29. DIONYSOS Project-Team ......................................................................... 119
30. DISTRIBCOM Project-Team .................................................................. 123
31. DNET Team ............................................................................................ 128
32. GANG Project-Team ................................................................................ 131
33. HIPERCOM Project-Team ....................................................................... 134
34. MADYNES Project-Team ........................................................................ 137
35. MAESTRO Project-Team ........................................................................ 141
36. MASCOTTE Project-Team ...................................................................... 146
37. PLANETE Project-Team .......................................................................... 151
38. RAP Project-Team ................................................................................... 156
39. RESO Project-Team ................................................................. 157
40. SWING Team ...................................................................... 164
41. TREC Project-Team ............................................................. 167
ACES Project-Team (section vide)
ADAM Project-Team

8. Partnerships and Cooperations

8.1. Local Initiatives

8.1.1. INRIA ADT CALICO

Participants: Laurence Duchien, Antonio de Almeida Souza Neto, Anne-Françoise Le Meur.

The CALICO ADT (Action de Développement Technologique) is an ADT local to the INRIA Lille Nord Europe Center that aims to maintain and develop the CALICO framework (cf. section 5.2 ). The architecture of CALICO is based on a co-evolution approach where the model level enables software architects to describe and reason on application properties, and the runtime level holds the running application executed on a given platform. CALICO is generic and extensible in terms of target platforms, analyses at the model level, etc. This particularity makes CALICO a framework that could federate several of the ADAM research works and integrate external contributions. Antonio de Almeida Souza Neto (newly graduated engineer) has been recruited in the context of this INRIA ADT.

8.1.2. INRIA ADT UbInnov

Participants: Laurence Duchien, Christophe Demarey, Clément Quinton.

The UbInnov ADT (Action de Développement Technologique) aims at building a Software Product Line (SPL) for mobile applications named AppliDE reusing the technologies developed in the ADAM project-team. UbInnov aims to industrialize AppliDE, a software product line for mobile applications (iPhone, Android). With AppliDE, the development time of a mobile application is significantly reduced thanks to an automatic generation of code. The generated code supports required features from the device, such as geolocation, camera or connection to external services. Clément Quinton (INRIA ADAM New Graduate Engineer) has been recruited to achieve this task. The results have been published in [ 40 ].

8.1.3. INRIA ADT Adapt

Participants: Gwenael Cattez, Christophe Demarey, Philippe Merle.

The Adapt ADT (Action de Développement Technologique) is a local ADT of the Inria Lille - Nord Europe Center and aims at building a demonstrator of our ADAM software technologies in the application domain of smart digital homes. Firstly, this demonstrator will show adaptive and reflective capabilities of FraSCAti 5.4, i.e., supporting various implementation languages (e.g., Java, WS-BPEL, scripting languages, template technologies) to develop business components, supporting various remote communication protocols (e.g., SOAP, REST, JMS, JGroups) to access and expose services, supporting various non functional properties, deploying business components on demand, and reconfiguring business applications/components/services at runtime. Secondly, these capabilities will be illustrated on several ambient intelligence scenarios, e.g., Fire Emergency and Home Automation. Thirdly, this demonstrator will integrate our recent and future scientific results in the domains of dynamic software product lines, autonomic computing, control loops, complex event processing, energy control, etc. Gwenael Cattez (newly graduated engineer) has been recruited in the context of this Inria ADT.

8.2. National Initiatives

8.2.1. ANR ARPEGE SALTY

Participants: Laurence Duchien, Philippe Merle, Russel Nzekwa, Romain Rouvoy, Lionel Seinturier.

SALTY is a 3-year ANR ARPEGE project started in November 2009 and involving University of Nice, Deveryware, EBM WebSourcing, INRIA ADAM, MAAT-G France, Thales, University Paris 8 and University Paris 6.
The main objective of the SALTY project is an autonomic computing framework for large-scale service-oriented architectures and infrastructures. The SALTY project 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 analysis (or decision-making) model, and an adaptation model tackling large-scale underlying managed components. The project will be validated by two large use-cases: a neurodegenerative disease study for exploring the capacity of grid infrastructures and a path tracking application for exploiting the different positioning methods and appliances on a fleet of trucks.

8.2.2. ANR ARPEGE ITEmIS
Participants: Jonathan Labejof, Philippe Merle, Lionel Seinturier.

ITEmIS is a 30-month ANR ARPEGE project started in March 2009 and involving Thales, EBM WebSourcing, Inria (ADAM and ARLES), LAAS, ScalAgent, and IRIT.

The ITEmIS project aims at easing the evolution from today’s world of separate lightweight embedded applications and IT services to the future world of seamlessly integrated services, thus qualifying and defining a new generation SOA enabling IT and Embedded Integrated Systems (ITEmIS systems). This endeavour is undertaken along three main lines: (1) At business level, where IT/embedded services are integrated into advanced workflows supporting the multi-faceted interoperability and scalability required for ITEmIS systems; (2) At service infrastructure level, by introducing a specialized ESB-based and component-based solution addressing the requirements of the embedded world including deployment; and (3) Transversally for both above levels addressing end-to-end assurance of Quality of Service (QoS) and correctness verification of deployments and workflows at the level of their execution models. The PhD thesis of Jonathan Labejof is conducted in the context of this project.

Further information is available on the website of the project: http://itemis-anr.org/.

8.2.3. ANR ARPEGE SocEDA
Participants: Gabriel Hermosillo, Fawaiz Paraiso, Romain Rouvoy, Lionel Seinturier.

SocEDA is a 3-year ANR ARPEGE project started in November 2010 and involving EBM WebSourcing, ActiveEon, EMAC, I3S, LIG, LIRIS, INRIA ADAM, France Telecom and Thales Communications.

The goal of SocEDA is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize their execution, according to social network information. The main outcome will be a platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements.

Further information is available on the website of the project: http://www.soceda.org.

8.2.4. ANR CONTINT MOANO
Participants: Laurence Duchien, Anne-Françoise Le Meur, Nicolas Petitprez.

MOANO (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 36-month project of the ANR CONTINT program which has started in January 2011. The partners are LIUPPA/University of Pau and Pays de L’Adour, University of Toulouse/IRIT, University of Grenoble/LIG, University of Lille/LIIFL/INRIA.

While going through a territory, mobile users often encounter problems with their handheld computers/mobiles. Some locally stored data become useless or unnecessary whereas other data is not included in the handheld computer. Some software components, part of the whole applications can become unnecessary to process some information or documents that the user did no plan to manage during his mission.
In order to answer such difficulties, our project has three operational studies which are i) to enlarge the communication scale, ii) to provide people without computer-science skills with a toolset that will enable them to produce/configure mapping applications to be hosted on their mobile phone and iii) to process all the documents of interest in order to make their spatial and thematic semantics available to mobile users.


### 8.2.5. Trade cluster MIND

**Participants:** Damien Fournier, Frédéric Loiret, Rémi Mélisson, Philippe Merle, Lionel Seinturier.

MIND is a 32-month project funded by the Minalogic cluster on micro- and nano-technologies. The project started in 2008. The partners of this project include: STMicroelectronics (Leader), CEA, France Telecom R&D, Grenoble 1, INERIS, INRIA, ICT, ISTIA, Iiris Automation Square, LOGICA, Schneider Electric, Sogeti High Tech, VERIMAG.

It aims at consolidating the component-based technologies and the tools, which exist around the FRACTAL component model for building middleware and systems. The goal is to transfer these results into an industrial strength software tool suite in order to foster the adoption of the component-based technologies for designing and developing embedded applications and systems.

### 8.2.6. Trade Cluster EconHome

**Participants:** Aurélien Bourdon, Rémi Druilhe, Laurence Duchien, Adel Noureddine, Romain Rouvoy, Lionel Seinturier.

EconHome is a 30-month project funded by FUI and labelized by the Minalogic and Systematic clusters. The project started in 2011. The partners of this project include: Sagemcom, Orange, STMicroelectronics, ST-Ericsson, SPI-DCOM, Utrema, COMSIS, DOCEA, CEA, ETIS.

The project aims at reducing the energy consumption of home and middleware networks. The target is to reduce of at least 70% the energy consumption of devices such as residential gateways, set top boxes, CPL plugs. Two axes are investigated: the optimization of the energy consumption of individual devices with innovative low power and sleep modes, and the optimization of the overall network with innovative techniques such as service migration and energy aware service feedbacks to the user.

### 8.2.7. Trade Cluster MACCHIATO

**Participants:** Laurence Duchien, Anne-Françoise Le Meur, Nicolas Petitprez, Romain Rouvoy.

Macchiato is a 36-month project of the competitiveness cluster of trade industry of Nord/Pas-de-Calais PICOM (Pôle des Industries du COMmerce, see [http://www.picom.fr](http://www.picom.fr)), which has started in January 2011. The partners of this project are Auchan (leader), University of Bordeaux/LABRI, INRIA, Web Pulser (an SME).

The Macchiato project is to rethink the design of e-commerce sites to better integrate the Internet of Things and facilitate online sales. In addition to setting up an infrastructure and a common application base, this challenge needs to refocus the design of e-commerce sites on the concept of “single basket”. We believe that including the next generation of e-commerce sites will be able to offer a personalized offer to consumers by adapting the content and form of site to their preferences and needs and allowing them to manage its purchases uniformly by through a single basket [46].

See [http://macchiato.lille.inria.fr/](http://macchiato.lille.inria.fr/)

### 8.2.8. Trade Cluster EasySOA

**Participants:** Michel Dirix, Philippe Merle, Christophe Munilla.

EasySOA is a 24-month project funded by FUI and labelized by the Systematic competitive cluster for Open Source (see at [http://www.systematic-paris-region.org/](http://www.systematic-paris-region.org/)). The project started in 2011. The partners of this project include: Open Wide (Leader), Bull, Easyfab, Inria, Nuxeo, Talend.
The EasySOA goal is to add an open, light, agile layer on top of « traditional » SOA, thanks to an online, social and collaborative approach, involving all actors of the SOA process. Beyond cartography and documentation, it helps gathering and fast-prototyping the business needs, and eases the transition to final implementations in the existing SOA solution.

Further information is available on the website of the project: [http://www.easysoa.org](http://www.easysoa.org).

### 8.2.9. GDR GPL Action: UbiLab

**Participants:** Nicolas Haderer, Romain Rouvoy, Lionel Seinturier.

The objective of UbiLab is to build an open software platform for federating scientific activities related to ubiquitous computing. In particular, UbiLab focuses on the definition of a remote sensing platform for collecting activity traces from mobile users using Android smartphones. This action is realized in collaboration with researchers from the CNRS LAAS research laboratory, who are currently working on geo-privacy concerns. In this context, the UbiLab action aims at defining common standards and procedures for collecting and exploiting such activity traces. At short-term, the results of UbiLab will leverage the research in the domains of geo-privacy and ubiquitous computing. At mid-term, we expect that the results of this action will allow other scientific communities to build specific experiments related to the study of mobile crowds behaviors.

### 8.2.10. INRIA ARC SERUS

**Participants:** Laurence Duchien, Alexandre Feugas, Anne-Françoise Le Meur, Lionel Seinturier.

SERUS (Software Engineering for Resilient Ubiquitous Systems) is founded by the INRIA collaboration program. The partners are INRIA ADAM Team, INRIA PHOENIX Team and TSF-LAAS (CNRS). Resilience is defined as the ability of a system to stay dependable when facing changes. For example, a building management system (e.g., anti-intrusion, fire detection) needs to evolve at runtime (e.g., deployment of new functions) because its critical nature excludes interrupting its operation. Resilience concerns occur in various application domains such as civil systems (civil protection, control of water or energy, etc.) or private systems (home automation, digital assistance, etc.).

The objectives of this project is to propose a design-driven development methodology for resilient systems that takes into account dependability concerns in the early stages and ensures the traceability of these requirements throughout the system life-cycle, even during runtime evolution. To provide a high level of support, this methodology will rely on a design paradigm dedicated to sense/compute/control applications. This design will be enriched with dependability requirements and used to provide support throughout the system life-cycle.

See [http://serus.bordeaux.inria.fr/](http://serus.bordeaux.inria.fr/)

### 8.3. European Initiatives

#### 8.3.1. INRIA Associate Team SeaS: University of Oslo

**Participants:** Frédéric Loiret, Gabriel Hermosillo, Russel Nzekwa, Daniel Romero, Romain Rouvoy, Lionel Seinturier.

*Middleware for Sensor as a Service (Seas)* is a collaboration initiative that intends to contribute to the vision of the Future Internet as an open-source middleware platform, based on robust Web standards, breaking existing IT silos and leveraging the development of innovative hybrid service-oriented architectures spanning from Wireless Sensor Networks to Ubiquitous and Cloud Computing. Given that one of the objectives of Europe is to develop the convergence of IT networks (mobile or fixed) and the fact that many of the upcoming mobile devices are integrating services (from phones down to sensors and radio frequency identification), we believe that one of the challenges for the next generation society will consist in enabling a distributed middleware platform for the dynamic provision of hybrid services and the scalable dissemination of data. In particular, we believe that the sensor capabilities can be reflected as a service accessible from the Internet or any IT system using standard Web protocols. The resulting services will be hybrid in the sense that they will
reflect the wide diversity of sensor devices available nowadays, but we aim at providing a uniform solution to leverage the development of applications on top of physical or virtual sensors. This platform includes not only the sensor level (description, discovery, communication, reconfiguration...), but also the platform level services (dissemination, storage, query, adaptation...) that are required for enabling such a vision. The resulting platform will bring additional opportunities for the development of innovative service-based systems by exploiting the emergence of Wireless Sensor Networks (WSN), Ubiquitous Computing, and Cloud Computing environments. Along the three years of activity, the SeaS collaboration will target to incrementally achieve the following objectives:

- **TASK 1 on Integration**: Enabling Hybrid Service-Oriented Architectures,
- **TASK 2 on Adaptation**: Supporting Dynamic Evolution of Hybrid Sensor Services,
- **TASK 3 on Scalability**: Building a Scalable Data Dissemination Infrastructure.

Read more at [http://seas.ifi.uio.no/](http://seas.ifi.uio.no/).

### 8.3.2. ERCIM Working Group Software Evolution

**Participant:** Laurence Duchien.

The Working Group (WG) on Software Evolution is one of the many working groups supported by ERCIM. The main goal of the WG is to identify a set of formally-founded techniques and associated tools to support software developers with the common problems they encounter when evolving large and complex software systems. With this initiative, the WG plans to become a Virtual European Research and Training Centre on Software Evolution. Read more at [http://www.planet-evolution.org](http://www.planet-evolution.org).

### 8.3.3. IAP MoVES

**Participants:** Laurence Duchien, Patrick Heymans, Daniel Romero.

The Belgium IAP (Interuniversity Attraction Poles) MoVES (Fundamental Issues in Software Engineering: Modeling, Verification and Evolution of Software) is a project whose partners are the Belgium universities (VUB, KUL, UA, UCB, ULB, FUNDP, ULg, UMH) and three European institutes (INRIA, IC and TUD) respectively from France, Great Britain and Netherlands. The project has started in January 2007 and is scheduled for a 60-month period.

This consortium combines the leading Belgian research teams and their neighbors in software engineering, with recognized scientific excellence in MDE, software evolution, formal modeling and verification, and AOSD. The long term objective of our network is to strengthen existing collaborations and forge new links between those teams, and to leverage and disseminate our research expertise in this domain at an European level. The project focuses on the development, integration and extension of state-of-the-art languages, formalisms and techniques for modeling and verifying dependable software systems and supporting the evolution of Software-intensive systems.

This year, we welcome Patrick Heymans from FUNDP as invited scientist.

Read more at [http://moves.vub.ac.be](http://moves.vub.ac.be).

### 8.3.4. ICT FP7 SOA4All Integrated Project

**Participants:** Damien Fournier, Philippe Merle.

*Service-Oriented Architectures for All (SOA4All)* is a large-scale Integrating Project funded by the European Seventh Framework Program, under the Service and Software Architectures, Infrastructures and Engineering research area. This is a 36-month project started in March 2008. Partners are: Atos Origin (Spain), British Telecommunications (UK), CEFRIEL (Italy), EBM WebSourcing (France), Hanival Internet Services GmbH (Austria), INRIA (France), Intelligent Software Components (Spain), Ontotext Lab (Bulgaria), Open University (UK), SAP AG (Germany), Seekda OG (Austria), TIE (Netherlands), The University of Manchester (UK), TXT e-Solutions Spa (Italy), Universitaet Karlsruhe (Germany), University Innsbruck (Austria).
SOA4All will help to realize a world where billions of parties are exposing and consuming services via advanced Web technology: the main objective of the project is to provide a comprehensive framework and infrastructure that integrates complementary and evolutionary technical advances—i.e., SOA, context management, Web principles, Web 2.0 and Semantic Web—into a coherent and domain-independent service delivery platform [52].

Further information is available on the website of the project: http://www.soa4all.eu.

8.4. International Initiatives

8.4.1. OW2

Participants: Christophe Demarey, Damien Fournier, Philippe Merle, Romain Rouvoy, Lionel Seinturier.

OW2, previously ObjectWeb, is an international consortium to promote high quality open source middleware (see at http://www.ow2.org). The vision of OW2 is that of a set of components which can be assembled to offer high-quality middleware.

We are members of this consortium since a long time ago. Philippe Merle is the leader of both FRACTAL and FRASCATI projects, which are hosted by this consortium. Philippe Merle and Lionel Seinturier are members of the Technology Council of OW2.

8.4.2. University of Los Andes (Bogota)

Participants: Laurence Duchien, Gabriel Tamura.

The Ph.D. Student Gabriel Tamura is co-supervised by Rubby Casallas, University of Los Andes, and Laurence Duchien from University of Lille 1. The objective is to study a component-based architecture reconfiguration model and to address QoS (quality-of-service) contract preservation. The proposal is based on a formal theory to perform, in a safe way, the process of self-adaptation in response to quality-of-service (QoS) contracts violation. The results have been published in [36], [44]. The student has been in the ADAM project-team during six months this year. Laurence Duchien has visited the University of Los Andes in October 2009 and Rubby Casallas has visited the ADAM team in June 2010 and 2011.

8.5. Exterior research visitors

We have received four exterior research visitors in the year:

- Rubby Casallas, Associate Professor, University of Los Andes, Colombia, June 2011
- Norha Villegas, Ph.D Student, University of Victoria, Canada, April 2011
- Nadia Gamez, Ph.D. Student, University of Malaga, Spain, Sept-Dec 2011
- Patrick Heymans, Professor, University of Namur, Belgium, Sept-Dec 2011
AMAZONES Team

8. Partnerships and Cooperations

8.1. Local Initiatives

8.1.1. BQR - Design Methods for Energetic Optimisation in Wireless Sensor Networks

Participants: Nicolas Stouls [Project leader], Antoine Fraboulet, Lionel Morel, Guillaume Salagnac.

Glossary

BQR (Bonus Qualité Recherche) project funded by an academic institution.

This project, funded by INSA Lyon, is a collaboration between three research laboratories: CITI (Center of Innovation in Telecommunications and Integration of services), LIRIS (Computer Science, Image and Information Systems Laboratory) and CETHIL (Lyon Thermal Center). The project aims at proposing a practical instrumentation technique for measuring energetic efficiency of buildings by means of using a wireless network of sensor nodes (WSN). In order to make it feasible to scale both space-wise (instrumenting a whole building will require tens or hundreds of nodes) as well as duration-wise (the experiments we envision in this project will span over several months), we adopt a software architecture based on a dedicated streaming database technology. Finally, this whole system is also a case-study for another goal of this project, that of proposing new metrics to characterize energy consumption on embedded devices (in particular we aim at somehow relating energy consumption to a high-level view of the software running on the nodes).

8.1.2. BQF - Smart Chappe Building: A Context-aware Service Platform

Participants: Frédéric Le Mouël [Project leader], Julien Ponge, Stéphane Frénot.

Glossary

BQF (Bonus Qualité Formation) project funded by an academic institution.

This project, funded by INSA Lyon, is leaded by the Telecommunication Department with the participation of two research laboratories: CITI (Center of Innovation in Telecommunications and Integration of services) and LIRIS (Computer Science, Image and Information Systems Laboratory).

Computers and Information Systems are now all around us (Ubiquitous Computing) with a great number of portable and mobile devices (Mobile Computing) that have to adapt to highly changing environments (Context-aware Computing) and that even disappear in our every life in small, active and smart objects (Ambient Intelligence). Smart Houses and Buildings is now an emerging research topic with power managing, security monitoring, .... We think that mobile phones will be the universal remote controller for a user-personalized access to services of such buildings.

Build in 2008, the Claude Chappe Building - hosting the Telecommunication Department and the CITI Lab - is the perfect experimentation place. The Smart Chappe Building proposes a Context-aware Service Platform integrating (i) devices: static ones (large display screens, interactive terminal), mobile phones (iPhone with iOS, Samsung with Android, HTC with Windows Mobile), sensors (temperature, hydrometry), RFID, (ii) wireless connectivity: Bluetooth, WIFI and (iii) context-aware and user-personalized services: building guidance, news broadcasting, lecture agenda. This plateform is bothly used for teaching and doing research, for instance, by allowing to develop and integrate new innovative services.

8.1.3. INRIA ADT ORSI

Participants: Antoine Fraboulet [Project leader], Julien Carpentier.

ORSI (Outil de Raffinement de la Simulation à l’Implantation) is an INRIA ADT project started in November 2010.
The ORSI ADT is in the context of programming tools for constrained embedded systems applications. This ADT is the continuation and extension of techniques and tools developed in the scope of wireless sensor networks. Projects like RECAP, SensLab, WASP and Mosar have demonstrated the value and contribution of WSIM and WSNet software simulation tools which are now used outside of their original projects frames. Dissemination and software use in academic and industrial projects can consider their evolution in order to take into account new types of uses and new development paths. The ORSI ADT aims to extend the models used in these software to prepare them for next generation applications hardware and software targets.

8.2. Regional Initiatives

8.2.1. SEmba - Embedded Systems

**Participants:** Nicolas Stouls [Co-leader], Stéphane Frénot, Antoine Fraboulet, Lionel Morel, Guillaume Salagnac, Yufang Dan.

SEmba, standing for Embedded Systems (“Systèmes Embarqués” in French), is a project funded by the ISLE cluster of the Rhône-Alpe department. This project aims at animating and structuring regional research activities, in order to give more visibility of our results, and at promoting collaborations between academic and industrial teams of the regions. Current academic labs of the project are:

- TIMA, GIPSA-Lab, INRIA Grenoble, LIG, VERIMAG (Grenoble),
- CITI, INL, LIP (Lyon),
- LHC (Saint-Etienne),
- LAMA (Savoie),
- LCIS (Valence).

To produce enhanced embedded systems is a non-stopping effort, due to constant technologies evolutions in nano and micro-electronic. Locks lie in the low cost, low electrical consumption, fast conception and development processes and the quality of systems, as well for the hardware as for the software parts. Project is managed by Dominique Borrione (TIMA Lab) and Nicolas Stouls (CITI Lab), and is organized with three themes:

1. Architectures and conception (software/hardware, components, synthesis)
2. Evaluation of embedded systems quality (validation, test, reliability, performance, quality of service)
3. Communicating infrastructures (protocols, OS, middleware, sensors networks, security, networks on chip)

8.3. National Initiatives

8.3.1. Ubiquest

**ANR Ubiquest,** Ubiquitous Quest: declarative approach for integrated network and data management in wireless multi-hop networks, with Grenoble Institute of Technology (Christine Collet, Christophe Bobineau), 2009-2012

8.3.2. ANR LISE

**Participant:** Stéphane Frénot.

Software quality and patterns of security frauds are directly related to legal liability patterns but, so far, software providers have succeeded in limiting their legal liability for their products. The increasing dependence of society on software changes the situation however, and calls for stronger liability rules.
The precise definition of the expected functionalities of software products is quite a challenge, not to mention the use of such definition as a basis for a liability agreement. Taking up this challenge is precisely the objective of the LISE project. To achieve this goal, software liability is addressed both from the legal and the technical points of view with the aim to put forward methods (1) to define liability in a precise and legally sound way and (2) to establish liability in case of incident. http://licit.inrialpes.fr/lise/

8.3.3. ANR TLCOM Senslab

Participant: Antoine Fraboulet.

The purpose of the SensLAB project is to deploy a very large scale open wireless sensor network platform. SensLAB’s main and most important goal is to offer an accurate and efficient scientific tool to help in the design, development, tuning, and experimentation of real large-scale sensor network applications. Amazones contributes to the Senslab project through the participation of Antoine Fraboulet who was involved in the early project design phases and through the use of the software simulation suite WSNet, WSim and eSimu in the Senslab project.

8.3.4. ADT SensTools

Participant: Antoine Fraboulet.

SensTools is a national INRIA ADT. The project ended in 2010, the final review was held in Lyon on December, 15th. SensTools provides a set of hardware and software tools for the WSN430 platform. Some basic drivers and several OSes are provided.

8.3.5. ADT SensAS

Participants: Antoine Fraboulet, Guillaume Salagnac.

SensAS is an INRIA national ADT project started in December 2010. The SENSAS project’s ambition is to support the development of innovative applications from INRIA EPIS involving several networks of sensors / actuators and / or fleets of robots. From the strong experience in sensor networks, the idea is to build and pool equipment and software in order to have a leverage at the application level. The target applications are selected monitoring / intrusion detection by a fleet robot, self organizing fleets of drones flying biologging applications in the field of health and supervision of large networks of sensors. The SENSAS ADT will amplify skills transfer and facilitate access to implementation of sensor networks technology. In deploying demonstrators at the forefront of technology, the SENSAS ADT showcases the technological expertise and scientific excellence of INRIA who established his reputation in this field.

Amazones is leader of the WP4: SensBOX : software suite for sensor and actuator networks.

8.4. European Initiatives

8.4.1. EU Project Wasp (FP6 IP project)

Participant: Antoine Fraboulet.

The WASP project (Wirelessly Accessible Sensor Populations, European Project IST-034963) ended in November 2010. The final review took place in London on October, 21th and 22th 2010. The general goal of the project was the provision of a complete system view for building large populations of collaborating objects. The system incorporates networking protocols for wireless sensor nodes to hide the individual nodes from the application.

Amazones was involved in the project through the participation of Antoine Fraboulet. Antoine Fraboulet was responsible for several deliverables for precompilation tools and software support. He was also member of the project’s architecture team.

8.4.2. EU Project Mosar (LSH European Project)

Participant: Antoine Fraboulet.
The goal of the MOSAR project is to study the dynamics of neighborhood people using networks of sensors in a hospital. Amazones was involved in MOSAR through the participation of Antoine Fraboulet. Involvement: implementation of hardware and software support for the project, large scale deployment of a full wireless sensor network and study of dynamic graph patterns.
7. Partnerships and Cooperations

7.1. European Contracts and Grants

7.1.1. FP7 ICT FET IP CONNECT

Participants: Emil Andriescu, Amel Bennaceur, Luca Cavallaro, Nikolaos Georgantas, Sneha-Sham Godbole, Valérie Issarny, Rachid Saadi, Daniel Sykes.

- **Name:** CONNECT – Emergent Connectors for Eternal Software Intensive Networked Systems
- **URL:** http://www.connect-forever.eu/
- **Related activities:** § 6.2
- **Period:** [February 2009 - July 2012]
- **Partners:** Inria (CRI Paris-Rocquencourt) [project coordinator], CNR (Italy), DoCoMo (Germany), Lancaster University (UK), Thales Communications SA (France), Universita degli Studi L’Aquila (Italy), Technische Universitaet Dortmund (Germany), University of Oxford (UK), Uppsala Universitet (Sweden), Peking University (China).

The CONNECT Integrated Project aims at enabling continuous composition of networked systems to respond to the evolution of functionalities provided to and required from the networked environment. At present the efficacy of integrating and composing networked systems depends on the level of interoperability of the system’s underlying technologies. However, interoperable middleware cannot cover the ever growing heterogeneity dimensions of the networked environment. CONNECT aims at dropping the interoperability barrier by adopting a revolutionary approach to the seamless networking of digital systems, that is, synthesizing on the fly the connectors via which networked systems communicate. The resulting emergent connectors are effectively synthesized according to the behavioral semantics of application- down to middleware-layer protocols run by the interacting parties. The synthesis process is based on a formal foundation for connectors, which allows learning, reasoning about and adapting the interaction behavior of networked systems at run-time. Synthesized connectors are concrete emergent system entities that are dependable, unobtrusive, and evolvable, while not compromising the quality of software applications. To reach these objectives the CONNECT project undertakes interdisciplinary research in the areas of behavior learning, formal methods, semantic services, software engineering, dependability, and middleware. Specifically, CONNECT investigates the following issues and related challenges: (i) Modeling and reasoning about peer system functionalities, (ii) Modeling and reasoning about connector behaviors, (iii) Runtime synthesis of connectors, (iv) Learning connector behaviors, (v) Dependability assurance, and (vi) System architecture. The effectiveness of CONNECT research is assessed by experimenting in the field of wide area, highly heterogeneous systems where today’s solutions to interoperability already fall short (e.g., systems of systems).

7.1.2. FP7 ICT IP CHOREOS

Participants: Sandrine Beauche, Nebil Ben Mabrouk, Benjamin Billet, Nikolaos Georgantas, Sara Hachem, Valérie Issarny, Animesh Pathak, Roberto Speicys Cardoso.

- **Name:** CHOREOS – Large Scale Choreographies for the Future Internet
- **URL:** http://www.choreos.eu/
- **Related activities:** § 6.3
- **Period:** [February October 2010 - September 2013]
- **Partners:** BPI (Lithuania), CEFRIEL (Italy), CNR (Italy), eBM WebSourcing S.A.S (France), Inria (CRI Paris-Rocquencourt) [scientific leader], MLS Multimedia A.E. (Greece), OW2 Consortium, Thales Communications S.A. (France) [coordinator], The City University, London (UK), Università degli Studi dell’Aquila (Italy), Universidade de São Paulo (Brazil), University of Ioannina (Greece), SSII VIA (Latvia), Virtual Trip Ltd. (Greece), Wind Telecommunicazioni S.p.A (Italy).
CHOReOS aims at assisting the engineering of software service compositions in the revolutionary networking environment created by the Future Internet. Indeed, sustaining service composition and moving it closer to the end users in the Future Internet is a prime requirement to ensure that the wealth of networked services will get appropriately leveraged and reused. This again stresses the required move from static to dynamic development, effectively calling for adequate support for service reuse; much like software reuse has been a central concern in software engineering over the last two decades. This is why CHOReOS adopts the Service Oriented Computing (SOC) paradigm, where networked resources are abstracted as services so as to ease their discovery, access and composition, and thus reuse. However, although latest advances in the SOC domain enable facing (at least partly) the requirements of today’s Internet and related networking capabilities, engineering service compositions in the light of the Future Internet challenges — in particular the ultra large scale (ULS) on all imaginable dimensions as well as the evolution of the development process from a mostly static process to a dynamic user-centric one — is far from adequately addressed. Therefore, the CHOReOS goal is to address these challenges by devising a dynamic development process, and associated methods, tools and middleware, to sustain the composition of services in the Future Internet.

7.1.3. FP7 PEOPLE Requirements@run.time

Participants: Nelly Bencomo, Valérie Issarny.

- **Name:** Requirements@run.time: Requirements-aware systems
- **URL:** https://www-roc.inria.fr/arles/index.php/members/220-marie-curie-project-requirements-aware-systems-requirementsruntime
- **Related activities:** § 6.2
- **Period:** [May 2011 - May 2013]
- **Partners:** Inria (CRI Paris-Rocquencourt).

This project uses the novel notion of requirements reflection, that is, the ability of a system to dynamically observe and reason about its requirements. It aims to address the need of having systems requirements-aware by reifying requirements as run-time objects (i.e. requirements@run.time). These systems provide a runtime model of their requirements that allow them to reason, evaluate and report on their conformance to their requirements during execution. This project contributes towards development of conceptual foundations, engineering techniques, and computing infrastructure for the systematic development of dynamically-adaptive systems based on the principle of requirements reflection. The researchers build upon their extensive expertise in the area of reflective middleware and reflective architectures and research projects like CONNECT.

7.1.4. FP7 ICT NoE NESSoS

Participants: Valérie Issarny, Animesh Pathak, Rachid Saadi, Amir Seyedi.

- **Name:** NESSoS – Network of Excellence on Engineering Secure Future Internet Software Services and Systems
- **URL:** http://www.nessos-project.eu
- **Related activities:** § 6
- **Period:** [October 2010 - March 2013]
- **Partners:** Atos Origin (Spain), CNR (Italy) [coordinators], ETH Zürich (Switzerland), IMDEA Software (Spain), Inria (EPI ARLES, CASSIS, and TRISKELL), KU Leuven (Belgium), LMU München (Germany), Siemens AG (Germany), SINTEF (Norway), University Duisburg-Essen (Germany), Universidad de Malaga (Spain), Università degli studi di Trento (Italy).
The Network of Excellence on Engineering Secure Future Internet Software Services and Systems (NESSoS) aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. The NESSoS engineering of secure software services is based on the principle of addressing security concerns from the very beginning in system analysis and design, thus contributing to reduce the amount of system and service vulnerabilities and enabling the systematic treatment of security needs through the engineering process. In light of the unique security requirements exposed by the Future Internet, new results are achieved by means of an integrated research, as to improve the necessary assurance level and to address risk and cost during the software development cycle in order to prioritize and manage investments. NESSoS integrates the research labs involved; NESSoS re-addresses, integrates, harmonizes and fosters the research activities in the necessary areas, and increases and spreads the research excellence. NESSoS also impacts training and education activities in Europe to grow a new generation of skilled researchers and practitioners in the area. NESSoS collaborates with industrial stakeholders to improve the industry best practices and support a rapid growth of software-based service systems in the Future Internet.

7.1.5. FP7 ICT CA EternalS

Participants: Amel Bennaceur, Valérie Issarny, Animesh Pathak, Daniel Sykes.

- Name: EternalS – Trustworthy Eternal Systems via Evolving Software, Data and Knowledge
- URL: http://www.eternals.eu
- Related activities: § 6.2
- Period: [March 2010 - February 2013]
- Partners: Inria (CRI Paris-Rocquencourt), KU Leuven (Belgium), Queen Mary University (UK), University of Chalmers (Sweden), University of Trento (Italy), Waterford Institute of Technology (Ireland).

Latest research work within ICT has allowed to pinpoint the most important and urgently required features that future systems should possess to meet users’ needs. Accordingly, methods making systems capable of adapting to changes in user requirements and application domains have been pointed out as key research areas. Adaptation and evolution depend on several dimensions, e.g., time, location, and security conditions, expressing the diversity of the context in which systems operate. A design based on an effective management of these dimensions constitutes a remarkable step toward the realization of Trustworthy Eternal Systems. The EternalS Coordination Action specifically aims at coordinating research in that area based on a researcher Task Force together with community building activities, where the organization of large workshops and conferences is just one of the tools that will be used to conduct a successful CA.

7.1.6. PHC Ulysses: Middleware for Mobile Social Applications in Smart Urban Environments

Participant: Animesh Pathak.

- Name: Middleware for Mobile Social Applications in Smart Urban Environments
- Related activities: § 6.6
- Period: [Jan 2011 - December 2011]
- Partners: Inria (CRI Paris-Rocquencourt), Trinity College, Dublin, Ireland.

This project aims at investigating how the exploitation of novel information and communication technologies (ICT) in the field of mobile social networking can improve the quality of life of citizens. In particular, it investigates how novel shared urban infrastructures, such as bike sharing schemes, can become neighborhood hubs and offer community services to users. For example as users collect a bike, the application that they have installed on their smart phone synchronizes with the infrastructure installed on the bike sharing station, automatically retrieving information relevant to their interests and publishing any prepared postings. Users can read information or prepare postings at their leisure. The main research questions that need to be addressed to fulfill this vision include: (i) the design of appropriate data representation, management and exchange models, to support different types of data (local vs. global, short-lived vs. long-lived), to deal
with distributed/inconsistent knowledge, as well as with data provenance and authentication; (ii) the seamless integration of different computing platforms and architectures (e.g., user devices, city infrastructure); (iii) the need for adequate privacy and security support to protect personal social data; and (iv) the need to design applications that are able to deal with the scale of urban environments. The project relies on the Yarta middleware (§ 5.6 ), which includes a flexible and expressive representational framework for social data, tools to develop application-specific data models, and a set of middleware components to manage social information in mobile environments.

7.2. International Research Networks and Work Groups

7.2.1. ForeverSOA Associated Team

- **Name:** ForeverSOA – *A rigorous approach to the evolution of service-oriented software*
- **URL:** [http://dmod.cs.uoi.gr/ForeverSOA/index.htm](http://dmod.cs.uoi.gr/ForeverSOA/index.htm)
- **Related activities:** § 6.3
- **Period:** [2009 - 2011]
- **Participants:** Joint team with University of Ioannina (UoI), Department of Computer Science, Greece.

This objective of the team is to study a principled approach for the dynamic maintenance of service-oriented software (i.e., software that is built by composing available services) on the basis of fundamental design principles and middleware that supports their adoption. The need for maintaining service-oriented software may be triggered by changes in the quality requirements of the end-users of service-oriented software (e.g., performance, availability, reliability), or by the the independent evolution of constituent services (e.g., services may be deployed or undeployed at anytime).

7.2.2. ERCIM WG SERENE

- **Name:** ERCIM Working Group – *Software EngineeRing for rEsilieNt systEms*
- **URL:** [http://serene.uni.lu/tiki/tiki-index.php](http://serene.uni.lu/tiki/tiki-index.php)
- **Period:** [Created 2004]
- **Participants:** Aabo Akademi (Finland), BUTE (Hungary), CNR (Italy), CWI (The Netherlands), FNR (Luxembourg), FORTH (Greece), Fraunhofer FOKUS & IPSI (Germany), Inria (CRI Paris-Rocquencourt), LAAS-CNRS (France), National Aerospace University (Ukraine), Nokia Research (Finland), NTNU (Norway), Oak Ridge National Laboratory (USA), Polit. di Milano (Italy), Poznan University of Technology (Poland), SARIT (Switzerland), SpaRCIM (Spain), SZTAKI (Hungary), University of L’Aquila (Italy), University Mc Gill (Canada), University Mc Master (Canada), University of Florence (Italy), University of Ioannina (Greece), University of Groningen (The Netherlands), University of Newcastle (UK), University Roma Tor Vergata (Italy), University of Southern Denmark in Odense (Denmark), VTT (Finland).

SERENE considers resilient systems as open and distributed systems that can dynamically adapt in a predictable way to unexpected events. Engineering such systems is a challenging issue still not solved. Achieving this objective is a very complex task since it implies reasoning explicitly and in a combined way, on system’s functional and non-functional characteristics.

SERENE advocates that resilience should be explicitly included into traditional software engineering theories and practices and should become an integral part of all steps of software development. As current software engineering practices tend to capture only normal behavior, assuming that all abnormal situations can be removed during development, new software engineering methods and tools need to be developed to support explicit handling of abnormal situations. Moreover, every phase in the software development process needs to be enriched with phase specific resilience means.
7.2.3. ERCIM WG STM

- **Name:** ERCIM Working Group – Security and Trust Management
- **URL:** http://www.iit.cnr.it/STM-WG/
- **Period:** [Created 2005]
- **Participants:** AARIT Research (Austria), ATOS Research(Spain), British Telecom, CNR (Italy), CETIC (Belgium), CWI (The Netherlands), DTU (Denmark), FORTH-ICS (Greece), FNRS (Belgium), Fraunhofer SIT (Germany), HP Labs (UK), IBM Research, Ie Business School (Spain), Inria (CRI Paris-Rocquencourt & Sophia Antipolis), IUC (Ireland), L3S (Germany), Marasyk University (Czech Republic), Microsoft EMIC (Germany), NTNU (Norway), Politecnico Torino (Italy), SAP (Germany), SARIT (Switzerland), SICS (Sweden), Siemens Corporate Technology, SparCIM (Spain), SZTAKI (Hungary), TUBITAK UEKAE (Turkey), VTT (Finland), University of East London (UK), University of Luxembourg (Luxembourg), University of Milan (Italy), University of Twente (The Netherlands), VCPC (Austria), VTT (Finland), W3C.

The pervasive nature of the emerging Information and Communication Technologies (ICT) expands the well known current security problems on ICT, due to the increased possibilities of exploiting existing vulnerabilities and creating new threats. On the other hand, it poses new problems in terms of possible attack scenarios, threats, menaces and damages. Moreover, the increased virtual and physical mobility of the users enhances their interaction possibilities. Thus, there is a demand for a reliable establishment of trust relationships among the users. Privacy is also a main concern in the current ambient intelligence paradigm: everywhere there are devices interacting with users and information about the users is possibly being gathered by the devices at anytime. All these problems are perceived at different levels of concern by users, technology producers, scientific and governance communities.

This ERCIM Working Group aims at focusing the research of the ERCIM institutions on a series of activities (e.g., projects and workshops) for fostering the European research and development on security, trust and privacy in ICT. These will be among the main issues of current and future research efforts for “security” in a broad sense in Europe (http://www.cordis.lu/security/).

7.3. National Contacts and Grants

7.3.1. ANR ITeMIS: IT and Embedded Integrated Systems

**Participants:** Mohammad Ashiqur Rahaman, Sandrine Beauche, Amir Seyedi, Nikolaos Georgantas.

- **Name:** ITeMIS – IT and Embedded Integrated Systems
- **Related activities:** § 6.3
- **Period:** [January 2009 – December 2011]
- **Partners:** Thales Communications S.A, EBM Websourcing, Inria ARLES, Inria ADAM, LAAS - CNRS, ScalAgent, IRIT.

Service-Oriented Architecture (SOA), as a key architectural pattern for prompt and rapid integration, is today a cornerstone of the agile Information Technology (IT) wave. Indeed, most of today’s greatest successes, in terms of bringing agility to the whole enterprise through its IT backbone, have been provided by SOA and its major technological counterparts that are the Web Services and the Enterprise Service Bus (ESB). At the same time, large control and command systems are envisaged, which may roughly be described as net-centric assemblies of heterogeneous lightweight sensors and actuators along with several large control systems. To accomplish such systems, there is currently a strong need of techniques at the cutting edge of technology that could bring seamless integration and deployment of lightweight embedded applications and IT services in a global agile system of services. In this context, ITeMIS aims at easing the evolution from today’s world of separate lightweight embedded applications and IT services to the future world of seamlessly integrated services, thus qualifying and defining a new generation SOA enabling IT and Embedded Integrated Systems (ITeMIS systems).
7.3.2. **ANR MURPHY: Dependability-focused Evaluation of Sensor Networks**

**Participant:** Animesh Pathak.

- **Name:** MURPHY – Dependability-focused Evaluation of Sensor Networks
- **Related activities:** § 6.5
- **Period:** [January 2011 – December 2013]
- **Partners:** CNAM, Inria ARLES, LAAS - CNRS, SmartGrains, Univ. Valenciennes.

Murphy aims at easing the development of dependable and pervasive applications built on top of robust wireless sensor networks, thus providing a mean for early detection of possible failures, by estimating dependability metrics. This endeavor is undertaken by providing:

- Fault detection based on in-network event processing,
- Fault injection which attempts to accelerate the occurrence of faults so as to judge the quality of the error handling and hence, facilitate the evaluation of dependability,
- Advanced code dissemination across sensor networks, which is intended to (i) enable the dynamic and distributed insertion of faults and (ii) hide from the end user the complexity related to this task,
- Suitable abstractions to reason on faults, wireless sensor networks, data-centric and event-driven applications.

The aforementioned components enable to detect faults, diagnose possible causes and select appropriate corrective actions, and therefore to consolidate the dependability of sensor applications.

7.3.3. **Inria D2T Action de Developpement Technologique Srijan**

**Participants:** Animesh Pathak, Iraklis Leontiadis.

- **Name:** Srijan – Data-driven Macroprogramming for Heterogeneous Sensor
- **Related activities:** § 6.5 , § 5.5
- **Period:** [October 2009 – September 2011]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

Macroprogramming is an application development technique for wireless sensor networks (WSNs) where the developer specifies the behavior of the system, as opposed to that of the constituent nodes. In this research, we are working on Srijan, a toolkit that enables application development for WSNs in a graphical manner using data-driven macroprogramming, including specification of application as a task graph, customization of the auto-generated source files with domain-specific imperative code, specification of the target system structure, and compilation and deployment of the macroprogram into individual customized runtimes for each constituent node of the target system.

7.3.4. **Inria D2T Action de Developpement Technologique MobiTools**

**Participants:** Valérie Issarny, Bachir Moussa Tari Bako.

- **Name:** MobiTools – Environnement de développement logiciel pour plateforme mobiles
- **Related activities:** § 5
- **Period:** [January 2011 – December 2012]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

As part of the development of our software prototypes, MobiTools focuses on setting a supporting continuous integration platform (compilation, test, profiling, quality).
7.3.5. **Inria DTI Action de Transfert iBICOOP**

**Participants:** Valérie Issarny, Roberto Speicys Cardoso.

- **Name:** iBICOOP – *Middleware for mobile collaborative applications*
- **Related activities:** § 5.7
- **Period:** [November 2009 - April 2011]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

The *Action de transfert* iBICOOP supports the development of the iBICOOP middleware towards its transfer to industry and more specifically its exploitation by the AMBIENTIC spin-off for the development of innovative, mobile collaborative services.
8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. LABEX CominLabs

Participants: Anne-Marie Kermarrec, Davide Frey, Stéphane Weiss.

ASAP participates in the CominLabs initiative sponsored by the “Laboratoires d’Excellence” program. The initiative federates the best teams from Bretagne and Nantes regions in the broad area of telecommunications, from electronic devices to wide area distributed applications “over the top”. These include, among the others, the INRIA teams: ACES, ALF, ASAP, CELTIQUE, CIDRE, DISTRIBCOM, MYRIADS, TEMICS, TEXMEX, and Visages. The scope of CominLabs covers research, education, and innovation. While being hosted by academic institutions, the CominLabs build on a strong industrial ecosystem made of large companies and competitive SMEs.

8.1.2. ANR ARPÈGE project Streams

Participants: Achour Mostefaoui, Marin Bertier, Michel Raynal, Stéphane Weiss.

The Streams project started in November 2010. Beside the ASAP group, it includes Teams from INRIA Nancy and PARIS. Its aim it to design a real-time collaborative platform based on a peer-to-peer network. For this it is necessary to design a support architecture that offers guarantees on the propagation, security and consistency of the operations and the updates proposed by the different collaborating sites.

8.1.3. ANR VERSO project Shaman

Participants: Marin Bertier, Achour Mostefaoui, Anne-Marie Kermarrec, Michel Raynal.

The Shaman project started in 2009, gathering several members of the team working on distributed systems and distributed algorithms. The aim of this project is to propose new theoretical models for distributed algorithm inspired from real platform characteristics. From these models, we elaborate new algorithms and try to evaluate their theoretical power.

8.1.4. ANR Blanc project Displexity

Participants: Achour Mostefaoui, Anne-Marie Kermarrec, Michel Raynal.

The Displexity project started in October 2011. The aim of this ANR project that also involves researchers from Paris and Bordeaux is to establish the scientific foundations for building up a consistent theory of computability and complexity for distributed computing. One difficulty to be faced by DISPLEXITY is to reconcile two non necessarily disjoint sub-communities, one focusing on the impact of temporal issues, while the other is focusing on the impact of spatial issues.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. Gossple


Title: Gossple
Type: IDEAS
Instrument: ERC Starting Grant (Starting)
Duration: September 2008 - August 2013
Coordinator: INRIA (France)
See also: http://www.gossple.fr
Abstract: Anne-Marie Kermarrec is the principal investigator of the GOSSPLE ERC starting Grant (Sept. 2008 - Sept. 2013). GOSSPLE aims at providing a radically new approach to navigating the digital information universe. This project has been granted a 1.250.000 euros budget for 5 years.
G OSSPLE aims at radically changing the navigation on the Internet by placing users affinities and preferences at the heart of the search process. Complementing traditional search engines, GOSSPLE will turn search requests into live data to seek the information where it ultimately is: at the user. GOSSPLE precisely aims at providing a fully decentralized system, auto-organizing, able to discover, capture and leverage the affinities between users and data.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. Transform Marie Curie Initial Training Network

Participants: Tyler Crain, Anne-Marie Kermarrec, Achour Mostefaoui, Michel Raynal.

Program: Marie Curie Initial Training Network
Project acronym: Transform
Project title: Theoretical Foundations of Transactional Memory
Duration: May 2010 - October 2013
Coordinator: Michel Raynal - Panagiota Fatourou

Other partners: Foundation for Research and Technology Hellas ICS FORTH Greece, University of Rennes 1 UR1 France, Ecole Polytechnique Federale de Lausanne EPFL Switzerland, Technische Universitaet Berlin TUB Germany, and Israel Institute of Technology Technion.

Abstract:
Transform is a Marie Curie Initial Training Networks European project devoted to the Theoretical Foundations of Transactional Memory (Grant agreement no.: 238639 Date of approval of Annex I by Commission: May 26, 2009). It involves the following universities: Foundation for Research and Technology Hellas ICS FORTH Greece, University of Rennes 1 UR1 France, Ecole Polytechnique Federale de Lausanne EPFL Switzerland, Technische Universitaet Berlin TUB Germany, and Israel Institute of Technology Technion.

Major chip manufacturers have shifted their focus from trying to speed up individual processors into putting several processors on the same chip. They are now talking about potentially doubling efficiency on a 2x core, quadrupling on a 4x core and so forth. Yet multi-core is useless without concurrent programming. The constructors are now calling for a new software revolution: the concurrency revolution. This might look at first glance surprising for concurrency is almost as old as computing and tons of concurrent programming models and languages were invented. In fact, what the revolution is about is way more than concurrency alone: it is about concurrency for the masses. The current parallel programming approach of employing locks is widely considered to be too difficult for any but a few experts. Therefore, a new paradigm of concurrent programming is needed to take advantage of the new regime of multicore computers. Transactional Memory (TM) is a new programming paradigm which is considered by most researchers as the future of parallel programming. Not surprisingly, a lot of work is being devoted to the implementation of TM systems, in hardware or solely in software. What might be surprising is the little effort devoted so far to devising a sound theoretical framework to reason about the TM abstraction. To understand properly TM systems, as well as be able to assess them and improve them, a rigorous theoretical study of the approach, its challenges and its benefits is badly needed. This is the challenging research goal undertaken by this MC-ITN. Our goal through this project is to gather leading researchers in the field of concurrent computing over Europe, and combine our efforts in order to define what might become the modern theory of concurrent computing. We aim at training a set of Early Stage Researchers (ESRs) in this direction and hope that, in turn, these ESRs will help Europe become a leader in concurrent computing. Its keywords are Transactional Memory, Parallelization Mechanisms, Parallel Programming Abstractions, Theory, Algorithms, Technological Sciences.
8.2.3. Major European Organizations with which Asap has followed Collaborations

- Ecole Polytechnique Federale de Lausanne EPFL Switzerland
  collaboration on Gossple ERC, Transform
- Foundation for Research and Technology Hellas ICS FORTH Greece
  Transform
- Technische Universitaet Berlin TUB Germany
  Transform
- Lancaster University
  Gossple

8.3. International Initiatives

8.3.1. Participation In International Programs

8.3.1.1. Demdyn: INRIA/CNPq Collaboration

**Participants:** Achour Mostefaoui, Marin Bertier, Michel Raynal.

The aim of this project is to exploit dependable aspects of dynamic distributed systems such as VANETs, WiMax, Airborn Networks, DoD Global Information Grid, P2P, etc. Applications that run on these kind of networks have a common point: they are extremely dynamic both in terms of the nodes that take part of them and available resources at a given time. Such dynamics results in instability and uncertainty of the environment which provide great challenges for the implementation of dependable mechanisms that ensure the correct work of the system.

This requires applications to be adaptive, for instance, to less network bandwidth or degraded Quality-of-Service (QoS). Ideally, in these highly dynamic scenarios, adaptiveness characteristics of applications should be self-managing or autonomic. Therefore, being able to detect the occurrence of partitions and automatically adapting the applications for such scenarios is an important dependable requirement for such new dynamic environments.

8.3.2. Visits of International Scientists


8.3.2.1. Internship

- **A. Moin** was an intern at ETHZ from September 2011 to November 2011.
- **K. Kloudas** was an intern at Imperial College of London from June to September 2011.
- **A. Boutet** was an intern at the Computer Laboratory, University of Cambridge from July 2011 to September 2011.
ASCOLA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. CESSA: Compositional Evolution of Secure Services with Aspects (ANR/ARPEGE)

Participants: Mario Südholt <coordinator>, Hervé Grall, Diana Allam, Rémi Douence, Jean-Claude Royer.

The project CESSA is an (industrial) ANR project running for 36 months. It was accepted in Jun. 2009 for funding amounting to 290 KEUR for ASCOLA from Dec. 2009 on. Three other partners collaborate within the project that is coordinated by ASCOLA: a security research team from Eurecom, Sophia-Antipolis, the Security and Trust team from SAP Labs, also located at Sophia-Antipolis, and IS2T, an innovative start-up company developing middleware technologies located at Nantes. The project deals with security in service-oriented architectures.

This year our group has contributed several scientific publications as part of the project. All partners have been involved in the publication of two surveys on models for service-oriented architectures and security properties. Furthermore, they have set up a blog for SAP’s worldwide developper community.

All information is available from the CESSA web site: http://cessa.gforge.inria.fr .

8.1.2. Cool-IT (FUI)

Participant: Jean-Marc Menaud.

The Cool-IT project is an (industrial) FUI project running for 24 months. It was accepted in Sept. 2010 for funding amounting to 130 KEUR (ASCOLA only).

The objective of this project is to design systems adapted to new standards of “Green IT” to reduce the electrical consumption of data centers.

To this end, the COOL IT project develops processes for cooling computer servers, optimizes the servers power chain supply, implements tools and methods for collecting energy data in real time, and specifies methods for controlling the data centers consumption as a tradeoff between the computational power needed, its availability, and its energy consumption.

8.1.3. Entropy (ANR/Emergence)

Participant: Jean-Marc Menaud.

The Entropy project is an (industrial) ANR/Emergence project running for 18 months. It was accepted in Dec. 2010 for funding amounting to 242 KEUR (ASCOLA only).

The objective of this project is to conduct studies on economic feasibility (market, status, intellectual property, website) for creating an industrial business based on the Entropy software.

Some task must complete the Entropy core solution with a graphical unit interface to produce convincing demonstrators and consolidate our actual and future results. At the end of the project, the goal is to create a company whose objective is to sell the service, support and software building blocks developed by this ANR Emergence project.

8.1.4. MyCloud (ANR/ARPEGE)

Participants: Thomas Ledoux <coordinator>, Jean-Marc Menaud, Yousri Kouki, Frederico Alvares.

The MyCloud project is an ANR/ARPEGE project running for 42 months, starting in Nov. 2010. It was accepted in Jul. 2010 for funding amounting to 190 KEUR (ASCOLA only). MyCloud involves a consortium with three academic partners (INRIA, LIP6, EMN) and one industrial partner (We Are Cloud).
Cloud Computing is a paradigm for enabling remote, on-demand access to a set of configurable computing resources. However, the ad-hoc management of a cloud in terms of Quality of Service (QoS) and Service Level Agreement (SLA) poses significant challenges to the performance, availability, energy consumption and economical costs of the cloud.

The objective of MyCloud (http://mycloud.inrialpes.fr) is to define and implement a novel cloud model: SLAaaS (SLA as a Service). The SLAaaS model enriches the general paradigm of Cloud Computing and enables systematic and transparent integration of SLA to the cloud. From the cloud provider’s point of view, MyCloud proposes autonomic SLA management to handle performance, availability, energy and cost issues in the cloud. From the cloud customer’s point of view, MyCloud provides SLA governance allowing cloud customers to be part of the loop and to be automatically notified about the state of the cloud, such as SLA violation and cloud energy consumption.

This year, the ASCOLA project-team has proposed the global architecture and framework for the SLAaaS model and has provided a solution for self-optimisation of the energy footprint in cloud infrastructures [22].

8.1.5. **SelfXL (ANR/ARPEGE)**

**Participant:** Jean-Marc Menaud.

The SelfXL project is an (industrial) ANR/ARPEGE project running for 36 months. It was accepted in Jul. 2008 for funding amounting to 315 KEUR (ASCOLA only) from Jan. 2009 on.

The SelfXL project aims at investigating abstractions and implementation techniques (language mechanisms, runtime structures...) for complex and large-scale autonomic systems. The scope of this project encompasses any system that has a high software complexity (distributed, size of code etc.) and is large-scale in terms of size and heterogeneity of resources and software. Systems to be targeted range from cluster computing to embedded systems, including legacy software.

Two main issues will be addressed by SelfXL: How to implement administration policies for complex systems and how to coordinate administration policies in a complex system? Regarding the first issue, SelfXL proposes to explore the DSL programming approach, i.e., designing specific languages for defining specific kinds of administration policies (self-repair, self-optimization, self-protection). The general use of DSLs would ensure the correctness of the policies.

We propose to design a decision module based on Constraints Programming (CP). As the Rules Based Systems (RBS) or the Event Condition Action (ECA) approach, CP belongs to the declarative paradigm but does not share the major drawback of the other approaches when some rules are simultaneously asserted. This is the case when there is an overlap between the domain or the target of rules.

Finally, we propose to extend the Jasmine autonomic administration platform (http://wiki.jasmine.objectweb.org) for supporting a decentralized and hierarchical infrastructure to address the large-scale administration.

8.2. **European Initiatives**

8.2.1. **SCALUS: SCALing by means of Ubiquitous Storage (MC ITN)**

**Participant:** Adrien Lèbre.

The vision of the Scalus Marie Curie international training network (MC ITN) is to deliver the foundation for ubiquitous storage systems, which can be scaled with respect to multiple characteristics (capacity, performance, distance, security, ...).

Providing ubiquitous storage will become a major demand for future IT systems and leadership in this area can have significant impact on European competitiveness in IT technology. To get this leadership, it is necessary to invest into storage education and research and to bridge the current gap between local storage, cluster storage, grid storage, and cloud storage. The consortium will proceed in this direction by building the first interdisciplinary teaching and research network on storage issues. It consists of top European institutes and companies in storage and cluster technology, building a demanding but rewarding interdisciplinary environment for young researchers.
The network involves the following partners: University of Paderborn (Germany, coordinator), Barcelona Super Computing (Spain), University of Durham (England), University of Frankfurt (Germany), ICS-FORTH (Greece), Universidad Politecnica de Madrid (Spain), EMN/ARMINES (France), INRIA Rennes Bretagne Atlantique (France), XLAB (Slovenia), University of Hamburg (Germany), Fujitsu Technology Systems (Germany).

The overall funding of the project by the European Union is closed to 3.3 MEUR. ASCOLA’s share amounts to 200 KEUR.

8.2.2. COST IC0804

Participant: Jean-Marc Menaud.

The COST IC 0840 Action will propose realistic energy-efficient alternate solutions to share IT distributed resources. As large scale distributed systems gather and share more and more computing nodes and storage resources, their energy consumption is drastically increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, networks and applications. The action will characterize the energy consumption and energy efficiencies of distributed applications. [http://www.cost804.org/](http://www.cost804.org/)

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. RAPIDS

- Title: Reasoning about Aspect-oriented Programs and security in Distributed Systems
- INRIA principal investigator: Jacques Noyé
- International Partner:
  - Institution: University of Chile (Chile)
  - Laboratory: Computer Science Department
- Duration: 2010 - 2012
- See also: [http://rapids.gforge.inria.fr/doku.php](http://rapids.gforge.inria.fr/doku.php)
- While Aspect-Oriented Programming offers promising mechanisms for enhancing the modularity of software, this increased modularity raises new challenges for systematic reasoning. This project studies means to address fundamental and practical issues in understanding distributed aspect-oriented programs by focusing on the issue of security. To this end, the project tackles three complementary lines of work: 1. Designing a core calculus to model distributed aspect-oriented programming languages and reason about programs written in these languages. 2. Studying how aspects can be used to enforce security properties in a distributed system, based upon guarantees provided by the underlying aspect infrastructure. 3. Designing and developing languages, analyses and runtime systems for distributed aspects based on the proposed calculus, therefore enabling systematic reasoning about security. These lines of work are interconnected and confluent.

8.3.2. Visits of International Scientists

8.3.2.1. Invited Researchers and Professors

- Prof. Awais Rashid (from Feb. until Mar. 2011)
  - Subject: Sustainable Software for a Sustainable World
  - Institution: Lancaster University, U.K.
  - Pays de la Loire regional chair in Computer Science at École des Mines de Nantes, 2009-2011
• Dr. Paolo Anneda (Nov. 2011)
  Subject: Optimization of the energy footprint of Cloud infrastructures
  Institution: CRS4, Italie
  LINA (CNRS) grant

8.3.2.2. Internships

• Mohammad Mohammad Atiqul Haque (from Mar. until Jul. 2011)
  Subject: Impact of dynamic VM scheduling in cloud platforms
  Institution: Colorado State University (United States)
  INRIA grant

• Mauricio De Diana (from Mar. until Jul. 2011)
  Subject: Federation of distributed file systems for grid and cloud architectures
  Institution: Universidade de São Paulo (Brazil)
  INRIA grant
8. Partnerships and Cooperations

8.1. Regional Initiatives

Program: Pays de la Loire regional funding. Call: Soutenir et accompagner la constitution et/ou l’implantation de nouvelles équipes sur des thématiques émergentes

Project title: AtlanMod New Team Creation
Duration: 2011 - 2014
Coordinator: AtlanMod

Abstract: AtlanMod has been funded by the Pays de la Loire Regional Council new research teams program. This funding will mainly cover a PhD Student and two years of a postdoc to work on the quality of models research line.

8.2. National Initiatives

Program: ANR - ARPEGE program

Project acronym: Galaxy
Project title: Galaxy
Duration: 2010 - 2013
Coordinator: Airbus

Other partners: Industry (Airbus), Research and University (Armines -AtlanMod-, IRIT, LIP6) and Vendors and service providers (AKKA, Softeam)

Abstract: GALAXY ( http://galaxy.lip6.fr ) proposes to deal with the model driven collaborative development of complex systems. Galaxy aims at defining an open and flexible architecture particularly designed to be scalable. One of the key points is related to the fragmentation and distributiveness of huge models, their synchronization and relationship with communication means classically used by development teams. The work is being driven by use cases provided by a company (Airbus), which describe scalability issues they face during systems developments. Our work in this project is composed of two main parts: 1) the conception of efficient mechanisms for multiple views of complex (large) models; 2) the definition of a solution for the automation of modeling tasks on large model repositories, like the execution of large amounts of transformations, the orchestration of their execution, and the effective browsing of repositories for finding specific models. In this context we have developed MoScript, a scripting language (and corresponding execution engine) to write batch processing modeling tasks.

Program: ANR
Project acronym: IDM++
Project title: Ingénierie dirigée par les modèles ++
Duration: 2008 - 2011
Coordinator: IBM (ILOG)
Other partners: CEA, Mia-Software, Prima Solution
Abstract: IdM++ (http://www.emn.fr/x-info/idmpp/index.php/accueil) main goal is to investigate advanced issues in model engineering. The IDM++ consortium proposes the combination of Global Model Management and Model Configuration techniques. The goal is to bring together two different communities: the Model-Driven Engineering (MDE) community and the logic programming community, to explore how each community can benefit from the techniques of the other. We refer to the logic programming community in a broad sense (i.e. including Constraint Logic Programming, Answer-Set Programming but also ontology and semantic web aspects).

This approach is promoted according to the partners background in Model Driven Engineering, Constraint based programming and optimization techniques. The team is particularly in charge of WP 2, on global model management.

8.3. European Initiatives

Program: Artemis
Project acronym: CESAR
Project title: Cost-Efficient methods and processes for SAFety Relevant embedded systems
Duration: 2009 - 2012
Other partners: More than 50 partners
Abstract: The three transportation domains, automotive, aerospace, and rail, as well as the automation domain share the need to develop ultra-reliable embedded systems to meet social demands for increased mobility and safety in a highly competitive global market. To maintain the European leading edge position in the transportation as well as automation market, CESAR aims to boost cost efficiency of embedded systems development and safety and certification processes by an order of magnitude. CESAR pursues a multi-domain approach integrating large enterprises, suppliers, SME’s and vendors of cross sectoral domains and cooperating with leading research organizations and innovative SME’s. In particular, we work on the Reference Technology Platform, which aims at tool integration. We propose to achieve tool integration by means of metamodeling and model transformations [46]. In the context of this project we are developing VirtualEMF (http://code.google.com/a/eclipselabs.org/p/virtual-emf/), an approach and tool for the transparent composition, weaving and linking of heterogeneous models.

Program: ITEA2
Project acronym: OPEES
Project title: Open Platform for the Engineering of Embedded Systems
Duration: 2009 - 2012
Coordinator: Obeo
Other partners: Many other research labs and companies
Abstract: OPEES (http://www.opees.org) mission statement is to settle a community and build the necessary means and enablers to ensure long-term availability of innovative engineering technologies in the domain of dependable or critical software-intensive embedded systems. In particular, within OPEES, our schema of open source industrial collaboration [37] (e.g. around ATL) will be tested and developed as a team contribution to this project. AtlamMod is also responsible for providing a model-driven interoperability solution for the integration of the ecosystem of OPEES components, based on metamodeling the domain data of each component and bridging, by model transformation, the specific data representations.

8.3.1. Collaborations in European Programs, except FP7

Program: Leonardo da Vinci (LifeLong learning programme)
Project acronym: MDEExpertise

Project title: Exchanging knowledge, techniques and experiences around Model Driven Engineering education

Duration: 2010 - 2012

Coordinator: Lublin University of Technology

Other partners: Politecnico di Milano, Universidad de Alicante

Abstract: MDE Expertise (http://www.learnMDE.org) is an European Leonardo da Vinci project focused on the development of common educational materials for the Model Driven Engineering (MDE) area. The main aim of the project is to transfer and adapt the education in Model Driven Engineering concepts to the local IT education societies of the partner’s countries, thus improving the partners’ knowledge about up to date current software development methods. This results in the best preparation for professionals competing on the IT market. Direct results include: development of common MDE teaching methods, suited for the partners’ local needs and market requirements; creation of teaching materials (with online version) localized for the partners’ languages and definition of tools for e-learning and knowledge exchange. Indirect effects include improving the capability of local SMEs in solving complex software design problems through modeling, and evolving the software development job market.

8.4. International Initiatives

8.4.1. INRIA International Partners

AtlanMod keeps a close and continuous collaboration with a number of foreign research group. To mention the top 5:

- Vienna University of Technology. Collaboration on model transformations (refactoring, refinement, evolution,...)
- University of Bremen. Collaboration on model validation and verification.
- Technical University of Barcelona. Collaboration on conceptual modeling, semantics of modeling primitives, code-generation and the like.
- Politecnico di Milano. Collaboration on modeling in a web engineering context and on model search problems in repositories.
- University of Toronto. Collaboration on intentional models, requirements engineering and social modeling topics.

8.4.2. Visits of International Scientists

In 2011 three visitors did a research stay with AtlanMod:

- Dennis Wagelaar (Vrije Universiteit Brussel, Belgium), January-February
- Jesus Gallardo (Universidad de Castilla la Mancha, Spain), July
- Jokin Garcia (University of the Basque Country, Spain), May

8.4.2.1. Internship

Víctor García from the technical university of Valencia did his master thesis in AtlanMod, in the context of our MoDisco project.
8. Partnerships and Cooperations

8.1. Regional Initiatives
The PhD of Regina Marin (on privacy protection in distributed social networks) is supported by a ARED grant (with Région Bretagne).

8.2. National Initiatives

  POLUX aimed at configuring automatically the security mechanisms (prevention and detection) from the specification of the system in terms of its security policy. Indeed, current security tools are totally uncoordinated. They come from a large number of vendors. Even worse, they are sometimes developed by newcomers to the security field and they use different configuration logics and languages that bear little resemblance one to another or to the previously proposed formalisms. As a result, ensuring interoperability between these tools is a difficult endeavor. Researchers are facing the same issues, different communities looking at either access control, security protocols or intrusion detection, but with little coordination or fusion between these domains. A few standard formats have been defined over the years, but they only cover small areas, and they have been very long in the making. We first studied this interoperability problem and developed a framework allowing a unified expression of security policies for the entire range of security tools related to prevention of security issues, detection of threats, and countermeasures. The expression of these security policies obeyed precise constraints permitting the verification of their soundness and the validation of their application to a particular information system. It also allowed interoperability and negotiation of security policies and included the management of the security policy as a meta-policy. This formalism and framework applied to the complete range of security tools covering the three key properties of security, integrity, confidentiality and availability. This project is led by Télécom Bretagne and involves Supélec.

  PLACID is an interdisciplinary project that combines expertise in artificial intelligence and computer security. Alarm correlation is a subfield of intrusion detection whose goal is to make heterogeneous IDS sensors cooperate in order to improve the attack detection rate, enrich the semantics of alerts and reduce the overall number of alerts. Several solutions have been proposed in the literature, all of which require knowledge about the attacks and the context in which they occur. At the same time, complementary tools have appeared to support alarm correlation by providing knowledge databases about attacks, as well as local and global contextual observations. However, none of these correlation solutions received a wide acceptance. We believe that one of the reason for this is that the intrusion detection domain lacks a common logic that would allow security systems to reason about complementary evidences and security operators to interact with these systems efficiently. The objective of the PLACID project is twofolds. First we investigate a formal description logic for intrusion detection, called IDDL, which stands for Intrusion Detection Description Logic. IDDL will provide security components with a formal framework to characterize their observation, share their knowledge with third-party components and reason about complementary evidence information. Second, we investigate bayesian-based approaches for alert correlation. Our aim is to model uncertainty associated with alerts, to represent malicious actions, and to model correlation relations between alerts. The use of bayesian networks has several advantages such as evaluating the success of attacks, reducing the set of possible attacks scenarios, learning correlation relations, or finding the root cause of alerts. This project is led by the University of Nantes and involves the University of Artois and Supélec.
• **ANR Arpege Project: DALI (2009-2011)**

DALI aims at developing innovative design solutions to enhance the capabilities of current intrusion detection systems at the application level as well as new methodologies and tools for assessment and evaluation of the proposed solution with respect to their ability to detect potential intrusions. We expect to enhance the detection capability by inserting the mechanisms directly inside the software. Our work focuses on two complementary methods: First, the specification of software security contracts in terms of application level security policy, and second, an introspective method to learn the software specification at run-time. Both methods will lead to instrument the software to insert intrusion detection mechanisms. The challenges that will be addressed include the identification of the security attributes which must be captured by contracts, the ability to have enough introspection at run-time to learn program behavior, and finally the ability to instrument automatically the software. Our analysis of the state of the art reveals that there is still a lack of rigorous methodologies defining how the developers should proceed for testing security and a lack of tools supporting the implementation of such a methodology. Our project aims at fulfilling these two objectives. One of our objectives is to develop a uniform, repeatable, and cost-effective way to test and evaluate IDS, either as a stand-alone assessment or, more often, for comparative evaluation across systems and components. Particular attention is put on the generation of inputs combining normal and malicious activities and the definition of input selection criteria taking into account the security properties and the specification of the application. Moreover, in the context of the project, we will develop a platform that will permit to show the feasibility of the different approaches in the project, both in terms of intrusion detection design and assessment.

This project is led by Kereval and involves Télécom Bretagne, Supélec and the LAAS/ CNRS.

• **ANR SeSur Project: LISE (2008-2011)**

The LISE project intends to study the relationship between law and technique in the realization of secure computing systems. In particular, solutions for assessing and proving the responsibility of parties should be defined. LISE follows a top-down approach, starting with the definition of liability and deriving sufficient and acceptable execution traces. The main phases of the project are as follows: (1) State of the art and recommendations for potential evolutions of current regulations in order to make them suitable to the new ICT society and to favor the emergence of a true “liability economy” of software. (2) Method for software liability specification and definition of a legally acceptable link with execution traces. (3) Method for the analysis of execution traces to determine liability based on the agreed specification.

This project is led by INRIA Rhône-Alpes and involves the University of Versailles Saint-Quentin-en-Yvelines, the University of Caen Basse-Normandie, Supélec and VERIMAG.

• **ANR INS Project: AMORES (2011-2015)**

Situated in the ubiquitous context characterized by a high mobility of individuals, most of them wearing devices capable of geolocation (smartphones or GPS-equipped cars), the AMORES project is built around three use-cases related to mobility, namely (1) dynamic carpooling, (2) real-time computation of multi-modal transportation itineraries and (3) mobile social networking. For these three use cases, the main objective of the AMORES project is to define and develop geocommunication primitives at the middleware level that can offer the required geo-located services, while at the same time preserving the privacy of users, in particular with respect to their location (notion of geo-privacy). This project is joint between the Université de Rennes 1, Supélec, LAAS-CNRS, Mobigis and Tisséo.

• **ANR INS Project : LYRICS (2011-2014)**

With the fast emergence of the contactless technology such as NFC, mobile phones will soon be able to play the role of e-tickets, credit cards, transit pass, loyalty cards, access control badges, e-voting tokens, e-cash wallets, etc. In such a context, protecting the privacy of an individual becomes a particularly challenging task, especially when this individual is engaged during her daily
life in contactless services that may be associated with his identity. If an unauthorized entity is technically able to follow all the digital traces left behind during these interactions then that third party could efficiently build a complete profile of this individual, thus causing a privacy breach. Most importantly, this entity can freely use this information for some undesired or fraudulent purposes ranging from targeted spam to identity theft. The objective of LYRICS (ANR INS 2011) is to enable end users to securely access and operate contactless services in a privacy-preserving manner that is, without having to disclose their identity or any other unnecessary information related to personal data. The project is joint between France Télécom, Atos Wordline, CryptoExperts, ENSI Bourges, ENSI Caen, MoDyCo, Oberthur Technologies, NEC Corporation, Microsoft and Université de Rennes 1.

- **LABEX Comin Labs**

CIDRE participates in the CominLabs initiative sponsored by the “Laboratoires d’Excellence” program and which federates the best teams from Bretagne and Nantes regions in the broad area of telecommunications, from electronic devices to distributed applications. We are in particular involved in the “security and privacy” focus that is co-chaired by a member of the team.

### 8.3. European Initiatives

- **Quaero**

CIDRE is involved in the Quaero project. Quaero is a program promoting research and industrial innovation on technologies for automatic analysis and classification of multimedia and multilingual documents. The partners collaborate on research and the realisation of advanced demonstrators and prototypes of innovating applications and services for access and usage of multimedia information, such as spoken language, images, video and music. The Quaero consortium (composed of French and German public and private research organisations) is coordinated by Technicolor. Sébastien Gambs is involved in one of the task (led by Amedeo Napoli, équipe INRIA Orpailleur) of the Quaero project whose aim is to study the implications in terms of privacy for a user to participate in personalized applications (such as video-on-demand) adapted to the user context, background and preferences as well as proposing solutions that can contribute to enhance this privacy. On one hand using personal data to tailor the content to the user needs may be important for improving the quality of service and its relevance but on the other hand this raises serious privacy issues regarding how this data will be collected, used and disseminated. The main purpose of the solutions developed in this task is to enable an individual to access personalized content/service in a privacy-preserving manner and without having to disclose any unnecessary personal information. Since November 2011, Julien Lolive has also join the project as an engineer.

- **EIT ICT Labs**

EIT ICT Labs is one of the first three Knowledge and Innovation Communities (KICs) selected by the European Institute of Innovation & Technology (EIT) to accelerate innovation in Europe. Nowadays, Information Technologies have invaded many aspects of the daily lives of individuals, thus creating a lot of new possibilities but also raising privacy concerns to the point that some individuals feel that they no longer have suitable guarantees or any control over their privacy. Indeed, protecting the privacy of individuals is one of the main challenges of the « Information Society » but is difficult to achieve as individuals constantly leave digital traces of their actions and whereabouts, often without even knowing it. If an unauthorized entity gathers these digital traces, he (or she) can use them for malicious purposes ranging from targeted spam to profiling, and even identity theft. The goal of the action line “Protection of Privacy in the Information Society” (created by Sébastien Gambs together with Daniel Le Métayer and Claude Castelluccia from INRIA Rhône-Alpes) is to address the new challenges raised by the most recent developments and usages of information technologies (e.g., geo-located applications, social networking sites, profiling, pervasive computing, data
mining) by providing solutions to enhance the privacy protection of individuals in the Information Society. Essentially, this action line is transversal to most of the thematic and research action lines of EIT ICT labs and it is envisioned that it should also contribute to their developments. While the action line was originally intended to focus on privacy, its scope was recently extended to include security and trust thus being renamed as “Security, Privacy and Trust in the Information Society”.

In 2012, Sébastien Gambs will lead an activity in this action line related to location privacy that involves partners coming from 3 different nodes of EIT ICT labs.

8.4. International Initiatives

8.4.1. INRIA International Partners

**CANADA**: Sébastien Gambs is co-supervising Ai Thanh Ho, a PhD student from the Université de Montréal with whom he has been actively collaborating for 2 years on the subject of privacy issues in social networking sites. The main supervisor of Ai Thanh Ho is Esma Aïmeur (full professor, Université de Montréal). Ai Thanh Ho has visited us in November 2011. In 2011, this cooperation has led to a joint publication [23].

**BRAZIL**: Francisco Brasilheiro, Professor at the Federal University of Paraiba (Campina Grande) was involved with us in a four years Capes/Cofecube project (2005-2009). We still cooperate with him on the dependability evaluation of cluster-based systems [15].

We have also strong links with University of Brasilia (Brazil) and in particular with Prof. Rafael de Sousa (Brasilia) who has spent one year and an half in Supélec (March 2006 to August 2007). With his team, we study the concept of trust in the context of mobile ad hoc networks.

**AUSTRALIA**: With Queensland University of Technology (QUT, Brisbane) we cooperate to study policy-based intrusion detection problems. Jacob Zimmermann (QUT) spent one month in Supélec (January 2007). Two people from Supélec (Benjamin Morin and Ludovic Mé) visited QUT in September 2007. Andrew Clark (QUT) spent 3 months in Supélec from August to November 2009. The PhD thesis of Christophe Hauser, “Détection d’intrusions dans les systèmes distribués”, started in October 2009, is supervised jointly with Queensland University of Technology, Brisbane, Australia (Prof. Andrew Clarck). Since February 2011, Christopher Hauser works in Brisbane. His one year visit is supported by a grant from Rennes Métropole.

8.4.2. Visits of International Scientists

**ALGERIA**: Linda Zeghache, Phd student at USTBH-CEDRIC (université des Sciences et de la Technologie Houari Boumédiène, Algeria) visited us during one month in December 2010/January 2011. This cooperation has led to a joint publication in 2011 [33].

**CANADA**: Frédéric Massicotte from the “Communications Research Centre Canada” has visited us in March 2011. The CRC is the federal government’s primary laboratory for research and development in advanced telecommunications.

**CHINA**: Chuanyou Li, PhD student at Southeast University (Nanjing, China) is visiting us during a period of one year (December 2011 - November 2012). Since the end of a LIAMA project (2000-2002), strong relationships are maintained with the research team of Prof. Yun Wang of Southeast university. The joint works focus mainly on fault-tolerance in distributed systems and security in ad hoc networks.

8.4.3. Participation In International Programs

CIDRE participates to a project for the ICST Algeria program (Information and Communication Science and Technology). The title of the project is “Utilisation de la plate-forme de test Senslab pour le projet irrigsense”. This 2-year project (2011-2012) is leaded by the Project-Team DIONYSOS and involves two other INRIA teams ASAP, CIDRE. The CERIST represents the Algerian partner. The project focuses on using the senslab node of Rennes, for testing different protocols developed by the partners in the context of an algerian project which aims at using sensors for agricultural irrigation.
FOCUS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- AEOLUS (Mastering the Cloud Complexity) is an ANR-ARPEGE project started on 1st December 2010 and with a 40-month duration. AEOLUS studies the problem of installation, maintenance and update of package-based software distributions in cloud-based distributed systems. The problem consists of representing the distribution and the dependencies of packages, in such a way that modification plans can be (semi)automatically synthesized when packages should be updated or the system should be reconfigured. Main persons involved: Zavattaro, Sangiorgi.

- ETERNAL (Interactive Resource Analysis) is an INRIA-ARC project which started on January 1st, 2011 and will end on December 31st, 2012. ETERNAL aims at putting together ideas from Implicit Computational Complexity and Interactive Theorem Proving, in order to develop new methodologies for handling quantitative properties related to program resource consumption, like execution time and space. People involved: Dal Lago, Gaboardi, Martini, Petit. This project has been presented during a poster session at the “journées scientifiques de l’INRIA” in Paris, November 2011.

- S. Martini, U. Dal Lago, M. Gaboardi, and D. Sangiorgi are involved in the CNRS PICS 2010 (“International Projects for Scientific Cooperation”) project “Linear Logic and applications”.

- REVER (Programming Reversible Recoverable Systems) is an ANR project starting on 1st December 2011 and with a 48-month duration. REVER aims to study the possibility of defining semantically well-founded and composable abstractions for dependable computing on the basis of a reversible programming language substrate, where reversibility means the ability to undo any distributed program execution, possibly step by step. The critical assumption behind REVER is that by adopting a reversible model of computation, and by combining it with appropriate notions of compensation and modularity, one can develop systematic and composable abstractions for recoverable and dependable systems. Main persons involved: Lanese, Laneve, Zavattaro.

7.2. European Initiatives

- Hats (Highly Adaptable and Trustworthy Software using Formal Models) is an EU Integrated Project from FP7, started March 2009 and with a 4 year duration. Hats studies formal methods for obtaining high adaptability combined with trustworthiness in the setting of object-oriented languages and software product lines. Most Focus members are involved.

7.3. International Initiatives

7.3.1. INRIA International Partners

- Department of Computer and Information Science, University of Pennsylvania. There has been several collaborations in the past. Presently M. Gaboardi is a long-term visiting researcher in the programming language group, working on resource control and programming languages.

7.3.2. Visits of International Scientists

Ferret’s visit below has also been used to give a short intensive course on abstract interpretation for PhD students in Bologna.
• Matteo Cimini, Icelandung Center of Excellence in Theoretical Computer Science, Reykjavik, 1 week in December. Topic: logics for concurrent languages.
• Giorgio Delzanno, University of Genova. 2-day visit. Topic: Verification of protocols for Mobile Ad Hoc Networks.
• Claudia Faggian, PPS Paris 7, July 18-21 and October 3-7. Topic: linear logic and quantum computation
• Jerome Ferret, ENS Paris and INRIA, 1 week. Topic: abstract interpretation.
• Harry Mairson, Brandeis University, USA. February 4-16. Topic: the complexity of evaluation in the simply typed lambda calculus.
• Matias David Lee. Currently PhD student at Universidad Nacional de Córdoba, Argentina. Arrived in November 2001 for a long-term visit (6 months).
• Claudio Mezzina, Inria Grenoble, a few visits throughout the year, two months in total. Topic: constructs for reversible computations.
• Jean-Bernard Stefani, Inria Grenoble, two 2-day visits. Topic: models for components and reversibility.

7.3.3. Other cooperations

We list here the cooperations and contacts with other groups, without repeating those already listed in previous sections.

• Inria EPI Indes, (on orchestration and programming languages). A common meeting was organised in Sophia Antipolis, May 2011, where 8 people from Focus and almost everybody from Indes participated. Focus and Indes have moreover significantly contributed to the “Programming language day”, May 31, 2011, Amphi Morgenstern, INRIA Sophia Antipolis – Méditerranée.
• Inria EPI Sardes (on models and languages for components, reversibility). Contact person(s) in Focus: Lanese, Sangiorgi. A number of visits in both directions. One joint PhD supervision (C. Mezzina).
• ENS Lyon (on concurrency models and resource control). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini, Sangiorgi. Several visit exchanges during the year, in both directions. One joint PhD supervision (J.-M. Madiot, starting in September 2011).
• Laboratoire d’Informatique, Université Paris Nord, Villetaneuse (on implicit computational complexity). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini. Several visit exchanges during the year, in both directions. An Italian PhD student (Marco Solieri) will soon start a PhD thesis with joint supervision. Gaboardi has made a 2-month visit.
• Team PPS, University of Paris-Diderot Paris 7 (on logics for processes, resource control). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini, Sangiorgi, Zavattaro. Various short visits in both directions during the year.
• Research Institute for the Mathematical Sciences – RIMS – University of Kyoto, Japan (on typing and resource control). Contact person(s) in Focus: Dal Lago. A 2-week exchange (Dal Lago) in 2011.
- Computer Science Department, Brandeis University, USA (on complexity of evaluation in functional programming languages). Contact person(s) in Focus: Dal Lago, Martini. A 2-week visit exchange (Mairson) in 2011.
- Facultad de Informatica, Universidad Complutense de Madrid (on web services). Contact person(s) in Focus: Bravetti. Bravetti is an external collaborator in the Spanish Ministry of Science and Education project TESIS (advanced methodologies and tools for TESting and web servIceS).
- EPI Carte, INRIA-Nancy Grand Est and LORIA (on implicit computational complexity). Contact person(s) in Focus: Gaboardi. A few short visits during 2011.
- Institut de Mathématiques de Luminy, Marseille (on lambda-calculi, linear logic and semantics). Contact person(s) in Focus: Dal Lago, Martini. One joint PhD supervision (Michele Alberti) is starting at the end of 2011.
- Inria EPI Signes, Inria Bordeaux Sud-Ouest (on lambda-calculi, linear logic and semantics). Contact person(s) in Focus: Dal Lago, Martini. Martini visited Signes for a few days in December 2010. One joint PhD supervision (Ivano Ciardelli).
INDES Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. ANR DEFIS ParTout

The PARTOUT project (PARTOUT = PARallélisme parTOUT) is funded by the ANR Défis programme for 4 years, starting January 2009. The partners of this project are the teams INDES (coordinator), CNAM/CÉDRIC, and LRI, Université d’Orsay.

8.1.2. ANR DEFIS PWD

The PWD project (for “Programmation du Web diffus”) has been funded by the ANR Défis programme for 4 years, starting November 2009. The partners of this project are the teams INDES (coordinator), LIP6 at University Pierre et Marie Curie and PsS at University Denis Diderot.

8.1.3. MEALS

The MEALS project (Mobility between Europe and Argentina applying Logics to Systems), IRSES program, started October 1st (2011), and will end September 30th, 2015. The project goals cover three aspects of formal methods: specification (of both requirement properties and system behavior), verification, and synthesis. The Indes members are involved in the task of Security and Information Flow Properties (WP3). The partners in this task include University of Buenos Aires, University of Cordoba, INRIA (together with Catuscia Palamidessi, Kostas Chatzikokolakis, Miguel Andrés) and University of Twente.

8.1.4. CIRIC

Indes participated in the proposal of the CIRIC project, a joint lab between Inria and Chile, that will start in 2012. Indes members are involved in the line: Internet Research and Development.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ASYST (2010-2013)

Participants: Françoise André, Christine Morin, Nikos Parlavantzas.

The objective of the ASYST project (Adaptation dynamique des fonctionnalités d’un SYSTème d’exploitation large échelle) funded by the Brittany council is to provide the view of an Operating System as an "Infrastructure as a Service" (IaaS) and even more as a set of adaptable services. The main functionalities of an Operating System such as memory allocation or job scheduling have to be dynamically adapted to cope with the ever changing environment. This project funds 50% of a PhD grant (Djawida Dib).

8.1.2. HOCL4WS (2010-2012)

Participants: Thierry Priol, Cédric Tedeschi.

The objective of the HOCL project funded by the Brittany council is to develop a prototype of a middleware system for the distributed execution of chemical programs (targeted for large scale platforms). This project funds 50% of a PhD grant (Marko Obrovac).

8.2. National Initiatives

8.2.1. AUTOCHEM ANR White Project (2007-2011)

Participants: Thierry Priol, Cédric Tedeschi.

The goal of the AUTOCHEM project funded under the ANR white program is the programming of desktop Grids using the chemical programming model (http://www.irisa.fr/myriads/collaborate/national/anr/autochem/). This project funds a PhD grant (Héctor Fernandez).

8.2.2. ECO-GRAPPE ANR ARPEGE Project (2009-2012)

Participant: Christine Morin.

The goal of the ECO-GRAPPE project (http://www.irisa.fr/myriads/collaborate/national/anr/autochem/) funded under the ANR ARPEGE program is to design, implement and validate energy saving policies in clusters. This project funds a PhD grant (Eugen Feller). Partners involved in the ECO-GRAPPE project are EDF R&D and Kerlabs.

8.2.3. COOP ANR COSINUS Project (2009-2012)

Participants: Christine Morin, Yvon Jégou.

The COOP project (http://coop.gforge.inria.fr/) funded under the ANR COSINUS program relates to multi level cooperative resource management. The two main goals of this project are to set up a cooperation as general as possible with respect to programming models and resource management systems (RMS) and to develop algorithms for efficient resource selection. Experimentations will be conducted in particular with the SALOME platform and TLSE as examples of programming environments and Marcel, DIET and XtremOS as examples of RMS. Partners involved in the COOP project are the GRAAL and RUNTIME INRIA EPI, IRIT and EDF R&D. This project funds a research engineer (Yann Radenac).

8.2.4. CLOUD ANR project (October 2011 - September 2012)

Participant: Christine Morin.
The CLOUD project aims at extending an XtreemOS Grid with resources dynamically provisioned from IaaS clouds. An algorithm to select resources in a multi-cloud environment will be defined. A prototype based on XtreemOS Grid and OpenNebula and Nimbus clouds will be built. This project is related to the EIT ICT labs activity 10239 on cloud computing described in Section 8.3.2. It funds a research engineer.

**8.2.5. HEMERA INRIA AEN (2010-2013)**

**Participants:** Christine Morin, Yvon Jégou.

The Myriads team is involved in the HEMERA large wingspan project funded by INRIA (http://www.grid5000.fr/mediawiki/index.php/Hemera). This project aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid’5000 infrastructure, at animating the scientific community around Grid’5000 and at enlarging the Grid’5000 community by helping newcomers to make use of Grid’5000. Yvon Jégou is co-chair of the "Bring Grids Power to Internet-Users thanks to Virtualization Technologies" working group.

**8.2.6. INRIA ADT Aladdin (2008-2012)**

**Participant:** Yvon Jégou.

The Aladdin technological development action funded by INRIA aims at the construction of a scientific instrument for experiments on large-scale parallel and distributed systems, building on the Grid’5000 platform (http://www.grid5000.fr). It structures INRIA's leadership role as the institute is present in 8 of the 9 Grid’5000 sites distributed across France.

An executive committee, where each of the 10 project-teams supporting Grid’5000 in the 8 research centers is represented, meets every month. It gives recommendations to the directors on scientific animation, access policy to the instrument as well as for the hardware and software development according to the resources devoted to this ADT. Yvon Jégou represents INRIA Rennes in this executive committee.

The technical team is now composed of 12 engineers, of which 3 are hosted in the Myriads team (David Margery, technical director, (SED ² member), Pascal Morillon (SED member), Ghislain Charrier). This technical team is structured in a sysadmin team, managing the instrument, and a development team building the tools to build, execute and analyze experiments.

**8.2.7. INRIA ADT XtreemOS Easy (2010-2012)**

**Participants:** Christine Morin, Yvon Jégou.

The XtreemOS EASY technological development action funded by INRIA aims at developing a set of tools and environments to ease the installation, configuration, deployment, experimentation and use of the XtreemOS Grid operating system and at providing support to the XtreemOS open source community. Two associate engineers are involved in this project: Amine Belhaj and Rémy Garrigue. David Margery (SED) is tutoring them in software development.

**8.2.8. INRIA ADT DAUM (2011-2012)**

**Participants:** Erwan Daubert, Jean-Louis Pazat.

We participate to the ADT DAUM which is coordinated by the Triskell Team. DAUM is a a Technology Development Action (ADT) by INRIA aiming at providing an integrated platform for distributed dynamically adaptable component based applications. DAUM unites and integrates results and software from the Triskell EPI and the Myriads team. More precisely, DAUM extends the Kevooree component framework designed by Triskell with adaptation mechanisms from the SAFDIS framework designed by Myriads.

²The SED is the INRIA Experimentation and Development Service.
DAUM will evaluate this integration by designing a full scale system for a tactical assistant for firefighter officers, in collaboration with the firefighters organization of Ille et Vilaine department (2800 firefighters).

Project duration: October 2011 - September 2012
Triskell budget share: One associated engineer shared with the Triskell EPI
Project Coordinator: Noël Plouzeau, Triskell INRIA Project.
Participants: Myriads, Triskell.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. S-CUBE (2008-2012)

François André, Jean-Louis Pazat

Title: S-Cube: Software Services and Systems Network
Type: COOPERATION (ICT)
Defi: Service & software architectures, infrastructures and engineering
Instrument: Network of Excellence (NoE)
Duration: March 2008 - February 2012
Coordinator: Universität Duisburg-Essen (Germany)
Others partners: University of Duisburg-Essen, Paluno - Ruhr Institute for Software Technology (Germany); Tilburg University (Netherlands); City University London (U.K.); Consiglio Nazionale delle Ricerche (Italy); Center for Scientific and Technological Research, FBK (Italy); Lero - The Irish Software Engineering Research Centre (Ireland); Politecnico di Milano (Italy); MTA SZTAKI – Computer and Automation Research Institute (Hungary); Vienna University of Technology (Austria); Université Claude Bernard Lyon (France); University of Crete (Greece); Universidad Politécnica de Madrid (Spain); University of Stuttgart (Germany); University of Hamburg (Germany); Vrije University Amsterdam (Netherlands)
See also: http://www.s-cube-network.eu/

Abstract:S-Cube is the European network of excellence in software services and systems federating the software engineering and distributed system research communities to shape the Internet of Services (http://www.s-cube-network.eu/). The MYRIADS team is involved in service discovery, coordination and adaptation. Three PhD thesis grants are funded by the S-Cube project.

8.3.1.2. CONTRAIL (2010-2013)

Yvon Jégou, Christine Morin

Title: Contrail, Open Computing Infrastructures for Elastic Services
Type: COOPERATION (ICT)
Defi: Internet of Services, Software & Virtualisation
Instrument: Integrated Project (IP)
Duration: October 2010 - September 2013
Coordinator: INRIA (France)
Others partners: XLAB Razvoj Programske Opreme In Svetovanje d.o.o., Slovenia; Italian National Research Council, ISTI-CNR & IIT-CNR, Italy; Vrije Universiteit Amsterdam, The Netherlands; Science and Technology Facilities Council, STFC, UK; Genias Benelux bv, The Netherlands; Tiscali Italia SpA, Italy; Konrad-Zuse-Zentrum für Informationstechnik Berlin, ZIB, Germany; Hewlett Packard Italiana S.r.l - Italy Innovation Center, Italy; Country Constellation Technologies Ltd, UK; EBM WebSourcing, France;
Abstract: The goal of the Contrail project is to design, implement, evaluate and promote an open source system for Cloud Federations. To allow open access to shared computing resources, the vision of the Contrail project is that any organization should be able to be both a Cloud provider when its IT infrastructure is not used at its maximal capacity, and a Cloud customer in periods of peak activity. Resources that belong to different operators will be integrated into a single homogeneous Federated Cloud that users can access seamlessly.

Contrail will vertically integrate an open-source distributed operating system for autonomous resource management in Infrastructure-as-a-Service environments, and high level services and runtime environments as foundations for Platform-as-a-Service. Contrail will address key technological challenges in existing commercial and academic Clouds: the lack of standardized rich and stable interfaces; limited trust from customers; and relatively poor Quality of Service (QoS) guarantees regarding the performance and availability of Cloud resources.

8.3.1.3. SCALUS Marie Curie Initial Training Networks (MCITN) (2009-2013)
Christine Morin

Title: SCALUS - SCALing by means of Ubiquitous Storage
Type: PEOPLE (ICT)
Defi: elevating education, research, and development inside the area of storage architectures with a focus on cluster, grid, and cloud storage
Instrument: Marie Curie Initial Training Networks (MCITN)
Duration: 4 years
Coordinator: Padeborn University, Germany
Others partners: Paderborn Center for Parallel Computing (PC2), Germany; BSC, Spain; Durham University, UK; Goethe Universität Frankfurt, Germany; FORTH-ICS, Greece; Universidad Politecnica De Madrid, Spain; Ecole des Mines de Nantes, France; XLAB, Slovenia; Universität Hamburg, Germany; Xyratex, UK; Fujitsu Technology Solutions Gmbh, Germany (associated partner); CERN, Switzerland (associated partner); Microsoft Research, UK (associated partner); NEC, Germany (associated partner); ORACLE, Germany (associated partner).

See also: http://www.scalus.eu/

Abstract: The consortium of this Marie Curie Initial Training Network (MCITN) SCALing by means of Ubiquitous Storage (SCALUS) aims at elevating education, research, and development inside the area of storage architectures with a focus on cluster, grid, and cloud storage. The vision of the SCALUS MCITN is to deliver the foundation for ubiquitous storage systems, which can be scaled in arbitrary directions (capacity, performance, distance, security, . . .). The consortium involves 8 full academic partners, 2 full industrial partners and 5 additional associated industrial partners. Christine Morin participates in this project by co-advising with Professor Ludwig from the University of Hamburg a PhD student (Amandine Pignier) working on Load Balancing and Scheduling in Parallel and Cluster File Systems.

8.3.1.4. BonFire IP Project (2010-2013)
David Margery

Title: BonFIRE, Building service testbeds on FIRE
Type: COOPERATION (ICT)
Defi: Future Internet experimental facility and experimentally-driven research
Instrument: Integrated Project (IP)
Duration: June 2010 - November 2013
Coordinator: ATOS SPAIN SA (Spain)

Others partners: The university of Edinburgh (U.K.); SAP AG (Germany); Universitaet Stuttgart (Germany); Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forshung E.V (Germany); Interdisciplinary Institute for Broadband Technology (Belgium); Universidad Complutense De Madrid (Spain); Fundacio Privada I2CAT, Internet I Innovacio Digital A Catalunya (Spain); Hewlett-Packard Limited (U.K.); The 451 Group Limited (U.K.) Techniche Universitat Berlin (Germany); University of Southampton (U.K.); Inria (France); Instytut Chemii Bioorganicznej Pan (Poland); Nextworks (Italy); Redzinc Services Limited (Ireland); Cloudium systems Limited (Ireland); Fundacio Centro Tecnologico De Supercomputacion De Galicia (Spain); Centre d’Excellence en technologies de l’Information et de la communication (Belgium); University of Manchester (U.K.);

See also: http://www.bonfire-project.eu/

Abstract: The BonFIRE (Building service testbeds for Future Internet Research and Experimentation) project will design, build and operate a multi-site cloud facility to support applications, services and systems research targeting the Internet of Services community within the Future Internet (http://www.bonfire-project.eu/). The MYRIADS team is involved in this project as it hosts the Aladdin ADT.

In the context of BonFIRE, we operate one of the five cloud sites integrated into the BonFIRE cloud federation. This cloud site is based on OpenNebula and can be extended on-request to all the machines of the local Grid’5000 site. We have also contributed to the cloud federation layer and host the integration infrastructure for the project, generated from configuration management tools using puppet.

8.3.1.5. IC0804 - Energy Efficiency in Large Scale Distributed Systems
Françoise André, Jean-Louis Pazat

This COST Action will propose realistic energy-efficient alternate solutions to share IT distributed resources (http://www.irit.fr/cost804/). As large scale distributed systems gather and share more and more computing nodes and storage resources, their energy consumption is exponentially increasing. While much effort is nowadays put into hardware specific solutions to lower energy consumptions, the need for a complementary approach is necessary at the distributed system level, i.e. middleware, network and applications. The Action will characterize the energy consumption and energy efficiencies of distributed applications. In his PhD thesis work, Eugen Feller is contributing to this COST action. He is one of the two co-proposers of a working group on energy and QoS-aware workload management in clouds.

8.3.2. Collaborations in European Programs, except FP7

Program: EIT ICT Labs
Project acronym: Activity 10239
Project title: Boosting Innovative Software in Cloud and Service Computing
Duration: January - December 2011
Coordinator: Christine Morin

Other partners: Institut Telecom Sud Paris (France), VTT (Sweden), SAP (Germany)

Abstract: This activity aims at building testbeds integrating XtremOS and Contrail open source software and at experimenting these testbeds on large scale experimentation platforms such as Grid’5000 and BonFire. We organized an EIT ICT Labs summer school (jointly with Contrail European project) held June 27-July 1, 2011 in Presqu’île de Giens, France.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. SEROS
Title: Scalable, Efficient, and Resilient Operating Systems
INRIA principal investigator: Christine Morin
International Partner: Stephen Scott
   Institution: Oak Ridge National Laboratory (United States)
   Laboratory: System Research Team
Duration: 2009 - 2011
See also: http://www.irisa.fr/myriads/ser-os/
The main objectives of the collaboration in the area of operating systems and system tools for HPC
are: operating systems for HPC (focusing on system-level virtualization), system management tools
for HPC platforms, and resilience for HPC systems.

8.4.1.2. DataCloud@Work
Title: DataCloud@Work
INRIA principal investigator: Gabriel Antoniu, Kerdata
International Partner: Valentin Cristea
   Institution: University Polytechnical Bucharest (UPB)
   Laboratory: Team of Prof. Valentin Cristea
Duration: 2010 - 2012
See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start
The goal of the Associated team is to study massive data management in cloud based service
infrastructures. In this context, the Myriads team is involved in a study aiming at the integration of
the BlogSeer large scale storage system in XtreemOS distributed system in a vision where XtreemOS
is used for the management of IaaS clouds.

8.4.2. INRIA International Partners
Nikos Parlavantzas is collaborating with the team of Prof. Héctor Duran-Limon of the University of Guadala-
jara, Mexico on resource management in virtualised environments. We have produced a joint publication and
are preparing an ANR project proposition[23].
Héctor Fernandez and Cédric Tedeschi collaborate with the team of Dr. Patricia Lago from Vrije University
Amsterdam. Héctor spent 3 weeks there, working on the use of the Chemical Programming Model to
implement a proof of concept of a method for Global Software Development developed in VUA’s team,
financed by the S-Cube project.
Christine Morin has visited Professor Vladimir Getov, Westminster University, UK in February 2011. A PhD
thesis topic in the area of cloud computing has been jointly proposed. Professor Vladimir Getov visited
Myriads team in May 2011.

8.4.3. Visits of International Scientists
Chokchai Leangsuksun, Professor at Louisina Tech University (USA) spent one month and a half in the
Myriads team in June and July 2011, as an invited professor, funded by the University of Rennes 1. We
investigated potential joint research directions related to resilience in cloud computing [30].
8.4.3.1. Internships

Neha Jatav
Subject: Planning software deployment on heterogeneous and distributed infrastructures
Institution: IIT Bombay (India)

Vidya Lakshmi Rajagopalan
Subject: Dynamic vertical scaling of parallel applications in clouds
Institution: Vrije Universiteit, Amsterdam (Netherlands)

Ancuta Iordache
Subject: Elastic MapReduce in cloud federations
Institution: West Timisoara University (Romania)

8.4.4. Participation In International Programs

Christine Morin was involved in the Master school education action line to participate in the definition of the Distributed Systems and Services (DSS) major of the EIT ICT Labs Master in ICT innovation. Since September 2011, Christine Morin has been an affiliate at Lawrence Berkeley National Laboratory working in the Advanced Computing for Science (ACS) department of the Computational Research Division (CRD). During her sabbatical visit at the Lawrence Berkeley National Laboratory, Christine Morin is in charge of the INRIA@SiliconValley program jointly with the INRIA international affairs department.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. PACAGRID Platform

Program: CPER
Project acronym: PacaGrid
Project title: Contrat Plan État Région Grille et Calcul Pair-à-Pair
Duration: jan 2009 - dec 2011
Coordinator: INRIA Oasis
Other partners: Conseil Regional PACA
See also: http://proactive.inria.fr/pacagrid/

Abstract: This contract aims at building a regional computing platform. This is achieved by mixing desktop machines with dedicated ones like clusters. Users willing to submit a job will do so by accessing a web-page and uploading their program. It will then be scheduled and executed on a machine when available. A scheduler, a resource manager, and a web portal have been developed and are now operational.

In the first part of the project, the access to the platform was restricted to Inria members. Now that most of the tools have been developed, the access is open to industrial partners.

8.2. National Initiatives

8.2.1. ANR OMD2

Program: Cosinus
Project acronym: OMD2
Project title: Optimisation Multidisciplinaire
Duration: jan 2009 - jun 2012
Coordinator: Renault
Other partners: INRIA, ENSM-SE, UTC, ECP, IRCCyN, ENS CACHAN, CD-adapco, SIREHNA, ACTIVEEON, Digiteo (all french)

Abstract: The aim of this project is to define, develop and experiment a collaborative platform of multidisciplinary optimization - As "platform" we consider here a software environment hosting heterogeneous code and data, geographically distributed in equally heterogeneous machines. These codes can be sequential or parallel. These machines can be data servers, supercomputers, PC farms, etc. - As "collaborative" we consider this environment to be able to host, control and allow communication of these codes transparently for the user, according to their own work habits. - As "multidisciplinary optimization", we consider the collection of methods and numerical tools, objects of the other tasks in OMD2 and previously realized during project OMD. It has been decided that ProActive will be used as middleware for communication between machines, and that the ProActive Scheduler will be used as a basis for the collaborative platform. Similarly, Scilab will be used as a common language to describe optimization strategies.

8.2.2. ANR SocEDA
Program: Arpège
Project acronym: SocEDA
Project title: Plate-forme EDA sociale, largement distribuée pour l’informatique dans les nuages
Duration: nov. 2010 - oct. 2013
Coordinator: EBM WebSourcing
Other partners: ActiveEon, Ecole des Mines Albi, I3S CNRS (OASIS), CNRS/LIG (SARDES), INSA Lyon/LIRIS, France Telecom, INRIA Lille (ADAM), Thales communications.
See also: http://www.soceda.org
Abstract: The goal of SocEDA is to build a flexible, elastic and efficient platform for handling events generated by services deployed on top of federated and distributed enterprise service buses. To scale up and be highly configurable, the platform will be designed as a GCM based application built along Peer-to-peer principles for scalability and robustness, and deployed on Grid/Cloud hybrid environments. Publications/subscriptions will be organized along social links that may exist between the deployed services.

8.2.3. FUI CompatibleOne

Program: FUI
Project acronym: CompatibleOne
Project title: CompatibleOne
Duration: aug. 2010 - oct. 2013
Coordinator: Bull
Other partners: ActiveEon, Bull, CityPassenger, eNovance, INRIA, Institut Télécom, Mandriva, Nexedi, Nuxeo, OW2, Prologue, XWiki
See also: http://www.compatibleone.org/
Abstract: The competitiveness cluster Systematic, in Ile de France, has launched the Compatible One project, also labelled by the SCS cluster. The goal is to define an open solution for IaaS and PaaS. The CompatibleOne project identifies, aggregates and integrates leading open source technologies into a rich and comprehensive ‘cloudware’ stack. CompatibleOne is developing a meta-model-based framework for the abstraction of the configuration, management and integration of these technologies. This ‘cloudware’ framework, based on open, common standards and leading open source technologies, will offer cloud builders the greatest possible interoperability

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. SOA4ALL

Title: Service Oriented Architectures for All
Type: COOPERATION (ICT)
Defi: Service & SA architectures, infrastructures and engineering
Instrument: Integrated Project (IP)
Duration: March 2008 - February 2011
Coordinator: Atos Origin (Spain)
Others partners: British Telecommunications (UK); The Open University (UK); SAP; CEFRIEL (It); STI - University of Innsbruck (At); EBM WebSourcing (Fr); Hanival Internet Services (At); Universität Karlsruhe (De); INRIA (Fr); iSOCO (Sp); Ontotext Lab (Bu); seekda (Au); TIE Nederland; TXT e-Solutions (It); The University of Manchester (Uk); Universidad de Sevilla (Es)
Abstract: Service Oriented Architectures for All (SOA4All) is a Large-Scale Integrating Project funded by the European Seventh Framework Programme, under the Service and Software Architectures, Infrastructures and Engineering research area.

SOA4All will help realize a world where billions of parties are exposing and consuming services via advanced Web technology: the main objective of the project is to provide a comprehensive framework and infrastructure that integrates complementary and evolutionary technical advances (i.e., SOA, context management, Web principles, Web 2.0 and Semantic Web) into a coherent and domain-independent service delivery platform.

8.3.1.2. PLAY

Title: Pushing dynamic and ubiquitous interaction between services Leveraged in the Future Internet by ApplYing complex event processing

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: FZI (Germany)

Others partners: EBM WebSourcing (Fr), INRIA (OASIS and SARDES) (Fr), France Telecom (Fr), ICCS (Gr), Ecole des Mines Albi (Fr), CIM (Serbia).

See also: http://www.play-project.eu/

Abstract: The PLAY project will develop and validate an elastic and reliable architecture for dynamic and complex, event-driven interaction in large highly distributed and heterogeneous service systems. Such an architecture will enable ubiquitous exchange of information between heterogeneous services, providing the possibilities to adapt and personalize their execution, resulting in the so-called situational-driven process adaptivity. The OASIS Team is in charge of designing the key element of the PLAY Platform: the event cloud that is a publish/subscribe P2P based system, developed using the GCM technology.

8.3.1.3. TEFIS

Title: TEstbed for Future Internet Services

Type: COOPERATION (ICT)

Defi: Future Internet Experimental Facility and Experimentally-driven Research

Instrument: Integrated Project (IP)

Duration: June 2010 - November 2012

Coordinator: THALES Services SAS (France)

Others partners: Engineering Ingegneria Informatica S.p.A. (It); IT Innovation (UK); Fundação de Apoio à Universidade de São Paulo (Br); Thales Communications (Fr); ActiveEon (Fr); Lulea University of Technology (Se); Software Quality System S.A. (Es); Fraunhofer Institute FOKUS (De)

See also: http://www.tefisproject.eu/

Abstract: TEstbed for Future Internet Services (TEFIS) is a Large-Scale Integrating Project funded by the European Seventh Framework Programme, under the ICT research area and, more precisely, around the theme of Future Internet Experimental Facility and Experimentally-driven Research.

Internet is more and more used by services and applications as the common communication infrastructure. However, the Internet and Software industry is facing two main challenges. The
first one is that Internet is progressively reaching a saturation point in meeting an ever increasing variety of user expectations. The second one is that the increasing complexity of ICT environments (user communities, network heterogeneity, multiplicity of terminals and platforms) is paralysing testing processes for the assessment of Internet-based services at large-scale. Product and business developers must be able to rapidly satisfy and anticipate user requirements while testing and sizing their applications and services, being sure to constantly have the right amount of reactivity with regards to market demands.

To address these challenges, TEFIS will provide an open platform to enable the design, dimensioning and user-centric validation of innovative applications and services on top of upcoming Future Internet technologies. The TEFIS platform will be a central access point to heterogeneous and complementary experimental facilities addressing the full development lifecycle of innovative services with the appropriate tools and testing methodologies.

8.3.1.4. FI-WARE

Title: Future Internet Core Platform  
Type: COOPERATION (ICT)  
Defi: PPP FI: Technology Foundation: Future Internet Core Platform  
Instrument: Integrated Project (IP)  
Duration: May 2011 - April 2014  
Coordinator: Telefonica (Spain)  

Others partners: Alcatel-Lucent (De,It); Atos Origin (Sp); Deutsche Telecom (De); Engineering - Ingegneria Informatica (It); Ericsson (Se); France Telecom (Fr); Fraunhofer GFD (De); Angewandten Forschung (De); IBM Israel Science And Technology (Il,Ch); IBM Research (Is); INRIA (Fr); INTEL Performance Learning Solutions (Ir); NEC Europe (UK); Nokia Siemens Networks (Ge,Hu,Fi); SAP (Ge); SIEMENS (Ge); Telecom Italia (It); Thales Communications (Fr); Technicolor SNC (Fr); Universita Di Roma La Sapienza (It); Universitaet Duisburg-Essen (De); University of Surrey (UK); Universidad Politecnica De Madrid (Es)

See also: http://www.fi-ware.eu/

Abstract: The high-level goal of the FI-W ARE project is to build the Core Platform of the Future Internet, introducing an innovative infrastructure for cost-effective creation and delivery of versatile digital services, providing high QoS and security guarantees.

8.4. International Initiatives

8.4.1. Visits of International Scientists

8.4.1.1. Internship

We are hosting Ms Yanwen Chen, PhD student form East China Normal University (ECNU, Shanghai), for a 9 month visit funded by the INRIA Internship program, from 2011 nov. 15 to 2012 aug. 15. The thesis subject is “Formal Model and Scheduling Algorithms for Real-time CPS”.
8. Partnerships and Cooperations

8.1. Regional Initiatives

- **Assistive Technologies for Elderly**
  The objective of this project is to provide an open platform of digital assistance dedicated to aging in place. This project is in collaboration with researchers in Cognitive Science (Bordeaux University) and the UDCCAS Gironde (Union Départementale des Centres Communaux d’Action Sociale) managing elderly care. This project will include a need analysis, the development of new assistive applications and their experimental validation.
  This work is funded by CARSAT Aquitaine (“Caisse d’Assurance Retraite et de la Santé au Travail”).

- **Cognitive Assistance for Supporting the Autonomy of Persons with Intellectual Disabilities**
  The objective of this project is to develop assistive technologies enabling people with intellectual disabilities to gain independence and to develop self-determined behaviors, such as making choices and taking decisions. This project is in collaboration with the “Handicap et Système Nerveux” research group (EA 4136, Bordeaux University), the TSA Chair of UQTR (Université du Québec à Trois-Rivières) in Psychology and the Association Trisomie 21 Gironde (Down’s Syndrom). The TSA chair has recently designed and built a smart apartment that is used to conduct experimental evaluation of our assistive technologies in realistic conditions.

8.2. National Initiatives

- **SmartImmo: Towards intelligent and environmentally-friendly buildings**
  The SmartImmo project gathers research groups in pervasive systems and French companies working in the building construction, installation, and management. This project led by Orange Labs aims to make a building able to “communicate” with its occupants and to be environmentally-friendly (e.g., automatic temperature adjusting). The main objectives of this project are to design a M2M (Machine-To-Machine) box for the heterogeneous equipment communication and to build several services on top of this platform.
  This project is funded by the SCS (Secured Communicating Solutions), a French pole of competitiveness.

- **SERUS: Software Engineering for Resilient Ubiquitous Systems**
  The objectives of this project is to propose a design-driven development methodology for resilient systems that takes into account dependability concerns in the early stages, ensures the traceability of these requirements throughout the system life-cycle, even during runtime evolution. To provide a high level of support, this methodology will rely on a design paradigm dedicated to sense/compute/control applications. This design will be enriched with dependability requirements and used to provide support throughout the system life-cycle. This project is in collaboration with the TSF-LAAS research group (CNRS, Toulouse) and the ADAM research project-team (Inria Lille Nord Europe).
  This work is funded by the Inria collaboration program (in French, “actions de recherches collaboratives”).

- **School Inclusion for Children with Autism**
  The objective of this project is to provide children with assistive technologies dedicated to the school routines. This project is in collaboration with the “Handicap et Système Nerveux” research
group (EA 4136, Bordeaux University), the PsyCLÉ research center (EA 3273, Provence Aix-Marseille University) and the “Parole et Langage” research laboratory (CNRS, Provence Aix-Marseille University).

This work is funded by the French Ministry of National Education.

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: SUDOE territorial cooperation program (Interreg IV B)

Project acronym: Biomasud

Project title: Mechanisms for sustainability and enhancement of solid biomass market in the space of SUDOE

Duration: July 2011 - June 2013

Coordinator: AVEBIOM

Other partners: UCE (Consumers Union of Spain), CIEMAT (Public Research Agency for excellence in energy and environment, Spain), CBE (Centro da Biomassa para a Energia, Portugal), CVR (Centro para la Valorización de Residuos, Portugal) and UCFF (Union Française de la Coopération Forestière, France)

Abstract: The goal of the Biomasud European project is to show the viability of the biomass-based energy model. The project aims to propose a certification and traceability process throughout the value chain of biofuel. Our objective is to design and implement a prototype of traceability system that will extract automatically traceability information based on sensors such as RFID tags, simplifying the certification process. This work will leverage our DIA SUITE development methodology and will be evaluated by the Biomasud partners.

8.3.2. Major European Organizations with which you have followed Collaborations

University of Copenhagen, DIKU (Denmark)

Subject: we have been exchanging visits and publishing articles with Julia Lawall

8.4. International Initiatives

8.4.1. Inria International Partners

- University of McGill, Montréal, Canada
- University of Québec, Trois-Rivières, Canada

8.4.2. Visits of International Scientists

The Phoenix group has been visited by:

- Scott Lee (University of Auckland, New Zealand) on April 27, 2011.
- Kay Connely (Indiana University, US) from October 6, 2011 to October 7, 2011.
- Dany Lussier-Desrochers (University of Québec, Trois-Rivières, Canada) from October 3, 2011 to October 7, 2011.
POPS Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. DECARTE

Participants: Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: Développement de Carton électronique
Type: FUI
Duration: November 2008 - June 2012
Coordinator: Cartonneries de Gondardennes

Others participants: ___Inria POPS___ ___IEMN___ ___CTP___ ___Cascades___ ___IER___ ___TagSys___

Abstract: DECARTE studies the printing of an UHF RFID tag on packaging in order to reduce manufacturing costs.

7.1.2. IDC

Participants: Roudy Dagher, Michael Hauspie [correspondant], Nathalie Mitton, David Simplot-Ryl.

Title: Intelligent Data Center
Type: IPER
Duration: November 2010 - June 2012
Coordinator: NooliTic

Others partners: ___Inria POPS___ ___CIV___

Abstract: IDC studies wireless sensor network based solution to optimize the server monitoring in data centers.

7.2. National Initiatives

7.2.1. ANR

7.2.1.1. SensLAB

Participants: Nathalie Mitton [correspondant], Loic Schmidt, David Simplot-Ryl, Julien Vandaele.

Title: Project Very large scale open wireless sensor network testbed
Type: TLCOM
Duration: December 2007 - December 2011
Coordinator: Inria DNET (Lyon)

Others partners: ___Inria POPS and ASAP___ ___Thales___ ___UPMC___ ___Université de Strasbourg___

See also: ___http://www.senslab.info/___
Abstract: SensLAB is a group of 1K sensor nodes available as a testbed for distributed embedding sensor network application and distributed systems research. Distributed systems based on networked sensors and actuators with embedded computation capabilities allow for an instrumentation of the physical world at an unprecedented scale and density, thus enabling a new generation of monitoring and control applications. The SensLAB project was started in 2008. As of June 2009, SensLAB was composed of 1024 nodes at 4 sites. Accounts are available to persons affiliated with corporations and universities that host SensLAB nodes but also to any researchers for R&D purpose on request. SensLAB members actively participate in developing tools for the greater good of the community, and as a result each user has a wide choice of tools to use in order to design, compile, simulate, emulate, debug his/her embedded sensor application. There are a number of free, public services / tools / packages have been deployed on SensLAB, including drivers, OS portage, network simulator (WSNET) and a software-driven simulator for full platform estimations and debug (WSIM). SensLAB forms the core of the an emerging testbed for the future internet of things technologies.

7.2.1.2. RESCUE
Participants: Milan Erdelj, Nathalie Mitton, Karen Miranda, Tahiry Razafindralambo [correspondant], David Simplot-Ryl.

Title: Réseau Coordonné de substitution mobile
Type: VERSO
Duration: December 2010 - December 2013
Coordinator: Inria POPS
Others partners: ___LAAS___ ___UPMC___ ___France Telecom___ ___ENS Lyon___
See also: __ http://rescue.lille.inria.fr/ ___

Abstract: In RESCUE, we propose to exploit the controlled mobility of mobile routers to help a base network in trouble provide a better service. The base network may be any access network or metropolitan network (including wired and wireless technologies). Troubles may come from an increase of unplanned traffic, a failure of an equipment, or a power outage.

When no backup networks are available, it would be interesting to deploy, for a limited time corresponding to the period of the problem (i.e., failure or traffic overload), a substitution network to help the base network keep providing services to users. In the RESCUE project, we will investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure.

7.2.1.3. WINGS
Participants: Nathalie Mitton [correspondant], Roberto Quilez, David Simplot-Ryl.

Title: Widening Interoperability for Networking Global Supply Chains
Type: VERSO
Duration: November 2009 - March 2012
Coordinator: GS1
Others partners: ___Inria POPS___ ___UPMC___ ___France Telecom___ ___AFNIC___ ___GR-EYC___
See also: __ http://www.wings-project.fr/ ___

Abstract: This 2-year project focus on a proof-of-concept platform demonstrating the federated ONS model and the interaction with a prototype of Discovery Service.
7.2.1.4. F-Lab

**Participants:** Nathalie Mitton [correspondant], Priyanka Rawat, Tahiry Razafindralambo, David Simplot-Ryl.

Title: Federating Computing Resources
Type: VERSO
Duration: November 2010 - November 2013
Coordinator: UPMC
Others partners: Inria DNet, Planete, POPS, Thales, ALU
See also: [http://f-lab.fr/](http://f-lab.fr/)

Abstract: The F-Lab project works towards enabling an open, general-purpose and sustainable large-scale shared experimental facility that fosters the emergence of the Future Internet. F-Lab builds on a leading prototype for such a facility: the OneLab federation of testbeds. F-Lab will enhance the OneLab federation model with the addition of SensLAB’s unique sensor network and LTE-based cellular systems, and develop tools to conduct experiments on these enriched facilities. Project partners include some of France’s top academic and industrial research institutions, working together to develop experimental facilities on the Future Internet. F-Lab presents an unique opportunity for the French community to play a stronger role in the design of federation systems; for the SensLAB testbed to reach an international visibility and use; and for the pioneering of testbeds based on LTE technology.

7.2.1.5. BinThatThinks

**Participants:** Tony Ducrocq, Michael Hauspie, Nathalie Mitton [correspondant], David Simplot-Ryl.

Title: BinThatThinks
Type: ECOTECH
Duration: November 2010 - November 2013
Coordinator: Inria ACES (Rennes)
Others partners: Etineo, Veolia
See also: [http://binthatthink.inria.fr/](http://binthatthink.inria.fr/)

Abstract: Efficient dust sorting is a main challenge for the current society. BinThatThinks is a research project that aims to propose a system that makes the collect and sorting easier through the use of RFID and sensors.

7.2.2. ARC

7.2.2.1. MISSION

**Participants:** Milan Erdelj, Nathalie Mitton, Enrico Natalizio, Tahiry Razafindralambo [correspondant], David Simplot-Ryl.

Title: Mobile Substitution Networks
Type: ARC
Duration: January 2010 - December 2011
Coordinator: Inria POPS
Others partners: Inria Reso, UPMC
See also: [http://arcmission.lille.inria.fr/](http://arcmission.lille.inria.fr/)

Abstract: In MISSION, we study the feasability of the set up of a substitution network by using mobile robots equipped with one or several wireless technologies. More precisely, the focus is be put on the deployment and re-deployment of robots based on QoS constraints.
7.2.3. ADT

7.2.3.1. Sensas

**Participants:** Nathalie Mitton [correspondant], Lucie Jacquelin, Tahiry Razafindralambo, Julien Vandaele.

Title: Sensor Network Applications
Type: ADT
Duration: November 2010 - November 2014
Coordinator: Inria POPS

Others partners: Inria Non-A, Inria D-NET, Inria Planete, Inria NECS, Inria DEMAR, Inria MADYNES, Inria AMAZONE, Inria SED

See also: [http://sensas.gforge.inria.fr/](http://sensas.gforge.inria.fr/)

Abstract: Sensas aims to propose mainly control science application based on wireless sensor and actuator network nodes provided from the work done around senslab and senstools projects.

7.2.3.2. SensLille

**Participants:** Victor Corblin, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: SensLille
Type: ADT
Duration: November 2011 - November 2013
Coordinator: Inria POPS

Abstract: SensLille is an ADT that aims to improve SensLab Lille platform by offering new functionalities as the use of electric trains to experiment mobile nodes.

7.2.4. Equipements d’Excellence

7.2.4.1. FIT

**Participants:** Nathalie Mitton [correspondant], Tahiry Razafindralambo, Loic Schmidt, Julien Vandaele.

Title: Future Internet of Things
Type: EquipEx
Duration: March 2010 - December 2019
Coordinator: UPMC

See also: [http://fit-equipex.fr/](http://fit-equipex.fr/)

Abstract: FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet.

FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research’s "Equipements d’Excellence" (Equipex) research grant program. Coordinated by Professor Serge Fdida of UPMC Sorbonne Universités and running over a nine-year period, the project will benefit from a 5.8 million euro grant from the French government.
7.3. European Initiatives

7.3.1. FP7 Projet

7.3.1.1. SECURE CHANGE

**Participants:** Arnaud Fontaine, Isabelle Simplot-Ryl [correspondant].

- **Title:** Security Engineering for lifelong Evolvable Systems (SecureChange)
- **Type:** COOPERATION (ICT)
- **Defi:** ICT forever yours
- **Instrument:** Integrated Project (IP)
- **Duration:** February 2009 - February 2012
- **Coordinator:** Università degli Studi di Trento (Italy)
- **Others partners:** Budapest University of Technology and Economics (Hungary), Gemalto (France), Katholieke Universiteit Leuven (Belgium), Smartesting (France), Open University (UK), Stiftelsen for industriell og teknisk forskning ved Norges Tekniske Høgskole (Norway), Thales (France), Telefonica Investigacion y Desarrollo (Spain), University of Innsbruck (Austria), Deep Blue (Italy), Technische Universität Dortmund (Germany)

See also: [http://www.securechange.eu/](http://www.securechange.eu/)

**Abstract:** Software-based systems are becoming increasingly long-living. This was demonstrated strikingly with the occurrence of the year 2000 bug, which occurred because software had been in use for far longer than its expected lifespan. At the same time, software-based systems are getting increasingly security-critical since software now pervades the whole critical infrastructures dealing with critical data of both nations and also private individuals. There is therefore a growing demand for more assurance and more verified security properties of IT systems both during development and at deployment time, in particular also for long living systems. Yet a long lived system also needs to be flexible, to adapt to changes and adjust to evolving requirements, usage and attack models. However, using today’s system engineering techniques we are forced to trade flexibility for assurance or vice versa.

7.3.1.2. ASPIRE

**Participants:** Nathalie Mitton [correspondant], Loic Schmidt, Lei Zhang, David Simplot-Ryl.

- **Title:** Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications (Aspire)
- **Type:** COOPERATION (ICT)
- **Instrument:** Integrated Project (IP)
- **Duration:** January 2008 - June 2011
- **Coordinator:** Aalborg University (Denmark) (Italy)
- **Others partners:** Université Joseph Fourrier - Grenoble University - LIG Laboratory (France), Athens Information Technology (Greece), Melexis technologies SA (Switzerland), Open Source Innovation Ltd (UK), UEAPME European Office of Crafts, Trades and SMEs for Standardisation (Belgium), SENS@P (Greece), Pole Traceability Valence (France), Instituto Telecomunicacões (Portugal)

See also: [http://www.fp7-aspire.eu/](http://www.fp7-aspire.eu/)
Abstract: The ASPIRE Project (Advanced Sensors and lightweight Programmable middleware for Innovative Rfid Enterprise applications) will change the current RFID deployment paradigm, through introducing and boosting a shift towards royalty-free RFID middleware, while also placing the middleware at the heart of RFID infrastructures. In this paradigm a great deal of an RFID’s solution intelligence is place on the middleware, which is freely offered to end-users (particularly SMEs). Accordingly, the RFID middleware can integrate with low-cost hardware, as well as with legacy IT and networking infrastructures of the networked enterprise. To support this paradigm ASPIRE will develop and deliver a lightweight, royalty-free, programmable, privacy friendly, standards-compliant, scalable, integrated and intelligent middleware platform that will facilitate low-cost development and deployment of innovative fully automatic RFID solutions. The above attributes of this middleware platform can be analyzed as follows: (i) Lightweight, (ii) Programmable, (iii) Intelligent, (iv) Standards-Compliant, (v) Scalable, (vi) Privacy-Friendly, (vii) Integrated. ASPIRE will research and provide a radical change in the current RFID deployment paradigm through innovative, programmable, royalty-free, lightweight and privacy friendly middleware. This new middleware paradigm will be particular beneficial to European SME, which are nowadays experiencing significant cost-barriers to RFID deployment.

7.3.2. Collaborations in European Programs, except FP7

7.3.2.1. EGO

Participants: Gilles Grimaud [correspondant], Michael Hauspie, Francois Serman.

Program: EUREKA CATRENE
Project acronym: EGO
Project title: EGO
Duration: 2010 - 2013
Coordinator: Gemalto (France)

Other partners: Atos Worldline (France), Cork Institute of Technologe (Ireland), Continental Automotive (France), IDEX (Norway), Decawave (Ireland), Precise Biometrics (Sweden), STMicroelectronics (France), Tyndall (Ireland)

Abstract: The eGo project offers an innovative way to establish wireless bidirectional channels of communication between objects and users. Using signal transmission via the user’s body, every eGo-compliant object you touch is "paired" with the eGo device you carry on you, close to your skin. The objective is to enable very intuitive, very simple applications where touching a device turns into a personalization of such a device to install, for example, the user's rights and credentials. "what you touch is yours". eGo offers a vast horizon of new intuitive applications, making user interfaces as simple as possible. eGo will be prototyped, integrated in several form factors in miniaturized system (System In Package) for new sensors, new batteries, ultra low-power transmitters for intrabody communication (via a natural connector: human skin), a highly secure micro controller comparable to those embedded in smart cards, a large data storage capacity and a high performance, high-speed wireless (Ultra Wide Band) transmitters. Embedded software, including JavaCard technology and secure remote management (Trusted Service Management) for managing services will also be integrated. This web site presents multiple use cases where eGo can add value.

See also: [http://www.ego-project.eu/](http://www.ego-project.eu/)
REGAL Project-Team

7. Partnerships and Cooperations

7.1. National initiatives

7.1.1. ODISEA2 - (2011–2014)

Members: Orange, LIP6 (Regal), UbiStorage, Technicolor, Institut Telecom

Funding: FUI project, Ile de France Region

Objectives: ODISEA aims at designing new on-line data storage and data sharing solutions. Current solutions rely on big data centers, which induce many drawbacks: (i) a high cost, (ii) proprietary solutions, (iii) inefficiency (one single location, not necessarily close to the user). The goal is to tackle these issues by designing a distributed/decentralized solution that leverage edge resources like set-top boxes.

It involves a grant of 159 000 euros from Region Ile de France over three years.


Members: INRIA Rhones-Alpes (SARDES), LIP6 (REGAL), EMN, WeAreCloud, Elastic Cloud

Funding: MyCloud project is funded by ANR Arpège

Objectives: Cloud Computing is a paradigm for enabling remote, on-demand access to a set of configurable computing resources. The objective of the MyCloud project is to define and implement a novel cloud model: SLAaaS (SLA aware Service). Novel models, control laws, distributed algorithms and languages will be proposed for automated provisioning, configuration and deployment of cloud services to meet SLA requirements, while tackling scalability and dynamics issues. The principal investigators for Regal are Luciana Arantes, Pierre Sens, and Julien Sopena. It involves a grant of 155 000 euros from ANR to LIP6 over three years.

7.1.3. ConcoRDanT - (2010–2013)

Members: INRIA Regal, project leader; LORIA, Universidade Nova de Lisboa

Funding: PROSE project is funded by ANR Blanc

Objectives: CRDTs for consistency without concurrency control in Cloud and Peer-To-Peer systems

Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone. The ConcoRDanT project investigates a promising new approach that is simple, scales indefinitely, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of meta-data). The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency. The project leader and principal investigator for Regal is Marc Shapiro. ConcoRDanT involves a grant of 192 637 euros from ANR to INRIA over three years.
7.1.4. STREAMS - (2010–2013)

Members: LORIA (Score, Cassis), INRIA (Regal, ASAP), Xwiki

Funding: STREAMS is funded by ANR Arpège

Objectives: Solutions for a peer-To-peer REAL-tiMe Social web The STREAMS project proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that eliminate the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services. The project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication techniques. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes. Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issues in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentation. The principal investigators for Regal is Marc Shapiro. It involves a grant of 57 000 euros from ANR to INRIA over three years.

7.1.5. PROSE - (2009–2011)

Members: Technicolor, INRIA (Regal), EURECOM, PLAYADZ, LIAFA

Funding: PROSE project is funded by ANR VERSO

Objectives: Content Shared Through Peer-to-Peer Recommendation & Opportunistic Social Environment

The Prose project is a collective effort to design opportunistic contact sharing schemes, and characterizes the environmental conditions as well as algorithmic and architecture principles that let them operate. The partners of the Prose project will engage in this exploration through various expertise: network measurement, system design, behavioral study, analysis of distributed algorithms, theory of dynamic graph, networking modeling, and performance evaluation.

The principal investigators for Regal are Sébastien Monnet and Marc Shapiro. It involves a grant of 152 000 euros from ANR to INRIA over three years.

7.1.6. ABL - (2009–2012)

Members: Gilles Muller, Gaël Thomas, Julia Lawall, Saha Suman

Funding: ANR Blanc

Objectives: The goal of the “A Bug’s Life” (ABL) project is to develop a comprehensive solution to the problem of finding bugs in API usage in open source infrastructure software. The ABL project has grown out of our experience in using the Coccinelle code matching and transformation tool, which we have developed as part of the former ANR project Blanc Coccinelle, and our interactions with the Linux community. Coccinelle targets the problem of documenting and automating collateral evolutions in C code, specifically Linux code. A collateral evolution is a change that is needed in the clients of an API when the API changes in some way that affects its interface. Coccinelle provides a language for expressing collateral evolutions by means of Semantic Patches, and a transformation tool for performing them automatically.

We have used Coccinelle to reproduce over 60 collateral evolutions in recent versions of Linux, affecting almost 6000 files. Recently, we have begun using Coccinelle to generate traditional patches for improving the safety of Linux. Over 800 of these patches developed using Coccinelle have been
integrated into the mainline Linux kernel. Julia Lawall was among the top 10 in terms of the number of contributed patches in Linux 2.6.36. Finally, about 20 semantic patches are integrated into the Linux sources so that developers can improve the quality of their programs by running Coccinelle as part of the development process.

In the ABL project, we are building on the results of Coccinelle by 1) designing libraries of semantic patches to identify API protocols and detect violations in their usage, 2) extending Coccinelle to address the needs of bug finding and reporting, and 3) designing complementary tools to help the programmer to track and fix bugs.

7.1.7. SHAMAN - (2009–2011)

Members: LIP6 (NPA), Inria Saclay (Grand-Large), Inria Bretagne (ASAP), LIP6 (Regal)
Funding: SHAMAN project is funded by ANR TELECOM
Objectives: Large-scale networks (e.g. sensor networks, peer-to-peer networks) typically include several thousands (or even hundred thousand) basic elements (computers, processors) endowed with communication capabilities (low power radio, dedicated fast network, Internet). Because of the large number of involved components, these systems are particularly vulnerable to occurrences of failures or attacks (permanent, transient, intermittent). Our focus in this project is to enable the sustainability of autonomous network functionalities in spite of component failures (lack of power, physical damage, software or environmental interference, etc.) or system evolution (changes in topology, alteration of needs or capacities). We emphasize the self-organization, fault-tolerance, and resource saving properties of the potential solutions. In this project, we will consider two different kinds of large-scale systems: on one hand sensor networks, and on the other hand peer to peer networks.


Members: MIS, LASMEA, GREYC, LIP6 (Regal), Thales
Funding: R-DISCOVER project is funded by ANR CONTINT
Objectives: This project considers a set of sensors and mobile robots arbitrarily deployed in a geographical area. Sensors are static. The robots can move and observe the positions of other robots and sensors in the plane and based on these observations they perform some local computations. This project addresses the problem of topological and cooperative navigation of robots in such complex systems.

7.1.9. PACTOL - (2009–2011)

Members: LIP6 (NPA, Regal), CNAM
Funding: Ile de France Region
Objectives: The scope of PACTOL is to propose verification tools for self-stabilizing distributed algorithms.

7.2. European Initiatives

7.2.1. Google European Doctoral Fellowship “A principled approach to eventual consistency based on CRDTs

Cloud computing systems suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone. The Commutative Replicated Data Type (CRDT) approach, based on commutativity, is a simple and principled solution to this conundrum; however, only a handful of CRDTs are known, and CRDTs are not a universal solution. This PhD research aims to expand our knowledge of CRDTs, to design and implement a re-usable library of composable CRDTs, to maintain study techniques for maintaining strong
invariants above CRDTs, and to experiment with CRDTs in applications. We are hopeful that significant distributed applications can be designed using our techniques, which would radically simplify the design of cloud software, reconciling scalability and consistency. This Google European Doctoral Fellowship is awarded to Marek Zawirski, advised by Marc Shapiro. This award includes a grant of 41,000 euros yearly over three years starting September 2010.

7.2.2. FTH-GRID - (2009–2011)

Members: Université de Lisbonne (LASIGE), LIP6 (Regal)
Funding: Egide

Objectives: FTH-Grid, Fault-Tolerant Hierarchical Grid Scheduling, is a cooperation project between the Laboratoire d’Informatique de Paris 6 (LIP6/CNRS, France) and the Large-Scale Informatics Systems Laboratory (LASIGE/FCUL, Portugal).

Its goal is to foster scientific research collaboration between the two research teams. The project aims at rendering Map Reduce on top of Grid tolerant to byzantine failure. Map Reduce is a programming model for large-scale data-parallel applications whose implementation is based on master-slave scheduling of bag-of-tasks. MapReduce breaks a computation into small tasks that run in parallel on different machines, scaling easily to several cluster. The core research activities of the project consist mainly in extending the execution and programming model to make Byzantine fault-tolerant MapReduce applications. The project was extended for another year, after a results assessment by Egide.

7.3. International Initiatives

7.3.1. DEMEDYS - INRIA-CNPq - (2010–2011)

Members: INRIA Bretagne (ASAP), INRIA Paris Rocquencourt (REGAL), UFBA (Bahia, Brazil), IME (Sao Paulo, Brazil)
Funding: INRIA / CNPq

Objectives: DEMEDYS Project (Dependable Mechanisms for Dynamic Systems) will study fundamental aspects of dynamic distributed systems.

7.3.2. Dependability of dynamic distributed systems for ad-hoc networks and desktop grid (ONDINA) (2011-2013)

Members: INRIA Paris Rocquencourt (REGAL), INRIA Rhone-Alpes (GRAAL), UFBA (Bahia, Brazil))
Funding: INRIA

Objectives: Modern distributed systems deployed over ad-hoc networks, such as MANETs (wireless mobile ad-hoc networks), WSNs (wireless sensor networks) or Desktop Grid are inherently dynamic and the issue of designing reliable services which can cope with the high dynamics of these systems is a challenge. This project studies the necessary conditions, models and algorithms able to implement reliable services in these dynamic environments.

7.3.3. Enabling Collaborative Applications For Desktop Grids (ECADeG) (2011–2013)

Members: INRIA Paris Rocquencourt (REGAL), USP (Sao Paulo, Brazil))
Funding: INRIA

Objectives: The overall objective of the ECADeG research project is the design and implementation of a desktop grid middleware infrastructure for supporting the development of collaborative applications and its evaluation through a case study of a particular application in the health care domain.
7.3.4. Bi-lateral collaborations

JAIST (Japon). With the group of Prof. Xavier Defago we investigate various aspects of self-organization and fault tolerance in the context of robots networks.

UNLV (USA) With the group of Prof. Ajoy Datta we collaborate in designing self* solutions for the computations of connected covers of query regions in sensor networks.

Technion (Israel). We collaborate with Prof. Roy Friedman on divers aspects of dynamic systems ranging from the computation of connected covers to the design of agreement problems adequate for P2P networks.

Ben Gurion (Israel). We collaborate recently with prof. Shlomi Dolev on the implementation of self-stabilizing atomic memory.

Kent University (SUA) With prof. Mikhail Nesterenko we started recently a collaboration on FTSS solutions for dynamic tasks.

Nagoya Institute of Technology (Japon). With prof. Taisuke Izumi we started this year a collaboration on the probabilistic aspects of robot networks.

COFECUB (Brazil). With the group of Prof. F. Greve. (Univ. Federal of Bahia), we investigate various aspects of failure detection for dynamic environments such as MANET of P2P systems.

CONYCIT (Chili). Since 2007, we start on new collaboration with the group of X. Bonnaire Fabre (Universidad Técnica Federico Santa María - Valparaiso). The main goal is to implement trusted services in P2P environment. Even if it is near impossible to fully trust a node in a P2P system, managing a set of the most trusted nodes in the system can help to implement more trusted and reliable services. Using these nodes, can reduce the probability to have some malicious nodes that will not correctly provide the given service. The project will have the following objectives: 1. To design a distributed membership algorithm for structured Peer to Peer networks in order to build a group of trusted nodes. 2. To design a maintenance algorithm to periodically clean the trusted group so as to avoid nodes whose reputation has decreased under the minimum value. 3. To provide a way for a given node X to find at least one trusted node. 4. To design a prototype of an information system, such as a news dissemination system, that relies on the trusted group.

Collaboration with CITI-UNL, Portugal. Our collaboration with CITI, the Research Center for Informatics and Information Technologies of UNL, the New University of Lisbon (Portugal), is materialised by several joint articles. Furthermore, Marc Shapiro is an advisor to the project “RepComp - Replicated Components for Improved Performance or Reliability in Multicore Systems,” funded by Fundacio para a Ciencia e a Tecnologia (FCT, Portuguese equivalent of ANR). Finally, Marc Shapiro is a Member of the CITI Advisory Board.
7. Partnerships and Cooperations

7.1. Regional Initiatives

We have signed a convention with team DIA led by Noury Bouraoudi of Ecole des Mines de Douai. In such context we co-supervised two PhD students (Mariano Martinez-Peck and Nick Papoylias). The team is also an important contributor and supporting organization of the Pharo project.

7.2. National Initiatives

7.2.1. Cutter ANR Project

Stéphane Ducasse [correspondant], Nicolas Anquetil.

Participants are RMoD and the D’Oc (M. Huchard)–APR(J.C. Koenig) groups at Lirmm. The aim of Cutter is to develop, combine, and evaluate new techniques for analyzing and modularizing code. The innovation of Cutter is to: (1) combine different package decomposition techniques (graph decomposition, program visualization...); (2) support different levels of abstractions (system, packages, classes); and (3) be directed by the quality of the resulting remodularization and take into account expert input.

7.2.2. Resilience FUI Project

Stéphane Ducasse [correspondant], Marcus Denker. Participants: Nexedi, Morphom Alcatel-Lucent Bell Labs, Astrium Geo Information, Wallix, XWiki, Alixen, Alterway, Institut Télécom, Université Paris 13, CEA LIST, Inria. Started in September 2011-September 2014.

RESILIENCE’s goal is to protect private data on the cloud, to reduce spying and data loss in case of natural problems. RESILIENCE proposes to develop a decentralized cloud architecture: SafeOS. SafeOS is based on replication of servers. In addition a safe solution for documents should be developed. Sandboxing for Javascript applications should be explored.

7.3. European Initiatives

Participants: Stéphane Ducasse [correspondant], Veronica Uquillas Gomez, Marcus Denker.

7.3.1. IAP MoVES

Participant: Stéphane Ducasse [correspondant].

The Belgium IAP (Interuniversity Attraction Poles) MoVES (Fundamental Issues in Software Engineering: Modeling, Verification and Evolution of Software) is a project whose partners are the Belgium universities (VUB, KUL, UA, UCB, ULB, FUNDP, ULg, UMH) and three European institutes (Inria, IC and TUD) respectively from France, Great Britain and Netherlands. This consortium combines the leading Belgian research teams and their neighbors in software engineering, with recognized scientific excellence in MDE, software evolution, formal modeling and verification, and AOSD. The project focuses on the development, integration and extension of state-of-the-art languages, formalisms and techniques for modeling and verifying dependable software systems and supporting the evolution of Software-intensive systems. The project has started in January 2007 and is scheduled for a 60-months period. Read more at http://moves.vub.ac.be.

7.3.2. Réseau ERCIM Software Evolution

We are involved in the ERCIM Software Evolution working group since its inception. We participated at his creation when we were at the University of Bern.
7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. PLOMO

- Title: Customizable Tools and Infrastructure for Software Development and Maintenance
- Inria principal investigator: Stéphane Ducasse
- International Partner:
  - Institution: Universidad de Chile (Chile)
  - Laboratory: PLEIAD
- Duration: 2011 - 2013
- See also: http://pleiad.dcc.uchile.cl/research/plomo

Project Description

Software maintenance is the process of maintaining a software system by removing bugs, fixing performance issues and adapting it to keep it useful and competitive in an ever-changing environment [44]. Performing effective software maintenance and development is best achieved with effective tool support, provided by a variety of tools, each one presenting a specific kind of information supporting the task at hand [47]. The goal of PLOMO is to develop new meta tools to improve and bring synergy in the existing infrastructure of Pharo (for software development) and the Moose software analysis platform (for software maintenance).

PLOMO will (1) enhance the Opal open compiler infrastructure to support plugin definition, (2) offer an infrastructure for change and event tracking as well as model to compose and manipulate them, (3) work on a layered library of algorithms for the Mondrian visualization engine of Moose, (4) work on new ways of profiling applications. All the efforts will be performed on Pharo http://www.pharo-project.org and Moose http://www.moosetechnology.org/, two platforms heavily used by the RMoD and PLEIAD team.

The outcomes of PLOMO will include new research advances in the field of (i) bytecode generation for dynamic language; (ii) change and event tracking; (iii) software visualization engine; (iv) agile profiling framework. These four topics are recurrently considered by the most prestigious and competitive conferences (e.g., ECOOP, OOPSLA, FSE, ESEC, ICSE, TOOLS) and journals (e.g., TSE, TOPLAS, ASE), to which the participants of the PLOMO project are used to publish.

A strong focus on publishing our results in relevant scientific forum will remain a top priority. The artifacts produced by PLOMO will strongly reinforce the Pharo programming language and the Moose software analysis platform. The development and progress of Pharo is structured by RMoD, which has successfully created a strong and dynamic community. Moose is being used to realize consulting activities and it is used as a research platform in about 10 Universities, worldwide. We expect PLOMO to have a strong impact in both the software products and the communities structured around them.

Publications

1. S. Ducasse, M. Oriol, A. Bergel, Challenges to support automated random testing for dynamically typed languages [17]
3. Romain Robbes, Johan Fabry, Marcus Denker, DIE: A Domain Specific Aspect Language for IDE Events, in submission
Research Visits

- Vanessa Pena and A. Bergel, Aug 15 until Aug 20. From Aug 20 until Aug 28 they attended ESUG 2011, a conference co-organized by RMoD.
- Romain Robbes from July 18 until July 24.
- Esteban Allende from July 19 until October 2. Esteban’s stays is founded by the French Embassy in Chile. He received a grant of 3180 euros.
- Marcus Denker visited Chile Nov 7th-28th.

7.4.2. Visits of International Scientists

Dr. Andy Kellens from the VUB is visiting us during 3 months.

In the context of the PLOMO associated Team with the University of Chile we got three visitors over a period of one week (V. Pena, A. Bergel, R. Robbes). Esteban Allende, a PhD Student from Pleiad University of Chile, visited from July-Sept 2011.

7.4.2.1. Internships

RMoD hosted students for internships:

- Guido Chari, University of Buenos Aires, Argentina, Sept.-Dec. 2011
- Cesar Couto, Federal University of Minas Gerais, Brazil, Dec. 2011-Feb. 2012 as part of the Pequi project (see 7.4.3.2)

7.4.3. Participation In International Programs

7.4.3.1. STICAmssud

This project focuses on software remodularization. Aspects, Traits and Classboxes are proved software mechanisms to provide modules in software applications. However, reengineering-based methodologies using these mechanisms have not yet been explored so far. This project intends to show how visualization and clustering techniques (such as Formal Concept Analysis) are useful to cope with the comprehension and transformation of module-based applications to applications which could use these mechanisms (i.e. aspects, traits, classboxes). The research results will be applied in a common reengineering platform MOOSE to show the applicability of the concepts.

CoReA spans three research institutions: Inria (the Lille Nord Europe research center, France), University of Chile (Santiago, Chile), LIFIA - Universidad Nacional de La Plata (La Plata, Argentina). The three national project leaders are Dr. Gabriela Arévalo (LIFIA - UNLP), Dr. Alexandre Bergel (Inria), Prof. Dr. Johan Fabry (University of Chile). The international coordinator is Dr. Alexandre Bergel. Participants are: Prof. Dr. Eric Tanter (University of Chile), and Dr. Stéphane Ducasse (senior scientist at Inria).

Marcus Denker visited Argentina November 3rd to November 5th, 2011.

7.4.3.2. Project Pequi – Inria/CNPq Brésil

The Pequi project is a collaboration between Professor Marco T. Valente’s team at the Federal University of Minas Gerais in Brazil and the RMoD team. It focuses in producing Metrics, Techniques, and Tools for Software Remodularization.

It is recognized that software systems must be continuously maintained and evolved to remain useful. However, ongoing maintenance over the years contributes to degrade the quality of a system. Thus reengineering activities, including remodularization activities, are necessary to restore or enhance the maintainability of the systems. To help in the remodularization of software systems, the project will be structured in two main research lines in which both teams have experience and participation: (i) Evaluation and Characterization of Metrics for Software Remodularization; and (ii) Tools and Techniques for Removal of Architectural Violations.

The project started in July 2011 with a visit of Dr. Nicolas Anquetil to the brazilian team. The project will last 24 months.
7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Aravis (ANR-Minalogic)

Participants: Vivien Quéma, Renaud Lachaize, Fabien Gaud, Sylvain Genevès, Fabien Mottet, Baptiste Lepers.

The ARAVIS project aims at addressing the challenges raised, both at the hardware and software levels, by the production of highly integrated multiprocessor systems on chip (MPSoCs) designed for demanding applications such as video encoding/decoding and software-defined radio communications. Due to the complexity of the manufacturing process, the latest generations of chips exhibit peculiar features that must be taken into account: (i) massively parallel processing units, (ii) irregular behavior and aging of the processing units due to unavoidable defects of the manufacturing process. The ARAVIS project strives to provide a hardware and software platform suited to the adaptation requirements raised by the needs of such emerging hardware technologies and applications. The proposed approach encompasses three contributions: (i) a symmetric hardware architecture based on an asynchronous interconnect with integrated voltage/frequency scaling, (ii) a set of regulation algorithms based on control theory to optimize quality of service and energy consumption, (iii) a component-based runtime environment and related software tools to ease the dynamic management of applications and execution resources.

The project partners are STMicroelectronics, CEA-LETI, TIMA and INRIA (Necs and Sardes project teams). The project runs from October 2007 to September 2011.

7.1.2. MIND (ANR-Minalogic)

Participants: Eric Rutten, Jean-Bernard Stefani, Tayeb Bouhadiba, Cinzia di Giusto.

The MIND project aims to develop an industrial technology for component-based construction of embedded systems, based on the Fractal component model.

This includes the development of programming languages (extended C, ADL, IDL), a chain for compiling software architecture descriptions and generating code, and a graphical IDE integrated to Eclipse. In addition, the project aims to study extensions and refinements to the Fractal model suitable for dealing with non-functional aspects such as real-time and priority constraints, the model-based control of dynamic reconfiguration of components, and its integration with the BIP component model developed at the Verimag laboratory.

The project partners include STMicroelectronics, CEA, INRIA (Adam and Sardes project teams), Schneider. The project runs from October 2008 to may 2011.

7.2. National Initiatives

7.2.1. ASR Network

The Sardes team is a member of the CNRS research network GDR 725 ASR “Architecture, Système et Réseau”. See http://asr.univ-perp.fr/.

7.2.2. Automatique pour l’informatique autonome (CNRS PEPS)

Participant: Eric Rutten.

This project is lead by Eric Rutten and funded by CNRS in the programme Projet Exploratoire-Premier(s) Soutien(s) PEPS Rupture de l’INS2I 2011. It concerns Control Techniques for Autonomic Computing, and intends to group researchers of different backgrounds (Architectures and FPGA, distributed systems and adaptative software, programming languages for reconfiguration, and control theory) to gather experiences and points of view on this multi-disciplinary topic.
7.2.3. **Cogip (CNRS PEPS)**

**Participant:** Damien Pous.

This project is lead by Filippo Bonchi (LIP, Lyon), and it includes two researchers from Paris: Samuel Mimram (CEA), and Paul-André Melliès (PPS). This project focuses on semantics of concurrent programming languages, by working at the interface between coalgebraic methods and game semantics.

http://perso.ens-lyon.fr/daniel.hirschkoff/cogip/

7.2.4. **SocEDA (ANR Arpege project)**

**Participants:** Vivien Quéma, Baptiste Lepers.

The goal of SocEDA is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize the execution of them, according to social network information.

The main outcome of the SocEDA project will be a platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements.

The project partners are INRIA (ADAM in Lilles), EBM WebSourcing (FR), ActiveEon (FR), ARMINES (FR), France Telecom R&D (FR), CNRS (I3S and LIG), INSA Lyon, Thales Communications.

The project runs from October 2010 to September 2013.

7.2.5. **PiCoq (ANR project)**

**Participants:** Damien Pous, Alan Schmitt, Jean-Bernard Stefani, Thomas Braibant.

The goal of the PiCoq project is to develop an environment for the formal verification of properties of distributed, component-based programs. The project’s approach approach lies at the interface between two research areas: concurrency theory and proof assistants. Achieving this goal relies on three scientific advances, which the project intends to address:

- Finding mathematical frameworks that ease modular reasoning about concurrent and distributed systems: due to their large size and complex interactions, distributed systems cannot be analysed in a global way. They have to be decomposed into modular components, whose individual behaviour can be understood.
- Improving existing proof techniques for distributed/modular systems: while behavioural theories of first-order concurrent languages are well understood, this is not the case for higher-order ones. We also need to generalise well-known modular techniques that have been developed for first-order languages to facilitate formalisation in a proof assistant, where source code redundancies should be avoided.
- Defining core calculi that both reflect concrete practice in distributed component programming and enjoy nice properties w.r.t. behavioural equivalences.

The project partners include INRIA (Sardes), LIP (Plume team), and Université de Savoie. the project runs from November 2010 to October 2014.

The ANR PiCoq is in the programme ANR 2010 BLAN 0305 01: http://sardes.inrialpes.fr/collaborations/PiCoq/.

7.2.6. **Project MyCloud (ANR project)**

**Participants:** Amit Sangroya, Sara Bouchenak, Dàmian Serrano.
The objective of the MyCloud project is to define and implement a novel cloud model: SLAaaS (SLAaware Service). The SLAaaS model enriches the general paradigm of Cloud Computing, and enables systematic and transparent integration of service levels and SLA to the cloud. SLAaaS is orthogonal to IaaS, PaaS and SaaS clouds and may apply to any of them. The MyCloud project takes into account both the cloud provider and cloud customer points of view. From cloud provider’s point of view, MyCloud proposes autonomic SLA management to handle performance, availability, energy and cost issues in the cloud. An innovative approach combines control theory techniques with distributed algorithms and language support in order to build autonomic elastic clouds. Novel models, control laws, distributed algorithms and languages will be proposed for automated provisioning, configuration and deployment of cloud services to meet SLA requirements, while tackling scalability and dynamics issues. On the other hand from cloud customer’s point of view, the MyCloud project provides SLA governance. It allows cloud customers to be part of the loop and to be automatically notified about the state of the cloud, such as SLA violation and cloud energy consumption. The former provides more transparency about SLA guaranties, and the latter aims to raise customers’ awareness about cloud’s energy footprint.

The project partners are INRIA (Sardes is the project coordinator), Grenoble; LIP6, Paris; EMN, Nantes; We Are Cloud, Montpellier; Elastic Grid LLC, USA.

The project runs from November 2010 to October 2013.

7.2.7. Famous (ANR project)

Participants: Eric Rutten, Xin An.

The FAMOUS project (FAst Modeling and Design FIOw for Dynamically ReconfigUrable Systems) intends to make reconfigurable hardware systems design easier and faster, by introducing a complete methodology that takes the reconfigurability of the hardware as an essential design concept and proposes the necessary mechanisms to fully exploit those capabilities at runtime. The tool under development in this project is expected to be used by both industrial designers and academic researchers, especially for modern application system specific design such as smart cameras, image and video processing, etc.

The project partners are INRIA (Sardes in Grenoble and DaRT in Lille), Université de Bretagne Sud, Université de Bourgogne, Sodius.

The project runs from December 2009 to November 2013.

7.3. European Initiatives

7.3.1. FP7 ICT Project

7.3.1.1. PLAY

Title: Pushing dynamic and ubiquitous interaction between services Leveraged in the Future Internet by ApplYing complex event processing

Type: COOPERATION (ICT)

Defi: Internet of Services, Software & Virtualisation

Instrument: Specific Targeted Research Project (STREP)

Duration: October 2010 - September 2013

Coordinator: FZI (Germany)

Others partners: INRIA (Oasis in Sophia), FZI (Germany), ICCS (Greece), EBM WebSourcing (FR), ARMINES (FR), France Telecom R&D (FR), CIM Grupa DOO (RS)

See also: http://www.play-project.eu/
Abstract: The goal of PLAY is to develop and validate an elastic and reliable federated SOA architecture for dynamic and complex, event-driven interaction in large highly distributed and heterogeneous service systems. Such architecture will enable exchange of contextual information between heterogeneous services, providing the possibilities to optimize/personalize the execution of them, resulting in the so called situational-driven adaptivity.

The main outcome will be a FOT (federated open trusted) Platform for event-driven interaction between services, that scales at the Internet level based on the proposed architecture and that addresses Quality of Service (QoS) requirements. The platform consists of:

- Federated middleware layer: a peer-to-peer overlay network combined with a publish/subscribe mechanism, that has the task to collect events coming from the heterogeneous and distributed services,
- Distributed complex event processor: an elastic, distributed computing cloud based engine for complex processing/combining of events coming from different services in order to detect interesting situations a service should react on
- Situational-aware business adapter: a recommender engine for proposing adaptation and changes in running business processes and services in a non-predefined (ad-hoc) way, by ensuring the consistency of the whole instance

The system will be tested in two use cases: crisis management and telecom industry, showing the advantages of such an architecture for Future Internet. Indeed, PLAY aims to revolutionize the Future Internet by making it situational-aware, which leads to the event-aware services that are able to proactively adapt themselves to the changes in the environment.
**SCORE Team**

### 8. Partnerships and Cooperations

#### 8.1. National Initiatives


**Participants:** Pascal Urso [contact], Mehdi Ahmed-Nacer, Claudia Ignat, Gérald Oster.

- **Partners:** REGAL project-team (INRIA Paris - Rocquencourt / LIP6, coordinator), CITI institute (Universidade Nova de Lisboa, Portugal), GDD team (University of Nantes) and SCORE team.


Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone.

The ConcoRDanT project (oct. 2010 – sep. 2013) will investigate a promising new approach that is simple, scales indefinitely, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of meta-data).

The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency.

**8.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2013)**

**Participants:** Gérald Oster [coordinator], Luc André, Claudia Ignat, Pascal Urso, Hien Thi Thu Truong.

- **Partners:** SCORE team (coordinator), ASAP project-team (University of Rennes 1 / INRIA Rennes - Bretagne Atlantique), CASSIS project-team (INRIA Nancy - Grand Est / Nancy University), REGAL project-team (INRIA Paris - Rocquencourt / LIP6) and GDD team (University of Nantes / LINA)

  - **Website:** [http://streams.loria.fr/](http://streams.loria.fr/)

The STREAMS project (nov. 2010 – oct. 2013) proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that eliminate the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services.

The STREAMS project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication technics. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes.

Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issues in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentations.
8.1.3. Wiki 3.0 (2009–2012)
Participants: Claudia Ignat [contact], Luc André, Gérald Oster, Gérôme Canals, Bogdan Flueras.

Partners: XWiki SAS, SCORE team and Mandriva.
Website: http://wiki30.xwikisas.com/

The Wiki 3.0 project (dec. 2009 - juin 2012) is sponsored by the call for projects “Innovative Web” launched by the French Ministry of Economy. The objective of this project is the development of an open-source platform based on XWiki (http://www.xwiki.org) that addresses the three major evolution axes of collaborative Web: real-time collaboration, social interaction integrated into the production (chat, micro-blogging, etc) and on demand scalability (cloud computing). This platform should be competitive with major editors of collaborative Web developed by Google such as Google Wave, IBM and Microsoft.

Participants: Gérôme Canals, Christophe Bouthier.

Website: http://www.projet-coclico.org/

The Coclico project (oct. 2009 – nov. 2011) aims to boost software forges communities by structuring a free and open source ecosystem for which a critical mass of actors exists in France. This reinforcement of communities is a key aspect to leverage issues related to collaborative and distributed software development that business companies are confronted.

In the framework of this project, SCORE Team has been designing and prototyping a demonstrator of the first semantic-based software forge.

8.1.5. ANR Kolflow (2011–2014)
Participant: Gérôme Canals.

Partners: GDD team (University of Nantes / LINA), Loria (Orpailleur and Score Teams), Silex Team (LIRIS, University of Lyon), Edelweiss (INRIA Project).
Website: http://kolflow.univ-nantes.fr/mediawiki/index.php

Kolflow aims at building a social semantic space where humans collaborate with smart agents in order to produce knowledge understandable by humans and machines. Humans are able to understand the actions of smart agents. Smart agents are able to understand actions of humans. Kolflow targets the co-evolution of content and knowledge as the result of interactions of humans and machines.

Participant: François Charoy [contact].

This project is a collaboration between LORIA, the Technological University of Troyes and EDF R&D and is sponsored byt the GIS 3SGS. It aims to start a pluridisciplinary investigation on facilitating crisis management decision-making.

8.2. International Initiatives

8.2.1. INRIA International Partners
François Charoy has been invited by NICTA (National ICT Australia Ltd) in the team of Anna Liu during his stay in Australia to contribute to a project involving BPM and the Cloud. This work is ongoing.

8.2.2. Visits of International Scientists
Victor Grishchenko, post-doc, TU Delft visited our group for two days in February 2011.
Ilaria Liccardi, postdoc in In-situ INRIA team in Paris who finished her Phd thesis at University Southampton visited our group for one day in September 2011.

### 8.2.3. Participation In International Programs

#### 8.2.3.1. GIS Interop Grande Région

**Participants:** Nacer Boudjlida [responsible], Khalid Benali, François Charoy, Olivier Perrin.

Following the INTEROP Network of Excellence, the INTEROP V-Lab (International Virtual Laboratory on interoperability, [http://www.interop-vlab.eu/](http://www.interop-vlab.eu/)) has been officially created in Brussels on March 2007 as an international non-profit making association. In this context, Nancy played also a leading role in the definition of the V-Lab and in the settlement of the so-called INTEROP Grande Region pole, a partner of the INTEROP V-Lab [http://www.interop-grande-region.eu/](http://www.interop-grande-region.eu/). On behalf of UHP Nancy 1, Nacer Boudjlida is the legal representative of this pole in the V-Lab and he is also the head of its management board. The Grande Region pole encompasses University of Namur, University of Paris I La Sorbonne, University Henri Poincaré Nancy 1 and University of Nancy 2 as the founding partners. It is defined as a Scientific (International) Interest Group (Groupement d’Intérêt Scientifique or GIS). Its attachment to the INTEROP V-Lab has been achieved in May 2009. In 2010, three institutions joined the INTEROP Grande Region pole: INSA Lyon, University Lyon III and INSA Strasbourg.

#### 8.2.3.2. Associate Team INRIA VanaWeb

SCORE is involved in the Associate Team INRIA VanaWeb (with UTFSM Valparaíso, Chili) which is interested in autonomous constraint solving concepts and their application to composition problems for Web services. The coordinators of this project are Carlos Castro (UTFSM Valparaiso, Chili) and Christophe Ringeissen (CASSIS).

#### 8.2.3.3. Co-advisory of PhD Thesis

- PhD Thesis of Yongxin Liao (UHP Nancy 1, LORIA and CRAN): started November 2010
- PhD Thesis of Badrina Gasmi with Béjaia University, Algeria: starts January 2011 (Nacer Boudjlida)
- PhD Thesis of Faïza Bouchaib with Béjaia University, Algeria: starts January 2011 (Nacer Boudjlida)
8. Partnerships and Cooperations

8.1. Technology Development Actions (ADT)

8.1.1. DAUM

Participants: Didier Vojtisek, Jean-émile Dartois, François Fouquet, Erwan Daubert, Noël Plouzeau.

DAUM is a Technology Development Action (ADT) by INRIA aiming at providing an integrated platform for distributed dynamically adaptable component based applications. DAUM unites and integrates results and software from the Triskell EPI and the Myriads EPI. More precisely, DAUM extends the Kevoree component framework designed by Triskell with adaptation mechanisms from the SAFDIS framework designed by Myriads.

DAUM will evaluate this integration by designing a full scale system for a tactical assistant for firefighter officers, in collaboration with the firefighters organization of Ille et Vilaine department (2800 firefighters).

Project duration: October 2011 - September 2012
Triskell budget share: One associated engineer shared with the Myriads EPI
Project Coordinator: Noël Plouzeau, Triskell INRIA Project.
Participants: Myriads, Triskell.

8.1.2. KerGekoz

Participants: Didier Vojtisek, Benoit Combemale, Olivier Barais, Clément Guy.

KerGekoz is a Technology Development Action (ADT) by INRIA which goal is to improve the Gecos platform of Cairn EPI by applying MDE technologies from Triskell EPI.

Gecos platform is a compiler infrastructure for the conception System on Chip. Gecos integrates ASIP flow synthesis, automatic parallelisation and hardware synthesis (C to hardware).

This ADT focuses on

- consolidation of existing work,
- improvement of the reusability and maintainability by applying Kermeta MDE technologies.

Triskell EPI mainly works in collaboration with CAIRN to integrate Kermeta to the Gecos platform.

Project duration: 2010-2012
Triskell budget share: One associated engineer shared with CAIRN EPI
Project Coordinator: Steven Derrien, CAIRN INRIA Project.
Participants: CAIRN, TRISKELL.

8.2. Labex

8.2.1. Participation to Comin Labs

Participants: Johann Bourcier, Jean-Marc Jézéquel.
The Triskell project is involved in the Laboratory of excellence Comin Labs (Digital Communications and Informatics for the Future Internet) which involves various academics in French Brittany. The triskell team is mainly involves in the first challenge of Comin Labs : Digital Environment for the Citizen. Johann Bourcier has made an invited presentation about Software Engineering for Smart Cities at the first seminar of this challenge.

Project duration: 2011 - 2021
Participants: CNRS, Inserm, Université de Rennes 1, Université Rennes 2, Université de Bretagne Occidentale, Université de Bretagne Sud, Université de Nantes, Ecoles des Mines de Nantes, INSA de Rennes, ENS Cachan - antenne de Bretagne, Télécom Bretagne, Supelec, INRIA Rennes - Bretagne Atlantique.

8.3. National Initiatives

8.3.1. CNRS GDRs

The Triskell project is connected to the national academic community through a lightweight participation to several CNRS GDR (Groupement de Recherche).

- GDR GPL: Génie de la Programmation et du Logiciel (http://www-lsr.imag.fr/GPL), where Jean-Marc Jézéquel is a member of the scientific committee.
- Action IDM (on Model Driven Engineering) (http://www.actionidm.org), a transversal action (GDRs GPL, ASR and I3S).

The Triskell team also led an "Action Spécifique 2011 du GDR GPL" about software engineering for software intensive heterogeneous systems. Both the AOSTE and Triskell INRIA teams evolved in this project led by Benoit Combemale, and sharing a 5 keuros budget.

8.4. European Initiatives

8.4.1. ERCIM Working Group on Software Evolution

Numerous scientific studies of large-scale software systems have shown that the bulk of the total software-development cost is devoted to software maintenance. This is mainly due to the fact that software systems need to evolve continually to cope with ever-changing software requirements. Today, this is more than ever the case. Nevertheless, existing tools that try to provide support for evolution have many limitations. They are (programming) language dependent, not scalable, difficult to integrate with other tools, and they lack formal foundations.

The main goal of the proposed WG (http://w3.umh.ac.be/evol/) is to identify a set of formally-founded techniques and associated tools to support software developers with the common problems they encounter when evolving large and complex software systems. With this initiative, we plan to become a Virtual European Research and Training Centre on Software Evolution.

Triskell contributes to this working group on the following points:
- re-engineering and reverse engineering
- model-driven software engineering and model transformation
- impact analysis, effort estimation, cost prediction, evolution metrics
- traceability analysis and change propagation
- family and product-line engineering
8.5. International Initiatives

8.5.1. Standardization in Eclipse projects

In 2011, Triskell project participates to the creation of Polarsys (A New Industry Collaboration to Build Open Source Tools for Safety-Critical Software Development) at the Eclipse Foundation to focus on building and maintaining tools for safety critical and embedded system development.

8.5.2. Standardization at OMG

In 2011, Triskell project participates to normalization actions at OMG (http://www.omg.org/). It was involved in the CVL Common Variability Language Response to RFP and was interested in the Analysis and Design group which promotes standard modeling techniques including UML and MOF.

8.5.3. Collaboration with foreign research groups

- University of Zürich Since 2010, Triskell has been working with the Requirements Engineering group on static analysis for model operations. Our work on metamodel footprint recovery has been published at ICSE [37]. We have started an empirical validation of this work with groups of students from Rennes and Zürich.

- University of Luxembourg. Since 2009 Triskell is involved in a collaborative project called SPLIT: Combine Software Product Line and Aspect-Oriented Software Development (with Nicolas Guelfi and Jacques Klein), that is funded by both the PICS program of CNRS and the FNR of Luxembourg. This project is providing the background and the funding for Paul Istoan’s PhD thesis, done in co-tutelle between University of Rennes and University of Luxembourg. As an initial research result, we showed how aspects can be unwoven, based on a precise traceability metamodel dedicated to aspect model weaving.

8.6. European Initiatives

8.6.1. FP7 Projects

8.6.1.1. DIVA

Participants: Jean-Marc Jézéquel, Benoit Baudry, Olivier Barais, Didier Vojitisek, Johann Bourcier, Arnaud Blouin.

The goal of DiVA is to provide a tool-supported methodology for managing dynamic variability of co-existing, co-dependent configurations in adaptive systems that span system administration and platform boundaries. Examples of such adaptive systems are communication infrastructure in rescue operations and mobile entertainment environments. This is addressed through a combination of aspect-oriented and model-driven techniques. DiVA explores how adaptation policies can be captured in the requirements, how aspects can model the variants used to adapt the system, how models can be kept at runtime to drive the adaptation and which validation techniques have to be developed in this context.

The Triskell team participates mainly in the definition of models that can drive the adaptation at runtime. The benefits of keeping models at runtime is to have an abstract view of the adaptation policies and mechanisms on which it is possible to reason (to check invariants, QoS properties, etc.) before actually adapting the running system. One important challenge tackled by Triskell is a mechanism to synchronize the running system with the model that has been adapted according to the changes in the environment. Triskell is also involved in the different validation tasks that occur when building such systems and when adapting these systems at runtime. An important issue for validation at design time is to select a subset of all possible configurations for testing. At design time, it is necessary to validate interactions between variants and to check that invariants on the system are satisfied.
The DiVA project has ended during the year 2011, with the final review in May. This project has been a real success as stated by the assessment of the final review: Excellent progress (the project has fully achieved its objectives and technical goals for the period and has even exceeded expectations).

Project duration: 2007-2011
Triskell budget share: 400 keuros
Project Coordinator: SINTEF
Participants: SINTEF, Uni. Lancaster, INRIA, Pure Systems, Thales IS, CAS.

8.6.1.2. S-CUBE

Title: S-CUBE
Type: COOPERATION (ICT)
Defi: Service & SW architectures, infrastructures and engineering
Instrument: Network of Excellence (NoE)
Duration: October 2008 - March 2012
Coordinator: University of Duisburg-Essen (Germany), Tilburg University (The Netherlands)
Others partners: Tilburg University (The Netherlands), City University London (UK), Consiglio Nazionale delle Ricerche (Italy), Center for Scientific and Technological Research, The French National Institute for Research in Computer Science and Control, Lero - The Irish Software Engineering Research Centre (Ireland), Politecnico di Milano (Italy), MTA SZTAKI - Computer and Automation Research Institute, Vienna University of Technology (Austria), Université Claude Bernard Lyon (France), University of Crete, Universidad Politécnica de Madrid (Spain), University of Stuttgart (Germany)
See also: http://www.s-cube-network.eu/
Abstract: S-Cube, the Software Services and Systems Network, will establish an integrated, multidisciplinary, vibrant research community which will enable Europe to lead the software-services revolution, thereby helping shape the software-service based Internet which is the backbone of our future interactive society.

An integration of research expertise and an intense collaboration of researchers in the field of software services and systems are needed to address the following key problems:

- Research fragmentation: Current research activities are fragmented and each research community (e.g., grid computing or software engineering) concentrates mostly on its own specific techniques, mechanisms and methodologies. As a result the proposed solutions are not aligned with or influenced by activities in related research fields.
- Future Challenges: One challenge, as an example, is to build service-based systems in such a way that they can self-adapt while guaranteeing the expected level of service quality. Such an adaptation can be required due to changes in a system’s environment or in response to predicted and unpredicted problems.

Triskell budget share: 150 keuros

8.6.1.3. NESSoS

Title: NESSoS
Type: COOPERATION (ICT)
Defi: Service & SW architectures, infrastructures and engineering
Instrument: Network of Excellence (NoE)
Duration: October 2010 - October 2014
Coordinator: CNR - Consiglio Nazionale delle Ricerche (Italy)

Others partners: ATOS (Spain), ETH (Switzerland), Katholieke Universiteit Leuven (Belgium), Ludwig-Maximilians-Universitaet Muenchen (Germany), IMDEA (Spain), INRIA (France), University of Duisburg-Essen (Germany), University of Malaga (Spain), University of Trento (Italy), SIEMENS (Germany), SINTEF (Norway)

See also: http://www.nessos-project.eu/

Abstract: The Network of Excellence on Engineering Secure Future Internet Software Services and Systems (NESSoS) aims at constituting and integrating a long lasting research community on engineering secure software-based services and systems. In light of the unique security requirements the Future Internet will expose, new results will be achieved by means of an integrated research, as to improve the necessary assurance level and to address risk and cost during the software development cycle in order to prioritize and manage investments. NESSoS will also impact training and education activities in Europe to grow a new generation of skilled researchers and practitioners in the area. NESSoS will collaborate with industrial stakeholders to improve the industry best practices and support a rapid growth of software-based service systems in the Future Internet.

Three INRIA EPIs are involved in NeSSoS: ARLES, CASSIS and Triskell. Triskell leads the research workpackage on design and architecture for secured future internet applications.

Triskell budget share: 100 keuros

8.6.1.4. CESAR

Title: CESAR
Duration: February 2009 - January 2012
Coordinator: AVL - GmbH (Austria)

See also: http://www.cesarproject.eu/

Abstract: In the context of CESAR, we have participated to the sub-project 3 demonstrator in order to demonstrate the usability of Polychrony as a co-simulation tool within the reference technology platform of the project, to which its open-source release has been integrated. The case-study, implemented in collaboration with Airbus and IRIT, consists of co-modeling the doors management system of an Airbus A350 by merging its architecture description, specified with AADL, with its behavioral description, specified with Simulink.

Triskell brings its model-driven engineering expertise to compositionally assemble, compile and verify heterogeneous specifications (AADL and Simulink). Our case study will cover code generation for real-time simulation and test as well as formal verification both at system-level and in a GALS framework. Based on that case study, we aim at developing further modular code-generation services, real-time simulation, test and performance evaluation, formal verification as well as the validation of the generated concurrent and distributed code.

8.6.1.5. Artemis CHESS

Participants: Noël Plouzeau, Jean-Marc Jézéquel, Jacques Falcou, Viet-Hoa Nguyen.

CHESS is an Artemis project that seeks industrial-quality research solutions to problems of property-preserving component assembly in real-time and dependable embedded systems, and supports the description, verification, and preservation of non-functional properties of software components at the abstract level of component design as well as at the execution level. CHESS develops model-driven solutions, integrates them in component-based execution frameworks, assesses their applicability from the perspective of multiple domains (such as space, railways, telecommunications and automotive), and verifies their performance through the elaboration of industrial use cases.
In 2011 Triskell contributed to the definition and development of the model editor specially built for CHESS on top of Papyrus. Triskell is also a contributor of model transformation tools, by adapting its Kermeta platform to the CHESS process, and by contributing to the interconnection of external tools from industrial tool provider partners. Triskell is also the implementor of a set of constraint checkers, which ensure that designers define models compliant with the CHESS metamodel.

Project duration: 2/2009-4/2012
Triskell budget share: 400 keuros
Project budget: 6 M euros
Project Coordinator: INTECS
Participants: AICAS, Aonix, Atego ENEA, Ericsson, Fraunhofer, FZI, GMV, INRIA (Triskell), INTECS, Thales Alenia Space, THALES Communications, UPM, University of Padua, X/Open

8.6.2. Collaborations in European Programs, except FP7

Program: ITEA2
Project acronym: OPEES
Project title: Open Platform for the Engineering of Embedded Systems
Duration: 2010-2012
Triskell budget share: 150 keuros
Coordinator: OBEO (Gaël Blondelle)
Other partners: AIRBUS, ADACORE, Anyware Technologies, Astrium Satellites, Atos Origin, CEA LIST, CNES, C-S, Dassault, EADS Astrium ST, ENAC, INPT-IRIT, INRIA (AtlannMod/EXPRESSO/TRISKELL), MBDA, OBEO, ONERA, Schneider Electric, Thales, Xipp
Abstract: OPEES is an ITEA2 project which goal is to build a community able to ensure long-term availability of innovative engineering technologies in the domain of software-intensive embedded systems. Its main benefits should be to perpetuate the methods and tools for software development, minimize ownership costs, ensure independence of development platform, integrate, as soon as possible, methodological changes and advances made in academic world, be able to adapt tools to the process instead of the opposite, take into account qualification constraints. In this purpose, OPEES relies on the Eclipse Modeling Project platform (EMF, GEF, GMF, OCL, UML2, ...) and on many available tools such as Kermeta. The participation of Triskell into the OPEES project aims at industrializing both ModMap and Pramana. ModMap is a method and the associated tool to specify and use alignment rules between both homogeneous and heterogeneous languages. Current use is the creation of adapters between aligned languages. Pramana is a model transformation testing framework that makes it possible to synthesize input data (i.e. test models) for model transformations and check that the transformation behaves "correctly" on them.

Program: Marie Curie
Project acronym: Relate
Project title: Trans-European Research Training Network on Engineering and Provisioning of Service-Based Cloud Applications
Duration: February 2011 - January 2015
Triskell budget share: 730 keuros
Coordinator: Karlsruhe Institute of Technology
Other partners: Université de Rennes, IRISA (France); King’s College, (UK); South East European Research Center, SEERC (Greece); Charles University (Czech Republic); CAS Software (Germany); Singular Logic (Greece)
Abstract: The RELATE Initial Training Network aims to establish a network of international academic and industrial partners for a joint research training effort in the area of engineering and provisioning service-based cloud applications. The training is intended to not only shape high-level academic researchers, but also educate next generation experts and innovators in the European software industry. Through an integrative and multidisciplinary research approach, RELATE aims to promote the advancement of the state of the art in the related areas of model-driven engineering and formal methods, service-based mash-ups and application integration, security, performance, and trust in service-based cloud applications, and quality management and business model innovation.

8.7. International Initiatives

8.7.1. INRIA Associate Teams

8.7.1.1. MOCAA

Title: Models Composition, Aspects and Analysis
INRIA principal investigator: Benoît Baudry
International Partner:
Institution: Colorado State University (United States)
Laboratory: Colorado State University, Software Assurance Lab
Duration: 2006 - 2011
See also: http://www.irisa.fr/triskell/matt/

Computer-based systems have been growing in complexity at an exponential rate (roughly 10 fold increase every ten years) for more than 40 years. Like in other sciences, people have been relying more and more on modeling to try to master this complexity. Modeling, in the broadest sense, is indeed the cost-effective use of a simplified representation of an aspect of the world for a specific purpose. Because in software a model has the same nature as the thing it models, this opens the possibility to automatically derive software (and other artifacts such as test cases, performance profiles, or documentation) from its model. This property is well known from any compiler writer (and others), but it was recently be made quite popular with initiatives such as Model Integrated Computing (MIC) or OMG’s Unified Modeling Language (UML) and Model Driven Architecture (MDA), globally known as Model Driven Development (MDD). In this context, models are formally described and can be automatically manipulated for refinement, composition, test case generation, documentation; All those operations are model transformations. This collaboration aims at better understanding how classical software engineering practices (design patterns, validation, methods, IDEs) can be adapted to develop model transformations. Clément Guy worked in collaboration with Prof. Robert B. France (from the software engineering domain), as well as with Prof. Sanjay Rajopadhye (from the optimizing compiler domain) to cross-fertilize both domains. In particular, he was studying the possibility to extend existing model typing to fit the needs of reusing model transformations.

8.7.2. INRIA-CONFAP

Title: Software Testing for Cloud Computing (TAAS)
International Partner:
Universidade Federal do Paraná.
Principal investigator: Gerson Sunyé
Duration: 2011 - 2012
Cloud computing is consolidating as an important paradigm for information technology to provide resources and Internet-based services. In clouds, a large amount of resources (e.g., memory, CPU, disk) is shared between several storage and processing machines or nodes, providing scalable environments. However, building reliable applications for clouds is a difficult task, because developers must face several non-trivial issues, such as: large-scale distribution, fault tolerance, massive data processing, hardware and software heterogeneity. In general, a cloud involves clusters and grids of nodes distributed over the Internet, where each new node shares its resources with the rest of the system, ensuring the scalability of clouds.

Since cloud applications are becoming ubiquitous in society’s critical activities (health, economics, governments, etc.), they must ensure that the eventual failures of nodes do not affect the applications running on it. Large-scale distribution increases risks related to the loss of data because of nodes that fail, delay in computation times because of unreliable distribution strategy, etc. and several algorithms are proposed to increase their tolerance to faults. Thus, quality factors such as: reliability, robustness, availability and performance are essential. The main practice to ensure these factors, as well as the correctness, is the systematic use of testing during the different stages of development. In this project, we propose to adapt and improve the testing architectures previously developed. More precisely, we propose to adapt the existing architecture for cloud environments, to define a testing language that supports the specification of large-scale tests as a whole and to provide both, a generator of test data and a fault injector, to reproduce real cloud environments.

8.7.3. INRIA International Partners
Following the Diva STREP project, we keep an active collaboration with the SINTEF institute. François Fouquet visited SINTEF for 8 weeks. During this visit, we combined the results of Kevoree and the result of the Moderate from SINTEF project to provide a dynamic component model for a micro-controllers based Internet of Things. Indeed, as the Internet of Things promises new ways for humans to interact with computing systems by seamlessly integrating resource constrained devices and traditional computing environment. These new computing environments are highly volatile and force applications to embed self-adaptive behaviors. The contribution of this collaboration is \( \mu \)-Kevoree: a plain C implementation of the Kevoree runtime which can be deployed on poor in resources micro-controllers. Evaluation of memory usage, reliability and performance shows that \( \mu \)-Kevoree is a viable solution with strong benefits over adaptation through dynamic firmware upgrades.

8.7.4. Visits of International Scientists
8.7.4.1. Internships
Hanen HAOUAS (from Mar 2011 until Aug 2011)
Subject: Autonomously Optimizing Service-Based Application Dependability in Smart Building
Institution: Ecole Nationale des Sciences de l’Informatique (Tunisia)

Wuliang Sun
Subject: Discovering the boundaries of a Modelling Space
Institution: Colorado State University (United States)

8.7.5. Participation In International Programs
Thanks to the MoCAA Equipe associée, Clément Guy realized a three-month stay in 2011 at Colorado State University (USA). He worked in collaboration with Prof. Robert B. France (from the software engineering domain), as well as with Prof. Sanjay Rajopadhye (from the optimizing compiler domain) to cross-fertilize both domains. In particular, he was studying the possibility to extend existing model typing to fit the needs of reusing model transformations.
8. Partnerships and Cooperations

8.1. Regional initiatives

Participants: Sylvain Contassot-Vivier, Lucas Nussbaum, Martin Quinson.

8.1.1. CPER MISN, EDGE project

Martin Quinson and Lucas Nussbaum are leading a project of the regional CPER contract, called Expéri-
mentations et calculs distribués à grande échelle (EDGE). A cluster targeting large-scale experiments (144
single-CPU nodes) was bought in 2010 in that context. In 2011, we focused on maintaining and improving
the local Grid’5000 infrastructure, and animating both the research on experimental grids and the research

8.1.2. Other regional grants

Martin Quinson received a grant from the Lorraine Region for two years (2010–2011) to fund our exploratory
work on the possibility to use formal methods such as model-checking to ensure some properties (such as the
lack of deadlocks in any case) of large-scale distributed algorithms. The results of this action are described in
Section 6.2.2.

Sylvain Contassot-Vivier received a grant from the Lorraine Region for two years (2011–2013) to support a
research project over dynamical systems: Dynamical systems: theoretical study and application to parallel
algorithmic for PDEs solving.

8.2. National Initiatives

Participants: Sébastien Badia, Sylvain Contassot-Vivier, Stéphane Genaud, Jens Gustedt, Emmanuel Jean-
voine, Lucas Nussbaum, Martin Quinson, Tinaherinantenaina Rakotoarivelos, Luc Sarzyniec, Stéphane Vialle.

8.2.1. INRIA ADT SimGrid for human beings (2009–2011)

SimGrid for human beings is another INRIA Technological Development Action aiming at providing engi-
neering manpower to the SimGrid project to improve the documentation and to provide stock implementations
of classical algorithms in order to ease its usage by the users. Mehdi Fekari was hired on this project, leading
to the results described in Section 6.2.1.

8.2.2. INRIA ADT Aladdin-G5K (2007–2012?)

ADT Aladdin-G5K (A LArge-scale Distributed Deployable INfrastructure) is an INRIA Technological Devel-
opment Action. It is a management structure for Grid’5000. The goal of Aladdin-G5K is to further develop the
Grid’5000 testbed, and perform system administration and maintenance, as well as additional tasks such as
maintaining the various tutorials. Three engineers from Nancy (two from AlGorille, one from SED) are con-
tributing to Aladdin-G5K: Tina Rakotoarivelos (hired for the ADT), Sébastien Badia (IE CPER) and Benjamin
Dexheimer (SED).

8.2.3. INRIA ADT Kadeploy (2011–2013)

ADT Kadeploy focuses on the Kadeploy software. Kadeploy is a tool for efficient, scalable and reliable cluster
deployment, used on several clusters at INRIA and playing a key role on the Grid’5000 testbed. This ADT
allows us to continue the development of Kadeploy, by improving its performance, its reliability and its
security. We are also adding features that are required in some contexts so that it will be possible to further
distribute Kadeploy and increase its usage. During the ADT, we are collaborating with INRIA platforms that
do not use Kadeploy yet, but have similar needs, as well as with industry. Luc Sarzyniec was hired as young
engineer (IJD) as part of this project.
8.2.4. INRIA ADT Solfege (2011–2013)

ADT Solfege (Services et Outils Logiciels Facilitant l’Experimentation à Grande Échelle) aims at developing or improving a tool suite for experimentation at large scale on testbeds such as Grid’5000. Specifically, we will work on control of a large number of nodes, on data management, and on changing experimental conditions with emulation. Emmanuel Jeanvoine (SED) is delegated in the AlgOrille team for the duration of this project.

8.2.5. INRIA AEN HEMERA

Héméra is an INRIA Large Wingspan project, started in 2010, that aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid’5000 infrastructure, at animating the scientific community around Grid’5000 and at enlarging the Grid’5000 community by helping newcomers to make use of Grid’5000.

Within that project, Martin Quinson, Lucas Nussbaum and Stéphane Genaud lead three working groups, respectively on simulating large-scale facilities, on conducting large and complex experimentations on real platforms, and on designing scientific applications for scalability.

8.2.6. CNRS initiatives, GDR-ASR and specific initiatives

We participate at numerous national initiatives. In the GDR-ASR (architecture, systems, and networks) we take part in RGE action 1. The finances of RGE, led by Stéphane Vialle at SUPÉLEC, are provided by the GDR ASR of CNRS and maintained by AlgOrille. The RGE action organizes three meetings per year, and usually gathers 40-45 people per meeting.

Sylvain Contassot-Vivier decided to stop his animation role in the Embedded Pole in 2011 in order to focus on his research activities. However, he continues his expert analysis for the MEI (Mission d’Expertises Internationales).

8.2.7. ANR USS-SimGrid (2009–2011) and ANR SONGS (2011–2015)

Martin Quinson is the principal investigator of one project of the ARPEGE call from the ANR (french funding agency), called USS-SimGrid (Ultra Scalable Simulation with SimGrid – 2009–2011). It aims at improving the scalability of the SimGrid simulator to allow its use in Peer-to-Peer research in addition of Grid Computing research. The challenges to tackle include models being more scalable at the eventual price of slightly reduced accuracy, automatic instantiation of these models, tools to conduct experiments campaigns, as well as a partial parallelization of the simulator tool.

Martin Quinson is also the principal investigator of a project of the INFRA call from the ANR, called SONGS (Simulation Of Next Generation Systems – 2012-2016). It aims at increasing the target community of SimGrid to two new research domains, namely Clouds (restricted to the Infrastructure as a Service context) and High Performance Computing. We will develop new models and interfaces to enable the use of SimGrid for generic and specialized researches in these domains.

As project leading team, we are involved in most parts of these projects, which allows the improvement of our tool even further and set it as the reference in its domain (see Sections 6.2.1 through 6.2.5).

8.2.8. Bilateral Collaborations

With Arnaud Giersch from the University of Franche-Comté, we work on the design and implementation of a decentralized load-balancing algorithm, based on asynchronous diffusion, that works with dynamical networks. In such a context, we consider that the nodes are always available but the links between them may be intermittent. According to the load-balancing task, this is a rather difficult context of use.

Lucas Nussbaum and Martin Quinson are participating to a research effort lead by F. Suter from the Computing Center of IN2P3. This project is jointly funded by CNRS’ Institut des Grilles and INRIA’s ADT Aladdin in a program that aims at bridging the production grids and distributed systems research communities. The overall goal of the project is to explore ways to enable the scientific study and the evaluation of improvements in the context of the gLite grid middleware. New results in this project are described in Section 6.2.7.

1 Réseau Grand Est
8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

8.3.1.1. Energy efficiency in large scale distributed systems.

Stéphane Vialle, Sylvain Contassot-Vivier and Thomas Jost participate to the COST (European Cooperation in the field of Scientific and Technical Research) Action IC0804 (Energy efficiency in large scale distributed systems), started in 2010.

Our designs of PDE solvers using synchronous and asynchronous distributed algorithms, implemented and experimented both on CPU and GPU clusters, have led to the design of some performance models. Main results have been introduced in 2011 in a book chapter [26].

Moreover, in 2011 we achieved a first design of a software architecture to build self-configurating applications, in order to track a user instruction (to run fast, or to run consuming low energy, or to run achieving a compromise) in an execution environment imposing some energy constraints on application runs. This software architecture has been introduced to the COST IC0804 meeting of May 19-20, 2011 in Budapest. This software architecture is still under investigation, and its implementation is planned for 2012.

Finally, in 2011 we have achieved the implementation of an American option pricer on our GPU clusters, and we have run many experiments to measure its speedup and energy gain. A second version, more efficient, including an optimized 4D to 2D reduction on each GPU node, is under experimentation at the end of 2011. These research are conducted in collaboration with some colleagues of University of Marne-la-Vallée.

8.4. International Initiatives

8.4.1. Bilateral Collaborations

This year, we formalized the collaboration on the modeling of storage elements that we had with the team PH-ADP-DDM lead by V. Garone at CERN and with F. Suter from the Computing Center of IN2P3. This work will now be done in the context of the SONGS project, that got funded by the ANR this year.

We also started working with IBM France and IBM Haifa on the modeling of Cloud jobs and resources, also in the loose context of the SONGS project. This collaboration should take some more momentum in the next few years.

Finally, we are working with the team of Jan Broeckhove (Professor at university of Antwerp, Belgium), in a project funded (2010-2011) by the PHC Tournesol program. This project aims at exploring Large-Scale Discrete-Event Simulation of Distributed Systems.

We collaborate with Henri Casanova of University of Hawai‘i at Manoa on the SimGrid framework, as detailed in 5.4. The result obtained this year on the simulation of MPI applications are detailed in Section 6.2.4.

We also collaborate with David Elizondo from the University of Leicester in Great Britain on the problem of linear separability determination. Our current work deals with the design and implementation of a fast algorithm to determine whether or not two or more sets of points in $\mathbb{R}^n$ are linearly separable. We have already obtained an interesting result in 2D whose publication is in preparation. The next step is the extension to $n > 2$ dimensions.

8.4.2. INRIA International Partners

8.4.2.1. Internships

Matías Ezequiel Vara

Subject: Ordered Read-Write Locks on Multicore Architectures

Institution: Universidad Nacional de La Plata (Argentina)
CEPAGE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Projet Région Aquitaine : Performance modeling for heterogeneous platforms

Participants: Lionel Eyraud-Dubois, Olivier Beaumont, Nicolas Bonichon.

This project in coordination with the INRIA project RUNTIME aims at designing models for communication times on heterogeneous platforms of two types: high-scale platforms for volunteer computing, and high performance NUMA machines. The goal is to reach a compromise between precision and algorithmic tractability.

8.2. National Initiatives

8.2.1. ANR "programme blanc" Aladdin (2007-2011)


The scientific objectives of ALADDIN are to solve what are identified as the most challenging problems in the theory of interaction networks. The ALADDIN project is thus an opportunity to create a full continuum from fundamental research to applications in coordination with both INRIA projects CEPAGE and GANG.

8.2.2. ANR programme "défis": project IDEA (2009-2012)

Participant: Ralf Klasing.

The goal of this ANR is the study of identifying codes in evolving graphs. Ralf Klasing is the overall leader of the project.

8.2.3. ANR “USS SimGrid” (2008-2011)

Participants: Olivier Beaumont, Nicolas Bonichon, Lionel Eyraud-Dubois.

The objectives of USS SimGrid is to create a simulation framework that will answer (i) the need for simulation scalability arising in the HPC community; (ii) the need for simulation accuracy arising in distributed computing. The Cepage team will be involved in the development of tools to provide realistic model instantiations.

The project involves the following INRIA and CNRS teams: AlGorille, ASAP, Cepage, Graal, MESCAL, SysCom, CC IN2P3.

8.2.4. ANR "programme blanc" Displexity (2012-2015)

Participants: Cyril Gavoille, David Ilcinkas, Ralf Klasing, Adrian Kosowski.

The main goal of DISPLEXITY (for DIstributed computing: computability and ComPLEXITY) is to establish the scientific foundations for building up a consistent theory of computability and complexity for distributed computing. The other partners are from IRISA (Rennes) and LIAFA (Paris).

8.2.5. ANR “SONGS” (2012-2016)

Participants: Olivier Beaumont, Nicolas Bonichon, Lionel Eyraud-Dubois.
SONGS (Simulation of Next Generation Systems) is a follow-up to the USS-SimGrid project. Its objective is to design a unified and open simulation framework for performance evaluation of next generation systems: Grids, Peer-to-Peer systems, Clouds and HPC systems. Cepage will be involved in the Peer-to-peer and Cloud use cases by designing and testing efficient allocation policies. Cepage will also take part in the design of efficient and realistic models and their validation.

The project involves the following INRIA and CNRS teams: AlGorille, ASCOLA, AVALON, CEPAGE, HiePACS, ICPS, MASCOTTE, MODALIS, MESCAL, RUNTIME, CC IN2P3.

8.3. European Initiatives

8.3.1. FP7 Projet

8.3.1.1. EULER

Title: EULER (Experimental UpdateLess Evolutive Routing)
Type: COOPERATION (ICT)
Defi: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2010 - September 2013
Coordinator: ALCATEL-LUCENT (Belgium)

Others partners:
- Alcatel-Lucent Bell, Antwerpen, Belgium
- 3 projects from INRIA: CEPAGE, GANG and MASCOTTE, France
- Interdisciplinary Institute for Broadband Technology (IBBT), Belgium
- Laboratoire d’Informatique de Paris 6 (LIP6), Université Pierre Marie Curie (UPMC), France
- Department of Mathematical Engineering (INMA) Université Catholique de Louvain, Belgium
- RACTI, Research Academic Computer Technology Institute University of Patras, Greece
- CAT, Catalan Consortium: Universitat Politècnica de Catalunya, Barcelona and University of...
- Girona, Spain

See also: http://www-sop.inria.fr/mascotte/EULER/wiki/

Abstract: The title of this study is "Dynamic Compact Routing Scheme". The aim of this projet is to develop new routing schemes achieving better performances than current BGP protocols. The problems faced by the inter-domain routing protocol of the Internet are numerous:

1. The underlying network is dynamic: many observations of bad configurations show the instability of BGP;
2. BGP does not scale well: the convergence time toward a legal configuration is too long, the size of routing tables is proportional to the number of nodes of network (the network size is multiplied by 1.25 each year);
3. The impact of the policies is so important that the many packets can oscillated between two Autonomous Systems.
In this collaboration, we mainly focus on the scalability properties that a new routing protocol should guarantee. The main measures are the size of the local routing tables, and the time (or message complexity) to update or to generate such tables. The design of schemes achieving sub-linear space per routers, say in \(n\) where \(n\) is the number of AS routers, is the main challenge. The target networks are AS-network like with more than 100,000 nodes. This project, in collaboration with the MASCOTE INRIA-project in Nice Sophia-Antipolis, makes the use of simulation, developed at both sites.

8.3.1.2. **Royal Society Grant with the University of Liverpool**

**Participants:** Nicolas Hanusse, David Ilcinkas, Ralf Klasing, Adrian Kosowski.

International Joint Project, 2011-2013, entitled “SEarch, RENdezvous and Explore (SERENE)”, on foundations of mobile agent computing, in collaboration with the Department of Computer Science, University of Liverpool. Funded by the Royal Society, U.K. Principal investigator on the UK side: Leszek Gasieniec. Ralf Klasing is the principal investigator on the French side.

8.3.1.3. **European COST Action ComplexHPC (2009-2012)**

**Participants:** Olivier Beaumont, Nicolas Bonichon, Lionel Eyraud-Dubois.

The goal of ComplexHPC is to coordinate European groups working on the use of heterogeneous and hierarchical systems for HPC as well as the development of collaborative activities among the involved research groups, to tackle the problem at every level (from cores to large-scale environments) and to provide new integrated solutions for large-scale computing for future platforms (see [http://complexhpc.org/index.php](http://complexhpc.org/index.php)).

8.3.1.4. **Emergent Project with the University of Perugia**

**Participants:** David Ilcinkas, Ralf Klasing, Adrian Kosowski.

International Joint Project, 2011, on foundations of mobile agent computing, in collaboration with the Department of Computer Science, University of Perugia, Italy. Principal investigator on the Italian side: Alfredo Navarra. Ralf Klasing is the principal investigator on the French side.

8.3.2. **Major European Organizations with which you have followed Collaborations**

Marcin Markiewicz, University of Gdansk (Poland)

Quantum distributed computing models and simulation of quantum correlations using classical information channels.

Ashley Deflumere and Alexey Lastovetsky, University College Dublin (Ireland)

Design of efficient distribution scheme for linear algebra kernels on modern heterogeneous architectures.

Gabriele Di Stefano, University of L’Aquila (Italy)

Mobile agent coordination in distributed computing.

Miroslaw Korzeniowski, Technical University of Wroclaw (Poland)

Design of distributed and randomized algorithms for P2P networks.

Leszek Gasieniec, University of Liverpool (UK)

Design of distributed algorithms for mobile agents in exploration and patrolling tasks.

Guido Proetti, University of L’Aquila (Italy)
Davide Bilo, University of Sassari (Italy)
Network discovery and verification. ation techniques for chosen task scheduling problems.

Tobias Mömke, KTH Royal Institute of Technology, Stockholm (Sweden)
Centralized approximation techniques for chosen task scheduling problems.

Thomas Sauerwald, Max-Planck-Institut für Informatik, Saarbrücken (Germany)
Propp machine, Multiple random walks.

8.4. International Initiatives

8.4.1. Visits of International Scientists

8.4.1.1. Visits to Cepage Members

- Ashley Deflumere, University College Dublin, 04/12 - 17/12/2011
- Alfredo Navarra, University of Perugia, Italy, 11/12-16/12/2011
- Ljubomir Perkovic, De Paul University Chicago, (September 2011–)
- Miroslaw Korzeniowski, Technical University of Wroclaw, (23/08- 28/08/2011)
- Marcin Markiewicz, University of Gdansk, 10/05-17/05/2011
- Miroslaw Korzeniowski, Technical University of Wroclaw, (06/07- 22/07/2011)
- Tobias Mömke, KTH Royal Institute of Technology, Stockholm, Sweden, 17/07 - 31/07/2011
- Leszek Gasieniec, University of Liverpool, UK, 10/09-17/09/2011
- Alfredo Navarra, University of Perugia, Italy, 10/09-17/09/2011
- Gabriele Di Stefano, University of L’Aquila, Italy, 10/09-17/09/2011
- Davide Bilo, University of Sassari, Italy, 27/11-07/12/2011

8.4.1.2. Visits of Cepage Members

- Microsoft Research Montainview, CA, invited research visit by I. Abhram (C. Gavoille, 10 days, April 2011)
- Weizmann Institute, research visit with D. Peleg (Q. Godfroy, one week, November 2011)
- Universidad Adolfo Ibanez, Chile, research visit as part of joint grant (A. Kosowski, 16/01-03/02/2011)
- University of Gdansk, Poland, research visit (A. Kosowski, 07/02-14/02/2011)
- University of Liverpool, UK, research visit as part of joint grant (A. Kosowski, 15/02-27/02/2011)
- Carleton University, Canada, invited research visit (A. Kosowski, 08/11-20/11/2011)

8.4.1.3. Internship

8.4.1.4. Major Non-European Organizations with which you have followed Collaborations

- Weizmann Institute (IL), David Peleg
- MIT (USA), Christian Sommer
- MicroSoft Research, Montainview (USA), Ittai Abraham

8.4.2. Participation In International Programs

8.4.2.1. Foreign partner of ANILLO grant at Universidad Adolfo Ibanez

Participant: Adrian Kosowski.
Foreign partner of the project entitled “Mathematical modeling for industrial and management science” funded by the Government of Chile through its CONICYT program (ANILLO for Science and Technology).

This grant involves research into mathematical programming models, network dynamics and graph models, stochastic models, as well as other interdisciplinary projects. The joint work performed during the research collaboration lead to new results on the computational power of interconnection networks in distributed computing, and to new algorithms for compact routing in special graph classes.

8.4.2.2. Foreign partner of Comunidad de Madrid grant

**Participants:** Olivier Beaumont, Lionel Eyraud-Dubois.

Foreign partner of the project entitled “CLOUDS: Cloud Computing para Servicios Escalables, Confiables y Ubicuos” (2010-2013) funded by the Comunidad de Madrid.
GRAAL Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Projet “Calcul Hautes Performances et Informatique Distribuée”

Participants: Yves Caniou, Eddy Caron, Frédéric Desprez, Christian Pérez.

E. Caron leads (with C. Prudhomme from LJK, Grenoble) the “Calcul Hautes Performances et Informatique Distribuée” project of the cluster “Informatique, Signal, Logiciels Embarrqués”. Together with several research laboratories from the Rhône-Alpes region, we initiate collaborations between application researchers and distributed computing experts.

7.2. National Initiatives

7.2.1. ANR White Project Rescue, 4 years, 2010-2014

Participants: Anne Benoit, Loris Marchal, Yves Robert, Frédéric Vivien, Dounia Zaidouni.

The ANR White Project RESCUE was launched in November 2010, for a duration of 48 months. It gathers three INRIA partners (Graal, Grand-Large and Hiepacs) and is led by Graal. The main objective of the project is to develop new algorithmic techniques and software tools to solve the exascale resilience problem. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel checkpoint protocols. The second thrust entails the development of novel execution models, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel parallel algorithms for scientific numerical kernels.

7.2.2. ANR grant SPADES, 3 years, 08-ANR-SEGI-025, 2009-2012

Participants: Eddy Caron, Florent Chuffart, Frédéric Desprez, Haiwu He.

Today’s emergence of Petascale architectures and evolutions of both research grids and computational grids increase a lot the number of potential resources. However, existing infrastructures and access rules do not allow to fully take advantage of these resources. One key idea of the SPADES project is to propose a non-intrusive but highly dynamic environment able to take advantage of the available resources without disturbing their native use. In other words, the SPADES vision is to adapt the desktop grid paradigm by replacing users at the edge of the Internet by volatile resources. These volatile resources are in fact submitted via batch schedulers to reservation mechanisms which are limited in time or susceptible to preemption (best-effort mode).

One of the priorities of SPADES is to support platforms at a very large scale. Petascale environments are therefore particularly considered. Nevertheless, these next-generation architectures still suffer from a lack of expertise for an accurate and relevant use. One of the SPADES goal is to show how to take advantage of the power of such architectures. Another challenge of SPADES is to provide a software solution for a service discovery system able to face a highly dynamic platform. This system will be deployed over volatile nodes and thus must tolerate failures. SPADES will propose solutions for the management of distributed schedulers in Desktop Computing environments, coping with a co-scheduling framework.

7.2.3. ANR grant: COOP (Multi Level Cooperative Resource Management), 3 years, ANR-09-COSI-001-01, 2009-2012

Participants: Frédéric Desprez, Cristian Klein, Christian Pérez.
The main goals of this project are to set up such a cooperation as general as possible with respect to programming models and resource management systems and to develop algorithms for efficient resource selection. In particular, the project targets the SALOME platform and GRID-TLSE expert-site (http://gridtlse.org/) as an example of programming models, and Marcel/PadicoTM, DIET and XtreemOS as examples of multithread scheduler/communication manager, grid middleware and distributed operating systems.

The project is led by Christian Pérez.

7.2.4. ANR JCJC: Clouds@Home (Cloud Computing over Unreliable, Shared Resources), 4 years, ANR-09-JCJC-0056-01, 2009-2012

Participants: Gilles Fedak, Bing Tang.

Recently, a new vision of cloud computing has emerged where the complexity of an IT infrastructure is completely hidden from its users. At the same time, cloud computing platforms provide massive scalability, 99.999% reliability, and speedy performance at relatively low costs for complex applications and services. This project, lead by D. Kondo from INRIA MESCAL investigates the use of cloud computing for large-scale and demanding applications and services over unreliable resources. In particular, we target volunteered resources distributed over the Internet. In this project, G. Fedak leads the Data management task (WP3).

7.2.5. ANR ARPEGE MapReduce (Scalable data management for Map-Reduce-based data-intensive applications on cloud and hybrid infrastructures), 4 years, ANR-09-JCJC-0056-01, 2010-2013

Participants: Julien Bigot, Frédéric Desprez, Gilles Fedak, Sylvain Gault, Christian Pérez, Anthony Simonet.

MapReduce is a parallel programming paradigm successfully used by large Internet service providers to perform computations on massive amounts of data. After being strongly promoted by Google, it has also been implemented by the open source community through the Hadoop project, maintained by the Apache Foundation and supported by Yahoo! and even by Google itself. This model is currently getting more and more popular as a solution for rapid implementation of distributed data-intensive applications. The key strength of the Map-Reduce model is its inherently high degree of potential parallelism.

In this project, the GRAAL team participates to several work packages which address key issues such as efficient scheduling of several MR applications, integration using components on large infrastructures, security and dependability, MapReduce for Desktop Grid.

7.2.6. ADT MUMPS, 3 years, 2009-2012

Participants: Maurice Brémond, Guillaume Joslin, Jean-Yves L’Excellent.

ADT-MUMPS is an action of technological development funded by INRIA. Tools for experimentation, validation, and performance study of MUMPS are being developed; one of the goals was also to efficiently use and benefit from the common porting, testing and compilation cluster from INRIA, pipol.

7.2.7. ADT ALADDIN

Participants: Frédéric Desprez, Matthieu Imbert, Christian Pérez.

ALADDIN is an INRIA action of technological development for “A LArge-scale DIstributed and Deployable INfrastructure” which aim is to manage the Grid’5000 experimental platform. Frédéric Desprez is leading this project (with David Margery from Rennes as the Technical Director).

7.2.8. ADT BitDew, 2 years, 2010-2012

Participants: Gilles Fedak, José Saray.

ADT BitDew is an INRIA support action of technological development for the BitDew middleware. Objectives are several fold : i/ provide documentation and education material for end-users, ii/ improve software quality and support, iii/ develop new features allowing the management of Cloud and Grid resources. The ADT BitDew, leaded by G. Fedak, allows to recruit a young engineer for 24 months.
7.2.9. **HEMERA Large Wingspan Inria Project, 2010-2013**

**Participants:** Daniel Balouek, Christian Pérez, Frédéric Vivien.

Hemera deals with the scientific animation of the Grid’5000 community. It aims at making progress in the understanding and management of large scale infrastructure by leveraging competences distributed in various French teams. Hemera contains several scientific challenges and working groups. Christian Pérez is leading the project that involves more than 20 teams located in 9 cities of France.

C. Pérez is leading the project and D. Balouek is managing scientific challenges on Grid’5000.

7.2.10. **Action Interfaces Recherche en grille – Grilles de production. Institut des Grilles du CNRS – Action Aladdin INRIA**

**Participant:** Yves Caniou.

This action addresses economical issues concerning green-ness in scientific and production grids. Different issues are addressed like the confrontation of energy models in place in experimental grids versus the operational realities in production grids, the study of new energy prediction models related to real measures of energy consumption in production grids, and the design of energy aware scheduling heuristics.

7.2.11. **FastExpand: Regional Grant**

**Participant:** Eddy Caron.

The FastExpand start’up asked to take benefit of the knowledge of the GRAAL research team on distributed systems and middleware systems. The aim of this company is to create games of new generation using a new distributed architecture. E. Caron and F. Desprez participate to this action. In 2011, a distributed prototype to work on burst requests from the MMORPG (Massively Multiplayer Online Role Playing Games) was successfully designed. The required performance has been reached.

7.3. **European Initiatives**

7.3.1. **FP7 Projects**

7.3.1.1. **BonFIRE**

- **Title:** Building service testbeds on FIRE BonFIRE
- **Type:** COOPERATION (ICT)
- **Defi:** Future Internet Experimental Facility and Experimentally-driven Research
- **Instrument:** Integrated Project (IP)
- **Duration:** June 2010 - November 2013
- **Coordinator:** ATOS Origin (Spain)
- **Others partners:** ATOS (coordinator, Spain), EPCC (UK), SAP (Germany), USTUTT (Germany), FRAUNHOFER (Germany), IBBT (Belgium), UCM (Spain), I2CAT (Spain), HP (UK), 451G (UK), TUB (Germany), IT-Innovation (UK), INRIA.

See also: [http://www.bonfire-project.eu/](http://www.bonfire-project.eu/)

Abstract: BonFIRE will design, build and operate a multi-site Cloud prototype FIRE facility to support research across applications, services and systems at all stages of the R&D lifecycle, targeting the services research community on Future Internet. The BonFIRE vision is to give researchers in these areas access to a facility that supports large scale multi-disciplinary experimentation of their systems and applications addressing all aspects of research across all layers. We will develop and support a framework which allows service-based computing practitioners to experiment with their latest ideas in service orientation and distributed computing. We have elaborated 3 usage scenarios. Our overall goal is to encourage new communities of experimenters to take advantage of the opportunities offered by the FIRE infrastructure to guide the development of the Future Internet from
a service-based applications standpoint. The facility will be demand-driven, open, standards-based and dynamic. It will provide additional functionality to that currently available. It will adopt the principle of "open coordinated federation of testbeds" and will provide innovative usage scenarios. We will stimulate research through 2 open calls to establish a methodology of experimentally driven research. The facility shall be open not only to the researchers selected and funded by BonFIRE through the open calls but also to a wider researcher community in order to encourage the usage and involvement of a significant number of end users.

7.3.1.2. EDGI

Title: EDGI: European Desktop Grid Initiative
Type: CAPACITIES (Infrastructures)
Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS (CPCSA)
Duration: June 2010 - May 2012
Coordinator: MTA SZTAKI (Hungary)
Others partners: CIEMAT, ES; Fundecyt, ES; University of Westminster, UK; Cardiff University, UK; University of Coimbra, PT; CNRS, FR, AlmerGrid, NL
See also: http://edgi-project.eu/
Abstract: The project EDGI will develop middleware that consolidates the results achieved in the EDGeS project concerning the extension of Service Grids with Desktop Grids in order to support EGI and NGI user communities that are heavy users of DCIs and require extremely large number of CPUs and cores. EDGI will go beyond existing DCIs that are typically cluster Grids and supercomputer Grids, and will extend them with public and institutional Desktop Grids and Clouds. EDGI will integrate software components of ARC, gLite, Unicore, BOINC, XWHEP, 3G Bridge, and Cloud middleware such as OpenNebula and Eucalyptus into SG→DG→Cloud platforms for service provision and as a result EDGI will extend ARC, gLite and Unicore Grids with volunteer and institutional DG systems. Our partners in EDGI are: SZTAKI, INRIA, CIEMAT, Fundecyt, University of Westminster, Cardiff University, University of Coimbra. In this project, G. Fedak is the INRIA representative and lead the JRA2 work package which is responsible for providing QoS to Desktop Grids.

7.3.1.3. PRACE 2IP

Title: PRACE – Second Implementation Phase Project
Type: Integrated Infrastructure Initiative Project (I3)
Instrument: Combination of Collaborative projects and Coordination and support action
Duration: September 2011 - August 2013
Coordinator: Thomas Lippert (Germany)
Others partners: Jülich GmbH, GCS, GENCI, EPSRC, BSC, CSC, ETHZ, NCF, JKU, Vetenskapsrådet, CINECA, PSNC, SIGMA, GRNET, UC-LCA, NUI Galway, UYBHM, CaSToRC, NCSA, Technical Univ. of Ostrava, IPB, NIIF
See also: http://prace-ri.eu/
Abstract: The purpose of the PRACE RI is to provide a sustainable high-quality infrastructure for Europe that can meet the most demanding needs of European HPC user communities through the provision of user access to the most powerful HPC systems available worldwide at any given time. In tandem with access to Tier-0 systems, the PRACE-2IP project will foster the coordination between national HPC resources (Tier-1 systems) to best meet the needs of the European HPC user community. To ensure that European scientific and engineering communities have access to leading edge supercomputers in the future, the PRACE-2IP project evaluates novel architectures, technologies, systems, and software. Optimizing and scaling of application for Tier-0 and Tier-1 systems is a core service of PRACE.
7.3.2. Collaborations in European Programs, except FP7

Program: ERCIM WG
Project acronym: CoreGRID
Project title: ERCIM WG CoreGRID
Coordinator: Frédéric Desprez
Other partners: Many partners from several european countries
Abstract: Following the success of the NoE CoreGRID, an ERCIM WG was started in 2009, leaded by F. Desprez. This working group gathers 31 research teams from all over Europe working on Grids, service oriented architectures and Clouds.
A workshop on Grids, Clouds, and P2P Computing was organized in conjunction with EuroPAR 2011, Bordeaux, August, 2011.

7.4. International Initiatives

7.4.1. INRIA International Partners
Henri Casanova, Information and Computer Sciences Department, University of Hawai`i at Mānoa: application resilience on failure-prone platforms, scheduling multiple workflows over grids.
Jack Dongarra, Computer Science Department, University of Tennessee Knoxville: linear algebra kernels for multicore and GPGPUs, exscale algorithms.
Rami Melhem, Computer Science Department, University of Pittsburgh: energy-aware scheduling algorithms.

7.4.2. Visits of International Scientists

7.4.2.1. Internship
• Lu LU, Huazong University of Science and Technology, 6 months internship

7.4.3. Participation In International Programs

7.4.3.1. INRIA-UIUC-NCSA Joint Laboratory for Petascale Computing
Participants: Julien Bigot, Mathias Jacquelin, Cristian Klein, Loris Marchal, Christian Pérez, Yves Robert, Frédéric Vivien.

The Joint Laboratory for Petascale Computing focuses on software challenges found in complex high-performance computers. The Joint Laboratory is based at the University of Illinois at Urbana-Champaign and includes researchers from the French national computer science institute called INRIA, Illinois’ Center for Extreme-Scale Computation, and the National Center for Supercomputing Applications. Much of the Joint Laboratory’s work will focus on algorithms and software that will run on Blue Waters and other petascale computers.

7.4.3.2. French-Japanese ANR-JST FP3C project

This project federates INRIA Saclay, CNRS IRIT, CEA Saclay, INRIA Bordeaux, CNRS Prism, INRIA Rennes on the French side and the University of Tokyo, The University of Tsukuba, Titech, Kyoto University on the Japanese side. The main goal of the project is to develop a programming chain and associated runtime systems which will allow scientific end-users to efficiently execute their applications on post-petascale, highly hierarchical computing platforms making use of multi-core processors and accelerators.
Y. Caniou and J.-Y. L’Excellent participate to this project.
7.4.3.3. CNRS délégation of Yves Caniou (2010-2011)
Yves Caniou obtained a CNRS delegation for the scholar year 2009-2010, and this delegation has been prolonged for the scholar year 2010-2011. He worked until 2011/09 at the CNRS Japan-French Laboratory in Informatics (JFLI) supervised by Philippe Codognet. The JFLI is located in Tokyo, Japan, and is composed of the Tokyo University, Université Pierre et Marie-Curie (UPMC), the Keio University, the CNRS, the NII partnership.

7.4.3.4. CADENCED (2009-2012)
The CADENCED project corresponds joint research activities between KAUST (King Abdullah University of Science and Technology), IFPEN (Institut Français du Pétrole Energie Nouvelle) and its partners, Ecole Normale Supérieure de Lyon (ENS-Lyon) and National Center for Scientific Research (CNRS). ENS de Lyon is funded to a total of 1000k€ supporting 6 years of post-doc salary, 2 years of senior researchers and the afferent side-costs. The CADENCED project will address designing a new catalyst for chemistry/petro-chemistry. In view of the extensive use of computing required, a challenging subproject on accelerated high performance computing (HPC) applied to catalysis is also proposed. This latest project deals with porting the VASP software to GPU and developing new QM/MM approaches.
7. Partnerships and Cooperations

7.1. Regional, National and International Actions

7.1.1. Activities starting in 2009

- Franck Cappello, Co-Director of the INRIA - Illinois Joint Laboratory on PetaScale Computing, since 2009

7.1.2. Other activities

- CALIFHA project (DIM Digiteo 2011): CALculations of Incompressible Fluid flows on Heterogeneous Architectures. Funding for a PhD student. Collaboration with LIMSI/CNRS. Participants: Marc Baboulin (Principal Investigator), Joel Falcou, Yann Fraigneau (LIMSI), Laura Grigori, Olivier Le Maître (LIMSI), Laurent Martin Witkowski (LIMSI).

- ANR SPADES Coordinated by LIP-ENS Lyon. (Sylvain Peyronnet, Franck Cappello, Ala Rezmerita)

- Défi ANR SECSI Participant to this challenge. From September 2008 to August 2010. Managed by the SAIC. (Thomas Hérault, Sylvain Peyronnet, Sébastien Tixeuil)

- ANR Cosinus project MIDAS - Microwave Data Analysis for petaScale computers December 2009 - December 2012 (http://www.apc.univ-paris7.fr/APC_CS/Recherche/Adamis/MIDAS09/index.html). Collaboration with APC, University Paris 7 and Lawrence Berkeley Laboratory. This is an interdisciplinary project devised to bring together cosmologists, computational physicists, computer scientists and applied mathematicians to face the challenge of the tremendous volume of data as anticipated from current and forthcoming Cosmic Microwave Background (CMB) experiments. (Laura Grigori, Coordinator for INRIA Saclay, F. Cappello, J. Falcou, T. Hérault, S. Peyronnet)

- ANR Cosinus project PETALh - PETascale ALgorithms for preconditioning for scientific applications January 2011- December 2012. Collaboration with Laboratoire Lions - Universite 6, IFP, INRIA Bordeaux and CEA, UC Berkeley and Argonne. The goal is to investigate preconditioning techniques on multicore architectures and apply them on real world applications from IFP, CEA and Argonne. (Laura Grigori, Principal Investigator)

- Digiteo DIM-08 project X-Scale-NL – Scheduling and numerical libraries enabling scientific applications on petascale machines 2008-2011. Funding for a Phd student and travel (114000 euros). Participants: Laura Grigori (Principal Investigator), F. Cappello (INRIA), T. Hérault, S. Peyronnet (LRI) and two foreign collaborators: J. Demmel from UC Berkeley and J. Darbon from UC Los Angeles.

- INRIA Associated Team "F-J Grid" with University of Tsukuba, head: Franck Cappello

- INRIA funding, MPI-V, collaboration with UTK, LALN and ANL, head: Franck Cappello

- ANR CIS Project FF2A3, 3 years (2007 - 2010), PI F. Hecht, subproject head L. Grigori

- HipCal, ANR CIS, 3 years (2006-2009), Franck Cappello

7.2. International Initiatives

7.2.1. INRIA Associate Teams
• **INRIA associated team COALA with Prof. J. Demmel, UC Berkeley, 2010-2013.** This project is proposed in the context of developing Communication Optimal Algorithms for Linear Algebra. The funding covers visits in both directions. The following visits of PhD students took place in the context of this associated team:
  
  – Visit of A. Khabou to UC Berkeley (August 2011, for 1 month).
  
  – Visit of E. Carson and N. Knight from UC Berkeley to INRIA Saclay (July 2011, for 1 month).
  
  – Visit of S. Donfack and A. Khabou to UC Berkeley (November 2010, for 1 month).

### 7.2.2. Visits of International Scientists

• Visit of E. Carson and N. Knight from UC Berkeley (July 2011, for 1 month, July 2011).

• Visit of Gary Howell from North Carolina State University, September 2011.
8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. NOSSI: New platform for parallel, hybrid quantum/classical simulations

Participants: Olivier Coulaud, Aurélien Esnard.
Grant: ANR 2007 – CIS
Partners: CPMOH (Bordeaux, UMR 5098), DRIMM, IMPREM (leader of the project, Pau, UMR 5254), Institut Néel ( Grenoble, UPR2940)
Overview: Physicists, chemists and computer scientists join forces in this project to further design high performance numerical simulation of materials, by developing and deploying a new platform for parallel, hybrid quantum/classical simulations. The platform synthesizes established functions and performances of two major European codes, SIESTA and DL-POLY, with new techniques for the calculation of the excited states of materials, and a graphical user interface allowing steering, visualization and analysis of running, complex, parallel computer simulations.

The platform couples a novel, fast TDDFT (Time dependent density functional theory) route for calculating electronic spectra with electronic structure and molecular dynamics methods particularly well suited to simulation of the solid state and interfaces.

The software will be capable of calculating the electronic spectra of localized excited states in solids and at interfaces. Applications of the platform include hybrid organic-inorganic materials for sustainable development, such as photovoltaic materials, bio- and environmental sensors, photocatalytic decontamination of indoor air and stable, non-toxic pigments.

Web: http://nossi.gforge.inria.fr/index.html

8.1.2. OPTIDIS: OPTimisation d’un code de dynamique des DISlocations

Participants: Olivier Coulaud, Aurélien Esnard, Luc Giraud, Jean Roman.
Grant: ANR-COSINUS
Dates: 2010 – 2014
Partners: CEA/DEN/DMN/SRMA (leader), SIMaP Grenoble INP and ICMPE / Paris-Est.
Overview: Plastic deformation is mainly accommodated by dislocations glide in the case of crystalline materials. The behaviour of a single dislocation segment is perfectly understood since 1960 and analytical formulations are available in the literature. However, to understand the behaviour of a large population of dislocations (inducing complex dislocations interactions) and its effect on plastic deformation, massive numerical computation is necessary. Since 1990, simulation codes have been developed by French researchers. Among these codes, the code TRIDIS developed by the SIMAP laboratory in Grenoble is the pioneer dynamic dislocation code. In 2007, the project called NUMODIS had been set up as team collaboration between the SIMAP and the SRMA CEA Saclay in order to develop a new dynamics dislocation code using modern computer architecture and advanced numerical methods. The objective was to overcome the numerical and physical limits of the previous code TRIDIS. The version NUMODIS 1.0 came out in December 2009, which confirms the feasibility of the project. The project OPTIDIS is initiated when the code NUMODIS is mature enough to consider parallel computation. The objective of the project in to develop and validate the algorithms in order to optimise the numerical and performance efficiencies of the NUMODIS code. We are aiming at developing a code able to tackle realistic material problems such as the interaction between dislocations and irradiation defects in a grain plastical deformation after irradiation. These kinds of studies where “local mechanisms” are correlated with macroscopic behaviour is a key issue for nuclear industry in order to understand material ageing under irradiation, and hence predict power plant secured service life. To carry out such studies, massive numerical optimisations of NUMODIS are required. They involve complex algorithms lying on advanced computational science methods. The project OPTIDIS will develop through joint collaborative studies involving researchers specialized in dynamics dislocations and in numerical methods. This project is divided in 8 tasks over 4 years. Two PhD thesis will be directly funded by the project. One will be dedicated to numerical development, validation of complex algorithms and comparison with the performance of existing dynamics dislocation codes. The objective of the second is to carry out large scale simulations to validate the performance of the numerical developments made in OPTIDIS. In both cases, these simulations will be compared with experimental data obtained by experimentalists.

8.1.3. RESCUE: RÉsilience des applications SCientifiqUEs

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.

Grant: ANR-Blanc (computer science theme)

Dates: 2010 – 2014

Partners: Inria EPI GRAAL (leader) and GRAND LARGE.

Overview: The advent of exascale machines will help solve new scientific challenges only if the resilience of large scientific applications deployed on these machines can be guaranteed. With 10,000,000 core processors, or more, the time interval between two consecutive failures is anticipated to be smaller than the typical duration of a checkpoint, i.e., the time needed to save all necessary application and system data. No actual progress can then be expected for a large-scale parallel application. Current fault-tolerant techniques and tools can no longer be used. The main objective of the RESCUE project is to develop new algorithmic techniques and software tools to solve the exascale resilience problem. Solving this problem implies a departure from current approaches, and calls for yet-to-be-discovered algorithms, protocols and software tools.

This proposed research follows three main research thrusts. The first thrust deals with novel checkpoint protocols. This thrust will include the classification of relevant fault categories and the development of a software package for fault injection into application execution at runtime. The main research activity will be the design and development of scalable and light-weight checkpoint and migration protocols, with on-the-fly storing of key data, distributed but coordinated decisions, etc. These protocols will be validated via a prototype implementation integrated with the public-domain MPICH project. The second thrust entails the development of novel execution models, i.e., accurate stochastic models to predict (and, in turn, optimize) the expected performance (execution time or throughput) of large-scale parallel scientific applications. In the third thrust, we will develop novel parallel algorithms for scientific numerical kernels. We will profile a representative set of key large-scale applications to assess their resilience characteristics (e.g., identify specific patterns to reduce checkpoint overhead). We will also analyze execution trade-offs based on the replication of crucial kernels and on decentralized ABFT (Algorithm-Based Fault Tolerant) techniques. Finally, we will develop new numerical
methods and robust algorithms that still converge in the presence of multiple failures. These algorithms will be implemented as part of a software prototype, which will be evaluated when confronted with realistic faults generated via our fault injection techniques.

We firmly believe that only the combination of these three thrusts (new checkpoint protocols, new execution models, and new parallel algorithms) can solve the exascale resilience problem. We hope to contribute to the solution of this critical problem by providing the community with new protocols, models and algorithms, as well as with a set of freely available public-domain software prototypes.

8.1.4. BOOST: Building the future Of numerical methOdS for iTer

Participants: Emmanuel Agullo, Mikko Byckling, Luc Giraud, Abdou Guermouche, Jean Roman.

Grant: ANR-Blanc (applied math theme)

Dates: 2010 – 2014

Partners: Institut de Mathématiques de Toulouse (coordinator); Laboratoire d’Analyse, Topologie, Probabilités in Marseilles; Institut de Recherche sur la Fusion Magnétique, CEA/IRFM and Inria-HiePaCS

Overview: This project regards the study and the development of a new class of numerical methods to simulate natural or laboratory plasmas and in particular magnetic fusion processes. In this context, we aim in giving a contribution, from the mathematical, physical and algorithmic point of view, to the ITER project.

The core of this project consists in the development, the analysis and the testing on real physical problems of the so-called Asymptotic-Preserving methods which allow simulations over a large range of scales with the same model and numerical method. These methods represent a breakthrough with respect to the state-of-the art. They will be developed specifically to handle the various challenges related to the simulation of the ITER plasma. In parallel with this class of methodologies, we intend to design appropriate coupling techniques between macroscopic and microscopic models for all the cases in which a net distinction between different regimes can be done. This will permit to describe different regimes in different regions of the machine with a strong gain in term of computational efficiency, without losing accuracy in the description of the problem. We will develop full 3-D solver for the asymptotic preserving fluid as well as kinetic model. The Asymptotic-Preserving (AP) numerical strategy allows us to perform numerical simulations with very large time and mesh steps and leads to impressive computational saving. These advantages will be combined with the utilization of the last generation preconditioned fast linear solvers to produce a software with very high performance for plasma simulation. For HiePACS this project provides in particular a testbed for our expertise in parallel solution of large linear systems.

8.2. European Initiatives

8.2.1. FP7 Projet

Title: MYPLANET

Type: PEOPLE

Instrument: Initial Training Network (ITN)

Duration: October 2008 - September 2012

Coordinator: CERFACS (France)

Others partners: Allinea software, Alstom Power Switzerland, Czestochowa University of Technology, Genias Graphics, Rolls Royce PLC UK, Technical Univ. Munich, Turbomeca, University of Cambridge, University Carlos III Madrid and University of Cyprus.

See also: http://www.cerfacs.fr/myplanet/
Abstract: The present MYPLANET project responds to the first FP7-call “PEOPLE-INITIAL-TRAINING-ITN-2007-1” published by the European Commission. This collaborative initial training network represents a European initiative to train a new generation of engineers in the field of high performance computing applied to the numerical combustion simulation, energy conversion processes and related atmospheric pollution issues. Indeed, the project is based on the recognised lack on the European level of highly skilled engineers who are equally well-trained in both combustion technologies and high-performance computing (HPC) techniques. Thus the MYPLANET project will clearly contribute to the structuring of existing high-quality initial research training capacities in fluid mechanics and the HPC field through combining both public and private (industrial) sectors. The participation of industrial partners in the training of the researchers will directly expose these industries to high performance computing, which will have a very favourable impact on the quality and efficiency of their activities. Reciprocally, the research community will learn more about the mid and long term industrial challenges which will enable the research partners to initiate new activities in order to anticipate and address these industrial requirements.

8.3. International initiatives

8.3.1. Inria Associate Teams

8.3.1.1. MORSE

Title: Matrices Over Runtime Systems at Exascale

Inria principal investigator: Emmanuel Agullo

International Partner:

Institution: University of Tennessee Knoxville (United States)
Laboratory: Innovative Computing Lab
Researcher: George Bosilca

International Partner:

Institution: University of Colorado Denver (United States)
Laboratory: Department of Mathematics and Statistical Sciences
Researcher: Julien Langou

Duration: 2011 - 2013


The goal of Matrices Over Runtime Systems at Exascale (MORSE) project is to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome, both by the numerical linear algebra and the runtime system communities. By designing a research framework for describing linear algebra algorithms at a high level of abstraction, the MORSE team will enable the strong collaboration between research groups in linear algebra and runtime systems needed to develop methods and libraries that fully benefit from the potential of future large-scale machines. Our project will take a pioneering step in the effort to bridge the immense software gap that has opened up in front of the High-Performance Computing (HPC) community.

8.3.2. Visits of International Scientists

The following researchers have visited HiePACS in 2011
• George Bosilca, University of Tennessee at Knoxville visited from June 15 to August 15.
• Ichitaro Yamazaki, from Lawrence Berkeley National Laboratory visited from August 29 to September 9.
• Hatem Ltaief, from KAUST visited from October 10 to October 14.

8.3.3. Participation in other International Programs

8.3.3.1. Scalable Hybrid Solvers for Large Sparse Linear Systems of Equations on Petascale Computing Architectures

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Xavier Vasseur.

Grant: France Berkeley Fund
Dates: 2010-2012
Partners: Lawrence Berkeley National Laboratory.
Overview: Our approach to high-performance, scalable solution of large sparse linear systems in parallel scientific computing is to combine direct and iterative methods. Such a hybrid approach exploits the advantages of both direct and iterative methods. The iterative component allows us to use a small amount of memory and provides a natural way for parallelization. The direct part provides its favorable numerical properties. In the framework of this joint research action we intend to address the problems related to exploiting hybrid programming models on NUMA clusters and the solution of indefinite/augmented systems.

8.3.3.2. ECS: Enabling Climate Simulation at extreme scale

Participants: Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman, Mawussi Zounon.

Grant: G8
Dates: 2011 – 2014
Partners: Univ. Illinois at Urbana Champaign, Inria, Univ. Tennessee at Knoxville, German Research School for Simulation Sciences, Univ. Victoria, Titech, Univ. Tsukuba, NCAR, Barcelona Supercomputing Center.
Overview: Exascale systems will allow unprecedented reduction of the uncertainties in climate change predictions via ultra-high resolution models, fewer simplifying assumptions, large climate ensembles and simulation at a scale needed to predict local effects. This is essential given the cost and consequences of inaction or wrong actions about climate change. To achieve this, we need careful co-design of future exascale systems and climate codes, to handle lower reliability, increased heterogeneity, and increased importance of locality. Our effort will initiate an international collaboration of climate and computer scientists that will identify the main roadblocks and analyze and test initial solutions for the execution of climate codes at extreme scale. This work will provide guidance to the future evolution of climate codes. We will pursue research projects to handle known roadblocks on resilience, scalability, and use of accelerators and organize international, interdisciplinary workshops to gather and disseminate information. The global nature of the climate challenge and the magnitude of the task strongly favor an international collaboration. The consortium gathers senior and early career researchers from USA, France, Germany, Spain, Japan and Canada and involves teams working on four major climate codes (CESM1, EC-EARTH, ECSM, NICAM).
KERDATA Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Participant: Diana Moise.

The Brittany Regional Council provides half of the financial support for the PhD thesis of D. Moise (GRID5000BD project). This support amounts to a total of around 14,000 Euros/year. This support ended on September 30, 2011.

8.2. National Initiatives

MapReduce (2010–2014). An ANR project (ARPEGE 2010) with international partners on optimized Map-Reduce data processing on cloud platforms. This project started in October 2010 in collaboration with Argonne National Lab, the University of Illinois at Urbana Champaign, the UIUC/INRIA Joint Lab on Petascale Computing, IBM, IBCP, MEDIT and the GRAAL INRIA Project-Team. URL: http://mapreduce.inria.fr/

Grid’5000. We are members of the Grid’5000 community: we make experiments on the Grid’5000 platform on an everyday basis.

HEMERA (2010–2014). An INRIA Large Wingspan Project, started in 2010. Within Hemera, G. Antoniu (KerData INRIA Team) and Gilles Fedak (GRAAL INRIA Project-Team) co-lead the Map-Reduce scientific challenge. KerData also co-initiated a working group called “Efficient management of very large volumes of information for data-intensive applications”, co-led by G. Antoniu and Jean-Marc Pierson (IRIT, Toulouse).

EquipEx projects (submitted in 2011). We participated to the submission of two EquipEx projects in 2011: DIP-HPC in the HPC area (leader: GENCI; KerData stands for the INRIA partner); and VIRTEXP in the cloud area (leader: Christian Pérez, INRIA-GRAAL).

8.3. European Initiatives

The SCALUS FP7 Marie Curie Initial Training Network (2009–2013). Partners: Universidad Politécnica de Madrid (UPM), Barcelona Supercomputing Center, University of Paderborn, Ruprecht-Karls-Universität Heidelberg, Durham University, FORTH, École des Mines de Nantes, XLAB, CERN, NEC, Microsoft Research, Fujitsu, Sun Microsystems. Topic: scalable distributed storage. We mainly collaborate with UPM (2 co-advised PhD theses).

8.3.1. Major European Organizations with which you have followed Collaborations

CoreGRID ERCIM Working Group, since 2009. The CoreGRID Symposium held in Las Palmas de Gran Canaria, Spain, 25-26 August 2008 marked the end of the ERCIM-managed CoreGRID Network of Excellence funded by the European Commission. There, it was decided to re-launch CoreGRID as a self-sustained ERCIM Working Group covering research activities on both Grid and Service Computing while maintaining the momentum of the European collaboration on Grid research.

8.4. International Initiatives

F3PC: ANR-JST project (2010–2013). In this project we mainly collaborate with Tsukuba University, Japan (GFarm Team). This project is a follow up to several previous collaborations: NEGST (2006–2009); CNRS-JST project. Bilateral PHC (ex-PAI) Sakura project (2006–2007).
8.4.1. INRIA Associate Teams

8.4.1.1. DataCloud@Work

Title: Distributed data management for cloud services
INRIA principal investigator: Gabriel Antoniu
International Partner:
   Institution: Politehnica University of Bucharest (UPB, Romania)
   Laboratory: Distributed Systems Software Laboratory, National Center for Information Technology (NCIT, http://cs.pub.ro/ )
   Researcher: Valentin Cristea, Professor at UPB

Duration: 2010–2012
See also: http://www.irisa.fr/kerdata/doku.php?id=cloud_at_work:start

Our research topics address the area of distributed data management for cloud services. We aim at investigating several open issues related to autonomic storage in the context of cloud services. The goal is explore how to build an efficient, secure and reliable storage IaaS for data-intensive distributed applications running in cloud environments by enabling an autonomic behavior, while leveraging the advantages of the grid operating system approach.

Our research activities involve the design and implementation of experimental prototypes based on the following software platforms:

- The BlobSeer data-sharing platform (designed by the KerData Team)
- The XtreemOS grid operation system (designed under the leadership of the Myriads Team)
- The MonALISA monitoring framework (using the expertise of the PUB Team).

8.4.2. Visits of International Scientists

- Bunjamin Memishi, Visiting PhD student Universidad Politecnica de Madrid (UPM), 1 month (April 2011), funded by Universidad Politecnica de Madrid through the SCALUS Marie-Curie Initial Training Network. His thesis is co-advised by Mariá Pérez (UPM) and Gabriel Antoniu (KerData).
- Florin Pop, Visiting Postdoc Fellow Polytechnic University of Bucharest, 1 month (June 2011), funded by the DataCloud@work Associate Team.
- Ciprian Dobre, Visiting Postdoc Fellow Polytechnic University of Bucharest, 1 month (June 2011), funded by the DataCloud@work Associate Team.
- Elena Apostol, Visiting PhD student Polytechnic University of Bucharest, 3 months (June - August 2011), funded by the DataCloud@work Associate Team.
- Daniel Higuero, Visiting PhD student Carlos III University, Madrid, 3 months (September-November 2011), funded by Carlos III University, Madrid.

8.4.3. Participation In International Programs

Joint INRIA-UIUC Lab for Petascale Computing (JLPC), since 2009. Collaboration on concurrency-optimized I/O for post-Petascale platforms (see details in Section 4.1). A joint project proposal with the team of Rob Ross (Argonne National Lab) has been submitted in 2011 to the FACCTS call for projects (evaluation pending).
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. CIMENT

The CIMENT project (Intensive Computing, Numerical Modeling and Technical Experiments, https://ciment.ujf-grenoble.fr/) gathers a wide scientific community involved in numerical modeling and computing (from numerical physics and chemistry to astrophysics, mechanics, bio-modeling and imaging) and the distributed computer science teams from Grenoble. Several heterogeneous distributed computing platforms were set up (from PC clusters to IBM SP or alpha workstations) each being originally dedicated to a scientific domain. More than 600 processors are available for scientific computation. The MESCAL project-team provides expert skills in high performance computing infrastructures.

8.1.2. High Performance Computing Center

- The ICluster2, the IDPot and the new Digitalis Platforms

The MESCAL project-team manages a cluster computing center on the Grenoble campus. The center manages different architectures: a 48 bi-processors PC (ID-POT), and the center is involved with a cluster based on 110 bi-processors Itanium2 (ICluster-2) and another based on 34 bi-processor quad-core XEON (Digitalis) located at Inria. The three of them are integrated in the Grid'5000 grid platform.

More than 60 research projects in France have used the architectures, especially the 204 processors Icluster-2. Half of them have run typical numerical applications on this machine, the remainder has worked on middleware and new technology for cluster and grid computing. The Digitalis cluster is also meant to replace the Grimage platform in which the MOAIS project-team is very involved.

- The Bull Machine

In the context of our collaboration with Bull the MESCAL project-team exploits a Novascale NUMA machine. The configuration is based on 8 Itanium II processors at 1.5 Ghz and 16 GB of RAM. This platform is mainly used by the Bull PhD students. This machine is also connected to the CIMENT Grid.

- GRID 5000 and CIMENT

The MESCAL project-team is involved in development and management of Grid’5000 platform. The Digitalis and IDPot clusters are integrated in Grid’5000. Moreover, these two clusters take part in CIMENT Grid. More precisely, their unused resources may be exploited to execute jobs from partners of CIMENT project.

8.2. National Initiatives

8.2.1. "Action d’envergure"

- HEMERA, 2010-2012

Leading action "Completing challenging experiments on Grid’5000 (Methodology)"

Experimental platforms like Grid’5000 or PlanetLab provide an invaluable help to the scientific community, by making it possible to run very large-scale experiments in controlled environment. However, while performing relatively simple experiments is generally easy, it has been shown that the complexity of completing more challenging experiments (involving a large number of nodes, changes to the environment to introduce heterogeneity or faults, or instrumentation of the platform to extract data during the experiment) is often underestimated.
This working group explores different complementary approaches, that are the basic building blocks for building the next level of experimentation on large scale experimental platforms. This encompasses several aspects.

8.2.2. ARC Inria

- **Meneur 2011-2013:**

  Partners: EPI Dionysos, EPI Maestro, EPI MESCAL, EPI Comore, GET/Telecom Bretagne, FTW, Vienna (Forschungszentrum Telekommunikation Wien), Columbia University, USA, Pennsylvania State University, USA, Alcatel-Lucent Bell Labs France, Orange Labs.

  The goal of this project is to study the interest of network neutrality, a topic that has recently gained a lot of attention. The project aims at elaborating mathematical models that will be analyzed to investigate its impact on users, on social welfare and on providers’ investment incentives, among others, and eventually propose how (and if) network neutrality should be implemented. It brings together experts from different scientific fields, telecommunications, applied mathematics, economics, mixing academy and industry, to discuss those issues. It is a first step towards the elaboration of a European project.

8.2.3. ADT Inria (2)

- **SimGrid for Human Beings, 2009-2011:**

  Partners: Inria Grand Est. Two young engineers have been allotted by the Inria to the SimGrid project to help with the software maintenance and with the transfer of research ideas and prototypes from the ANR USS SimGrid to public stable versions.

  - **Aladdin-G5K, 2008-2011**

    Partners: Inria FUTURS, Inria Sophia, IRISA, LORIA, IRIT, LABRI, LIP, LIFL.

    After the success of the Grid’5000 project of the ACI Grid initiative led by the French ministry of research, Inria is launching the ALADDIN project to further develop the Grid’5000 infrastructure and foster scientific research using the infrastructure.

    ALADDIN built on Grid’5000’s experience to provide an infrastructure enabling computer scientists to conduct experiments on large scale computing and produced scientific results that can be reproduced by others. MESCAL members are particularly involved in efficient large scale system utilization, providing confidence to the user about the infrastructure and modeling of large scale systems and validation of their simulators.

8.2.4. NANO 2012

Rapid advances in multi-core technologies have been incorporated in general-purpose processors from Intel, IBM, Sun, and AMD, and special-purpose graphics processors from NVIDIA and ATI. This technology will soon be introduced to the next generation of processors in embedded systems. The increase in the number of cores per processor will introduce critical challenges for the access of data stored in memory. The synchronization of memory accesses is often done using the use of locks for shared variables. As the number of threads increases, the cost of synchronization also increases due to increased access to these shared variables. Transactional memory is currently an approach being actively investigated. The goal of this project is to improve the programability and performance of parallel systems using the approach of transactional memory in the context of embedded systems.

8.2.5. ANR Jeunes Chercheurs et Jeunes Chercheuses (2)

- **DOCCA, 2007-2011**

  The race towards the design and development of scalable distributed systems offers new opportunities to applications, in particular as far as scientific computing, databases, and file sharing are concerned. Recently many advances have been done in the area of large-scale file-sharing systems, building upon the peer-to-peer
paradigm that somehow seamlessly responds to the dynamicity and resilience issues. However, achieving a fair resource sharing amongst a large number of users in a distributed way is clearly still an open and active research field. For all previous issues there is a clear gap between:

1. widely deployed systems as peer-to-peer file-sharing systems (KaZaA, Gnutella, EDonkey) that are generally not very efficient and do not propose generic solutions that can be extended to other kind of usage;
2. academic work with generally smart solutions (probabilistic routing in random graphs, set of node-disjoint trees, Lagrangian optimization) that sometimes lack a real application.

Up to now, the main achievements based on the peer-to-peer paradigm mainly concern file-sharing issues. We believe that a large class of scientific computations could also take advantage of this kind of organization. Thus our goal is to design a peer-to-peer computing infrastructure with a particular emphasis on the fairness issues. In particular, the objectives of the ANR DOCCA (Design and Optimization of Collaborative Computing Architectures) project are the following:

First, we want to combine theoretical tools and metrics from the parallel computing community and from the network community, and to explore algorithmic and analytical solutions to the specific resource management problems of such systems.

We also want to design a P2P architecture based on the algorithms designed in the second step, and to create a novel P2P collaborative computing system.

- Clouds@home, 2009-2013

The overall objective of this project is to design and develop a cloud computing platform that enables the execution of complex services and applications over unreliable volunteered resources over the Internet. In terms of reliability, these resources are often unavailable 40% of the time, and exhibit frequent churn (several times a day). In terms of "real, complex services and applications", we refer to large-scale service deployments, such as Amazon’s EC2, the TeraGrid, and the EGEE, and also applications with complex dependencies among tasks. These commercial and scientific services and applications need guaranteed availability levels of 99.999% for computational, network, and storage resources in order to have efficient and timely execution.

8.2.6. ANR COSI

- PROHMPT, 2009-2011

Partners: Bull SAS, CAPS entreprise, CEA CESTA, CEA INAC, Inria RUNTIME, UVSQ PriSM

Processor architectures with many-core processors and special-purpose processors such as GPUS and the CELL processor have recently emerged. These new and heterogeneous architectures require new application programming methods and new programming models. The goal of the ProHMPT project is to address this challenge by focusing on the immense computing needs and requirements of real simulations for nanotechnologies. In order for nanosimulations to fully leverage heterogeneous computing architectures, project members will novel technologies at the compiler, runtime, and scientific kernely levels with proper abstractions and wide portability. This project brings experts from industry, in particular HPC hardware expertise from Bull and nanosimulation expertise from CEA.

8.2.7. ANR ARPEGE

- PEGASE, 2009-2011

Partners: RealTimeAtWork, Thales, ONERA, ENS Cachan

The goal of this project to achieve performance guarantees for communicating embedded systems. Members will develop mathematical methods that give accurate bounds on maximum network delays in both space and aviation systems. The mathematical methods will be based on Network Calculus theory, which is type of queuing theory that deals with worst-case performance evaluation. The expected results will be novel models and software tools validated in mission-critical real-time embedded networks of the aerospace industry.
8.2.8. ANR SEGI (2)

- **USS Simgrid, 2009-2011**
  
  Partners: Inria Nancy, Inria Sophia, Inria Bordeaux, University of Reims, IN2P3, University of Hawaii at Manoa
  
  The goal of the USS-SimGrid project is to enable scalable and accurate simulations by means of the SimGrid simulation toolkit. This toolkit is widely used for simulation of Grid systems. We aim to extend the functionality of the toolkit to enable the simulation of heterogeneous systems with more than tens of thousands of nodes.
  
  There are three main thrusts in this project. First, we improve the models used in SimGrid, increasing their scalability and easing their instantiation. Second, we develop tools that ease the analysis of detailed and large simulation results, and aid the management of simulation deployments. Third, we improve the scalability of simulations using parallelization and optimization methods. A mid-term report summarizing our findings has been published in [59].

- **SPADES, 2009-2012**
  
  Partners: Inria GRAAL, Inria GRAND-LARGE, CERFACS, CNRS, Inria PARIS, LORIA
  
  Petascale systems consisting of thousands to millions of resources have emerged. At the same, existing infrastructure are not capable of fully harnessing the computational power of such systems. The SPADES project will address several challenges in such large systems. First, the members are investigating methods for service discovery in volatile and dynamic platforms. Second, the members creating novel models of reliability in PetaScale systems. Third, the members will develop stochastic scheduling methods that leverage these models. This will be done with emphasis on applications with task dependencies structured as graph.

8.3. European Initiatives

8.3.1. FP7 EDGI (European Desktop Grid Initiative)

Partners: SZTAKI institute (Hungary), CIEMAT (Spain), Univ. Coimbra (Portugal), Univ Cardi (UK), Univ Westminster (UK), AlmereGrid (NL), IN2P3 (FR), Inria (GRAAL, MESCAL)

Years: 2010-2012

EDGI is an FP7 European project whose goal is to build a Grid infrastructure composed of “Desktop Grids”, such as BOINC or XtremWeb, where computing resources are provided by Internet volunteers, and “Service Grids”, where computing resources are provided by institutional Grid such as EGEE, gLite, Unicore and “Clouds systems” such asOpenNebula and Eucalyptus, where resources are provided on-demand. The EDGI infrastructure will consist of Service Grids that are extended with public and institutional Desktop Grids and Clouds.

8.3.2. FP7 Mont-Blanc project: European scalable and power efficient HPC platform based on low-power embedded technology

FP7 Programme: ICT-2011.9.13 Exa-scale computing, software and simulation

Mont-Blanc Partners: BSC (Barcelona), Bull, ARM (UK), Julich (Germany), Genci, CINECA (Italy), CNRS (LIRMM, LIG)

Duration: 3 Years from 1/10/2011

There is a continued need for higher compute performance: scientific grand challenges, engineering, geophysics, bioinformatics, etc. However, energy is increasingly becoming one of the most expensive resources and the dominant cost item for running a large supercomputing facility. In fact, the total energy cost of a few years of operation can almost equal the cost of the hardware infrastructure. Energy efficiency is already a primary concern for the design of any computer system and it is unanimously recognized that Exascale systems will be strongly constrained by power.
The analysis of the performance of HPC systems since 1993 shows exponential improvements at the rate of one order of magnitude every 3 years: One petaflops was achieved in 2008, one exaflops is expected in 2020. Based on a 20 MW power budget, this requires an efficiency of 50 GFLOPS/Watt. However, the current leader in energy efficiency achieves only 1.7n GFLOPS/Watt. Thus, a 30x improvement is required.

In this project, the partners believe that HPC systems developed from today’s energy-efficient solutions used in embedded and mobile devices are the most likely to succeed. As of today, the CPUs of these devices are mostly designed by ARM. However, ARM processors have not been designed for HPC, and ARM chips have never used in HPC systems before, leading to a number of significant challenges.

8.3.3. HPC-GA project: High Performance Computing for Geophysics Applications

FP7 programme: Marie Curie Actions, International Research Staff Exchange Scheme (IRSES)

Partners: Inria (Grenoble, Bordeaux, Pau), BCAM (Bilbao), UFRGS (Brazil), UNAM (Mexico), BRGM (France), UJF (France)

Duration: 3 years from 1/1/2012

PI: Inria (Grenoble and Bordeaux)

Simulating large-scale geophysics phenomenon represents, more than ever, a major concern for our society. Recent seismic activity worldwide has shown how crucial it is to enhance our understanding of the impact of earthquakes. Numerical modeling of seismic 3D waves obviously requires highly specific research efforts in geophysics and applied mathematics, leveraging a mix of various schemes such as spectral elements, high-order finite differences or finite elements. But designing and porting geophysics applications on top of nowadays supercomputers also requires a strong expertise in parallel programming and the use of appropriate runtime systems able to efficiently deal with heterogeneous architectures featuring many-core nodes typically equipped with GPU accelerators. The HPC-GA project aims at evaluating the functionalities provided by current runtime systems in order to point out their limitations. It also aims at designing new methods and mechanisms for an efficient scheduling of processes/threads and a clever data distribution on such platforms.

8.3.4. Collaborations in European Programs, except FP7

- ESPON:
  The MESCAL project-team participates to the ESPON (European Spatial Planning Observation Network) http://www.espon.lu/ It is involved in the action 3.1 on tools for analysis of socio-economical data. This work is done in the consortium hypercarte including the laboratories LIG, Géographie-cité (UMR 8504) and RIATE (UMS 2414). The Hyperatlas tools have been applied to the European context in order to study spatial deviation indexes on demographic and sociological data at nuts 3 level.

- European Exascale Software Initiative (EESI)
  The objective of this Support Action, co-funded by the European Commission is to build a European vision and road-map to address the challenges of the new generation of massively parallel systems composed of millions of heterogeneous cores which will provide Petaflop performances in 2010 and Exaflop performances in 2020 (the speed of a supercomputer is measured in "FLOPS" (FLOating Point Operations Per Second)). "Petascale" supercomputers can process one quadrillion (1015) (1000 trillion) FLOPS, Exascale is computing performance is one quintillion (1018) FLOPS (one million teraflops) http://www.eesi-project.eu/pages/menu/homepage.php .

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. Cloud Computing at Home

Title: Cloud Computing over Internet Volunteer Resources
Inria principal investigator: Derrick Kondo
International Partner:
  Institution: University of California Berkeley (United States)
  Laboratory: Space Sciences Laboratory
  Researcher: David P.
Duration: 2009 - 2011
See also: http://abenaki.imag.fr/cloudcomputing/pmwiki.php

Recently, a new vision of cloud computing has emerged where the complexity of an IT infrastructure is completely hidden from its users. At the same time, cloud computing platforms provide massive scalability, 99.999% reliability, and speedy performance at relatively low costs for complex applications and services. In this proposed collaboration, we investigate the use of cloud computing for large-scale and demanding applications and services over the most unreliable but also most powerful resources in the world, namely volunteered resources over the Internet. The motivation is the immense collective power of volunteer resources (evident by FOLDING@home’s 3.9 PetaFLOPS system), and the relatively low cost of using such resources. We will address these challenges drawing on the experience of the BOINC team which designed and implemented BOINC (a middleware for volunteer computing that is the underlying infrastructure for SETI@home), and the MESCAL team which designed and implemented OAR (an industrial-strength resource management system that runs across France’s main 5000-node Grid called Grid’5000).

8.4.1.2. DIODEA
Title: France/Brazil Associated research team on Parallel Computing
Inria principal investigator: Bruno Raffin
International Partner:
  Institution: Universidade Federal do Rio Grande do Sul (Brazil)
  Laboratory: UFRGS
  Researcher: Philippe Olivier Alexandre Navaux
Duration: 2009 - 2011
See also: http://diodea.imag.fr/

Associate Team funded by Inria with the MOAIS project-team of Inria, and the Brazilian University UFRGS. The goal of this project is to design and develop programming tools for grid and clusters for virtual reality. This collaboration was initiated 10 years ago, and has greatly affected the activities (doctoral, publications and joint production software) of the Apache project-team, from which MOAIS and MESCAL were formed. In particular, four PhD Brazilian students have joined the MESCAL project-team as a result of this long-standing collaboration. In particular, this year, 3 members of the MESCAL project-team visited Brazil (Jean-François Méhaut, Arnaud Legrand, Jean-Marc Vincent) to enhance the existing collaborations and to form new ones.

8.4.2. Inria International Partners

- MESCAL has strong connections with both UFRGS (Porto Alegre, Brazil) and USP (Sao Paulo, Brazil). This year, Jean-François Méhaut visited both laboratories in July. The creation of the LICIA common laboratory (see next section) will make this collaboration even tighter.
- MESCAL has strong bounds with the University of Illinois Urbana Champaign, within the (Joint Laboratory on Petascale Computing (see next section).
- MESCAL also has long lasting collaborations with University of California in Berkeley and a new one with Google. Derrick Kondo is being visiting them in October and November.
- Vania Martin has been visiting the Pontifícia Universidade Catolica de Minas Gerais (Belo Horizonte, Brazil).

8.4.3. Participation In International Programs

8.4.3.1. Africa

SARIMA and IDASCO / LIRIMA (Cameroon)

MESCAL takes part in the SARIMA (Soutien aux Activités de Recherche Informatique et Mathématiques en Afrique http://www-direction.inria.fr/international/AFRIQUE/sarima.html) project and more precisely with the University of Yaoundé 1. Cameroon student Blaise Yenké completed his PhD under the joint supervision of Professor Maurice Tchuenté. SARIMA also funded Adamou Hamza to prepare his Master Thesis during three months in the MESCAL project-team. SARIMA proposed J-F Méhaut to give a course on Operating System and Networks at Master Research Students. In addition, MESCAL participates in the IDASCO joint project with the University of Yaoundé 1. This is part of the international LIRIMA laboratory, whose goal to develop novel methods and tools for collecting and analyzing massive data sets from biological or environmental domains.

8.4.3.2. North America

- Google Derick Kondo has received a Google Research Award in 2011 for his proposal on predicting idleness in data centers. The technical goal of the proposed work is to give probabilistic guarantees on when data centers are idle. The implication of such predictions is improved data center utilization, while reducing and amortizing monetary costs. The general goal of this award is to facilitate collaboration between Google Inc. and academic researchers. Google Inc. provides the award as an unrestricted gift without constraints on intellectual property.
- Amazon (2010-2011) The overall goal is to integrate G5K with Amazon Inc’s Elastic Compute Cloud (EC2) such that workload, especially during peak periods, can be rerouted to EC2. So we would like to adapt OAR for an on-demand cloud infrastructure. We envision an OAR server, running within G5K, that manages sites within G5K and remote instances in EC2.
- JLPC (Joint Laboratory on Petascale Computing) (with University of University of Illinois Urbana Champaign). Several members of MESCAL are partners of this laboratory, and have paid several visits to Urbana-Champaign. The latest workshop of the laboratory has been organized by Jean-François Méhaut in Grenoble.

8.4.3.3. South America

- LICIA. The CNRS, Inria, the Universities of Grenoble, Grenoble INP and Universidade Federal do Rio Grande do Sul have created the LICIA (laboratoire International de Calcul intensif et d’Informatique Ambiante). On the French side, the laboratory is co-directed by Yves Denneulin and Jean-Marc Vincent.

The grand opening workshop has taken place in Porto Alegre, Brazil from Oct. 31st to Nov. 1st. The main themes are artificial intelligence, high performance computing, information representation, interfaces and visualization as well as distributed systems.

More information can be found on http://www.inf.ufrgs.br/licia/.
MOAIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- CILOE, 2008-2011, Minalogic: This project is to develop tools and high level interfaces for compute-intensive applications for nano and micro-electronic design and optimizations. The partners are: two large companies CS-SI (leader), Bull; three small size companies EDXACT, INFINISCALE, PROBAYES, and four research units INRIA, CEA-LETI, GIPSA-LAB, TIMA. For Moais, the contract funds the PhD thesis of Jean-Noel Quintin.

- HiPeComp, NANO 2008-2012 contract. The project HiPeCoMP (High Performance Components for MPSoC) consists in the development an coupling of: on the one hand, wait-free scheduling techniques (pre-partitioning and mapping, on-line work stealing) of component based multimedia applications on MPSoC architectures; and on the other hand, monitoring, debug and performance software tools for the programming of MPSoC with provable performances. For Moais, the contract funds the PhD thesis of Christophe Laferrière who started on 1/9/2009.

- SHIVA, Minalogic 2009-2012 contract. This project aims at the development of a high throughput backbone ciphering that ensures a high level of security for intranet and extranet communications over internet. The partners are: CS-SI (leader); 1 small size companies: Easii-IC (support for Xilinx FPGA) IWall-Mataru (key management), Netheos (customizable FPGA for ciphering); INRIA; CEA-LETI (security certification); Grenoble-INP (TIMA lab, integration of cryptography on FPGA); UJF (LJK and Institut Fourier: open cryptographic protocols and handshake; VERIMAG: provable security). Within INRIA, the MOAIS and the PLANET teams provide the parallel implementation on a multicore pltaform of IP-Sec and coordination with hardware accelerators (Frog’s and GPUs). The contract funds the PhD thesis of Ludovic Jacquin, coadvised by PLANET and MOAIS and a 1 year engineer (Fabrice Schuler, from 11/2010).

- SOC-TRACE, Minalogic 2011-2014 contract. This project aims the development of tools for the monitoring and debug of multicore systems on chip. Leader: ST-Microelectonic. Partners: Inria (Mescal, Moais); UJF (TIMA, LIG/Hadas); Magilem, ProBayes. The contract funds 1 PhD thesis and 1 year engineer.

8.2. National Initiatives

- ANR EXAVIZ (2011-2015). Large-scale interactive visual analysis for life sciences and materials. Partners: project-team INRIA MOAIS, LIFO-lab Université d’Orléans, Laboratoire de Biochimie Théorique de l’IBPC, the LIMSI lab and the CEMHTI.


- New accepted ANR HPAC (2012-2015). High Performance Algebraic Computing. Coordinator: Jean-Guillaume Dumas (CASY team, LJK, Grenoble). Partners: project-team MOAIS (Grenoble), team CASYS (LJK, Grenoble), project-team ARENAIRE (LIP, Lyon), project-team SALSA (LIP6, Paris), the ARITH group (LIRMM lab, Montpellier).

8.3. European Initiatives

8.3.1. FP7 Projekt

8.3.1.1. VISIONAIR

Title: VISIONAIR
Type: CAPACITIES (Infrastructures)
Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS (CPCSA)
Duration: February 2011 - January 2015
Coordinator: Grenoble-INP (France)
VISIONAIR European platform. With the Grimage platform, we participate to the European project Visionair which objective is to provide an infrastructure that gathers advanced visualization and interaction infrastructures. Visionair is leaded by Grenoble-INP (Frédéric Noel, G-Scop lab) and gathers 25 international partners from 12 countries; it has been funded in 2010 and start in Q1 2011.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. DIODEA

Title: Parallel and distributed computing, scalability and visualization
INRIA principal investigator: Bruno Raffin
International Partner:
- Institution: Federal University of Rio Grande del Sul (Brazil)
- Laboratory: Instituto de Informática
- Researcher: Philippe Navaux
Duration: 2006 - 2011
See also: http://diodea.imag.fr/
The French research teams MOAIS and MESCAL, Grenoble, INRIA, and the Brazilian University UFRGS, Porto Alegre closely collaborate since 1992. This collaboration is centered on: Grid computing tools related to system and application deployment, job scheduling, execution monitoring and visualisation ; Modeling, evaluating and experimenting on large scale computer systems (performance evaluation, experimentations, simulation, emulation) ; New parallel programming paradigms: work stealing, fault tolerance, processor and cache oblivious algorithms, multi-core and multi-GPU programming. Frequent visits between partners and numerous co-advised Master and Ph.D. students make it a really fruitful collaboration. It as a strong influence on the development of many of our software tools, including KAAPI, OAR, Kadeploy, Taktuk. We also share some of our computing resources. The cluster from UFRGS was integrated in 2009 as the first non european non of the Grid5000 french experimental grid. The success of the associated team leads to the creation of the first Laboratoire International Associé (LIA) in computer science between the French CNRS and the Brazil.
8.4.2. Brazil

CAPES/COFECUB n° Ma660/10 (2010-2013) on the management of resources for parallel computing on a grid. Partners: University of Sao Paulo, project MOAIS.

8.5. Hardware Platforms

8.5.1. The GRIMAGE platform

The GrImage platform (http://grimage.inrialpes.fr) gathers a network of cameras and a PC cluster. It is dedicated to interactive applications. GrImage is co-led by the Moais and Perception projects. It is the milestone of a strong and fruitful collaboration between Moais and Perception (common publications, software and application development).

GrImage (Grid and Image) aggregates commodity components for high performance video acquisition, computation and graphics rendering. Computing power is provided by a PC cluster, with some PCs dedicated to video acquisition and others to graphics rendering. A set of digital cameras enables real time video acquisition. The main goal is to rebuild in real time a 3D model of a scene shot from different points of view. Visualization can be performed using a head mounted display for first-person interactions or on a multiprojector display-wall for high resolution rendering.

Since July 2009, the computing cluster was upgraded through grants from INRIA and CNRS-LIG. Grimage uses some specific nodes from the Digitalis machine capable of hosting several daughter boards (mainly video acquisition and graphics cards). It relies on Intel Nehalem processors and a high speed Infiniband network. This integrated approach will enable to test interactive applications using a very high number of processing resources as other nodes from the Digitalis machine can be reserved if needed.

8.5.2. The Digitalis machine

Digitalis is a 780 cores cluster based on Intel Nehalem processors and Infiniband network located at INRIA Rhône-Alpes. Digitalis has been designed to suit both the needs for batch computations and interactive applications. As mentioned before, one rack is dedicated to nodes hosting video acquisition boards and graphics cards. These nodes are mainly used for the Grimage platform, but can also be used for batch computing. Additional nodes with Nvidia Tesla GPUs have been installed.

By having a single unified machine for batch and interactive computing we expect to better use the available resources, favor the emergence of high performance applications integrating interactive steering and vice versa enable the development of a new generation of interactive 3D applications using a significantly larger number of CPUs and GPUs that what has been done so far on the Grimage platform.

8.5.3. Multicore Machines

MOAIS invested in 2006 on two multicore architectures

- A 8-way 16-cores machine equipped with Itanium processors.
- A 8-way 16-cores machine equipped with dual core processors (total of 8 sockets) and 2 GPUs.

These set of machines have been extended in 2010 with a new machines:

- A 8-way, 48-cores machine equipped with 12-core AMD processors (total of 4 sockets)
- A 6-cores machine equipped with 8 GPUs

These machines enables us to keep-up with the evolution of parallel architectures and in particular today’s availability of large multi-core machines. They are used to develop and test parallel adaptive algorithms taking advantage of the processing power provided by the multiple CPUs and GPUs available.
8. Partnerships and Cooperations

8.1. National Initiatives

COOP We participate to a research proposal to the ANR Cosinus program called “COOP” which was granted a three-year funding (dec. 2009 – dec. 2012). It aims at establishing generic cooperation mechanisms between resource management, runtime systems, and application programming frameworks to simplify programming models, and improve performance through adaptation to the resources. It involves academic partners and EDF R&D. (http://coop.gforge.inria.fr/)

FP3C We participate to the joint ANR-JST project FP3C (Framework and Programming for Post Petascale Computing). The goal of this project is to contribute to establish software technologies, languages and programming models to explore extreme performance computing beyond petascale computing, on the road to exascale computing.

ProHMPT Participants: Cédric Augonnet, Olivier Aumage, Denis Barthou, Andres Charif-Rubial, Jérôme Clet-Ortega, Nathalie Furmento, Raymond Namyst, Ludovic Stordeur, François Tessier, Samuel Thibault, Pierre-André Wacrenier.

We lead a research proposal to the ANR Cosinus program called “ProHMPT” which was granted a three-year funding (jan. 2009 – jun. 2012). It aims at focusing the joint research work of several teams about compilers, runtimes and libraries on programming heterogeneous platforms such as GPU and accelerators. It involves academic partners, companies (Bull, CAPS entreprise) and CEA teams. Olivier AUMAGE is the head of the ANR ProHMPT project. (http://runtime.bordeaux.inria.fr/prohmpt/)

Hemera The runtime team is member of the large wigspan project Hémera started in 2010, that aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid’5000 infrastructure, at animating the scientific community around Grid’5000 and at enlarging the Grid’5000 community by helping newcomers to make use of Grid’5000. It is not restricted to INRIA teams.

MEDIAGPU We participate to a research proposal to the ANR CONTINT program called “MEDIAGPU” which was granted a 30-month funding (jan. 2010 - jun. 2012). It will develop a software architecture and will review and adapt a number of classical multimedia algorithms, considering the latest advances offered by the new hardware architectures, such as combinations of CPUs and GPUs (http://picoforge.int-evry.fr/projects/mediagpu/).

8.2. European Initiatives

8.2.1. FP7 Project

8.2.1.1. PEPPHER

Title: Performance Portability and Programmability for Heterogeneous Many-core Architectures
Type: COOPERATION (ICT)
Defi: Computing Systems
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2010 - December 2012
Coordinator: Universität Wien (Austria)
Others partners: Chalmers Tekniska Högskola AB (Sweden), Codeplay Software Limited (United Kingdom), Intel GmbH (Germany), Linköpings Universitet (Sweden), Movidia Ltd. (Ireland), Universität Karlsruhe (Germany)

See also: http://www.peppher.eu/

Abstract: PEPPHER will provide a unified framework for programming architecturally diverse, heterogeneous many-core processors to ensure performance portability. PEPPHER will advance state-of-the-art in its five technical work areas:

1. Methods and tools for component based software
2. Portable compilation techniques
3. Data structures and adaptive, autotuned algorithms
4. Efficient, flexible run-time systems
5. Hardware support for autotuning, synchronization and scheduling

8.2.2. Collaborations in European Programs, except FP7

Program: COST
Project acronym: ComplexHPC
Project title: Open Network for High-Performance Computing on Complex Environments
Duration: may 2009 – may 2013
Coordinator: Emmanuel Jeannot

Other partners: 24 European Countries, 2 non-European counties.

Abstract: The goal of the Action is to establish a European research network focused on high performance heterogeneous computing in order to address the whole range of challenges posed by these new platforms including models, algorithms, programming tools and applications.

8.3. International Initiatives

8.3.1. INRIA Associate Teams

Morse The goal of Matrices Over Runtime Systems at Exascale (MORSE) project is to design dense and sparse linear algebra methods that achieve the fastest possible time to an accurate solution on large-scale multicore systems with GPU accelerators, using all the processing power that future high end systems can make available. To develop software that will perform well on petascale and exascale systems with thousands of nodes and millions of cores, several daunting challenges have to be overcome, both by the numerical linear algebra and the runtime system communities. By designing a research framework for describing linear algebra algorithms at a high level of abstraction, the MORSE team will enable the strong collaboration between research groups in linear algebra and runtime systems needed to develop methods and libraries that fully benefit from the potential of future large-scale machines. Our project will take a pioneering step in the effort to bridge the immense software gap that has opened up in front of the High-Performance Computing (HPC) community.

8.3.2. INRIA International Partners

- The Runtime project is the representative of Inria within the MPI Forum which designs and maintains the Message Passing Interface Standard (http://www.mpi-forum.org).
- We established a collaboration with the OPEN MPI project in the context of development of the HWLOC software (see Section 5.2). This collaboration was also informally extended to the development of high-performance intra-node communication with OPEN MPI over our KNEM driver (see Section 5.3).
• Runtime is a member of the CCI project together with the Oak Ridge National Laboratory and several other American academic and industrial partners (http://www.cci-forum.org). See Section 5.1.

• The Runtime project is part of the joint laboratory that was setup between INRIA and University of Illinois Urbana-Champaign (UIUC) about Petascale Computing (http://jointlab.ncsa.illinois.edu/).

8.3.3. Visits of International Scientists

• Jan PERHAC from Trondheim University visited the runtime team as an ERCIM Fellow from March 7 to March 11. We worked on the Thor runtime system.

• Keisuke FUKUDA from Tokyo Tech visited from December 12th to Friday 16th, for the FP3C project, to port an FMM application on top of STARPU.

• Tetsuya ODAJIMA from University of Tsukuba, Japan visited the Runtime Team from September 2th to September 16th, for the FP3C Project, to integrate the XcalableMP language environment with StarPU.

• Satoshi OHSHIMA from Tokyo University visited from April 4th to April 15th, for the FP3C project, to work on FEM methods.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ARED Région Bretagne
Participant: Bruno Tuffin.
ARED contract (with Région Bretagne) for the PhD thesis of Sagga Samira on rare event simulation with applications in telecommunications.

8.1.2. SISCom International Research Chair "Future Telecommunication Ecosystems"
Participants: Peter Reichl, Bruno Tuffin.
Cross-connecting related activities at SISCom partners (INRIA Rennes ? Bretagne Atlantique, Télécom Bretagne Rennes, and CNRS) and the Telecommunications Research Center Vienna (FTW), Austria, the main goal of the SISCom International Chair on "Future Telecommunication Ecosystems" is to develop an overall perspective of current and future research in this holistic area where user-driven research and microeconomic modeling meet the technical challenges of future telecommunications. Additionally, selected research questions in the areas of Quality of Experience, game theoretic models of cooperation and competition between users and/or providers, and future pervasive interaction will be addressed more specifically and may serve as starting points for joint follow-on activities, thus supporting the sustainability of this initiative.

The SISCom International Research Chair is funded jointly by Université Europèenne de Bretagne, Région Bretagne, and the European Regional Development Fund, and is hosted by INRIA Rennes Bretagne-Atlantique for the period December 2010 through September 2011.

8.2. National Initiatives

8.2.1. ARC MENEUR
Participants: Pierre Coucheney, Peter Reichl, Bruno Tuffin.
We coordinate an INRIA cooperative research action on Network Neutralité, called MENEUR (Modélisation en Economie des réseaux et NEUtralité du Net). This action runs over 2011-2012 in association with INRIA teams MAESTRO and MESCAL, Orange Labs, ALU-Bell Labs France, Telecom Bretagne, FTW (Austria), Columbia University and Penn State University.
The goal of this project is to study the interest of network neutrality, a topic that has recently gained a lot of attention. The project aims at elaborating mathematical models that will be analyzed to investigate its impact on users, on social welfare and on providers’ investment incentives, among others, and eventually propose how (and if) network neutrality should be implemented.
See http://www.irisa.fr/dionysos/pages_perso/tuffin/MENEUR/

8.3. European Initiatives

8.3.1. NoE EuroNF
Participants: Gerardo Rubino, Bruno Tuffin.
EuroNF Euro-NF is a Network of Excellence on the Network of the Future, formed by 35 institutions (from the academia and industry) from 16 countries. Its main target is to integrate the research effort of the partners to be a source of innovation and a think tank on possible scientific, technological and socio-economic trajectories towards the network of the future. It has started in January 2008 and is ending in June 2012 (see http://euronf.enst.fr/en_accueil.html ) .
Bruno Tuffin is the INRIA team leader in this project. The group is contributing to the following working packages (Joint Research Activities):

- WP.JRA.2.2: Traffic Engineering, Mechanisms and Protocols for Controlled Bandwidth Sharing;
- WP.JRA.2.4: Routing and Traffic Management in a Multi-Provider Context;
- WP.JRA.2.5: Design of Optimal Highly Dependable Networks;
- WP.JRA.3.2: SLAs, Pricing, Quality of Experience;
- WP.JRA.3.3: Cost Models.

8.3.2. AMESA project

**Participant:** Bruno Tuffin.

We are member of AMESA project (Analysis of MEchanisms for Sponsored search Auctions) within EuroNF NoE, funded for a period of about one year Oct. 2009 and Dec. 2011, in collaboration with, Athens University of Economics and Business, the CWI, TELECOM Bretagne and the University of Rome.

8.3.3. Collaborations in European Programs, except FP7

**Program:** COST
**Project acronym:** ECON@TEL
**Project title:** Econ@Tel - A Telecommunications Economics COST Network
**Duration:** October 2007 - September 2011
**Coordinator:** B. Stiller (ETH Zurich)
**Other partners:** FTW (Austria), INTEC (Belgium), CUT, UniCY (Cyprus), DTU, CBS (Denmark), Institut Telecom, Inria (France), PfH/NILC (Georgia), I-UG RUB (Germany), BME (Hungary), BRAUDE (Israel), FUB, CESPR, UniROM (Italy), RSM (The Netherlands), PUT (Poland), ASE (Romania), UniLj, CHAL, Telia (Sweden), UniLj (Slovenia), UNED, REDTEL (Spain), IC, WBC (U.K.)

**Abstract:** Bruno Tuffin is the French national delegate and project coordinator for the EU COST Activity IS0605. The goal of ECONTEL is to develop a strategic research and training network linking key individuals and organizations in order to enhance European competence in the field of telecommunications economics, to support related R&D-initiatives, and to provide guidelines and recommendations to European players (end-users, enterprises, operators, regulators, policy makers, content providers) concerning the provision to citizens and enterprises of new converged broadband and wireless content delivery networks (see [http://www.cost605.org/](http://www.cost605.org/)).

8.3.4. Major European Organizations with which you have followed Collaborations

**Partner 1:** FTW, Vienna (Austria)
We work with FTW on network economics.

**Partner 2:** NEC lab (Germany)
We work with NEC lab Germany on Machine Type Communication in LTE, and data offload in the context of Femto cell technology.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. MOCQUASIN

**Title:** Monte Carlo and Quasi-Monte Carlo for rare event simulation
INRIA principal investigator: Bruno Tuffin
International Partner:

Institution: Université de Montréal (Canada)
Laboratory: Département d’informatique et recherche opérationnelle
Researcher: Pierre L’Ecuyer

Duration: 2008 - 2013
See also: http://www.irisa.fr/dionysos/pages_perso/tuffin/MOCQUASIN/

Abstract: The goal of MOCQUASIN is to design efficient Monte Carlo and quasi-Monte Carlo simulation methods and to apply them to models in telecommunications. Simulation is indeed often the only method to analyze complex and/or large systems, but also suffers from inefficiency. Two specific situations on which we will focus are rare events, and revenue management. In the two cases, we want to deal with dependent individual events or decisions, a realistic situation requiring adapted solution techniques. The inefficiency of the standard simulation is a known issue to compute the probability of rare event since getting it only once requires in average a long simulation time, but most of the literature has up to now assumed independence in the models. The other framework, revenue management in telecommunications, is the situation of providers trying to define valid offers and capacity investments in front of complex demand models. Here too, a change in the decision of an actor has an impact on the others that has to be taken into account.

8.4.2. ECOS project with Uruguay

- Title: Mesh wireless networks and P2P multimedia applications: tools for guaranteeing Quality of Experience
- INRIA principal investigator: Gerardo Rubino
- Duration: 1 2009 - 12 2011
- International Partner:
  Institution: University of the Republic, Montevideo, Uruguay
  Laboratory: Institute of Computer Science (InCo)
  Researcher: Héctor Cancela (Dean of the Faculty of Engineering, Uruguayan Responsible of the project)

- Abstract: The project consists in developing tools for QoS and QoE analysis of communication networks. We produce techniques for analyzing these structures using Monte Carlo procedures. We also develop tools allowing to reach specific levels in the Quality of Experience of transport structures for multimedia purposes, in particular when the underlying network is a mesh wireless system.

8.4.3. Visits of International Scientists

8.4.3.1. Internships

Saurabh Saxena

Subject: Video streaming in BiTorrent (P2P) networks
Institution: IIT Kanpur (India)

8.4.4. STIC Algérie

Title: Utilisation de la plate-forme de test Senslab pour le projet irrigsense
Principal investigator: Adlen Ksentini
International Partner:
Institution: Centre de Recherche sur l’information Scientifique et Technique (CERIST)
INRIA: three teams involved: Dionysos, ASAP and Cider
Laboratory: Department of Theories and Computer engineering
Researcher: Abdelouahid Derhab

Duration: 2011 - 2013

Abstract: This collaboration aims at defining new protocols for data collecting in Wireless Sensor Networks, and evaluate them with the senslab platform. After validating the proposed protocols, CERIST intends to deploy them in the context of the project (Algerian) "Sensirrig", which aims at using sensors for agricultural irrigation.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. Contrat CREATE ActivDoc

Title: ActivDoc
Type: CREATE
Defi: Telecom
Duration: February 2007 - August 2011
Coordinator: Albert Benveniste
Abstract: Activdoc is funded by Région Bretagne. It started in February 2007, for 18 months, and was extended twice for 18 months. This project ended in August 2011, and funded studies on composite web services in a quantitative and qualitative way. The fundamental models studied during this project are models for Quality of Service and models for active documents. We have developed composition techniques for Web systems based on the paradigm of active documents. In particular, Activdoc funded Benoît Masson’s Post doctoral stay in Distribcom, which eventually led to the design of a distributed active document simulator.

8.1.2. Contrat CREATE Estase

Title: Estase
Type: CREATE
Defi: Lifting the applicability of formal methods to real life application.
Duration: Three years
Coordinator: Axel Legay
Others partners: None
Abstract: The main objective of the Estase project is to develop new statistical model checking algorithms. In addition, we shall study the concept of stochastic abstraction that allows to abstract the global behavior of a system by probability distribution. The results of Estase shall be implemented in the PLASMA toolset developed at INRIA Rennes.

8.2. National Initiatives

8.2.1. ANR DOTS

Participants: Claude Jard, Loïc Hélouët.


Dots (http://www.lsv.ens-cachan.fr/anr-dots/) is a national research project where Distribcom cooperates with the LSV/ENS Cachan, the LABRI/Bordeaux, the LAMSADE/Paris Dauphine and the IRCCyN/Nantes. It started in January 2007 and was originally scheduled to end in December 2010. It was extended for one additional year. The ambitious goal of the project is to consider open systems (that is interacting with other undefined systems) which are distributed and require timing information, in order to analyze concrete systems without abstracting one of these aspects. For instance, the interference between several systems require a combination of opened, distributed and timed information. Distribcom is in charge of the interaction of distributed systems with timing aspect (as timed Petri nets) or openness (as distributed controllers and distributed games).
8.2.2. ANR IMPRO

Participants: Claude Jard, Loïc Hélouët, Rouwaida Abdallah, Akshay Sundararaman.


ImpRo (http://anr-impro.irccyn.ec-nantes.fr/) is an academic research project funded by the French national research agency, within its non-thematic (“Blanc”) program. This project addresses the issues related to the practical implementation of formal models for the design of communicating embedded systems: such models abstract many complex features or limitations of the execution environment. The modeling of time, in particular, is usually ideal, with infinitely precise clocks, instantaneous tests or mode commutations, etc. Our objective is thus to study to what extent the practical implementation of these models preserves their good properties. We will first define a generic mathematical framework to reason about and measure implementability, and then study the possibility to integrate implementability constraints in the models. We will particularly focus on the combination of several sources of perturbation such as resource allocation, the distributed architecture of applications, etc. We will also study implementability through control and diagnostic techniques. We will finally apply the developed methods to a case study based on the AUTOSAR architecture, a standard of the automotive industry.

Distribcom cooperates with IRCCyN (Nantes), LIP6 (Paris), LSV (Cachan), LIAFA (Paris) and LIF (Marseille). The coordinator is Didier Lime from IRCCyN. It mainly adressses implementability of scenarios and Time Petri Nets, focusing on concurrency aspects.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. DISC

Title: Distributed supervisory control of large plants
Type: COOPERATION (ICT)
Defi: Networked embedded and control systems
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2008 - December 2011
Coordinator: Univ. of Cagliari (Italy)
Others partners: Univ. of Cagliari (IT), CWI (NL), Univ. of Gent (B), Tech. Univ. Berlin (G), Univ. Zaragosa (S), Akhela (IT), CyBio (G)
See also: http://www.disc-project.eu/

Abstract: Supervisory control is a formal approach for the control of discrete event systems that aims to solve logical problems of safety, resource allocation, liveness, and fault diagnosis that can be encountered in all systems with a high degree of automation. It provides a conceptual framework for developing methods and tools for system design.

An open issue is the application of this methodology to those control problems that arise in networked embedded systems. These distributed plants are composed by several local agents that take concurrently decisions, based on information that may be local or received from neighbouring agents; they require scalable and self-organising platforms for advanced computing and control. An important feature of this type of processes is the possibility of studying them at an appropriate level of abstraction where the resulting model is a purely discrete event one. The evolution is guided by the occurrence of asynchronous events, as opposed to other real-time models where the event occurrence is time-triggered.

We plan to use several techniques to reduce the computational complexity that is one of the major obstacles to the technology transfer of supervisory control methodologies to distributed plants. These techniques are: modularity in the modelling and control design phases; coordinating control; fluidisation of some discrete-event dynamics to reduce state-space cardinality; modular state identification and modular fault detection based on the design of decentralized observers.
8.3.1.2. UniverSelf

Title: UniverSelf
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: September 2010 - August 2013
Coordinator: Alcatel Lucent (France)
Others partners: Alcatel Lucent (F, Ir, G), NEC (G), Thales (F), Orange (F), Telecom Italia (It), Telefonica (E), Univ. College London (GB), Univ. of Surrey (GB), Univ. of Twente (NL), Univ. of Piraeus (G), Univ. of Athens (G), IBBT (B), VTT
See also: http://www.univerself-project.eu/
Abstract: UniverSelf unites 17 partners with the aim of overcoming the growing management complexity of future networking systems, and to reduce the barriers that complexity and ossification pose to further growth.

While there has been undeniable progress in the field of autonomies research over the past several years across the world and especially in Europe, widespread deployments of self-management techniques are still missing. At the same time the need for techniques enabling the transformation of operational models, the evolution of networks towards a flexible playground for operators, and more generally techniques participating to the increase of the return on investment, is becoming more and more evident. Further, most efforts and initiatives have been focussed on solving manageability bottlenecks in a given technological domain, while services extend anywhere, regardless of the technological boundaries (e.g., wireline/wireless). UniverSelf arises from this context and is thus driven by the need and objective to take self-management a leap further, and, in doing so, be both a federating and impactful project.

8.3.1.3. Danse

Type: COOPERATION (ICT)
Defi: Studying Systems of Systems (Dynamical Systems)
Instrument: Integrated Project (IP)
Duration: November 2011 - October 2014
Coordinator: Alcatel Lucent (France)
Others partners: OFFIS Institute for Information Technology (Germany), IBM Israel - Science and Technology LTD (ISRAEL), Israel Aerospace Industries (ISRAEL), Advanced Laboratory on Embedded Systems S.R.L (Italy), INRIA (France), Loughborough University (United Kingdom), EADS Innovation Works (United Kingdom), Selex Sistemi Integrati (Italy)
Abstract: Our objective is to build theory and practice for Systems of Systems (SoS). More precisely, we shall provide more important insights on SoS and understand why they must be treated differently to conventional systems.

8.3.1.4. Dali

Title: Devices for assisted Living
Type: Collaboration (ICT)
Defi: Building an automatic machine capable of assisting elderly people.
Instrument: STREP
Duration: November 2011 - October 2014
Coordinator: Trento (France)
Others partners: University of Trento (Italy), Visual Tools (Spain), Forth (Greece), Northumbria University (United Kingdom), University of Siena (Italy), INRIA (France), INDRA Software (Spain), Siemens AG Österreich (Austria)

Abstract: The objective is to build a machine that can help an elderly person to avoid obstacles. The role of INRIA is to design the algorithm that will run within the engine of the machine.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. DST

Title: Distributed Supervision and Time
INRIA principal investigator: Loïc Hélouët
International Partner:
  Institution: National University of Singapore (Singapore)
  Laboratory: National University of Singapore
  Researcher: Madhavan Mukund

International Partner:
  Institution: Chennai Mathematical Institute (India)
  Laboratory: Institute for Mathematical Sciences
  Researcher: P.S. Thiagarajan

International Partner:
  Institution: Institute of Mathematical Sciences Chennai (India)
  Laboratory: Theoretical Computer Science
  Researcher: R. Ramanujam

Duration: 2009 - 2011
See also: http://www.irisa.fr/distribcom/DST09/

This associated team is a tripartite collaboration between two projects at INRIA Rennes (S4 & Distribcom), the National University of Singapore (NUS), and two institutes in Chennai (INDIA), the Chennai Mathematical Institute (CMI) and the Institute of Mathematical Sciences (IMS). The objective of the DST project is to study distributed systems, supervision and time issues with the help of concurrency models. The two main themes of the project are supervision, and quantitative/timed aspects of systems. The supervision theme focuses on distributed scheduling policies of distributed systems to ensure satisfaction of some properties (preservation of some bound on communication channels, for instance), diagnosis, and distributed control techniques. The second theme on time aspects of distributed systems focuses on the analysis of qualitative and quantitative properties of timed systems and models. The quantitative approaches rely on network calculus applied to multimode Real Time Calculus, and the timed models studied during the collaboration are time-constrained scenarios. A recent advance is DST is the elaboration of a model to describe and verify sessions in web-based systems.

8.4.1.2. FOSSA

Title: Formalizing Orchestration & Secure Services Analysis
INRIA principal investigator: Albert Benveniste

International Partner:

Institution: University of Texas Austin (United States)
Laboratory: Computer Science Department

Duration: 2010 - 2012

See also: http://www.irisa.fr/distribcom/FOSSA2010/index.htm

The widespread deployment of networked applications and adoption of the internet has fostered an environment in which many distributed services are available. There is great demand to automate business processes and workflows among organizations and individuals. Solutions to such problems require orchestration or choreography of concurrent and distributed services in the face of arbitrary delays and failures of components and communication. The Orc team, lead by Jayadev Misra at the University of Texas at Austin, has developed the Orc language to support orchestrations. The DistribCom team has developed studies regarding the Quality of Services of orchestrations and choreographies, with emphasis on Orc. The teams cooperate since 2006 and have decided to join their efforts in launching the associated team FOSSA.

The above tracks have been developed to success in 2011:

- We have come up with a comprehensive theory of QoS for service orchestrations, and more generally composite services. We believe our contract-based approach for QoS is deeply novel and we have submitted a joint paper to the IEEE Transactions on Software, which is currently under revision.
- Causality analysis of Orc programs has been completed. An efficient implementation is under development by John Thywissen (Austin) and Ajay Kattepur, Claude Jard (DistribCom). A joint publication is planned.
- The combination of orchestration languages (such as Orc) and document based workflows (such as Active XML) is of primary interest, as it offers a nice blending of declarative and functional/imperative styles of programming, for large applications. This topic has now started, under the leadership of Loïc Hélouët, with the ongoing deployment on top of Rest of a platform of servers implementing Distributed AXML.

Visits and Exchanges in 2011:

- February 25 – March 4: Ajay Kattepur has extended his stay for one more week in Austin.
- June 27 – July 1st: John Thywissen visited Rennes. Minutes of his stay are available.
DNET Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ESPAD (FEDER)

Participants: Guillaume Chelius, Sandrine Avakian, Guillaume Roche.

The ESPAD (Embedded Sport Performance Analysis Data) is bio-mechanics / physiology logging project funded by FEDER. The goal is to contributed to the design of a distributed multi-sensor architecture that can be worn by an individual and that records bio-mechanical, physiological and environmental data.

8.2. National Initiatives

8.2.1. Complex Networks Metrology (RNSC)

Participant: Christophe Crespelle.

D-NET is a member of the project Complex Networks Metrology involving LIP6 (Université Paris 6), LSIIT (Université de Strasbourg) and LIP (ENS de Lyon, Université Lyon 1). The project, funded by RNSC (Réseau National des Systèmes Complexes), started in January 2011 and ended in December 2011. Its goal is to design rigorous methods for measuring complex networks. The originality of our approach is to lead measurements dedicated to a specific property instead of trying to get a complete view of the network, which has been showed to lead to significant biases in the obtained view. Its major domain of application is Internet measurements.

8.2.2. SensLAB (ANR)

Participants: Eric Fleury [Prime Investigator], Guillaume Chelius.

The purpose of the SensLAB project is to deploy a very large scale open wireless sensor network platform. SensLAB’s main and most important goal is to offer an accurate and efficient scientific tool to help in the design, development, tuning, and experimentation of real large-scale sensor network applications. The sensLAB platform is distributed among 4 sites and is composed of 1,024 nodes. Each location hosts 256 sensor nodes with specific characteristics in order to offer a wide spectrum of possibilities and heterogeneity. The four test beds are however part of a common global testbed as several nodes will have global connectivity such that it will be possible to experiment a given application on all 1K sensors at the same time.

8.2.3. FLab (ANR)

Participants: Eric Fleury, Sandrine Avakian.

As proposed by initiatives in Europe and worldwide, enabling an open, general-purpose, and sustainable large-scale shared experimental facility will foster the emergence of the Future Internet. There is an increasing demand among researchers and production system architects to federate testbed resources from multiple autonomous organizations into a seamless/ubiquitous resource pool, thereby giving users standard interfaces for accessing the widely distributed and diverse collection of resources they need to conduct their experiments. The F-Lab project builds on a leading prototype for such a facility: the OneLab federation of testbeds. OneLab pioneered the concept of testbed federation, providing a federation model that has been proven through a durable interconnection between its flagship testbed PlanetLab Europe (PLE) and the global PlanetLab infrastructure, mutualizing over five hundred sites around the world. One key objective of F-Lab is to further develop an understanding of what it means for autonomous organizations operating heterogeneous testbeds to federate their computation, storage and network resources, including defining terminology, establishing universal design principles, and identifying candidate federation strategies. On the operational side, F-Lab will enhance OneLab with the contribution of the unique sensor network testbeds from SensLAB, and LTE based
cellular systems. In doing so, F-Lab continues the expansion of OneLab’s capabilities through federation with an established set of heterogeneous testbeds with high international visibility and value for users, developing the federation concept in the process, and playing a major role in the federation of national and international testbeds. F-Lab will also develop tools to conduct end-to-end experiments using the OneLab facility enriched with SensLAB and LTE.

F-Lab is a unique opportunity for the French community to play a stronger role in the design of federation systems, a topic of growing interest; for the SensLAB testbed to reach an international visibility and use; and for pioneering testbeds on LTE technology.

8.2.4. SensAS (INRIA ADT)

Participants: Eric Fleury [Prime Investigator], Guillaume Chelius [scientific correspondent of the SENSBIOS work package].

The ambition of SensAS is to deploy wireless sensor and actuator applications. From the strong expertise gather in MOSAR, SensLAB and SensTOOLS, the goal is to transfer and help other INRIA research team to deploy their own application, not in the restricted networking area: flying drones, robots fleet, biologging, health, management?

8.2.5. DyVi (INRIA ARC)

Participants: Eric Fleury [Prime Investigator], Qinna Wang, Adrien Friggeri.

The goal of the ARC DyVi is to build a foundation for dynamic graph theory in order to be able to describe properties and design efficient and specific algorithmic for dynamic graph and overlapping communities The goal is to be able to tackle multi time scale visualization tools based on TULIP, to implement data structure / handling / time scale aggregation / browsing within the TULIP software developed by the INRIA GRAVITE team. We also target epidemic process visualization in order to be able to run ”see” dynamic processes on dynamic networks

8.3. European Initiatives

8.3.1. Collaborations in European Programs, except FP7

Program: FP6 - LSH
Project acronym: MOSAR
Project title: Mastering hOSpital Antimicrobial Resistance and its spread into the community
Duration: 2008 – 2012
Coordinator: INSERM
Other partners: University of Antwerp (Belgium), National Medicines Institute (Poland), August Pi i Sunyer biomedical research Institute (Spain), University Medical Center Utrecht (Netherlands), University of Geneva Hospitals (Swisslands), Tel Aviv Medical Center (Israel), Health Protection Agency (UK), Medical school of Paris 12 University (France), Pasteur Institute (France), Inserm-Transfert (France), Ingen Biosciences (France), BiologischeAnalyrensystemenGmbH (Germany), AmpTec GmbH (Germany), Array-On GmbH (Germany)

Abstract: MOSAR is an Integrated Project supported for 5 years by the European Commission under the Life Science Health Priority of the Sixth Framework Program. Infections caused by antimicrobial-resistant bacteria (AMRB) account for an increasing proportion of healthcare-associated infections, particularly in high-risk units such as intensive care units and surgery; patients discharged to rehabilitation units often remain carriers of AMRB, contributing to their dissemination into longer-term care areas and within the community. The overall objective of MOSAR is to gain breakthrough knowledge in the dynamics of transmission of AMRB, and address highly controversial issues by testing strategies to combat the emergence and spread of antimicrobial resistance,
focusing on the major and emerging multi-drug antimicrobial resistant microorganisms in hospitals, now spreading into the community. Microbial genomics and human response to carriage of AMRB will be integrated with health sciences research, including interventional controlled studies in diverse hospital settings, mathematical modeling of resistance dynamics, and health economics. Results from MOSAR will inform healthcare workers and decision-makers on strategies for anticipating and mastering antimicrobial resistance.

8.4. International Initiatives

8.4.1. Visits of International Scientists

- Thi Ha Duong Phan, Academy of Science and Technology in Vietnam, was in visit in the D-NET team for one month in June 2011.
- Renaud Lambiotte, University of Namur in Belgium, was in visit in the D-NET team in November 2011.
- Mariano Beiro, Universidad de Buenos Aires, was in visit in the DNET team for 4 months.
- Duc Thinh Nguyen, Intitut de la Francophonie pour l’Informatique in Hanoi (Vietnam), made his Master internship in the D-NET team for six months from March to September 2011.

8.4.2. Participation In International Programs

8.4.2.1. STIC AMSUD
Project 09STIC04, Dynamics of Layered Complex Networks, between the LNCC in Brazil (Prime Investigator is Artur Ziviani), UFMG in Brazil, Universidad de Buenos Aires in Argentina, UPMC in France and INRIA. The goal is to develop a better understanding of the issues involved in dealing with dynamic graphs and their applicability to real-world complex networks. We also establish a thematic and collaborative research network between the partners of this project involving complementary backgrounds to deal with the challenges of investigating complex network systems.

8.4.2.2. Inria/FAPERJ
Project CoDyN (Complex Dynamic Networks) between LNCC and DNET/INRIA. The main goal of the CoDyN project is to lay solid foundations to the characterization of dynamically evolving networks, and to the field of dynamical processes occurring on large scale dynamic interaction networks.

8.4.2.3. PICS CNRS – Combinatorial Structures for Complex Network Modeling
**Participant:** Christophe Crespelle.

D-NET is a member of a PICS project of the CNRS between the Academy of Science and Technology in Vietnam and the Laboratoire d’Informatique de Paris 6 (LIP6) and Université Claude Bernard Lyon 1 in France. The project started on January 2010 and will end in December 2012. Its goal is to design models of complex networks that are able to capture at the same time two of their most relevant properties: their heterogeneous degree distribution and their high local density. The goal is to provide very general models that do not make stronger assumptions on the structure of the graphs to be modeled. Our approach is based on the overlapping structure of cliques in complex networks and uses mainly tools coming from combinatorics, graph theory and statistics.
GANG Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

6.1.1. PEFICAMO

Participants: Hugues Fauconnier, Carole Gallet-Delporte, Julien Clément.

Managed by University Paris Diderot, H. Fauconnier is leading this project granting J. Clément from Région Ile de France.

6.2. National Initiatives

6.2.1. ANR Algorithm Design and Analysis for Implicitly and Incompletely Defined Interaction Networks (ALADDIN)

Participants: Cyril Gavoille [CNRS LABRI, University of Bordeaux, France], Dominique Fortin, Laurent Viennot, Michel Habib, Pierre Charbit, Pierre Fraigniaud.

Pierre Fraigniaud is leading an ANR project “blanc” (i.e. fundamental research) about the fundamental aspects of large interaction networks enabling massive distributed storage, efficient decentralized information retrieval, quick inter-user exchanges, and/or rapid information dissemination. The project is mostly oriented towards the design and analysis of algorithms for these (logical) networks, by taking into account proper ties inherent to the underlying infrastructures upon which they are built. The infrastructures and/or overlays considered in this project are selected from different contexts, including communication networks (from Internet to sensor networks), and societal networks (from the Web to P2P networks). Ending in november 2011, the project is prolonged until end of 2012 for LABRI partner.

6.2.2. ANR PROSE

Participants: Pierre Fraigniaud, Amos Korman, Laurent Viennot.

Managed by University Paris Diderot, P. Fraigniaud leads this project.

6.2.3. ANR Shaman

Participants: Hugues Fauconnier, Pierre Fraigniaud, Carole Gallet-Delporte, Hung Tran-The, Laurent Viennot.

Managed by University Paris Diderot, H. Fauconnier leads this project that grants Ph. D. H. Tran-The.

6.2.4. ANR Displexity

Participants: Hugues Fauconnier, Pierre Fraigniaud, Carole Gallet-Delporte, Amos Korman, Hung Tran-The, Laurent Viennot.

Managed by University Paris Diderot, C. Delporte and H. Fauconnier lead this project that grants 1 Ph. D. and 2 internships per year.
6.3. European Initiatives

6.3.1. FP7 Projet

6.3.1.1. EULER

Title: Experimental UpdateLess Evolutive Routing
Type: COOPERATION (ICT)
Defi: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2010 - September 2013
Coordinator: ALCATEL-LUCENT (Belgium)

See also: http://www.euler-fire-project.eu/

Abstract: EULER is a 3-year STREP Project targeting Challenge 1 “Technologies and systems architectures for the Future Internet” of the European Commission (EC) Seventh Framework Programme (FP7). The project scope and methodology position within the FIRE (Future Internet Research and Experimentation) Objective ICT-2009.1.6 Part b: Future Internet experimentally-driven research.

The main objective of the EULER exploratory research project is to investigate new routing paradigms so as to design, develop, and validate experimentally a distributed and dynamic routing scheme suitable for the future Internet and its evolution. The resulting routing scheme(s) is/are intended to address the fundamental limits of current stretch-1 shortest-path routing in terms of routing table scalability but also topology and policy dynamics (perform efficiently under dynamic network conditions). Therefore, this project will investigate trade-offs between routing table size (to enhance scalability), routing scheme stretch (to ensure routing quality) and communication cost (to efficiently and timely react to various failures). The driving idea of this research project is to make use of the structural and statistical properties of the Internet topology (some of which are hidden) as well as the stability and convergence properties of the Internet policy in order to specialize the design of a distributed routing scheme known to perform efficiently under dynamic network and policy conditions when these properties are met. The project will develop new models and tools to exhaustively analyse the Internet topology, to accurately and reliably measure its properties, and to precisely characterize its evolution. These models, that will better reflect the network and its policy dynamics, will be used to derive useful properties and metrics for the routing schemes and provide relevant experimental scenarios. The project will develop appropriate tools to evaluate the performance of the proposed routing schemes on large-scale topologies (order of 10k nodes). Prototype of the routing protocols as well as their functional validation and performance benchmarking on the iLAB experimental facility and/or virtual experimental facilities such as PlanetLab/OneLab will allow validating under realistic conditions the overall behaviour of the proposed routing schemes.

6.3.2. Collaborations in European Programs, except FP7

Program: EIT ICT Labs
Project acronym: TREC-EIT-GA2011-HORS-5643
Project title: 
Duration: 2011
Coordinator:Ilkka Norros
Other partners: KTH (Finland), Fraunhofer (Germany)

Abstract: Content Distribution challenging issues; managed by TREC for France, the project allowed Pascal Felber to be invited by Fabien Mathieu for a postdoctoral position.
6.4. Teaching

Master MPRI
- Michel Habib is in charge of a course entitled “graph algorithms”.
- Pierre Fraigniaud (12 hours) is in charge of the course “Algorithmique distribuée pour les réseaux”;
- Carole Delporte and Hugues Fauconnier are in charge of “Algorithmique distribuée avec mémoire partagée”;
- Laurent Viennot (12 hours) is teaching “Structures de données distribuées et routage”

D.U.T., University of Paris Diderot
- Yacine Boufkhad (192 hours) is teaching scientific computer science and networks.

Computer Science U.F.R., University of Paris Diderot
- Fabien de Montgolfier (192 hours) is teaching foundation of computer science, algorithms, and computer architecture (192 hours);

Master 2 Computer Science, University of Marne-la-Vallée
- Fabien de Montgolfier is teaching P2P theory and application.

Professional Master, Paris Diderot University
- Michel Habib (192 hours) is in charge of two courses entitled: Search Engines; Parallelism and mobility, which includes peer-to-peer overlay networks;
- Carole Delporte (192 hours) is teaching “Distributed programming”; 
- Hugues Fauconnier (192 hours) in charge of both courses “Internet Protocols and Distributed algorithms”.

Master 2 Computer Science, University of Paris 6
- Fabien Mathieu is teaching Peer-to-peer Networks (6 hours).

PhD : Mauricio Soto, "Quelques propriétés topologiques des graphes et applications à Internet et aux réseaux", Paris Diderot University, 2 December 2011, supervisors: Fabien de Montgolfier et Laurent Viennot;
PhD : Thu-Hien To: "On some graph problems in phylogenetics", Paris Diderot University, 15 September 2011, supervisor: Michel Habib;
PhD in progress : Hung Tran-The, Failure detection with Byzantine adversary, from 2010, supervisors: Hugues Fauconnier and Carole Delporte,
8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. FP7 Projet

8.1.1.1. OPNEX

Title: Optimization driven Multi-Hop Network Design and Experimentation
Type: COOPERATION (ICT)
Defi: New paradigms and experimental facilities
Instrument: Specific Targeted Research Project (STREP)
Duration: May 2008 - April 2011
Coordinator: CRTH (Greece)
Others partners: Technicolor, Freie Universitaet Berlin (FUB), Politechnika Poznanska (PUT)
See also: http://www.opnex.eu/

Abstract: OPNEX delivers a first principles approach to the design of architectures and protocols for multi-hop wireless networks. Systems and optimization theory is used as the foundation for algorithms that provably achieve full transport capacity of wireless systems. Subsequently a plan for converting the algorithms termed in abstract network models to protocols and architectures in practical wireless systems is given. Finally a validation methodology through experimental protocol evaluation in real network test-beds is proposed. OPNEX will use recent advances in system theoretic network control, including the backpressure principle, max-weight scheduling, utility optimization congestion control and primal-dual method for extracting network algorithms. These approaches exhibited already vast potential for achieving maximum capacity and full exploitation of resources in abstract network models and found their way to reality in high performance switching architectures and recent variants of TCP that embody the primal-dual optimization principle. Wireless, the fastest growing component of internet today, is also the least understood for the designer due to mobility, rapidly changing topology, radio link unpredictability and volatile load distribution among others. Current approaches used in practice for multi-hop wireless, the basic communication infrastructure for sensor network extensions of the internet, are mostly empirical and heuristic. Our system optimization approach will provide a rigorous integrated system design framework from physical up to network and transport layer that renders itself to validation and comparison with the theoretically optimal performance in terms of throughput, spectrum and energy utilization. The adopted approach on decentralization, communication and computational complexity reduction as well as autonomous operation will lead to implementable algorithms and architectures to be validated eventually in the proposed test-beds.

8.1.2. EDA project

Program: EDA (European Defense Agency
Project acronym: ETARE
Project title: ETARE
Duration: 2008-2011
Coordinator: Thales Italy
Other partners: Thales France and Belgium, Patria Aviation, Oulu university, Selex, Insta, Sapienza university and Elektrobit.

Abstract: ETARE is a project of EDA (European Defense Agency). The goal of the ETARE project is to ease the requirement to transmit more and more information and to interconnect the users in ad hoc networks. These ad hoc networks will link together the different elements on the battlefield (vehicles, foot soldiers, helicopters) and possibly connect them with naval forces. This will be possible through High Data Rate Networking waveforms, which will also insure interoperability between forces.

In this project, INRIA’s contribution is focused on network layer. INRIA studies the various protocol’s ability to handle heterogeneous ad hoc networks as well as QoS features. INRIA has delivered a draft document for this study with the following issues

- Legacy routing protocols and geographic aware protocols,
- Overhead of routing protocols,
- General QoS architecture and application of this architecture for CSMA and TDMA protocols.

Participants: Cédric Adjih, Philippe Jacquet, Paul Mühlethaler.

8.2. International Initiatives

8.2.1. INRIA Associate Teams

8.2.1.1. RSFCI

Title: Routing in Intermittently Connected Wireless Networks
INRIA principal investigator: Philippe Jacquet

International Partner:

Institution: Macquarie University (Australia)
Laboratory: Department of Computing

Duration: 2009 - 2011
See also: http://hipercom.inria.fr/RSFCI/home.html

We study the problem of routing in intermittently connected wireless networks. In such networks information remains blocked in a connected component as long as the node motion allows to jump into or form a new connected component. This kind of networks are often alternatively refered as Delay/Disruption Tolerant Networks (DTN) and is the focuse of many research efforts worldwide (DARPA, IETF). Our main objective is to specify efficients routing algorithms in delivery time, energy and overhead that allow to forward piece of information or packets toward a distant destination in a remote connected component currently out of reach. Our common studies range from theory to proactice: we focus as well on fundamental issues such as the information propagation speed determination to the specification of a routing algorithm and protocol that approaches this theoretical performances.

8.2.2. Participation In International Programs

8.2.2.1. STIC TUNISIE

Title: Auto-adaptativity of a wireless sensor network with mobile agents : toward a green sensor network.
INRIA principal investigator: Pascale Minet
International Partner:

Institution: ENSI (Tunisia)
Laboratory: CRISTAL
Team leader: Leila Saidane

Duration: 2009 - 2011

Abstract: This project aims to design algorithms and protocols for wireless sensors and mobile agents able to meet application requirements and provide the best performances in the considered environment. To achieve that, a cross-layering approach is considered. The network layer may use the information generated by any other higher or lower layer in the purpose of a better adaptivity to the application or the environment considered. Furthermore, since wireless sensor networks deployment is growing more and more, it is judicious to reduce their ecological impact starting with their design. This project focuses on strategies to improve energy efficiency.
8. Partnerships and Cooperations

8.1. Regional Initiatives

The TEAM is involved in several actions of the regional CPER (Contrat Plan Etat Region) initiative on networked security as well as in the security of industrial networked systems initiative. We are also involved in the smart living initiative of the CPER where we provide our expertise on embedded operating systems and sensors.

8.2. National Initiatives

The team is participating in several national research projects: ANR MAPE and coordinator of the ANR VAMPIRE project. In addition the team is involved in one P2P project with the University of Troyes (GIS 3S).

8.3. European Initiatives

8.3.1. Think tanks and european institutes

Olivier Festor is member of the Future Media Internet think tank at the European Commission, part of the European Future Internet Assembly. In 2011, the think tank did contribute to the FIA events and issue one white paper on the Future Media Internet Architecture [37].

Since November 1st 2011, Olivier Festor is the Director of Research of the European Institute of Innovation and Technology EIT ICT Labs.

8.3.2. Academics cooperations

MADYNES has an ongoing collaboration with the University of Luxembourg on network security. Two joint thesis are part of this collaboration: the thesis of Gerard Wagener on high interaction honeypot models and the thesis of Sheila Becker on game theory-based protocol fuzzing.

We are also members of the EUNICE consortium. EUNICE has been established to foster the mobility of students, faculty members and research scientists working in the field of information and communication technologies and to promote educational and research cooperations between its member institutions. The major event of EUNICE is an annual summer school which brings together lecturers, researchers, students and people from the industry across Europe for one week of presentations, discussions and networking. Isabelle Chrisment is member of EUNICE technical committee.

8.3.3. FP7 Projects

8.3.3.1. Universef

Title: Universef
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: September 2010 - August 2013
Coordinator: Alcatel Lucent Bellabs (France)
Others partners: Alcatel-Lucent Bell Labs (France), Alcatel Lucent Ireland Limited (Ireland),
Alcatel-Lucent Deutschland AG (Germany), NEC Europe Ltd. (Germany), Thales Communications
SA (France), France Telecom SA (France), Telecom Italia S.p.A (Italy), Telefonica Investigacion
y Desarrollo (Spain), Fraunhofer-Gesellschaft Zur Foerderung Der Angewandten Forschung E.V
(Germany), Interdisciplinary Institute for Broadband Technology (Belgium), Inria (France), VTT
Technical Research Centre of Finland (Finland), University College London (UK), University of
Surrey (UK), National and Kapodistrian University of Athens (Greece), University of Piraeus
Research Centre (Greece), Universiteit Twente (The Netherlands)
See also: www.univerself-project.eu/

Abstract: This FP7 european integrated project aims at consolidating the autonomic methods and
techniques supporting the management of the future Internet, and at integrating these methods into
a unified management framework. The objective of this framework is to address the management is-
issues of the evolving Internet through the self-organisation of the control plane and the empowerment
of the management plane with cognition.

Our work in the UniverseSelf project mainly concerns the security and safety challenges posed by the unified
management framework, in particular the prevention of configuration vulnerabilities.

8.3.3.2. FI-WARE

Title: Future Internet Core Platform
Type: COOPERATION (ICT)
Defi: PPP FI: Technology Foundation: Future Internet Core Platform
Instrument: Integrated Project (IP)
Duration: May 2011 - April 2014
Coordinator: Telefonica (Spain)
Others partners: Telefonica I+D (Spain), SAP AG (Germany), IBM, Thales (France), Telecom Italia
(Italy), Orange Labs - France Telecom (France), Nokia Siemens Networks (Germany), Deutsche
Telekom (Germany), Technicolor (France), Ericsson (Sweden), ATOS ORIGIN S.A.E (Space), En-
gineering Ingegneria Informatica S.p.A (Italy), Alcatel-Lucent Deutschland AG (Germany), Alcatel-
Lucent Italia S.p.A (Italy), Siemens AG (Germany), Intel (Ireland), NEC Europe Ltd. (Germany),
Fraunhofer Institute for Open Communication Systems FOKUS (Germany), Inria (France), Univer-
sidad Politectnica de Madrid (Spain), University of Duisburg-Essen (Germany), University of Rome
- Sapienza (Italy), University of Surrey (UK),
See also: http://www.fi-ware.eu/

Abstract: The goal of the FI-WARE project is to advance the global competitiveness of the EU
economy by introducing an innovative infrastructure for cost-effective creation and delivery of
services, providing high QoS and security guarantees. FI-WARE is designed to meet the demands
of key market stakeholders across many different sectors, e.g., healthcare, telecommunications, and
environmental services. The project unites major European industrial actors in an unique effort never
seen before.

The key deliverables of FI-WARE will deliver an open architecture and implementation of a
novel service infrastructure, building upon generic and reusable building blocks developed in
earlier research projects. This infrastructure will support emerging Future Internet (FI)ervices in
multiple Usage Areas, and will exhibit significant and quantifiable improvements in the productivity,
reliability and cost of service development and delivery - building a true foundation for the Future
Internet.

The MADYNES contributions to the FI-WARE project are:

- a fuzzing framework for the Internet of Things part dimension of the FI-WARE platform. More
  specifically we will instanciate the KIF framework to a SCADA case study;
- a smartphone level flow monitoring appliance;
- integration facility of OVAL specifications into the FI-WARE ecosystem.
8.3.3.3. **SCAMSTOP**

Title: SCAMSTOP  
Type: CAPACITIES (Research for SMEs)  
Instrument: Research for the Benefit of SMEs (SME)  
Duration: January 2010 - December 2011  
Coordinator: Fraunhofer Institute for Open communication Systems FhG Fokus (Germany)  
Others partners: TEI of Mesolonghi (Greece), Inria (France), Telio (Norway), Voz Telecom (Spain), PDM & FC (Portugal)  
See also: [http://www.sme-scamstop.eu/](http://www.sme-scamstop.eu/)

Abstract: SCAMSTOP will provide a complete framework/solution for automatic fraud detection that alarms providers when suspicious behaviour is detected. Thereby, SCAMTOP will make fraud detection not only simpler but much faster as well. The developed tools can be used by VoIP/ISP providers to protect their services against losses due to fraud and to identify previously uncollected revenue sources.

We do contribute to this project by the design and implementation of fraud detection mechanisms based on advanced clustering techniques.

8.4. **International Initiatives**

We actively participate to the Internet Research Task Force (IRTF) Network Management Research Group (NMRG). Since March 1st 2011, Olivier Festor was named co-chair of this research group within IRTF. The group did organize one meeting in Quebec in July 2011. A workshop on flow-level management will be held in conjunction with the next IETF (March 2012) in Paris.

8.4.1. **INRIA International Partners**

We have established a strong cooperation with the team of Thomas Djotio at the Polytechnical Superior National School (PSNS) of the Yaoundé University. We currently have two joint Ph.D. students and regular exchanges of researchers.

8.4.2. **Visits of International Scientists**

8.4.2.1. *Invited researchers and professors*

Ramin Sadre from the University of Twente, spent 3 weeks in the team, working on anomaly detection based on flow analysis.

Pr Priyadarsli Nanda from the University of Technology, Sydney Australia spent 6 months on the team working on new naming schemes and advanced routing on wireless sensor networks.

8.4.2.2. **Internships**

Balkiss Souissi (from Feb 2011 until Aug 2011)  
Subject: A self-monitoring approach for RPL-enabled wireless sensor networks  
Institution: Ecole Nationale d’Ingénieurs de Tunis (ENIT) (Tunisia)

Cesar Bernardini (from Mar 2011 until Oct 2011)  
Subject: An Offensive Security Tool for 6lowpan Networks  
Institution: Universidad Nacional de Cordoba (Argentina)

Bilel Saadallah (from Mar 2011 until Aug 2011)
Subject: Passive Monitoring of 802.15.4/6LowPan-enabled Wireless Sensor Networks  
Institution: Ecole Nationale des Sciences de l’Informatique (Tunisia)

Lucia Masola
Subject: Collaborative Sharing of Vulnerability Descriptions in Autonomic Networks  
Institution: Universidad Nacional del Centro de la Provincia de Buenos Aires (Argentina)

Francois Despaux
Subject: Highly Modular SIP Honeypot  
Institution: Universidad de la Republica (Uruguay)

Damian Vicino
Subject: Design and Implementation of a Multi-Protocol Peer-to-Peer Client  
Institution: Universidad de Buenos Aires (Argentina)

Prabhjot Prabhjot Singh
Subject: NETCONF Friendly Firewall Configuration Models  
Institution: IIT Bombay (India)

Imen Mahjri (from Mar 2011 until Aug 2011)
Subject: Exploring cognitive techniques for sensor networks management  
Institution: Ecole Nationale des Sciences de l’Informatique (Tunisia)
MAESTRO Project-Team

7. Partnerships and Cooperations

7.1. International Initiatives

7.1.1. INRIA International Partners

7.1.1.1. St. Petersburg State University

Participant: Konstantin Avrachenkov.

MAESTRO has a continuing collaboration with St. Petersburg State University. St. Petersburg State University is a partner in INRIA Internship International programme. In particular, MAESTRO hosts every year several intern students from St. Petersburg State University. The collaboration with L. Petrosyan and A. Garnaev is on the application of game theory to resource allocation in networks. The collaboration with V. Dobrynin is on data clustering.

7.1.2. Visits of International Scientists

7.1.2.1. Professors

Augustin Chaintreau (from November 4, 2011 until November 9, 2011)
Institution: Columbia University, New York (USA)

Andrey Garnaev (from May 8, 2011 until May 13, 2011)
Institution: St. Petersburg State University (Russian Federation)

Richard Gibbens (from April 4, 2011 until April 10, 2011)
Institution: University of Cambridge (United Kingdom)

Institution: Russian Academy of Sciences (Russian Federation)

Charles Pearce (from September 25, 2011 until September 30, 2011)
Institution: University of Adelaide (Australia)

Karl Sigman (from March 25, 2011 until March 26, 2011)
Institution: Columbia University, New York (USA)

Don Towsley (from March 28, 2011 until June 27, 2011)
Institution: University of Massachusetts at Amherst (USA)

Uri Yechiali (from March 27, 2011 until April 4, 2011)
Institution: Tel Aviv University (Israel)

7.1.2.2. Post-doctoral fellows

Josu Doncel (from July 9, 2011 until July 16, 2011)
Subject: Multiarmed Bandit Problems
Institution: Basque Center for Applied Mathematics (BCAM), Derio (Spain)
Nicolas Gast (from October 23, 2011 until October 25, 2011)  
Institution: École Polytechnique Fédérale de Lausanne (Switzerland)

Jasper Goseling (from November 14, 2011 until November 18, 2011)  
Institution: University of Twente (The Netherlands)

Peter Jacko (from July 9, 2011 until July 16, 2011)  
Subject: Multiarmed Bandit Problems  
Institution: Basque Center for Applied Mathematics (BCAM), Derio (Spain)

7.1.2.3. Ph.D. students

Eugenio Martin Della Vecchia (from July 11, 2011 until July 19, 2011)  
Subject: Rolling Horizon stochastic control  
Institution: National University of Rosario (Argentina)

Ana Maria Galindo (from September 15, 2011 until December 15, 2011)  
Institution: Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) (Spain)

Naveen K. P. (from October 11, 2011 until October 20, 2011)  
Subject: Self Organization in Wireless Networks  
Institution: Indian Institute of Science, Bangalore (India)

Sulan Wong (from May 2, 2010 until July 31, 2011)  
Subject: Intellectual property and human rights: Patent law interference in the exercise of the scientific research freedom, the right to life and the right to health  
Institution: University of A Coruña (Spain)

7.1.2.4. Graduate students

Tejas Bodas (from October 17, 2011 until October 20, 2011)  
Institution: Indian Institute of Technology Bombay (India)

7.1.2.5. Internships

Adam Abeshouse (from June 1, 2011 until July 21, 2011)  
Subject: Simulator for visualization of evolutionary games  
Institution: Brown University (USA)

Bogdan Augustin Benga (from April 1, 2011 until September 30, 2011)  
Subject: Monte Carlo Methods for Centrality Measures in Online Social Networks  
Institution: West Timisoara University (Romania)

John Boreiko (from June 1, 2011 until July 21, 2011)  
Subject: Simulator for visualization of replicator dynamics in evolutionary games  
Institution: Brown University (USA)

Vladimir Fux (from March 17, 2011 until June 15, 2011)
Subject: Framework for crawling and analyzing web and social networking graphs
Institution: St. Petersburg State University (Russia (Russian Federation))
Alexey Mishenin (from February 23, 2011 until March 25, 2011)

Subject: Random walks based clustering techniques
Institution: St. Petersburg State University (Russia (Russian Federation))
Harshil Mittal (from May 30, 2011 until August 26, 2011)

Subject: Study of network capacity sharing in contents distribution networks
Institution: LNM Institute of Information Technology (India)
Larissa Spinelli (from April 18, 2011 until July 15, 2011)

Subject: Consensus algorithms in complex networks
Institution: Universidade Federal do Rio de Janeiro (Brazil)

7.1.3. Participation in International Programs

7.1.3.1. STIC Tunisie
Participants: Eitan Altman, Majed Haddad.
E. Altman and M. Haddad have been collaborating with I. Mabrouki (Institut Supérieur d’Informatique et des Techniques de Communication, Tunisia) on intelligent jamming in wireless networks, i.e. jamming in which the jammer is aware of the protocol used by the network.

7.1.3.2. Indo-French Centre for the Promotion of Advanced Research (IFCPAR)
Participants: Eitan Altman, Manjesh Kumar Hanawal.
Within project 4000-IT on “Emerging Strategies for Wireless Communication Networks,” E. Altman and M. K. Hanawal (also with Univ. Avignon/LIA) have been collaborating with V. Kavitha (Univ. Avignon/LIA), R. Sundaresan and C. Singh (Indian Institute of Science, India) on evaluating and optimization issues in wireless networks. They also worked on network neutrality issues.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. ECODE
Participant: Konstantin Avrachenkov.
Title: Experimental COgnitive Distributed Engine (ECODE)
Type: COOPERATION (ICT)
Challenge: New paradigms and experimental facilities
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2008 – August 2011
Coordinator: Alcatel Lucent (Belgium)
Other partners:
- Universite Catholique de Louvain (UCL), IP Networking Lab (INL) (Belgium)
- Universite de Liege (ULg), Research Unit in Networking (Belgium)
- Interdisciplinair instituut voor BreedBand Technologie (IBBT), iLab.t (Belgium)
- Lancaster University (ULANC), Computing Department (United Kingdom)
• Centre National de la Recherche Scientifique (CNRS), Laboratory for Analysis and Architecture of Systems (LAAS) (France)

See also: http://www.ecode-project.eu/

Abstract: As part of the Future Internet Research and Experimentation (FIRE) initiative, the ECODE FP7 project designs and experiments machine learning-based control functionality. For this purpose, the project designs, develops, and experiments a distributed machine learning component that augments the capability and functionality of the routing and the forwarding engine of current routers. To evaluate the executability and the performance of the developed machine learning based control functionality, several experiments are conducted at the iLab.t experimental facility, located at IBBT in Ghent, Belgium.

MAESTRO’s task is to design and evaluate flow management schemes that can deal with potentially sampled traffic information. K. Avrachenkov is the coordinator for MAESTRO.

7.3. National Initiatives

7.3.1. ANR Verso ECOSCELLS (11/2009–10/2012)

Participants: Eitan Altman, Konstantin Avrachenkov, Philippe Nain.

ANR Verso ECOSCELLS (Efficient Cooperating Small Cells) aims at developing algorithms and solutions which will be required for the deployment of small cell networks. The theoretical studies will define and solve the models needed to understand the behavior of radio channels, and will design the algorithms which will allow the exploitation of the diversity (user, spatial, interference, etc.) in these networks. The consortium gathers two main industrial groups in the telecommunication domain (ALCATEL-LUCENT BELL LABS (leader) and Orange Labs), together with three leading SMEs (3ROAM, SEQUANS and SIRADEL) and six academic partners (University of Avignon, INRIA through its project-teams MAESTRO, MASCOTTE and SWING, INSTITUT EURECOM, LAAS-CNRS and Laboratoire des Signaux et Systèmes/SUPELEC).

http://perso.citi.insa-lyon.fr/hrivano/contrats/ecoscells.php

7.3.2. ANR Syscom MODECOL (01/2009–12/2011)

Participants: Eitan Altman, Alain Jean-Marie.

ANR Verso MODECOL (Using mathematical MODeling to improve ECOlogical services of prairial ecosystems) is integrated in the framework of the urgent need for solutions for compensating human deterioration of the environment. New environmental policies point out natural ecosystems as key elements for providing ecological services such as water purification, soil detoxification, climate regulation and advocate for the creation of new ecosystems (as surrogates for the degraded natural systems) for increasing their positive effect on the environment. The design of such new ecosystems needs to be optimized for providing the best ecological services. The project MODECOL aims at developing a hybrid model, sufficiently realistic, that will simulate a prairial ecosystem (modelled through IBM) correlated through feedbacks to environmental conditions (modelled through PDEs). This approach aims to provide a virtual laboratory for testing ecological hypothesis on complex ecological systems.

The participants are: UMR Ecobio (CNRS/Univ. Rennes 1), University of Houston (USA), University of Berkeley (USA), University of La Rochelle, and INRIA through its projects and project-teams MAESTRO, MODEMIC and TOSCA.


7.3.3. ANR Multimedia VOODDO (2008-2011)

Participant: Alain Jean-Marie.
The aim of this research project, now terminated, was the development of an innovative visualization interface for video contents, based on a safe, reliable and optimized storage and transport infrastructure. It was coordinated by the VodDnet company, and involved researchers of the LIRM-M (University of Montpellier 2 and CNRS). The last results obtained were on the optimal placement of data [84] and the problem of prefetching data so that users never experience blocking [86].

7.3.4. INRIA Cooperative Research Initiative (ARC) OCOQS (2011-2013)

Participant: Alain Jean-Marie.

The ARCOCOQS (Optimal threshold policies in COntrrolled Queuing Systems) is devoted to the structural analysis of Markov Decision Processes, with the objective to improve the set of formal techniques available to prove that optimal control policies have a particular structure (typically, threshold-type). One of the benchmarks for this project is the extension of the model solved in [102]. This project also involves A. Busic (INRIA project-team TREC), E. Hyon (LIP6 and Univ. Paris 10) and I. Vliegen (Univ. Twente).

http://www.di.ens.fr/~busic/OCOQS/

7.4. Visits of Maestro staff to other research institutions

K. Avrachenkov visited the Basque Center for Applied Mathematics (BCAM) (Derio, Spain) in the period January 10–15, 2011, the University of Liverpool (United Kingdom) in the period March 7–11, 2011, and the University of Twente in the period May 23, 2011 – June 24, 2011.


G. Neglia visited the Electrical Engineering Department of the University of Palermo (Italy), in the period December 22–23, 2011.
MASCOTTE Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR Jeunes Chercheurs DIMAGREEN, 09/2009-08/2012

Participants: David Coudert, Frédéric Giroire, Alvinice Kodjo, Dorian Mazauric, Joanna Moulierac, Truong Khoa Phan, Issam Tahiri.

The objectives of the project DIMAGREEN (DesIgn and MAngement of GREEN networks with low power consumption) are to introduce and analyze energy-aware network designs and managements in order to increase the life-span of telecommunication hardware and to reduce the energy consumption together with the electricity bill.

( http://www-sop.inria.fr/teams/mascotte/Contrats/DIMAGREEN/index.php )

8.1.2. ANR Blanc AGAPE, 10/2009-09/2013


The project AGAPE (Parameterized and exact graph algorithms) is led by MASCOTTE and implies also LIRMM (Montpellier) and LIFO (Orléans). The aim of AGAPE is to develop new techniques to solve exactly NP-hard problems on graphs. To do so, we envisage two approaches which are closely related ways to reduce the combinatorial explosion of NP-hard problems: moderately exponential exact algorithms and fixed-parameter tractability.

( http://www-sop.inria.fr/mascotte/Contrats/Agape.php )

8.1.3. ANR VERSO ECOSCells, 11/2009-12/2012

Participants: David Coudert, Issam Tahiri.

The ECOSCells (Efficient Cooperating Small Cells) project aims at developing the algorithms and solutions required to allow Small Cells Network (SCN) deployment. The consortium gathers industrial groups, together with 3 SMEs and 6 research institutes: ALcatel-Lucent Bell Labs (leader), Orange Labs, 3-ROAM, Sequans, SIRADEL, INRIA teams Maestro, MASCOTTE and SWING, Université d’Avignon et des Pays de Vaucluse, Laboratoire des Signaux et Systèmes / Supelec, LAAS and Eurecom.

( http://perso.citi.insa-lyon.fr/hrivano/contrats/ecoscells.php )

8.1.4. ANR USS-SimGrid, 12/2008-12/2011

Participants: Olivier Dalle, Emilio Mancini.

The USS-SimGrid project aims at Ultra Scalable Simulations with SimGrid. This tool is leader in the simulation of HPC settings, and the main goal of this project is to allow its use in the simulation of desktop grids and peer-to-peer settings.

( http://uss-simgrid.gforge.inria.fr/ )

8.1.5. Action ResCom, ongoing (since 2006)

Réseaux de communications, working group of GDR ASR, CNRS. ( http://citi.insa-lyon.fr/rescom/ )

8.1.6. Action Graphes, ongoing (since 2006)

Action Graphes, working group of GDR IM, CNRS. ( http://www.labri.fr/perso/raspaud/pmwiki/pmwiki.php )
8.2. European Initiatives

8.2.1. FP7 Projet

8.2.1.1. EULER

Participants: David Coudert, Aurélien Lancin, Nicolas Nisse, Bi Li.

Title: EULER (Experimental UpdateLess Evolutive Routing)
Type: COOPERATION (ICT)
Challenge: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: Specific Targeted Research Project (STREP)
Duration: October 2010 - September 2013
Coordinator: ALCATEL-LUCENT (Belgium)
Others partners: IBBT (Belgium), UPMC (France), UCL (Belgium), RACTI (Greece), CAT (Spain)
See also: http://www.euler-fire-project.eu/

Abstract: STREP EULER (Experimental UpdateLess Evolutive Routing) is part of FIRE (Future Internet Research and Experimentation) objective of FP7. It aims at finding new paradigms to design, develop, and validate experimentally a distributed and dynamic routing scheme suitable for the future Internet and its evolution. The STREP EULER gathers 7 partners: Alcatel-Lucent Bell (leader) (Antwerp, Belgique), IBBT (Ghent, Belgium), UCL (Louvain, Belgium), RACTI (Patras, Greece), UPC (Barcelona, Spain), UPMC (ComplexNetworks, Paris 6), INRIA (MASCOTTE, GANG, CEPAGE). MASCOTTE is the leader of WP3 on Topology Modelling and Routing scheme experimental analysis.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. PICS CNRS (with Charles University, Prague), 01/2009-12/2012
Participants: Nathann Cohen, Frédéric Havet, František Kardoš, Leonardo Sampaio.

On Graph coloring: theoretical and algorithmic aspects.

8.2.2.2. PHC PROCOPE (with Discrete Optimization group of RWTH Aachen University), 01/2011-12/2012
Participants: Christelle Caillouet, David Coudert, Alvinice Kodjo, Issam Tahiri.

"Défis algorithmiques dans les réseaux de communication". The purpose of the project is to exchange expertise between the discrete optimization group of RWTH Aachen University and the MASCOTTE team at INRIA Sophia-Antipolis and to address algorithmic problems in communication networks.

8.3. International Initiatives

8.3.1. INRIA Associate Teams

8.3.1.1. DISSIMINET
Participants: Olivier Dalle, Emilio Mancini, Van Dan Nguyen.

Title: Web-Service approaches for simulation
INRIA principal investigator: Olivier Dalle
International Partner:

Institution: Carleton University (Canada)
Laboratory: Advanced Real-Time Simulation Laboratory

Duration: 2011 - 2014
See also: http://www-sop.inria.fr/members/Olivier.Dalle/wiki/Main/Dissiminet

This Franco-Canadian team will advance research on the definition of new algorithms and techniques for component-based simulation using a web-services based approach. On the one hand, the use of web-services is expected to solve the critical issues that pave the way toward the simulation of systems of unprecedented complexity, especially (but not exclusively) in the studies involving large networks such as Peer-to-peer networks. Web-Service-oriented approaches have numerous advantages, such as allowing the reuse of existing simulators, allowing non-computer experts to merge their respective knowledge, or seamless integration of complementary services (e.g. on-line storage and repositories, weather forecast, traffic, etc.). One important expected outcome of such approaches is to improve significantly the simulation methodology in network studies, especially by enforcing the seamless reproducibility and traceability of simulation results. On the other hand, a net-centric approach of simulation based on web-services comes at the cost of added complexity and incurs new practices, both at the technical and methodological levels. The results of this common research will be integrated into the discrete-event distributed simulators of both teams: the CD++ simulator at Carleton University and the simulation middle-ware developed in the MASCOTTE EPI, called OSA, whose developments are supported by an INRIA ADT since January 2011.

8.3.1.2. EWIN

Participants: Julio Araújo, Frédéric Giroire, Frédéric Havet, Ana Karolinna Maia, Nicolas Nisse, Ronan Pardo Soares, Leonardo Sampaio.

Title: Efficient algorithms in WIreless Networks
INRIA principal investigator: Frédéric Havet
International Partner:

Institution: Universidade Federal do Ceara (Brazil)
Laboratory: Laboratorio de Inteligencia Artificial

Duration: 2009 - 2011
See also: http://www-sop.inria.fr/teams/mascotte/equipeassociee/ewin/

The research themes are the design of exact or approximate algorithms for solving problems in networks, in particular wireless networks. The problems that we will consider can be modelled as graph coloring or graph decomposition problems. More specifically, we studied the following problems: channel assignment in radio networks which can be modelled by various graph coloring problems, dynamic routing in wireless networks using microwave links, and routing reconfiguration in MPLS or WDM networks, certain models of which are closely related to graph searching problems and tree and path decompositions.

8.3.1.3. ANR International Taiwan GRATEL, 01/2010 – 12/2013

Participants: Jean-Claude Bermond, Nathann Cohen, Frédéric Havet, František Kardoš, Leonardo Sampaio.

GRATEL (Graphs and Telecommunications) has been started in collaboration with LABRI Bordeaux, UJF Grenoble and three partners in Taiwan: Sun Yat-sen University, the National Taiwan University and Academia Sinica. (https://gratel.labri.fr/pmwiki.php?n=Main.HomePage)

8.3.2. INRIA International Partners

Montreal, Canada: Collaboration and joint publications with B. Jaumard (Concordia), B. Reed (Mac Gill).

Vancouver, Canada: Visits of J. Yu and J. Peters (SFU Vancouver, Canada) in Mascotte and joint publications.
Santiago, Chile: Reciprocal visits of N. Nisse in Chile and I. Rapaport (Universidad de Chile) and K. Suchan (Universidad Adolfo Ibáñez) in Mascotte. Moreover, there are joint publications.

Odense, Denmark: Visits of J. Bang-Jensen (University of Southern Denmark). N. Nepomuceno (former PhD in Mascotte) went to University of Southern Denmark for his Post-Doc. Moreover, there are joint publications.

Patras, Greece: Long-term collaboration with University of Patras, D. Coudert spent 3 months there in 2011, joint participation in many European projects.

Salerno, Italy: Visits of L. Gargano and U. Vaccaro (University of Salerno) and joint publications.

8.3.3. Visits of International Scientists

Jørgen Bang-Jensen: University of Southern Denmark, Odense, Denmark, October 10-October 30, 2011 (3 weeks).

Victor Campos: Universidade Federal do Ceara, Fortaleza, Brazil, November 28 - December 4 (1 week).

Grit Classen: Lehrstuhl II für Mathematik, RWTH Aachen - Aachen, Germany, September 11-16, 2011 (1 week) and December 12-16 (1 week).

Li Da Tong: National Sun Yat-Sen University, Kaohsiung, Taiwan, November 25 - December 2 (1 week).

Michele Flammini: University of l’Aquila, Italy, June 18 - July 9 (3 weeks).

Fedor V. Fomin: University of Bergen, Bergen, Norway, April 4 - April 30, 2011 (1 month) and November 16-18 (Colloquium Morgenstern).

Luisa Gargano: Dipartimento di Informatica ed Applicazioni “Renato M. Capocelli” of the Università di Salerno, Salerno, Italy, July 15 - August 31 (1 month 1/2).

Tomas Kaiser: University of West Bohemia, Pilsen, Czech Republic, November 28 - December 4 (1 week).

Arie Koster: Lehrstuhl II für Mathematik, RWTH Aachen - Aachen, Germany, September 11-16, 2011 (1 week).

Daniel Král’: Charles University, Prague, Czech Republic, October 17-21, 2011 (1 week);

Manuel Kutschka: Lehrstuhl II für Mathematik, RWTH Aachen - Aachen, Germany, September 11-16, 2011 (1 week) and December 12-16 (1 week).

Joseph Peters: SFU Vancouver, Canada, May 14 - June 4 (3 weeks).

Ivan Rapaport: Universidad de Chile, Santiago, Chile, May, 2011 (2 weeks).

András Sebő: G-SCOP, Grenoble, October 19-21, 2011 (3 days).

Karol Suchan: Universidad Adolfo Ibáñez, Santiago, Chile, September 21 - December 28, 2011 (3 months).

Amel Tandjaoui: University of Oran, Algeria, November 7-25, 2011 (3 weeks).

Ugo Vaccaro: Dipartimento di Informatica ed Applicazioni “Renato M. Capocelli” of the Università di Salerno, Salerno, Italy, July 15 - August 31 (1 month 1/2).

Gabriel Wainer: Carleton University, Ottawa, Canada, January 19-24 (1 week) and June 13 - July 8 (3 weeks).

Joseph Yu: Abbotsford and SFU, Vancouver, Canada, March 1st - April 15, 2011 (1 month 1/2).

8.3.4. Visits of Mascotte Members to Other Research Institutions

J. Araújo: Visit to Federal University of Ceará, Fortaleza, Brazil (December 22th, 2010 - January 15th, 2011).

J. Burman: Visit to LRI, University Paris-Sud 11, Orsay, France, (January 31-February 3, 2011).

N. Cohen: Visit to University of Bergen, Norway (February 12-27, 2011); Visit the National Taiwan University, Taipei, Taiwan (March 9–16, 2011).

D. Coudert: Visit the Research Unit 1 (RU1) of the Research Academic Computer Technology Institute (RACTI), Patras, Greece (January 8 till March 31, 2011); Visit the mathematics department of the National and Kapodistrian University of Athens, Greece (February 23-25, 2011); Visit the mathematics departement of RWTH Aachen, Germany (October 30 till November 4, 2011).

O. Dalle: Visit to Carleton University, Ottawa, Canada (July 5 - August 3 2011).

G. D'Angelo: Visit University of L’Aquila, L’Aquila, Italy (November 5-14 and December 12-15); Visit ”Sapienza” University of Rome, Rome, Italy (November 8).

F. Havet: National Taiwan University, Taipei, Taiwan (March 9-12 and 17-18, 2011); National Sun Yat Sen University, Kiaooshung, Taiwan (March 13-16); Federal University of Ceara, Fortaleza, Brasil (April 4-8, 2011 and September 27-October 4, 2011); LIRMM, University Montpellier 2, (February 7-11, 2011 and October 14-15, 2011); LIFO, University of Orléans, (May 18-22, 2011); Lebanese University, Beyruth, Lebanon (May 16-20, 2011).

A. Kodjo: Visit RWTH Aachen University, Germany (December 5-9, 2011).

A. Lancin: Visit to Louvain-la-Neuve University, Belgium, (July 8, 2011).

E. Mancini: Visit to Carleton University, Ottawa, Canada (September 5-October 4-2011).

V. D. Nguyen: Visit to Carleton University, Ottawa, Canada (August 7-September 4 2011).

N. Nisse: Visit to Universidad de Chile, Santiago, Chile, (2 weeks, January 13-31, 2011); Visit to CITI, Lyon, France, (1 week, July 25-29, 2011).

I. Tahiri: Visit RWTH Aachen University, Germany (July 4-15, 2011 and December 5-9, 2011);

8.3.5. Internships


D. Coudert: supervised the internship of Felipe Menezes Machado (Universidade Federal de Minas Gerais, Belo Horizonte, Brasil) on studying community structures in dynamic graphs, April-June 2011 (3 months 1/2).

J. Moulierac: supervised the internship of Truong Khoa Phan (parcours UBINET master IFI, UNS, France) on Minimization of network power consumption with WAN Optimization, March-August 2011 (6 months).

N. Nisse: supervised the internship of Dang Dinh Khanh (parcours UBINET master IFI, UNS, France) on the study of variants of Cops and Robber Games, March-August 2011 (5 months 1/2).

8.3.6. Participation In International Programs

INRIA FUNCAP (Inria-FAP): ALERTE (ALgoritmes Efficaces pour les Réseaux de Télécocommunications), with Pargo Team, Universidade Federal do Ceará, Brazil, accepted in June 2011.

INRIA Conicyt: PhD Grant of J.-C. Maureira supervised by J.-C. Bermond and O. Dalle.
8. Partnerships and Cooperations

8.1. Regional Initiatives

PFT (2011-2014): DGCIS funded project, in the context of the competitiveness cluster SCS, whose aim is to provide to PACA region industrials wishing to develop or validate new products related to future mobile networks and services and M2M application, a networking infrastructure and tools helpful for development, test and validation of those products. Other partners: 3Roam, Audilog Groupe Ericsson, Ericsson, Eurecom, Inria, iQsim, MobiSmart, Newsteo, OneAccess, Orange Labs, Pôle SCS, ST Ericsson, Telecom Valley. Our contribution is centred around providing a test methodology and tools for wireless networks experimentation.

8.2. National Initiatives

ANR FIT (2011-2018): FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet. FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research’s “Équipements d’Excellence” (Equipex) research grant programme. The project will benefit from a 5.8 million euro grant from the French government. Other partners are UPMC, IT, Strasbourg University and CNRS. See also http://fit-equipex.fr/.

ANR ARESA2 (2009-2012): The Planète team is involved in the ARESA2 project which aims at advancing the state of the art in Secure, Self-Organizing, Internet-Connected, Wireless Sensor and Actuator Networks (WSANs). These challenges are to be addressed in an energy-efficient way while sticking to memory-usage constraints. The partners are INRIA, CEA-LETI, France Telecom R&D, Coronis Systems, LIG/Drakkar, Verimag and TELECOM Bretagne.

ANR pFlower (2010-2013): Parallel Flow Recognition with Multi-Core Processor. The main objective of this project is to take advantage of powerful parallelism of multi-thread, multi-core processors, to explore the parallel architecture of pipelined-based flow recognition, parallel signature matching algorithms. The project involves INRIA (planete), Université de Savoie, and ICT/CAS (China).

Inria Mobilitics (2011-2012): as a joint national project with CNIL (the French national committee of Information freedom), Platform for mobile devices privacy evaluation. This project strives to deploy an experimental mobile platform for studying and analyzing the weaknesses of current online (smartphone) applications and operating systems and the privacy implications for end-users. For instance, one of the objectives is to understand trends and patterns collected when they are aimed at obtaining general knowledge that does not pertain to any specific individual. Examples of such tasks include learning of commuting patterns, inference of recommendation rules, and creation of advertising segments.

Collaborative Action CAPRIS (2011-2014): the Collaborative Action on the Protection of Privacy Rights in the Information Society (CAPRIS), is an Inria national project, which goal is to tackle privacy-related challenges and provide solutions to enhance the privacy protection in the Information Society. His main tasks are the identification of existing and future threats to privacy, and the design of appropriate measures to assess and quantify privacy.
ANR CMON (2009-2012): This project involves, in addition to INRIA, Technicolor Paris Lab, LIP6, ENS and the Grenouille.com association. CMON stands for collaborative monitoring. It is an industrial research project that develops the technology needed to allow end-users to collaborate in order to identify the origin and cause of Internet service degradation. The main differentiating assumptions made in this project are that (i) ISPs do not cooperate together, and (ii) one cannot rely on any information they provide in order to diagnose service problems. Even more, CMON considers that these ISP will try to masquerade the user observations in order to make their service look better. The software designed in this project will be added to the toolbox currently provided by the Grenouille architecture. The hope is that such a project will encourage ISPs to improve their quality of service and will contribute to improve customer satisfaction.

See also http://wiki.grenouille.com/index.php/CMON.

ANR F-Lab (2011-2013): ANR funded project on the federation of computation, storage and network resources, belonging to autonomous organizations operating heterogeneous testbeds (e.g. PlanetLab testbeds and Sensors testbeds). This includes defining terminology, establishing universal design principles, and identifying candidate federation strategies. Other partners : UPMC, A-LBLF and Thales.

ANR Connect (2011-2012): ANR funded project on content centric Networking architecture. The aim is to propose adequate naming, routing, cache management and transmission control schemes for CCN based networks. Our contribution is centered on network traffic characterization video streaming and on the integration of the CCNx code in the ns-3 simulator. Other partners: UPMC, Alcatel Lucent, Orange R&D, IT.

ANR SCATTER (2011-2012): ANR funded project on Scalable Naming in Information Centric Networks. The goal of this activity is to evaluate the scalability of state of the art naming schemes both from the name resolution and routing points of view. The four main approaches that will be considered are: Content Centric Networking (CCN), Publish-Subscribe Internet Routing Paradigm (PSIRP), Network of Information (NetInf) and Data-Oriented Network Architecture (DONA). Other French partners: UPMC. International KIC partner: SICS.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. ECODE

Title: Experimental COgnitive Distributed Engine
Type: COOPERATION (ICT)
Defi: New paradigms and experimental facilities
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2008 - August 2011
Coordinator: Alcatel Lucent (Belgium)
Others partners: UCL (Belgium), ULg (Belgium), IBBT (Belgium), ULANC (UK), CNRS (France).

See also: http://www.ecode-project.eu/

Abstract: The goal of the ECODE project is to develop, implement, and validate experimentally a cognitive routing system that can meet the challenges experienced by the Internet in terms of manageability and security, availability and accountability, as well as routing system scalability and quality. By combining both networking and machine learning research fields, the resulting cognitive routing system fundamentally revisits the capabilities of the Internet networking layer so as to address these challenges altogether. For this purpose, the project investigates and elaborates novel
semi-supervised, on line, and distributed machine learning techniques kernel of the cognitive routing system. During the building phase, the cognitive routing system is both designed and prototyped. In the second phase, three sets of use cases are experimented to evaluate the benefits of the developed machine learning techniques. The experimentation and the validation of these techniques are carried out on physical (iLAB) and virtual (e.g., OneLab) experimental facilities.

8.3.1.2. NOVI

Title: Networking innovations Over Virtualized Infrastructures
Type: COOPERATION (ICT)
Defi: CAPACITIES programme.
Instrument: Specific Targeted Research Project (STREP)
Duration: September 2010 - February 2013
Coordinator: NTUA (Greece)
Others partners: 13 european partners including GARR, ELTE, Cisco, etc.
See also: http://www.fp7-novi.eu/

Abstract: NOVI (Networking innovations Over Virtualized Infrastructures) research concentrates on efficient approaches to compose virtualized e-Infrastructures towards a holistic Future Internet (FI) cloud service. Resources belonging to various levels, i.e. networking, storage and processing are in principle managed by separate yet interworking providers. NOVI will concentrate on methods, information systems and algorithms that will enable users with composite isolated slices, baskets of resources and services provided by federated infrastructures.

8.3.1.3. OPENLAB

Title: OpenLab: extending FIRE testbeds and tools
Type: COOPERATION (ICT)
Defi: ICT 2011.1.6 Future Internet Research and Experimentation (FIRE)
Instrument: Integrated Project (IP)
Duration: September 2011 - January 2014
Coordinator: Université Pierre et Marie Curie (France)
Others partners: 18 European partners (including ETH Zurich, Fraunhofer, IBBT, TUB, UAM, etc.) and Nicta from Australia.
See also: http://www.ict-openlab.eu/

Abstract: OpenLab brings together the essential ingredients for an open, general purpose and sustainable large scale shared experimental facility, providing advances to the early and successful prototypes serving the demands of Future Internet Research and Experimentation. OpenLab partners are deploying the software and tools that allow these advanced testbeds to support a diverse set of applications and protocols in more efficient and flexible ways. OpenLab’s contribution to a portfolio that includes: PlanetLab Europe (PLE), with its over 200 partner/user institutions across Europe; the NITOS and w-iLab testbeds; two IMS telco testbeds that can connect to the public PSTN, to IP phone services, and can explore merged media distribution; an LTE cellular wireless testbed; the ETOMIC high precision network measurement testbed; the HEN emulation testbed; and the ns-3 simulation environment. Potential experiments that can be performed over the available infrastructure go beyond what can be tested on the current internet. OpenLab extends the facilities with advanced capabilities in the area of mobility, wireless, monitoring, domain interconnections and introduces new technologies such as OpenFlow. These enhancements are transparent to existing users of each facility. Finally, OpenLab will finance and work with users who propose innovative experiments using its technologies and testbeds, via the open call mechanism developed for FIRE facilities.
8.3.1.4. WSN4CIP

Title: Wireless Sensor Networks for critical infrastructures Protection
Type: COOPERATION (ICT)
Defi: FP7 Security area, Objective 1.7 Critical Infrastructure Protection
Instrument: Specific Targeted Research Project (STREP)
Duration: 2009 - 2011
Coordinator: Eurescom (Germany)
Others partners: 11 European partners (including IHP, NEC, BUTE, etc.)
See also: http://www.wsan4cip.eu/home.html

Abstract: The goal of WSAN4CIP is to advance the technology of Wireless Sensor and Actuator Networks (WSANs) beyond the current state of the art, in order to improve the protection of Critical Infrastructures (CIs). By advancing WSAN technology, the project contributes to networked information and process control systems which are more secure and resilient. The distributed nature of WSANs enables them to survive malicious attacks as well as accidents and operational failures. It makes them dependable in critical situations, when information is needed to prevent further damage to CIs.

8.3.2. EIT KIC funded activities

Our project team was involved in 2011 in two activities funded by the EIT ICT Labs KIC: FITTING on Future InterneT (of ThINGs) facility and Information centric and device clouds (11901). In 2012, we will be involved in three additional activities on Software-Defined Networking (SDN) (11634), Information-centric networking (ICN) experimentation (12191) and Seamless P2P video streaming for the web (12199). The FITTING activity is mentioned as a “success story” by the EIT ICT Labs KIC. In fact, after an initial funding in 2010, the French partners succeeded to get the FIT Equipment of Excellence project accepted with a total budget of 5.8 MEuros to develop a testbed federation in France.

8.3.2.1. FITTING

Title: Future InterneT (of ThINGs) facility
Activity Number: 10340
Duration: 2011-2012
Coordinator: UPMC (France)
Others partners: Alcatel Lucent, Fraunhofer FOKUS, BME, IT, U. Paris XI.

Abstract: FITTING develops a testbed federation architecture that combines wireless and wired networks. Through FITTING, components and solutions developed in the projects OneLab2, PII and SensLAB are brought together to facilitate access. These components and devices complement each other - for instance SensLAB enhances the testbed federation by adding wireless sensors. FITTING addresses issues related to usability and accessibility of federated experimentation resources from multiple autonomous organizations. FITTING is a process of federating elements from various European and national initiatives into a global shared resource pool with a standardized interface to access them. Further, FITTING will adopt a user-driven (researchers, developers, students) approach with its running testbeds allowing experimentation with different technologies to meet the variety of needs of a broad customer base.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

COMMUNITY Associated team (2009-2011): Planète is an associated team with the UC Santa Cruz’s Jack Baskin School of Engineering. The collaborative project is about communication in heterogeneous networks prone to episodic connectivity, see URL http://inrg.cse.ucsc.edu/community/ . Our initial scientific objective throughout the project was to design efficient message delivery mechanisms for challenged and heterogeneous networks, and targeted:

- The design of a unifying solution to enable message delivery over heterogeneous networks with varying degrees of connectivity.
- The design of error- and congestion control techniques in episodically connected networks.
- The exploration of different mechanisms for quality-of-service (QoS) support in such environments.

We have re-oriented some of the initial proposed research. In particular, rather than investigating error and congestion control techniques for DTNs, we focused on the development of efficient routing strategies that take into account the utility of nodes to relay messages. Furthermore, we developed a naming scheme that supports message delivery over heterogeneous networks prone to connectivity disruptions, see further details in Section 1.

8.4.2. Visits of International Scientists

Luigi Alfredo Grieco, Visiting Professor (one week in December 2011)
Subject: On Evaluating Fairness in Content Centric Networks
Institution: University of Bari (Italy)

Katia Braczka, Visiting Professor (one week in January 2011 and one week in November 2011)
Subject: Communication in Heterogeneous Networks Prone to Episodic Connectivity
Institution: University of California at Santa Cruz (United States)

Marc Mendonca, Visiting PhD student (from Sep 2011 until Dec 2011)
Subject: Efficient Communication Mechanisms for Episodically Connected and Heterogeneous Networks
Institution: University of California at Santa Cruz (United States)

8.4.3. Visits to International teams

Thierry Turletti, Visiting researcher to University of California at Santa Cruz (one week in June 2011)
Subject: Efficient Communication Mechanisms for Episodically Connected and Heterogeneous Networks

8.4.4. Participation In International Programs

- WELCOME (STIC AmSud): This project (2010-2011) aims to design realistic models of the physical layer in order to be used in both simulations and experimentation of wireless protocols. In addition to the Planète Project-Team, the partners are Universidad de Valparaiso, Chile, Universidad de Córdoba, Argentina and Universidad Diego Portales, Chile.

- CIRIC: Our project-team was involved in the definition of the topics for the Network and Telecom R&D line of the (the Communication and Information Research and Innovation Center - CIRIC), the Inria research and innovation centre in Chili. In this context, we will extend our collaboration with Universidad Diego Portales, Chile.
6. Partnerships and Cooperations

6.1. PhD Grants

PhD grant CJS (Contrat Jeune Scientifique) Frontières du vivant of INRA for Emanuele Leoncini.

6.2. Visiting scientists

RAP team has received the following people:

- Thomas Bonald (Telecom ParisTech, Paris)
- Raluca Indre (Orange Labs)
- Davide Cuda (Orange Labs)
- Jonathan Touboul (INRIA, GANG)
- Amandine Véber (CMAP, École Polytechnique)
- Fabien Mathieu (INRIA BANG)
- Urtzi Ayesta (BCAM, Bilbao, Spain)
- Maaike Verloop (BCAM, Bilbao, Spain)
- Philippe Chassaing (Institut Élie Cartan, Université Henri Poincaré, Nancy)
- Nicolas Gast (EPFL)
- Irina Ignatiouk (Université de Cergy-Pontoise)
- Justin Salez (INRIA, TREC)
- Amar Prakash Azad (UC Santa Cruz, USA)
RESO Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ARC MISSION

Participants: Isabelle Guérin Lassous, Thomas Begin, Paulo Gonçalves.

The project Mobile SubStitutIOn Networks (MISSION) is focused on the performance study, the possibilities and the feasibility to deploy a fleet of mobile wireless routers to help a wired network that can not offer its services anymore. This project deals with the theoretical aspects as the practical aspects of such a deployment. From a theoretical point of view, one problem is to minimize the number of used routers while rebuilding the network to replace. The main difficulty lies in the possibility to offer the services provided by the wired network in a transparent way. The controlled mobility allows a redeployment or an adaptation of the built network according to the needs or to the on-going traffic on the network. This controlled mobility should improve the network performance.

8.1.2. GRID5000: ADT Aladdin

Participants: Laurent Lefèvre, Gelas Jean-Patrick, Olivier Glück, Paulo Gonçalves, Matthieu Imbert, Armel Soro, Olivier Mornard, Jean-Christophe Mignot, Diouri Mohammed, Orgerie Anne-Cécile.

ENS Lyon is involved in the GRID’5000 project, which is an experimental Grid platform gathering ten sites geographically distributed in France. ENS Lyon hardware contribution is done for now by two distinct set of computers. The Grid5000 of Lyon comprises now around 300 processors interconnected with the 10 Gbit per second network. Lyon site is nationally recognized to gather the "networking expertise" with skilled researchers and engineers and dedicated networking equipments (Metroflux, GNET10...). Lyon site also hosts an important part of the Green Grid5000 infrastructure by hosting a set of 1500 wattmeters and exposing energy measurements to the Grid5000 community.

RESO is strongly involved in the choices of Grid5000’s network components and architecture. Laurent Lefèvre is member of the national committee (comité de direction) of GRID’5000, of the Aladdin scientific committee and responsible of the Lyon site.

8.1.3. ANR RESCUE

Participants: Isabelle Guérin Lassous, Thomas Begin, Paulo Gonçalves, Thiago Abreu.

Access and metropolitan networks are much more limited in capacity than core networks. While the latter operate in over-provisioning mode, access and metropolitan networks may experience high overload due to evolution of the traffic or failures. In wired networks, some failures (but not all) are handled by rerouting the traffic through a backup network already in place. In developed countries, backup networks are adopted wherever possible (note that this is generally not the case for the links between end users and their local DSLAM). Such a redundant strategy may not be possible in emerging countries because of cost issues. When dedicated backup networks are not available, some operators use their 3G infrastructure to recover some specific failures; although such an alternative helps avoid full network outage, it is a costly solution. Furthermore, availability of 3G coverage is still mainly concentrated in metropolitan zones. When no backup networks are available, it would be interesting to deploy, for a limited time corresponding to the period of the problem (i.e., failure or traffic overload), a substitution network to help the base network keep providing services to users.
In the RESCUE project (2010-2013), we will investigate both the underlying mechanisms and the deployment of a substitution network composed of a fleet of dirigible wireless mobile routers. Unlike many projects and other scientific works that consider mobility as a drawback, in RESCUE we use the controlled mobility of the substitution network to help the base network reduce contention or to create an alternative network in case of failure. The advantages of an on-the-fly substitution network are manifold: Reusability and cost reduction; Deployability; Adaptability.

The RESCUE project addresses both the theoretical and the practical aspects of the deployment of a substitution network. From a theoretical point of view, we will propose a two-tiered architecture including the base network and the substitution network. This architecture will describe the deployment procedures of the mobile routing devices, the communication stack, the protocols, and the services. The design of this architecture will take into account some constraints such as quality of service and energy consumption (since mobile devices are autonomous), as we want the substitution network to provide more than a best effort service. From a practical point of view, we will provide a proof of concept, the architecture linked to this concept, and the necessary tools (e.g., traffic monitoring, protocols) to validate the concept and mechanisms of on-the-fly substitution networks. At last but not least, we will validate the proposed system both in laboratory testbeds and in a real-usage scenario.

http://rescue.lille.inria.fr/

8.1.4. FUI CompatibleOne Project
Participants: Laurent Lefèvre, Jean-Patrick Gelas, Olivier Mornard, Maxime Morel.

The project CompatibleOne (Nov 2010-Nov 2012) funded by the Fonds Unique Interministériel (FUI) is dealing with the building of a Cloud architecture open software stack.

In this project, RESO is focused on the design and provisioning of energy aware and energy efficient components in order to include energy aspects in QoS, SLAs and billing in clouds architectures. RESO is leading the task T3.4 on energy management and will participate in activities on virtual machines design and migration.

CompatibleOne is an open source project with the aim of providing inter-operable middle-ware for the description and federation of heterogeneous clouds comprising resources provisioned by different cloud providers. Services provided by INRIA RESO participation (module COEES) should allow to act on the system’s core by offering a scenario for the broker using energy constraints. These constraints should allow virtual machines placement and displacement using energy profile. Collected data must be available for CO and other systems for future researches. INRIA RESO took part in the analysis of the specification of the system. Mainly, we are in charge of the energy efficiency module. We also had participation in several modules like COMONS (monitoring module), ACCORDS (brokering module), EZVM (virtualization module) and CONETS (networking module). To make energy measurement, we used hardware probes and we studied software probes too. We evaluated several probes providers like Eaton and Schleifenbauer which provide smart PDU (Power Distribution Unit). We also evaluated IPMI board provided by DELL, our computers manufacturer, and OmegaWatt, a small company which provides custom hardware for energy measurement. To allow the exploitation of these probes, we made a first version of a software library and file format for data and monitoring daemon. To allow the use of this system outside of CompatibleOne, we developed a complete monitoring system, which is now in use in IN2P3 data center. To make our tests and developments, we specified, bought, installed and deployed our cluster of 12 nodes. Finally, we participated in international manifestations like SuperComputing 2011 (Poster and demonstration on INRIA booth), Cloud and Green Computing 2011[ 46 ].

8.1.5. FSN Magellan Project
Participants: Laurent Lefèvre, Jean-Patrick Gelas.

The project Magellan has been accepted in December 2011. The official beginning will be mid-february 2012.

8.1.6. ANR PETAFLOW
Participants: Paulo Gonçalves, Matthieu Imbert, Anne-Cécile Orgerie, Ashley Chonka.
This ANR (Appel Blanc International) started in October 2009 and will end in September 2012. It is a collaborative project between the GIPSA Lab (Grenoble), MOAIS (INRIA Grenoble), RESO (INRIA Grenoble), the University of Osaka (the Cybermedia Center and the Department of Information Networking) and the University of Kyoto (Visualization Laboratory).

We aim at proposing network solutions to guarantee the Quality of Service (in terms of reliability level and of transfer delay properties) of a high speed, long-distance connection used in an interactive, high performance computing application. Another specificity of this application is the peta-scale volume of the treated data corresponding to the upper airway flow modeling.

http://petaflow.gforge.inria.fr/

8.1.7. ANR DMASC

Participant: Paulo Gonçalves.

Started in October 2008, this ANR project, leaded by J. Barral (Univ. Paris 13), is a partnership between INRIA (Sisyphe and Reso), university of Paris 12 and Paris 13 and Paris Sud (équipe d’accueil EA 4046 Service de Réanimation Médicale CHU de Bicêtre).

Its main objective is to develop advanced multifractal analysis tools, from mathematically ground results to efficient estimators. We apply these methods to the analysis, to the modeling and to the classification (for non invasive diagnoses) of cardio-vascular systems.

http://www-rocq.inria.fr/~barral/DMASC.html

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. GEYSERS

Title: Generalised Architecture for dynamic infrastructure services
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: January 2010 - December 2012
Coordinator: Interoute (Italy)

Others partners: Interoute (Italy), martel Martel GmbH (Switzerland), ADVA AG Optical Networking (Germany), SAP AG (Germany), Alcatel-Lucent Italia S.p.A. (Italy), Telefónica I+D (Spain), Telekomunikacja Polska S.A. (Poland), Instytut Chemicz Bioorganicznej PAN, Poznan Supercomputing and Networking Centre (Poland), Nextworks s.r.l (Italy), Fundación i2CAT, Internet i Innovación Digital a Catalunya (Spain), Universiteit van Amsterdam (The Netherlands), University of Essex (UK), Research and Education Society in Information Technologies (Greece), Technical University of Braunschweig (Germany), Interdisciplinary Institute for BroadBand Technology VZW (belgium), Indian Institute of Technology (India), LYaTiss (France), ADVA Optica Networking Sp.zo.o. (Poland)

Abstract: GEYSERS’s vision is to qualify optical infrastructure providers and network operators with a new architecture, to enhance their traditional business operations. Optical network infrastructure providers will compose logical infrastructures and rent them out to network operators; network operators will run cost-efficient, dynamic and mission-specific networks by means of integrated control and management techniques. GEYSERS’s concept is that high-end IT resources at users’ premises are fully integrated with the network services procedures, both at the infrastructure-planning and connection-provisioning phases. Following this vision, GEYSERS will specify and implement a novel optical-network architecture able to support ‘Optical Network + Any-IT’ resource provisioning seamlessly and efficiently. Energy-consumption metrics for the end-to-end service routing are part of this efficiency. GEYSERS proposes to:
• Specify and develop mechanisms that allow infrastructure providers to partition their resources (optical network and/or IT), compose specific logical infrastructures and offer them as a service to network operators. This will be done overcoming the current limitations of networks/domain segmentation, and will support dynamic and on-demand changes in the logical infrastructures.

• Specify and develop a Network Control Plane for the optical infrastructure, by extending standard solutions (ASON/GMPLS and PCE), able to couple optical network connectivity and IT services automatically and efficiently, and provide them in 1 step, dynamically and on-demand, including infrastructure re-planning mechanisms.

These achievements will enable infrastructure providers, network operators and application providers to participate in new business scenarios where complex services with complex attributes and strict bandwidth requirements can be offered economically and efficiently to users and applications. GEYSERS’s outcomes will be validated in an EU-wide optical network test-bed.

8.2.1.2. SAIL

Title: Scalable and Adaptive Internet Solutions
Type: COOPERATION (ICT)
Defi: The Network of the Future
Instrument: Integrated Project (IP)
Duration: August 2010 - January 2013
Coordinator: Ericsson (Sweden)

Others partners: Ericsson AB (Sweden), Alcatel-Lucent Deutschland (Germany), Nokia Siemens Networks OY (Finland), NEC Europe LTD (United Kingdom), France Telecom SA (France), Telefonica Investigacion y Desarrollo (Spain), Telecom Italia (Italy), Portugal Telecom Inovacao (Portugal), Swedish institute of Computer science (Sweden), Instituto Superior Tecnico Address (Portugal), Universitaet Paderborn (Germany), Aalto-Korkeakoulusäätiö (Finland), Kungliga Tekniska Hoegskolan (Sweden), Fraunhofer Gesellschaft zur Förderung der angewandten Forschung (Germany), Universitaet Bremen (Germany), Hewlett-Packard Limited (United Kingdom), Fundacion Tecnalia Research and Innovation (Spain), Institut Telecom (France), Technion – Israel Institute of Technology (Israel), DOCOMO Communication Laboratoties Europe (Germany), The Provost Fellows & Scholars of the College of the Holy and undivided Trinity of Queen Elizabeth (Ireland), National ICT Australia Limited (Australia), Universidad de Cantabria (Spain), Lyatiss (France)

See also: https://twiki.verkstad.net/bin/view/Main/WebHome

Abstract: SAIL's objective is the research and development of novel networking technologies using proof-of-concept prototypes to lead the way from current networks to the Network of the Future. SAIL leverages state of the art architectures and technologies, extends them as needed, and integrates them using experimentally-driven research, producing interoperable prototypes to demonstrate utility for a set of concrete use-cases. SAIL reduces costs for setting up, running, and combining networks, applications and services, increasing the efficiency of deployed resources (e.g., personnel, equipment and energy). SAIL improves application support via an information-centric paradigm, replacing the old host-centric one, and develops concrete mechanisms and protocols to realize the benefits of a Network of Information (NetInf). SAIL enables the co-existence of legacy and new networks via virtualization of resources and self-management, fully integrating networking with cloud computing to produce Cloud Networking (CloNe). SAIL embraces heterogeneous media from fibre backbones to wireless access networks, developing new signaling and control interfaces, able to control multiple technologies across multiple aggregation stages, implementing Open Connectivity Services (OConS). SAIL also specifically addresses cross-cutting themes and non-technical issues, such as socio-economics, inclusion, broad dissemination, standardization and network migration, driving new markets, business roles and models, and increasing opportunities for both competition
and cooperation. SAIL gathers a strong industry-led consortium of leading operators, vendors, SME, universities and research centers, with a valuable experience acquired in previous FP7 projects, notably 4WARD. The impact will be a consensus among major European operators and vendors on a well-defined path to the Network of the Future together with the technologies required to follow that path.

8.2.1.3. PrimeEnergyIT

Title: SPEC on “Security and Privacy Concerns in Energy Efficient Computing”
Type: COOPERATION (ICT)
Defi: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: Intelligent Energy in Europe
Duration: 2010-2012
Coordinator: Electricity of Austria
Others partners: Berlin Energy Agency, Berlin Institute of Technology, BIO Intelligence Service, Politecnico di Milano, GAIA, ICLEI, University of Coimbra, Seven

Abstract:
The fast development of IT services and IT performance in many areas of the public and private service sector (e.g. administration, health services, entertainment etc.) has led to a rapid increase of energy consumption and energy costs for central IT equipment. EU and US studies (IEE E-Server project 2007, EPA 2007) have shown a strong increase of energy consumption of central IT-hardware and infrastructure during the last years and a growing trend is expected for the future. For EU-27 the energy consumption of central IT hardware and infrastructure (incl. servers, storage, network equipment, cooling) was calculated to 40TWh/a which is equal to 1.5% of the EU electricity consumption. If business-as-usual is continued in the next years a doubling of energy consumption to 80 TWh/a is expected to occur by 2012 already. A broad implementation of energy efficient technology in the EU however would allow a reduction of energy demand of about 60% compared to the business as usual scenario. Energy efficient technology is available but needs to be broadly implemented in the demand side market. To exploit the enormous saving potentials concerted action is needed across the EU member states. Measures to support energy efficient market development for central IT equipment have been started only recently in 2007. Thus compared to many other areas of technology (lighting, heating, client side IT etc.) activities to support sustainable solutions are quite new and more concerted action is needed to reach a good market impact. The major first initiatives at EU-level were The Green Grid, the Energy Star for servers, the Code of Conduct and the IEE E-Server project. These programmes started to develop guidelines, tools and criteria to support energy efficiency in data centres. However so far only part of the relevant products and technologies could be covered and energy efficiency criteria as well as market supporting instruments are still at an early stage of development and implementation. The proposed project is designed to further enforce energy efficient market development for central IT equipment based on the previous initiatives and with a focus on so far largely uncovered IT hardware including storage and network equipment as well as new power management technologies. The longer term objectives to be supported by the project are to avoid an annual energy consumption of 70TWha in the EU by 2015 compared to business as usual, to support the development of internationally accepted energy efficiency criteria and standards for central IT equipment and to implement energy efficiency as a key target for the major supply and demand side target groups. These goals shall be supported by the further development of energy efficiency criteria to be considered by the demand and supply side market, by the evaluation and demonstration of most energy efficient technology in best practise and by the development and implementation of education, certification and procurement concepts as major instruments to drive the market. The PrimeEnergyIT project deals with:
• The development and implementation of hardware and service based energy efficiency criteria as major tools to support IT and infrastructure managers in the selection and management of IT hardware and cooling equipment
• The demonstration and evaluation of energy efficient IT solutions in best practise
• Education and training of IT managers and experts to support energy efficient procurement and management
• Implementation of energy efficiency criteria for central IT equipment and cooling in public procurement

INRIA RESO has been mainly involved in energy efficiency criteria in the context of storage for small and medium datacenters.

8.2.1.4. EuroNF JRA.5.1.44 project SPEC

Title: SPEC on “Security and Privacy Concerns in Energy Efficient Computing”
Type: JRA
Defi: Future Internet Experimental Facility and Experimentally-driven Research
Instrument: EuroNef Project
Duration: 2011
Coordinator: University of Passau (Germany)
Others partners: University of Vienna, CERTH (Greece)

Abstract: To design highly energy efficient systems is one of the most important design goals which are under investigation currently. The underlying motifs to design such systems are economical as well as environmental in nature. However, it has been identified that while focusing solely on energy efficiency mechanisms, the other design parameters must also be considered to achieve a well balanced system. Security and privacy aspects are among those very important parameters. This SJRP focuses on the security and privacy aspects involved in the application of modern energy efficiency mechanisms. We focus on two of the key technologies including virtualization for energy efficiency and smart metering. In first part of the project, we investigate the security issues within virtualized environments for energy efficiency while the second part focus on the end user privacy concerns when monitoring physical resources in clouds.

8.2.1.5. COST Action IC804

Title: IC804 COST ACtion on “Energy efficiency for large scale distributed systems”
Type: European COST Action
Duration: 2009-2013
Coordinator: University of Toulouse
Others partners: 20 countries

Abstract: The main objective of the Action is to foster original research initiatives addressing energy awareness/saving and to increase the overall impact of European research in the field of energy efficiency in distributed systems. The goal of the Action is to give coherence to the European research agenda in the field, by promoting coordination and encouraging discussions among the individual research groups, sharing of operational know-how (lessons-learned, problems found during practical energy measurements and estimates, ideas for real-world exploitation of energy aware techniques, etc.). The Action objectives can be summarized on scientific and societal points of view: sharing and merging existing practices will lead the Action to propose and disseminate innovative approaches, techniques and algorithms for saving energy while enforcing given Quality of Service (QoS) requirements. Laurent Lefèvre is Management Committee member and French representative in this COST action.
8.3. International Initiatives

8.3.1. Visits of International Scientists

In the context of EuroNef project Spec Action, INRIA RESO has hosted Thomas Treutner form University of Vienna (Austria) during 2 weeks in July 2011. With RESO researchers, he has explored the topic of privacy in clouds when energy monitoring is performed. This collaboration has resulted in an international publication [26].
SWING Team

7. Partnerships and Cooperations

7.1. National Actions

7.1.1. ANR VERSO ARESA2 - “Avancées en Réseaux de capteurs Efficaces, Sécurisés et Auto-Adaptatifs” (2009-2012, 160 keuros)
**Participants**: Fabrice Valois, Marine Minier.

ARESA2 is a national initiative (ANR) started in December 2009 and focusing on IP and Security issues in wireless sensor networks. It follows the first ANR/RNRT - ARESA. Fabrice Valois is the leader of the workpackage about self-organisation and Marine Minier is involved in the workpackage on security. The leader of ARESA2 is Orange Labs and the others partners are: Coronis Systems, VERIMAG, LIG, Télécom Bretagne and INRIA.

7.1.2. ANR - Banet - Body Area Networks and Technologies (2007-2010, 129 keuros)
**Participants**: Paul Ferrand, Jean-Marie Gorce, Claire Goursaud, Nikolaï Lebedev, Guillaume Villemaud.

Banet is a national initiative (ANR) started in January 2008 and focusing on Body Area Network (BAN) systems. Jean-Marie Gorce is the leader of the workpackage ‘Standard air interface, network and protocol system design’. The budget for Swing is 120 keuros. Providing a framework for Body Area Networks (BAN), defining a reliable communication protocol, optimizing BAN technologies and enhancing energy efficiency of network components are the major stakes of then National Project BANET, led by CEA-Leti. It aims at defining precise frameworks to design optimized and miniaturized wireless communication systems. These body area networks target a wide applications range, such as consumer electronics, medical care and sports.

7.1.3. ANR - ECOSCELLS - Efficient Cooperating Small Cells (2009-2012, 260 keuros)
**Participants**: Virgile Garcia, Jean-Marie Gorce, Nikolaï Lebedev, Anis Ouni, Cengis Hasan, Hervé Rivano, Fabrice Valois.

ECOSCELLS is a national initiative (ANR) which aims at developing algorithms and solutions to ease Small Cells Network (SCN) deployment. Theoretical studies will provide models for understanding the impact of radio channels, and to permit the definition of new algorithms exploiting a full diversity (user, spatial, interferences, etc.) of such networks. The novelty of the project is not to consider the interference as a drawback anymore, but to exploit it in order to offer an optimal resource utilization. The algorithms will be based on most recent developments in distributed algorithms, game theory, reinforcement learning. Architecture and algorithms for the backhauling network will also be proposed.

7.1.4. ANR - Rapide - Design and analysis of stream ciphers for constrained environments (2006-2011, 47 keuros)
**Participants**: Cédric Lauradoux, Marine Minier.

Rapide is a national initiative (ANR). Marine Minier is responsible of the work package “MACs construction”. Stream ciphers are less popular than their block ciphers counterparts, due to the lack of real standards. However, they become essential as soon as we want to reach important flows for limited costs in software or hardware. The aim of this national project is to study, construct and evaluate new stream ciphers built upon a non-linear transition function and to better evaluate the properties of the filtering function to discard known attacks, especially the algebraic ones.

7.1.5. ANR INS BLOC - “block ciphers dedicated to constrained environments” (2011-2015, 80 keuros)
**Participants**: Marine Minier, Cédric Lauradoux.
BLOC is a research project partially funded by the French National Research Agency. It has been proposed to INS 2011 call. It aims at studying the design and analysis of block ciphers dedicated to constrained environments.

Participants: Paul Ferrand, Jean-Marie Gorce, Claire Goursaud, Isabelle Augé-Blum.

Cormoran project targets to figure out innovative communication functionalities and radiolocation algorithms that could benefit from inter/intra-WBAN cooperation. More precisely, the idea is to enable accurate nodes/body location, as well as Quality of Service management and communications reliability (from the protocol point of view), while coping with inter-WBAN coexistence, low power constraints and complying with the IEEE 802.15.6 standard. The proposed solutions will be evaluated in realistic applicative scenarios, hence necessitating the development of adapted simulation tools and real-life experiments based on hardware platforms. For this sake, CORMORAN will follow an original approach, mixing theoretical work (e.g. modelling activities, algorithms and cross-layer PHY/MAC/NWK design) with more practical aspects (e.g. channel and antennas measurement campaigns, algorithms interfacing with real platforms, demonstrations).

7.1.7. FUI ECONHOME - “Energy efficient home networking” (2010-2014, 330 keuros)
Participants: Nikolaï Lebedev, Florin Hutu, Jean-Marie Gorce, Guillaume Villemaud.

The project aims at reducing the energy consumption of the home (multimedia) data networks, while maintaining the quality requirements for heterogeneous services and flows, and preserving, or even enhancing the overall system performance. The equipments under concern are residential gateways, set-top-boxes (STB), PLC modules, Wifi extenders, NAS. The user equipment, such as smartphones, tablets or PCs are not concerned. The approach relies on combining both individual equipments IC and system level protocols that have to be eco-designed.


This action is a part of the common lab of Inria and Alcatel Lucent Bell Labs. This action groups several team of Inria with Alcatel teams and adresses different aspects of Self Networking: distributed algorithms, energy efficiency, mobility. Virgile Garcia is finishing his PhD on distributed power management in cellular networks and Sandesh Uppoor is in his 2nd year on mobility models.

7.2. Actions Funded by the EC

7.2.1. Projet iPLAN - FP7-PEOPLE-IAPP-2008 (2009-2012, 440 keuros)
Participants: Jean-Marie Gorce, Guillaume Villemaud, Nikolaï Lebedev, Dmitry Umansky, Meiling Luo.

iPLAN (is a FP7 project of the FP7-PEOPLE-IAPP-2008 call. iPLAN (Indoor Planning) The iPlan consortium is made of the Ranplan Company, the CITI Laboratory and the University of Bedfordshire and proposes the study of Indoor planning and optimization models and tools. The aim is to develop fast and accurate radio propagation models, investigate various issues arising from the use of femtocells, develop an automatic indoor radio network planning and optimization and facilitate knowledge integration and transfer between project partners, to enable cross-fertilization between radio propagation modeling, wireless communications, operations research, computing, and software engineering.

Meiling is currently seconded full-time for 2 years in Ranplan Company, and Nikolai Lebedev is seconded full-time for 1 year.

7.2.2. DistMo4wNet - FP6 fellowship (2006-2011, 240 keuros)
Participants: Jean-Marie Gorce, Katia Jaffrès-Runser.
DistMo4wNet is a FP6 project labelled in the FP6 framework in the outgoing fellowship program. Jean-Marie Gorce is the scientific responsible of the program, and Katia Jaffres-Runser is the applicant. She was supported from January 2007 through June 2009, for two years at the Stevens Institute of Technology where she works with Pr. Cristina Comaniciu on distributed optimization of wireless networks protocols.
8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. LINCS

TREC participates in the Laboratory of Information, Networking and Communication Sciences (LINCS); http://www.lincs.fr/ created on October 28th, 2010, by three French institutions of higher education and research: INRIA, Institut Télécom and UPMC. Alcatel-Lucent joined the LINCS in February 2011 as a strategic partner. The LINCS was officially launched by Ms Valérie Pécresse, the French Minister of Research, on May 2nd, 2011; see http://www.inria.fr/actualite/mediacenter/laboratoire-commun-internet-du-futur .

8.1.2. Digiteo ACRON

Participant: Bartłomiej Błaszczyszyn.

Project Analyse et Conception de Réseaux Sans Fil Auto-Organisés (ACRON) started in 2011. Coordinator: Supélec (Télécommunications), Partners: Inria HIPERCOM, Université Paris-Sud, IEF. Trec is associated partner.

The objective of this project is to work on characterization of the fundamental performance limits of large self-organizing wireless networks and develop distributed and self-organizing communication techniques that will approach the theoretical limits.

8.2. National Initiatives

8.2.1. ARC OCOQS

Participant: Ana Bušić.

Two-year Inria Collaborative action Action de recherche collaborative (ARC) OCOQS “Optimal threshold policies in COn troll ed Queuing Systems” OCOQS started in 2011. Coordinator: Ana Bušić, Participants: Alain Jean-Marie (MAESTRO, INRIA Sophia-Antipolis), Emmanuel Hyon (University of Paris Ouest and LIP6), Ingrid Vliegen (University of Twente); http://www.di.ens.fr/~busic/OCOQS . The research subject is the optimal control of stochastic processes, with applications to the control of networks and manufacturing systems. The principal aim is to widen the set of mathematical techniques that can be used to prove that optimal policies are of threshold type, thereby widening the set of classes of models that can be effectively solved exactly or numerically handled in practice.

8.2.2. GdR Stochastic Geometry

Participants: François Baccelli, Bartłomiej Błaszczyszyn.

TREC has participated in the mounting of the Research Group (Groupement de recherche, GdR) on Stochastic Geometry led by Pierre Calka (Université de Rouen). This GdR is going to be a collaboration framework for all French research teams working in the domain of spatial stochastic modeling, both on theory development and in applications. This year the application has been accepted by the National Committee of CNRS and the group will be officially created in 2012.

8.2.3. PEPS INS2I MonoSimPa

Participants: Anne Bouillard, Ana Bušić.

Exploratory research (Projet Exploratoire Premier Soutien (PEPS)) of INS2I CNRS titled “Simulation Temps Parallèle, Simulation Parfaite et Monotonie” (MonoSimPa) is a one year exploratory project on parallel and perfect simulation. It is a joint project with PRiSM, Versailles (UMR 8144) and LIG, Grenoble (UMR 5217).
8.3. European Initiatives

8.3.1. Collaborations in European Programs FP7

Participant: All Trec.

European Network of Excellence (NoE), http://euronf.enst.fr/en_accueil.html;
Project acronym: Euro-NF;
Duration: January 2008 - June 2012;
Coordinator: D. Kofman (Intitut Télécom);
Partners: about 30 partners;
Abstract: This NoE is focused on the next generation Internet. Its main target is to integrate
the research effort of the partners to be a source of innovation and a think tank on possible
scientific, technological and socio-economic trajectories towards the network of the future. Euro-
NF is supported by the theme “Information and Communication Technologies (ICT)” under the 7th
Framework Programme of the European Community for RTD. Euro-NF is a continuation of Euro-
NGI

8.3.2. Collaborations in European Programs, except FP7

Participants: François Baccelli, Bartłomiej Błaszczyszyn, Marc Lelarge.

EIT ICT Labs Action Line: Internet Technologies and Architectures.
Project acronym: FUN
Project title: Fundamentals of Networking
Duration: January 2011 - December 2011
Coordinator: INRIA TREC
Partners: the partners are INRIA TREC and INRIA GANG (Fabien Mathieu) in France, VTT (Ilkka
Norros, Samuli Aalto) and Aalto University (Pekka Orponen) in Finland, Eindhoven University (Sem
Borst, Onno Boxma and Remco van der Hofstad) in the Netherlands.
Abstract: The aim of this project is to build a community of researchers focusing on fundamental
theoretical issues of future networking. The topics of interest include: communication theory,
network information theory, distributed algorithms, self-organization and game theory, modeling
of large random and complex networks and structures. The proposal builds upon collaborations
within the EURONF Network of Excellence, where the three institutions are partners and where the
researchers have had fruitful scientific interactions.

8.4. International Initiatives

8.4.1. INRIA Associate Teams

8.4.1.1. IT-SG-WN

Title: Information Theory, Stochastic Geometry, Wireless Networks
INRIA principal investigator: François Baccelli
International Partner:
Institution: University of California Berkeley (United States)
Laboratory: EECS Department
Researcher: Venkat Anantharam, Anant Sahai, David Tse.

International Partner:
Institution: Stanford University (United States)
Laboratory: EE
Researcher: Abbas El Gamal.

Duration: 2011 - 2013
See also: [http://www.di.ens.fr/~baccelli/IT_SG_WN_web_site.htm](http://www.di.ens.fr/~baccelli/IT_SG_WN_web_site.htm)

The activity of this proposal is centered on the inter-play between stochastic geometry and network information theory, with a particular emphasis on wireless networks. In terms of research, three main lines of thought will be pursued: 1. Error exponents and stochastic geometry 2. Stochastic geometry and network Information Theory 3. Cognitive radio and stochastic geometry

8.4.2. Visits of International Scientists
8.4.2.1. Internships

Aleksander Wieczorek
Subject: Optimal control of an inventory system
Institution: Poznan University of Technology (Poland)

Mir Omid Haji Mirsadeghi (from Jan 2011 until Sep 2011)
Subject: Graph matching based on semi-definite positive relaxation
Institution: Sharif University of Technology (Iran, Islamic Republic of)