
RESEARCH CENTER

FIELD
**Networks, Systems and Services, Distributed Computing**

Activity Report 2012

# Section Partnerships and Cooperations

Edition: 2013-04-24

ACES Project-Team

# 6. Partnerships and Cooperations

## 6.1. National Initiatives

### *6.1.1. Bin That Thinks*

- Partners: ACES (Inria Rennes) and POPS (Inria Lilles), Veolia Propreté, and Etineo (a start up company focused on M2M communications and ambient networking)
- Starting: November 2010; ending: November 2013

Bin That Think is a research project funded by the ANR Ecotech program, which aims at sorting domestic waste at early stage in order to reduce costs and risks in waste sorting center, as well as helping citizens to adopt environment respectful. To this end, Bin That Think introduces a new system for (1) identifying the waste which involve a reject during waste collection, (2) detecting incompatible products and (3) implementing a reporting infrastructure enabling an efficient management/planning of the waste collecting process. Bin That Think will use RFID and embedded sensors to enable waste containers as an intelligent waste infrastructure and a network of smart sensors.

ADAM Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

**Adapt** is a local ADT (Action de Développement Technologique) 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 (see Section 5.5 ), *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 (recent graduated engineer) has been recruited in the context of this ADT.
**Participants**: Gwenael Cattez, Philippe Merle.

## 8.2. National Initiatives

### *8.2.1. ANR*

**SALTY** is a 36-month 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 to provide 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.
**Participants**: Laurence Duchien, Russel Nzekwa, Romain Rouvoy, Lionel Seinturier.

**SocEDA** is a 36-month 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.
**Participants**: Nabil Djarallah, Gabriel Hermosillo, Fawaz Paraiso, Romain Rouvoy, Lionel Seinturier.

**MOANO** (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 36-month project of the ANR CONTINT program which 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/LIFL/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.
**Participants**: Nabil Djarallah, Laurence Duchien, Nicolas Petitprez.

**YourCast** (Software Product Lines for Broadcasting Systems) is a 18-month ANR Emergence project that started in 2012 and that involves University of Nice Sophia Antipolis, Valorpaca and Inria ADAM. The project aims at defining an information broadcasting system by a dedicated software product line which will be used in schools or events, such as gatherings of scouts.
**Participants**: Laurence Duchien, Daniel Romero.

### *8.2.2. Competitivity Clusters*

**Macchiato** is a 36-month project of the competitivity cluster PICOM (Pôle des Industries du COMmerce), which has started in January 2011. The partners of this project are Auchan (leader), University of Bordeaux/LABRI, Inria, and the Web Pulser SME. The Macchiato project aims at rethinking 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 electronic cart". We believe that including the next generation of e-commerce sites will enable to offer a personalized offer to consumers by adapting the content and form of the web sites to their preferences and needs and will allow them to manage their purchases uniformly with a single electronic cart [118].
**Participants**: Nabil Djarallah, Laurence Duchien, Nicolas Petitprez, Romain Rouvoy.

**EasySOA** is a 24-month project funded by FUI and labelized by the Systematic competitivity cluster for Open Source Software. 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.
**Participants**: Antonio de Almeida Souza Neto, Michel Dirix, Jonathan Labéjof, Philippe Merle, Christophe Munilla.

**EconHome** is a 30-month project funded by FUI and labelized by the Minalogic and Systematic competitivity clusters. The project started in 2011. The partners of this project include Sagemcom, Orange, STMicroelectronics, ST-Ericsson, SPiDCOM, 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.
**Participants**: Aurélien Bourdon, Rémi Druilhe, Laurence Duchien, Adel Noureddine, Romain Rouvoy, Lionel Seinturier.

**Hermes** is a 36-month project funded by FUI and labelized by the PICOM (Pôle des Industries du COMmerce) competitivity cluster which has started in November 2012. The goal of the project is to define a modular and context-aware marketing platform for the retail industry. The focus is put on the interactions with customers in order to extract and mine relevant informations related to shopping habits, and on a multi-device, cross-canal, approach to better match customer usages.
**Participants**: Laurence Duchien, Romain Rouvoy, Lionel Seinturier.

### *8.2.3. Inria*

**ARC SERUS** (Software Engineering for Resilient Ubiquitous Systems) is founded by the Inria collaboration program. The partners are Inria ADAM, Inria PHOENIX 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.
**Participants**: Laurence Duchien, Alexandre Feugas, Lionel Seinturier.

**ADT AntDroid** (2012–2014) is a technology development initiative supported by Inria that aims at pushing the results of Nicolas Haderer's PhD thesis into production. AntDroid therefore focuses on deploying and disseminating the *Bee.sense* software platform to the public and to support the users of the platform. Bee.sense is a distributed platform dedicated to crowd-sensing activities. Bee.sense exploits the sensors of mobile devices that are shared by participants to observe physical or behavioral phenomenons. The challenges related to the development of such a platform encompasses user privacy and security, battery preservation, and user accessibility.
**Participants**: Romain Rouvoy, Nicolas Haderer.

## 8.3. European Initiatives

### *8.3.1. FP7 Projects*

Program: FP7 ICT

Project acronym: PaaSage

Project title: Model Based Cloud Platform Upperware

Duration: October 2012–September 2016

Coordinator: ERCIM

Other partners: ERCIM (Fr), SINTEF (No), STFC (UK), U. of Stuttgart (De), Inria (Fr), CETIC (Be), FORTH (El), Be.Wan (Be), EVRY Solutions (No), SysFera (Fr), Flexiant (UK), Lufthansa Systems AG (De), Gesellschaft fur wissenschaftliche Datenverarbeitung mbh Gottingen (De), Automotive Simulation Center Stuttgart (De).

Abstract: Cloud computing is a popular and over-hyped concept in ICT. The concept of infinitely scalable elastic resources changing without complex systems administration and paying only for resources used is attractive. These benefits are not immediately realizable. Within organisation benefits are realizable at considerable cost. IaaS (Infrastructure as a Service) public CLOUDs have different interfaces and conditions of use thus for an organisation to 'scale out' requires considerable investment using skilled technical staff. The business need is to allow organisations to "scale out" from their private CLOUD to public CLOUDs without a technical chasm between. This cannot

easily be achieved. Aligned with the EU strategic direction of an open market for services, SOA (service-oriented architecture) offers a way to virtualize across heterogeneous public CLOUDs and organizational private CLOUDs. It opens a market for European SMEs to provide services to be utilized (and paid for) by business applications and for all organisations to benefit from a catalogue of services that can be used across the environment. PaaSage will deliver an open and integrated platform, to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based development, configuration, optimisation, and deployment of existing and new applications independently of the existing underlying Cloud infrastructures. Specifically it will deliver an IDE (Integrated Development Environment) incorporating modules for design time and execution time optimisation of applications specified in the CLOUD Modeling Language (CLOUD ML), execution-level mappers and interfaces and a metadata database.

Participants: Laurence Duchien, Romain Rouvoy, Lionel Seinturier.

Program: FP7 FET

Project acronym: DIVERSIFY

Project title: More software diversity. More adaptivity in CAS.

Duration: 36 months

Coordinator: Inria

Other partners: SINTEF (Norway), Trinity College Dublin (Ireland), University of Rennes 1 (France)

Abstract: DIVERSIFY explores diversity as the foundation for a novel software design principle and increased adaptive capacities in CASs. Higher levels of diversity in the system provide a pool of software solutions that can eventually be used to adapt to unforeseen situations at design time. The scientific development of DIVERSIFY is based on a strong analogy with ecological systems, biodiversity, and evolutionary ecology. DIVERSIFY brings together researchers from the domains of software-intensive distributed systems and ecology in order to translate ecological concepts and processes into software design principles.

Participant: Martin Monperrus.

## 8.4. International Initiatives

### *8.4.1. Inria Associate Teams*

#### *8.4.1.1. SEAS*

Title: Middleware for Sensor as a Service

Inria principal investigator: Romain Rouvoy

International Partner (Institution - Laboratory - Researcher):

University of Oslo (Norway) - Department of informatics

Duration: 2010–2012

See also: http://seas.ifi.uio.no

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 (being it 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.

### *8.4.2. Inria International Partners*

#### *8.4.2.1. OW2*

OW2, previously ObjectWeb, is an international consortium to promote high quality open source middleware. The vision of OW2 is that of a set of components which can be assembled to offer high-quality middleware systems. We are members of this consortium since 2002. 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.
**Participants**: Philippe Merle, Romain Rouvoy, Lionel Seinturier.

#### *8.4.2.2. ERCIM Working Group on Software Evolution*

The Working Group (WG) on Software Evolution is one of the 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.
**Participant**: Laurence Duchien.

#### *8.4.2.3. University of Los Andes, Bogota, Colombia*

The ADAM project-team has a long term collaboration since 2005 with this university. Over the years, four PhD thesis (Carlos Noguera, Carlos Parra, Daniel Romero, Gabriel Tamura) have been defended in our team with students who obtained their MSc in this university. The first three were full French PhD, whereas the last one was a co-tutelle with this university. Professor Rubby Casallas from University of Los Andes is frequently visiting our team. The most recently defended PhD thesis, that of Gabriel Tamura, deals with QoS (quality-of-service) contract preservation in distributed service-oriented architectures. A formal theory to perform, in a safe way, the process of self-adaptation in response to quality-of-service (QoS) contracts violation has been proposed. The results have been published in [67], [66] and in the PhD thesis document itself [12].
**Participant**: Laurence Duchien.

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

Patrick Heymans (1 January 2012 to 30 April 2012).

Subject: Software and Information Systems Engineering, Requirements Engineering, Software Product Lines, Software Evolution.

Institution: University of Namur (Belgium).

Gabriel Tamura (October 2012).

Subject: Software architecture, dynamic software adaptation, and engineering of self-adaptive software systems.

Institution: University ICESI (Cali, Colombia).

Norha Villegas (October 2012).

Subject: Application of software engineering models, techniques and architectures to the development of self-adaptive and self-managing systems.

Institution: University of Victoria, Canada.

*8.5.1.1. Internships*

Diego Mendez (from June 2012 until November 2012).

Subject: Characterization of API Usage Diversity for Driving API-based Software Repair.

Institution: National University of the Center of the Buenos Aires Province (Argentina).

Daniel René Fouomene Pewo (from May 2012 until October 2012).

Subject: Elastic solution to tolerate peak load of users and queries generated by the so-called Slashdot effect.

Institution: University of Youndé (Cameroun).

Maxence G. de Montauzan (from March 2012 until July 2012).

Subject: An Empirical Study of Exception-Handling Design Strategies In Open-Source Applications.

Institution: University Lille 1 (France).

Anthony Da Costa Maia (from March 2012 until July 2012).

Subject: Extracting Knowledge from the Q&A Website StackOverflow at Debug Time.

Institution: University Lille 1 (France).

Sébastien Poulmane (from June 2012 until August 2012).

Subject: Integrating third-party sensors in the Bee.sense platform.

Institution: University Lille 1 (France).

**ARLES Project-Team**

# 7. Partnerships and Cooperations

## 7.1. National Grants

### *7.1.1. ANR*

*7.1.1.1. ANR MURPHY: Dependability-focused Evaluation of Sensor Networks*

**Participant:** Animesh Pathak [correspondent].

- **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.

### *7.1.2. Inria Support*

*7.1.2.1. Inria D2T Action de Developpement Technologique MobiTools*

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

- **Name:***MobiTools – Environnement de développement logiciel pour plateforme mobiles*
- **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).

*7.1.2.2. Inria D2T Action de Developpement Technologique Yarta*

**Participants:** Animesh Pathak, George Rosca.

- **Name:***Yarta – Middleware for mobile social ecosystems*
- **Period:** [October 2012 – September 2013]
- **Partners:** Inria (CRI Paris-Rocquencourt, EPI ARLES)

This project targets the development of Yarta, a middleware for managing mobile social ecosystems, which builds upon existing research in context-awareness in the pervasive computing domain. The work involves development effort in the multi-layer middleware architecture of Yarta, providing the needed functionalities, including *i*) Storage of social data in an interoperable format, using semantic technologies such as RDF; *ii*) Extraction of social ties from context (both physical and virtual); *iii*) Enforcement of access control to protect social data from arbitrary access; and *iv*) A rich set of mobile social ecosystem (MSE) management functionalities, using which mobile social applications can be developed. Specifically, the ADT will be used to support the public open source release and evolution of the Yarta middleware, which is currently a research prototype.

## 7.2. European Initiatives

### *7.2.1. FP7 Projects*

#### *7.2.1.1. FP7 ICT FET IP CONNECT*

**Participant:** Valérie Issarny [correspondent].

**Name:**CONNECT – *Emergent Connectors for Eternal Software Intensive Networked Systems*

**URL:** http://www.connect-forever.eu/

**Type:** COOPERATION (ICT)

**Defi:** ICT forever yours

**Instrument:** Integrated Project (IP)

**Related activities:** § 6.2

**Period:** [February 2009 - November 2012]

**Partners:** Inria (CRI Paris-Rocquencourt) [**project coordinator**], Ambientic (France), 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 systems'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).

*7.2.1.2. FP7 ICT IP CHOReOS*

**Participants:** Nikolaos Georgantas [correspondent], Valérie Issarny [correspondent].

**Name:** CHOReOS – *Large Scale Choreographies for the Future Internet*

**URL:** http://www.choreos.eu/

**Type:** COOPERATION (ICT)

**Defi:** Internet of Services, Software & Virtualisation

**Instrument:** Integrated Project (IP)

**Related activities:** § 6.3 & § 6.4

**Period:** [February October 2010 - September 2013]

**Partners:** NoMagic Europe (Lithuania), CEFRIEL (Italy), CNR (Italy), Linagora (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.

*7.2.1.3. FP7 PEOPLE Requirements@run.time*

**Participant:** Nelly Bencomo [correspondent].

**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

**Type:** PEOPLE

**Instrument:** Marie Curie Intra-European Fellowships for Career Development (IEF)

**Related activities:** § 6.6

**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.

*7.2.1.4. FP7 ICT NoE NESSoS*

**Participants:** Valérie Issarny [correspondent], Animesh Pathak [correspondent].

**Name:** NESSoS – *Network of Excellence on Engineering Secure Future Internet Software Services and Systems*

**URL:** http://www.nessos-project.eu

**Type:** COOPERATION (ICT)

**Defi:** Trustworthy ICT

**Instrument:** Network of Excellence (NoE)

**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.

*7.2.1.5. FP7 ICT CA EternalS*

**Participant:** Valérie Issarny [correspondent].

**Name:** EternalS – *Trustworthy Eternal Systems via Evolving Software, Data and Knowledge*

**URL:** http://www.eternals.eu

**Type:** CAPACITIES (ICT)

**Defi:** FET - Proactive

**Instrument:** Coordination and Support Action (CSA)

**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.

## 7.3. International Initiatives

### *7.3.1. Participation In International Programs*

*7.3.1.1. Project M@TURE – International scientific cooperation programme Inria/Brazil*

**Participant:** Nikolaos Georgantas [Correspondant].

**Name:** M@TURE – Models @ runtime for self-adaptive pervasive systems: enabling user-in-the-loop, requirement-awareness, and interoperability in ad hoc settings

**Instrument:** Inria-Brazil cooperation programme

**Period:** [October 2012 – September 2014]

**Partners:** Joint project with Institute of Informatics, Federal University of Goias, Brazil.

The overall goal of the M@TURE project is to design, implement and evaluate a novel approach and architecture – comprising conceptual foundations, engineering techniques, and supporting middleware infrastructure – for self-adaptive pervasive systems by building on the notion of Models@run.time. Models@run.time extends the applicability of models and abstractions to the runtime environment. In contrast to design-time models, runtime models are used to reason about the running system taking into account its operating environment, and thus these models enable automating runtime decisions and actions regarding the creation, configuration, and evolution of the system. We will in particular focus on the following dimensions and related models: (i) Requirements models making a system requirements-aware at runtime; (ii) Application- and middleware-level interoperability models exposing to an external observer the technological and business features of a system; and (iii) End-user and system engineer models modeling the internal elements of a system at two different abstraction levels. These models will be considered both independently and, more importantly, in synergy in order to introduce a comprehensive conceptual and architectural solution for self-adaptive pervasive systems.

## 7.4. International Research Visitors

### *7.4.1. Visits of International Scientists*

*7.4.1.1. Internships*

Amel Belaggoun (from Apr 2012 until Sep 2012)

Subject: Exploring the Use of Dynamic Decision Networks for Self-Adaptive Systems

Institution: Université de Versailles Saint-Quentin-en-Yvelines (France)

Ajay Chhatwal (from Jan 2012 until Mar 2012)

Subject: Supporting Application Development for the Future Internet of Smart Things and Services

Institution: Indian Institute of Technology, Banaras Hindu University, Varanasi (India)

Guilherme Nogueira (from Apr 2012 until Oct 2012)

Subject: Facilitating the Specification of Fault Tolerance Requirements in Sensor Network Macroprograms

Institution: University of São Paulo (Brazil)

ASAP Project-Team

# 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, CominLabs builds on a strong industrial ecosystem made of large companies and competitive SMEs.

### *8.1.2. ANR ARPÈGE project Streams*

**Participants:** 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, 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 algorithms 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:** George Giakkoupis, 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 focusing on the impact of spatial issues on distributed algorithms.

## 8.2. European Initiatives

### *8.2.1. FP7 Projects*

#### *8.2.1.1. ALLYOURS ERC Proof of Concept*

Title: AllYours, a distributed Privacy-aware Instant Item Recommender

Type: IDEAS

Instrument: ERC Proof of Concept Grant (Starting)

Duration: January 2013 - December 2013.

Coordinator: Inria (France)

See also: http://www.gossple.fr

Abstract: The goal of this PoC proposal is to boost the creation of a start-up (AllYours) targeting both Internet users as well as small to medium companies (SME) offering full-fledged personalization in notification systems. AllYours is a direct outcome from the GOSSPLE ERC Starting Grant, and more specifically from one of the activities conducted within the project, that today (after 3.5 years of the GOSSPLE ERC SG) involves most of the team and forces. In the GOSSPLE ERC SG project, we have invented the concept of implicit social network, built and maintained in a fully decentralized manner so that each user is in charge of her own personalized data, addressing both the privacy concern that users may have with respect to Big Brother-like companies, and scalability as the resources present at the edges of the Internet can then be fully leveraged. The GOSSPLE social network has been the basis of several Web 2.0 applications in order to personalize Web functionalities within the project, such as search, recommendation, query expansion, top-k queries, etc. More specifically, we have been applying the GOSSPLE social network to personalized notification, defining on top of it a novel dissemination protocol. This is P2P-AllYours currently under development. AllYours is investigating how to turn such inventions into a successful innovation with high potential targeting both end users and SMEs with an enterprise, semi-centralized, version of the system.

*8.2.1.2. TOWARD THE ALLYOURS START-UP*

Title: TOWARD THE ALLYOURS START-UP: focus on the mobile version

Type: EIT-ICT Labs

Instrument: ACLD Computing in the Cloud

Duration: January 2013 - December 2013.

Coordinator: Inria (France)

Partners: Trento Rise, BDP EIT-ICT

See also: http://www.gossple.fr

Abstract: The goal of the Activity proposal is to turn the inventions from the ERC Starting Grant Project GOSSPLE to innovation by setting up a start-up (AllYours) targeting both Internet users as well as small to medium companies (SME) offering full-fledged personalization in notification systems. This proposal will focus on the mobile versions of AllYours software. While the wired setting is a goal of the foreseen startup, this proposal will focus on the mobile versions of E-AllYours and P2P AllYours that will be experimented on the live platform provided by the TrentoRise partners.

*8.2.1.3. ERC SG Gossple*

Title: GOSSPLE

Type: IDEAS

Instrument: ERC Starting Grant

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.

GOSSPLE 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, self-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, Eleni Kanellou, Anne-Marie Kermarrec, Michel Raynal.

Program: Marie Curie Initial Training Network

Project acronym: Transform

Project title: Theoretical Foundations of Transactional Memory

Duration: May 2010 - October 2013

Grant agreement no.: 238639

Date of approval of Annex I by Commission: May 26, 2009

Coordinators: 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 ( 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. Collaborations with Major European Organizations*

Ecole Polytechnique Federale de Lausanne EPFL Switzerland
collaboration on the ERC SG GOSSPLE and Transform.

Foundation for Research and Technology Hellas ICS FORTH Greece
Transform

Lancaster University
collaboration on the ERC SG GOSSPLE

Imperial College London
collaboration on the Map-Reduce systems

## 8.3. International Initiatives

### *8.3.1. Inria International Partners*

University of Calgary
Universidad Nacional Autonoma de Mexico

### *8.3.2. Participation In International Programs*

*8.3.2.1. Demdyn: Inria/CNPq Collaboration*

**Participants:** 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.

## 8.4. International Research Visitors

The team welcomed the following research visitors in 2012.

Swan Dubois, Lip 6, 27 January 2012.

Paolo Costa, Imperial College London, from 8 to 10 February 2012 and one week in November.

Rachid Guerraoui, several one week visits in 2012.

Gregor Von Bochmann, University of Ottawa, from 12 to 17 March 2012.

Zekri Lougmiri, Faculté de Sciences d'Oran, 23 April to 4 May 2012.

Zhu Weiping, Hong Kong Polytechnic University, from 15 November 2011 until 14 May 2012.

Anna-Kaisa Pietilainen ; Technicolor Paris, 31 May 2012.

Jean-Pierre Lozzi, Lip 6, 1 June 2012.

Vincent Leroy, Université Joseph Fourier de Grenoble, 29 to 31 October 2012.

Bin Xiao, Hong Kong Polytechnic University, 26 December 2012.

### *8.4.1. Internships*

Mathieu GOESSENS; 6 February 2012 to 6 July 2012. "Peer-to-peer content dissemination". Supervised by Davide Frey and Anne-Marie Kermarrec.

Ilham IKBAL; 1 March 2012 to 15 August 2012. "Integration du routage en oignon (TOR) dans les protocoles epidemiques". Supervised by Davide Frey.

Imane ALIFDAL; 1 March 2012 to 31 August 2012. "Integration du routage en oignon (TOR) dans les protocoles epidemiques". Supervised by Davide Frey.

Benjamin Girault; 19 March to 31 August 2012. "Heterogeneous gossip protocols for news recommendation". Supervised by Anne-Marie Kermarrec.

Asiff Shaik; 3 August 2012 to 2 January 2013. "Understanding offline social networks and its advantages over the online social network ; resolving some challenges in the offline social networks such as privacy, trust, security and scalability.". Supervised by Anne-Marie Kermarrec.

### *8.4.2. Visits to International Teams*

**Anne-Marie Kermarrec** has been a part-time (50%) visiting professor at EPFL Lausanne since September 2012.

**ASCOLA Project-Team**

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### *8.1.1. ANR*

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

**Participants:** Mario Südholt [coordinator], Diana Allam, Rémi Douence, Hervé Grall, Jean-Claude Royer.

The project CESSA is an (industrial) ANR project running for 3 years months, with funding amounting to 290 KEUR for ASCOLA from Jan. 10 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 a unifying model for WD*/SOAP-based and RESTful web services. Furthermore, we have formally defined a type system that is safe in the presence of malicious attackers and insecure communication channels.

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

*8.1.1.2. Entropy (ANR/Emergence)*

**Participants:** Jean-Marc Menaud [coordinator], Thomas Ledoux, Adrien Lèbre.

The Entropy project is an (industrial) ANR/Emergence project running for 18 months. It was accepted in December 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 a industrial business 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.

*8.1.1.3. 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 provides a convenient means of remote on-demand and pay-per-use access to computing resources. However, its ad-hoc management of quality-of-service (QoS)and SLA poses significant challenges to the performance, dependability and costs of online cloud services.

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 (i) CSLA, a novel language to describe QoS-oriented SLA associated with cloud services [23]; (ii) a SLA-driven capacity planning for cloud applications [24].

*8.1.1.4. SONGS (ANR/INFRA)*

**Participants:** Adrien Lèbre [coordinator], Flavien Quesnel, Jonathan Pastor.

The SONGS project (Simulation of Next Generation Systems) is an ANR/INFRA project running for 48 months (starting from January 2012 with an allocated budget of 1.8MEuro, 95KEuro for ASCOLA).

The consortium is composed of 11 academic partners from Nancy (AlGorille, coordinator), Grenoble (MESCAL), Villeurbanne (IN2P3 Computing Center, GRAAL/Avalon - LIP), Bordeaux (CEPAGE, HiePACS, RUNTIME), Strasbourg (ICPS - LSIIT), Nantes (ASCOLA), Nice (MASCOTTE, MODALIS).

The goal of the SONGS project (http://infra-songs.gforge.inria.fr) is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area. The ASCOLA involvement will start in 2013 with the arrival of Takahiro Hirofuchi from the AIST institute in Japan.

### *8.1.2. FUI*

*8.1.2.1. Cool-IT (FUI)*

**Participant:** Jean-Marc Menaud [coordinator].

The Cool-IT project is an (industrial) FUI project running for 24 months. It was accepted in September 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 data centers electrical consumption.

To this end, the COOL IT project will develop processes for cooling computer servers, optimize the server power chain supply, implement tools and methods of collecting energy data in real time, and specify methods for controlling the data centers consumption as a tradeoff between the computational power needed, the availability, and the energy consumption.

### *8.1.3. FSN*

*8.1.3.1. OpenCloudware (FSN)*

**Participants:** Jean-Marc Menaud [coordinator], Thomas Ledoux, Yousri Kouki.

The OpenCloudware project is coordinated by France Telecom, funded by the French Fonds National pour la Société Numérique (FSN, call Cloud n°1) and endorsed by competitiveness clusters Minalogic, Systematic and SCS. OpenCloudware is developed by a consortium of 18 partners bringing together industry and academic leaders, innovative technology start-ups and open source community expertise. Duration: 36 months - 2012-2014.

The OpenCloudware project aims at building an open software engineering platform, for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures. It will be available through a self-service portal. We target virtualized multi-tier applications such as JavaEE - OSGi. The results of OpenCloudware will contain a set of software components to manage the lifecycle of such applications, from modelling(Think), developing and building images (Build), to a multi-IaaS compliant PaaS platform (Run).

The ASCOLA project-team is mainly involved in the sub-projects "Think" (SLA model accross Cloud layers) and "Run" (virtual machine manager for datacenters and placement constraints).

## 8.2. European Initiatives

### *8.2.1. FP7 Projects*

*8.2.1.1. A4Cloud: Accountability for the Cloud (Integrated Project)*

**Participants:** Mario Südholt [coordinator], Omar Chebaro, Ronan-Alexandre Cherrueau, Rémi Douence, Hervé Grall, Jean-Claude Royer.

The A4Cloud project is an integrated EU project, coordinated by HP, UK, on the topic of accountability, that is, the responsible stewardship of private data, in the Cloud. This 42-months project started in Oct. 2012 and Ascola's funding amounts to 600 KEuro.

The project involves 13 partners: in addition to HP, two enterprises (SAP AG, Germany; ATC, Greece), a non-governmental organisation (the Cloud Security Alliance, CSA) and 9 universities and research organisations (EMNantes and Eurecom, France; HFU. Furtwangen, Germany; Karlstadt U., Sweden; U. Malaga, Spain; Queen Mary U., U.K.; U. Stavanger and Sintef, Norway; Tilburg U., The Netherlands).

A4Cloud will create solutions to support users in deciding and tracking how their data is used by cloud service providers. By combining methods of risk analysis, policy enforcement, monitoring and compliance auditing with tailored IT mechanisms for security, assurance and redress, A4Cloud aims to extend accountability across entire cloud service value chains, covering personal and business sensitive information in the cloud.

### *8.2.2. Collaborations in European Programs, except FP7*

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

**Participants:** Adrien Lèbre [coordinator], Mario Südholt, Gustavo Bervian Brand.

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 into 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 Polytecnica de Madrid (Spain), EMN/ARMINES (France), Inria Rennes Bretagne Atlantique (France), XLAB (Slovenia), University of Hamburg (Germany), Fujistu 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.

*8.2.2.2. COST IC0804*

Program: Energy efficiency in large sclae distributed systems

Project acronym: COST IC0804

Project title: Energy efficiency in large scale distributed systems

Duration: Jan. 2009 - May 2013

Coordinator: Jean-Marc Pierson (IRIT, France)

Participating countries: AT, BE, CH, CY, DE, DK, EE, FI, FR, GR, HU, IE, IL, IT, LU, PL, PT, RO, SE, SP, TR, UK,

Abstract: 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/

## 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 - Laboratory - Researcher):

University of Chile (Chile) - PLEIAD - Éric Tanter

Duration: 2010 - 2012

See also: 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. A concrete outcome of RAPIDS will be prototypes for two concrete distributed aspect-oriented extensions of languages increasingly used by current practitioners: Javascript and Java/Scala.

## 8.4. International Research Visitors

### *8.4.1. Internships*

Rahma CHAABOUNI (from April 2012 until June 2012)

Subject: Flexible evolution of service-oriented systems

Institution: ENIS school, Sfax, Tunisie

Ismael FIGUEROA (from May 2012 until Jul 2012)

Subject: Exploring membranes for aspect oriented programming

Institution: University of Chile (Chile)

ATLANMOD Team

# 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
Other partners: None
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.
Program: Pole de competitivite Images et Reseaux - Appel Projets PME 2011
Project title: StreamMaster
Duration: 2012 - 2014
Coordinator: Data Syscom
Other partners: Research and University (Universite de Nantes, Ecole de Design Nantes Atlantique, ESC Rennes) and Vendors and service providers (IMINFO)
Abstract: The purpose of the StreamMaster project is creating a universal software solution for the smart management of document streams, providing an added value over all the chain. StreamMaster will provide: an hybrid (local and remote) technological platform to allow user access, the possibility of connection to every information system and every input and output stream, the management of all the parameters of the document stream (cost, speed, delay, quality, environmental impact), security and reinforced document authentication mechanisms, non-falsifiable documents by means of invisible document tatooing, an innovative and multimodal HMI.

## 8.2. National Initiatives

### *8.2.1. ANR*

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: FUI - AAP 13

Project acronym: TEAP

Project title: TOGAF Entreprise Architecture Platform

Duration: 2012 - 2014

Coordinator: Obeo

Other partners: Industry (DCNS), Research and University (Inria AtlanMod) and Vendors and service providers (Obeo, Capgemini)

Abstract: The fast evolution of technologies (SOA, Cloud, mobile environments), the systems complexity and the growing need for agility require to be able to represent information systems as a whole. The high-level approach promoted by Enterprise Architecture (EA) is a key element in this context and intends to address all the systems dimensions: software components, associated physical resources, relationships with the companies requirements and business processes, implied actors/roles/structures, etc. The objective of the TEAP project is to specify and implement an EA platform based on the Open Group international standard named TOGAF and on the SmartEA technical solution. In addition to its base modeling capabilities, this platform will allow data federation from different existing sources (e.g. for reverse engineering purposes such as retro-cartography) as well as the definition of possible transformation chains (for governance and modernization). As part of this project, we are notably using in practice (and improving) some of our works such as Virtual EMF, ATL or some MoDisco components.

## 8.3. European Initiatives

### *8.3.1. FP7 Projects*

Title: Advanced software-based seRvice provisioning and migraTIon of legacy Software

Type: FP7, COOPERATION (ICT)

Defi: Cloud Computing, Internet of Services and Advanced Software engineering

Instrument: Integrated Project (IP)

Duration: October 2012 - September 2015

Coordinator: Atos Origin R&I (Spain)

Others partners: Tecnalia (Spain), Inria (France), Fraunhofer (Germany), TUWIEN (Austria), ENG (Italy), ICCS (Greece), SPARX (Austria), ATC (Greece), SPIKES (Belgium)

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

Abstract: Successful software has to evolve to keep it compatible and up to date. Up to 90% of software cost is spent on maintenance and of this 75% is spent on the development of new features for staying competitive. The industry progresses through periods of incremental development interlaced with true paradigm shifts. Accordingly, more and more traditional software vendors notice the need to transform their current business and technology model in order to remain competitive. Software-as-a-Service (SaaS) is seen as the most promising way to achieve this change. However, this transition from Software-off-the-shelf (often residing as legacy applications) to SaaS is a tremendous challenge comprising business, application and technical issues. Having an automated, vendor, technology and hardware independent way to migrate an application would permit the software to evolve easily even in case of transition to new paradigms. ARTIST proposes a software migration approach covering the premigration and postmigration phases. The premigration phase analyzes the technical and non-technical consequences of migrations, supporting the decision-making process on how a migration should be done. The migration phase itself is based on Model Driven Engineering techniques to automate the reverse engineering of the legacy applications to platform independent models. These models are the input for the forward engineering process to generate and deploy modernized applications and to support future migrations. In the postmigration

phase, the modernized applications are certified with respect to the stated goals of the premigration phase. ARTIST will reduce the risk, time and cost of migrating legacy software. It will lower the barriers for companies (with existing software) wanting to take advantage of the latest technologies and business models, particularly when considering the current benefits of Cloud Computing and SaaS.

Title:Cost-Efficient methods and processes for SAfety Relevant embedded systems

Program: Artemis

Project acronym: CESAR

Duration: 2009 - 2012

Coordinator:

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 pursuits 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 [42]. 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.

Title:Open Platform for the Engineering of Embedded Systems

Program: ITEA2

Project acronym: OPEES

Duration: 2009 - 2012

Coordinator: Obeo

Other partners: Many other research labs and companies. Our main partner was the Obeo company.

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 [3] (e.g. around ATL) will be tested and developed as a team contribution to this project. AtlanMod 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.

### *8.3.2. 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: Potecnico 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*

The three main research partners of the team are:

- Politecnico di Milano (Italy) - DB Group, specially with Marco Brambilla
- TU Wien (Austria) - BiG Group, specially Manuel Wimmer
- Politecnica de Catalunya (Spain) - GESSI Group, specially Xavier Franch

With all three teams we have published several papers and made research visits this year.

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

In 2012 the following visitors did a research stay with AtlanMod:

- Ralf Lammel (University of Koblenz-Landau, Germany), February
- Soichiro Hidaka (National Institute of Informatics (NII), Tokyo, Japan), September
- David Ameller (Universitat Politècnica de Catalunya), June
- Juan Manuel Dodero (University of Cádiz, Spain), June
- Jokin García (University of Basque Country, Spain), May-August

CIDRE Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

- **Région Bretagne ARED grant:** the PhD of Regina Marin on privacy protection in distributed social networks is supported by a grant from the Région Bretagne.
- **Labex COMINLAB contract (2012-2015): « POSEIDON »**

  POSEIDON deals with the protection of data in outsourced or mutualized systems such as cloud computing and peer-to-peer networks. While these approaches are very promising solutions to outsource storage space, contents, data and services, they also raise serious security and privacy issues since users lose their sovereignty on their own data, services and systems. Instead of trying to prevent the bad effects of the cloud and of peer-to-peer systems, the main objective of the POSEIDON project is to turn benefit from their main characteristics (distribution, decentralization, multiple authorities, etc.) to improve the security and the privacy of the users' data, contents and services.

  This study is conducted in cooperation with Télécom Bretagne and Université de Rennes 1.
- **Labex COMINLAB contract (2012-2015): « SecCloud »**

  Nowadays attacks targeting the end-user and especially its web browser constitute a major threat. Indeed web browsers complexity has been continuously increasing leading to a very large attack surface. Among all possible threats, we tackle in the context of the SecCloud project those induced by client-side code execution (for example javascript, flash or html5).

  Existing security mechanisms such as os-level access control often only rely on users identity to enforce the security policy. Such mechanisms are not sufficient to prevent client-side browser attacks as the web browser is granted the same privileges as the user. Consequently, a malicious code can perform every actions that are allowed to the user. For instance, it can read and leak user private data (credit cart numbers, registered passwords, email contacts, etc.) or download and install malware.

  One possible approach to deal with such threats is to monitor information flows within the web browser in order to enforce a security information flow policy. Such a policy should allow to define fine-grained information flow rules between user data and distant web sites. This implies to propose an approach and to design and implement a mechanism that can handle both OS-level and browser-level information flows.

  Dynamically monitoring information flow at the web browser level may dramatically impact runtime performances of executed codes. Consequently, an important aspect of this work will be to benefit as far as possible from static analysis of application code. This static-dynamic hydride approach should reduce the number of verifications performed at run time.

  This study is conducted in cooperation with other Inria Teams (Ascola and Celtique).

## 8.2. National Initiatives

### *8.2.1. ANR*

- **ANR ARPEGE Project: DALI (2009-2012) - http://dali.kereval.com/**

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

Our activity consists in the design and development of a mechanism to discover invariants in web applications. These invariants are weaved in the application source code, in order to be dynamically checked at runtime. The approach has been applied on an e-commerce application. The assessment phase which has been carried out by the LAAS-CNRS demonstrated a good detection rate of our mechanisms. This projet has been evaluated during the ANR « Grand Colloque STIC » January 2012 and has reached an end in June 2012.

- **ANR INS Project: AMORES (2011-2015) - http://amores-project.org/**

  Situated in the mobiquitous 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 geo-communication 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). Within this context, we study in particular the problem of anonymous routing and the design of a key generation protocol tied to a particular geographical location. Each of these services can only work through cooperation of the different entities composing the mobile network. Therefore, we also work on the development of mechanisms encouraging entities to cooperate together in a privacy-preserving manner. The envisioned approach consists in the definition of generic primitives such as the management of trust and the incentive to cooperation. This project is joint between the Université de Rennes 1, Supélec, LAAS-CNRS, Mobigis and Tisséo. The research project AMORES received the Innovation Award at the Toulouse Space Show last June. Simon Boche and Paul Lajoie-Mazenc are doing their PhD in the context of this project.

- **ANR INS Project: LYRICS (2011-2014) - http://projet.lyrics.orange-labs.fr/**

  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. Within this project, we work mainly on the privacy analysis of the risks incurred by users of mobile contactless services as well as on the development of the architecture enabling the development of privacy-preserving mobile contactless services. 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.

### *8.2.2. Inria Large-scale Actions*

- **CAPPRIS (2012-2016)**

  CAPPRIS stands for “Collaborative Action on the Protection of Privacy Rights in the Information Society”. The main objective of CAPPRIS is to tackle the privacy challenges raised by the most recent developments and usages of information technologies such as profiling, data mining, social networking, location-based services or pervasive computing by developing solutions to enhance the protection of privacy in the Information Society. To solve this generic objective, the project focuses in particular on the following four fundamental issues:

  – The design of appropriate metrics to assess and quantify privacy, primarily by extending

and integrating the various possible definitions existing for the generic privacy properties such as anonymity, pseudonymity, unlinkability and unobservability, as well as notions coming from information theory or databases such as the recent but promising concept of differential privacy;

– The definition and the understanding of the fundamental principles underlying "privacy by design", with the hope of deriving practical guidelines to implement notions such as data minimization, proportionality, purpose specification, usage limitation, data sovereignty and accountability directly in the formal specifications of our information systems;

– The integration between the legal and social dimensions, intensely necessary since the developed privacy concepts, although they may rely on computational techniques, must be in adequacy with the applicable law (even in its heterogeneous and dynamic nature). In particular, privacy-preserving technologies cannot be considered efficient as long as they are not properly understood, accepted and trusted by the general public, an outcome which cannot be achieved by the means of a mathematical proof.

Three major application domains have been identified as interesting experimentation fields for this work: online social networks, location-based services and electronic health record systems. Each of these three domains brings specific privacy-related issues. The aim of the collaboration is to apply the techniques developed to the application domains in a way that promotes the notion of privacy by design, instead of simply considering them as a form of privacy add-ons on the top of already existing technologies. CAPPRIS is a joint project between Inria, CNRS, Université de Rennes 1, Supélec, Université de Namur, Eurecom, and Université de Versailles.

### *8.2.3. Research mission "Droit et Justice"*

- **Droit à l'Oubli (2012-2014)**

  The "right to be forgotten" can be viewed as a consequence and an extension of the right to privacy and to personal data protection, emphasized by the inherent difficulty to erase any given information from the omnipresent digital world. The French ministry of Justice has launched two twin projects (one of which is the DAO project), in order to explore the possible legal definitions of a "right to be forgotten". Even though there are no legal foundations for such a right in France at the moment, the concept is already known from the general public and is also present in courts. Furthermore, individuals expect to be protected by such a right, thus it is important to understand why, how, in which circumstances and to which extent this new right may apply before envisioning a legal notion defining it. The DAO project involves a major legal component, a sociological survey and a technical study. In a nutshell, the legal part explores the possible boundaries and requirements of a right to be forgotten with respect to labor law, civil statuses, personal data protection, legal prescription and IT law. The sociological survey aims at understanding the root causes making people build a desire for forgetfulness in others. Finally, the objective of the computer science part is to elaborate a state of the art of the techniques that could be used to enforce a right to be forgotten in practice in the digital world. The expected output of the project as a whole is a detailed recommendation about whether an independent legislation proposal for the right to be forgotten would be justified, and how it should be done. The project is joint between Université de Rennes 1, Inria and Supélec.

### *8.2.4. Competitivity Clusters*

The following projects are recognized by the Images & Réseaux cluster:

- DALI (ANR ARPEGE 2008): http://www.images-et-reseaux.com/en/content/dali
- AMORES (ANR INS 2011): http://www.images-et-reseaux.com/en/content/amores

## 8.3. European Initiatives

### *8.3.1. Collaborations in European Programs, except FP7*

Program: EIT KICs

Project acronym: EIT ICT Labs

Project title: action line « Security, Privacy and Trust in the Information Society »

Duration: 2012-

Coordinator: Sébastien Gambs (until September 2012 and since then Guido Bertoni, STMictoelectronics)

Abstract: Information Technologies have invaded many aspects of people's daily lives, creating new possibilities but also raising concerns in term of privacy and trust. Protecting the privacy of individuals is one of the main challenges of the Information Society but it is difficult to achieve as individuals constantly leave digital traces of their lives, often without even being aware of this. 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. From the technology viewpoint, a number of Privacy Enhancing Technologies (PETs) and Privacy Aware Architectures have been proposed. So far, these technologies have not stimulated a strong public interest and are not widely used yet. However, the European Commission is putting forward the "privacy by design" principle, which integrates the privacy issues in the design phase of a system or application.

Security and trust can be seen as complementary requirements to privacy. Large scale adoption of digital devices, like in eHealth and smart cities, requires trustworthy products and communication. These requirements are not (always) completely understood and off-the-shelf solutions could not fulfill the security, trust and privacy needs. There is a large gap between what is applied, usability requirements and the right level of security. This gap represents a strategic opportunity where European players have a recognized know-how and where leadership should be leveraged and nurtured.

While the action line was originally intended to focus on privacy (created by a joint effort from Sébastien Gambs, Daniel Le Métayer and Claude Castelluccia from Inria Rhône-Alpes), its scope was recently extended to include security and trust thus being renamed as "Security, Privacy and Trust in the Information Society". In 2012, a "location privacy" activity leaded by Sébastien Gambs was created that involves CIDRE and other partners (namely KTH, Alcatel-Lucent, University of Trento, Inria Rhône-Alpes, Nokia) coming from 3 different nodes of EIT ICT labs. An engineer funded by the project (Izabela Moise) is currently working on the development of a distributed version of GEPETO based on the MapReduce paradigm and the Hadoop framework, in order to make it able to deal with datasets composed of millions of mobility traces. In 2013, this activity will be extended to also address the issues of privacy and security for location-based services, thus being renamed "Security and privacy for location-based services".

### *8.3.2. Collaborations with Major European Organizations*

**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.

Our activity focuses on a task (leaded 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. From November 2011 until November 2012, Julien Lolive has worked on the project as an engineer. Izabela Moise has also joined the Quaero project since October 2012.

## 8.4. International Initiatives

### *8.4.1. Inria International Partners*

**CANADA**: Sébastien Gambs was co-supervising Ai Thanh Ho, a PhD student from the Université de Montréal with whom he has been actively collaborating since many 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 successfully defend her PhD thesis in June 2012.

**AUSTRALIA**: With Queensland University of Technology (QUT, Brisbane) we cooperate to study policy-based intrusion detection problems. 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. From February 2011 to February 2012, Christopher Hauser has worked in Brisbane. His one year visit was supported by a grant from Rennes Métropole.

**STIC Algeria (Program Inria/DGRST, 2011-2013):** This cooperation project is managed by Adlen Ksentini (member of the Inria Project DIONYSOS, Rennes) and Abdelouahid Derhab (member of CERIST, Centre de Recherche sur l'Information Scientifique et Technique, Alger). 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. With L. Zeghache and N. Badache (CERIST), we investigate the use of Mobile Transactional Agents.

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

**CANADA**: Jean-Marc Robert, Professor Professor of ETS (École de Technologie Supérieure) at Montreal was visiting us during a period of four months (September 2012 - December 2012). The joint works focus mainly on privacy in pro-active ad hoc routing protocols. Based on the OLSR protocol, we have proposed a privacy preserving ad hoc proactive routing protocol that preserves the anonymity of the participants, and assure the unlinkability of two different packet flows between two given nodes.

### *8.5.2. Internships*

**CHINA**: Chuanyou Li, PhD student at Southeast University (Nanjing, China) was 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.

**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: Gabbrielli, Mauro, Sangiorgi, Zavattaro.
- 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.
- REVER (Programming Reversible Recoverable Systems) is an ANR project that started 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: Giachino, Lienhardt, Lanese, Laneve, Zavattaro.
- The ANR project PACE (Processus non-standard: Analyse, Coinduction, et Expressivité) has been recently accepted but will start only in 2013. The project targets three fundamental ingredients in theories of concurrent processes, namely coinduction, expressiveness and analysis techniques. The project aims at processes that are beyond the realm of "traditional" processes. Specifically, the models studied exhibit one or more of the following features: probabilities, higher-order, quantum, constraints, knowledge, and confidentiality. These models are becoming increasingly more important for today's applications. Coinduction is intended to play a pivotal role. Indeed, the approaches to expressiveness and the analysis techniques considered in the project are based on coinductive equalities. Main persons involved: Hirschkoff (project coordinator), Dal Lago, Lanese, Sangiorgi, Zavattaro.

## 7.2. European Initiatives

### *7.2.1. FP7 Projects*

- 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.
- PLATFORM (Practical Light Types for Resource Consumption) is a Marie Curie IOF project from FP7, started July 2011 with a three-year span. It involves one Focus member (Gaboardi) in research work at University of Pennsylvania and in Bologna. Project aim is the development of a practical programming language with information, in the form of dependent types, about the resources needed by programs during their execution, and where type checking a program will naturally corresponds to exhibit a certification of its resource consumption.

### *7.2.2. Collaborations in European Programs, except FP7*

- The ICT COST Action BETTY (Behavioural Types for Reliable Large-Scale Software Systems), initiated in October 2012 and with a four-year duration, will use behavioural type theory as the basis for new foundations, programming languages, and software development methods for communication-intensive distributed systems. Behavioural type theory encompasses concepts such as interfaces, communication protocols, contracts, and choreography. Main persons involved: Bravetti, Giachino, Lanese, Laneve, Sangiorgi, Zavattaro.
- The EIT activity "Intelligent Services for Digital Cities" in the context of the Digital Cities Action Line, has been approved, with funding to be spent in 2013. Main persons involved: Gabbrielli.

### *7.2.3. Collaborations with Major European Organizations*

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

- 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).
- 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).
- Laboratoire d'Informatique, Université Paris Nord, Villetaneuse (on implicit computational complexity). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini. An Italian PhD student (Marco Solieri) is working on his PhD thesis with joint supervision (Martini, Guerrini).
- 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).
- Team PPS, University of Paris-Diderot Paris 7 (on logics for processes, resource control). Contact person(s) in Focus: Dal Lago, Gaboardi, Martini, Sangiorgi. Various short visits in both directions during the year.
- IRILL Lab, Paris (on models for the representation of dependencies in distributed package based software distributions). Contact person(s) in Focus: Zavattaro. Various short visits in both directions during the year.
- University of Innsbruck (on resource control and termination). Contact person(s) in Focus: Dal Lago. A few short visits during 2012.
- Inria EPI Indes, (on orchestration and programming languages). A common meeting was organised in Bologna, January 2012, where 4 people from Indes and almost everybody from Focus participated.
- EPI Carte, Inria-Nancy Grand Est and LORIA (on implicit computational complexity). Contact person(s) in Focus: Dal Lago,Gaboardi. A few short visits during 2012.
- LMU Munich (M. Hofmann) (on Implicit computational complexity and IntML). Contact person(s) in Focus: Dal Lago.
- IMDEA Software, Madrid (G. Barthe) (on Implicit computational complexity for cryptography). Contact person(s) in Focus: Dal Lago.
- 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).

## 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.

## 7.4. International Research Visitors

### *7.4.1. Visits of International Scientists*

Among the visits below, we note 2 long-term visits: the 6-month visit of Matias Lee (paid by a EADIC II - Erasmus Mundus scholarship); and the sabbatical year of Xian Xu, from East China University of Science and Technology, Shanghai (paid a scholarship from the Chinese Science Foundation).

- Peter Hofner, Nicta, Sydney, Australia. 1 week end of January. Topic: Formal Methods for Wireless Networks.
- Martin Avanzini, Institute of Compute Science, University of Innsbruck, Austria. 23 to 27 April, 2012. Topic: order-theoretic approaches to complexity analysis of functional programs.
- Marco Carbone, IT University of Copenhagen. A week in May/June 2012. Topic: faults and compensations in choreography languages.
- Raju Halder, Macquarie University, Australia. 2 days in May 2012. Topic: Abstract Interpretation and concurrency.
- Luca Fossati, Imperial College London. A week in May 2012. Topic: Liveness properties by means of types in the $\pi$-calculus.
- Xian Xu has began in May a year sabbatical in Focus. He is lecturer at the East China University of Science and Technology in Shanghai.
- Matias David Lee. Currently PhD student at Universidad Nacional de Córdoba, Argentina, has spent 5 months during 2012, from January to May (having arrived in November 2011), for a long-term visit.
- Bertrand Meyer, ETH Zurich. One day in September 2012. Topic: Concurrent Object-Oriented Programming.
- Mariangiola Dezani, Univ. Turin, Italy. 4 days October 2012. Topic: Session Types.
- Clement Aubert, LIPN Université Paris 13. From 5 to 16 November 2012. Topic: implicit complexity and the geometry of interaction.
- Matthieu Perrinel, LIP ENS Lyon. From 17 to 21 December 2012. Topic: context semantic and decideable criteria for complexity analysis.

**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 PPS 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.

## 8.2. European initiatives

### *8.2.1. Collaborations in European Programs, except FP7*

Program: ICT Cost Action IC1201

Program acronym: BETTY

Project title: Behavioural Types for Reliable Large-Scale Software Systems

Duration: October 2012 - October 2016

Coordinator: Simon Gay, University of Glasgow

Other partners: Several research groups, belonging to 17 european countries

Abstract: The aim of BETTY is to investigate and promote behavioural type theory as the basis for new foundations, programming languages, and software development methods for communication-intensive distributed systems. Behavioural type theory encompasses concepts such as interfaces, communication protocols, contracts, and choreography.

**LOGNET Team**

# 7. Partnerships and Cooperations

## 7.1. European Initiatives

### *7.1.1. Collaborations in European Programs, except FP7*

Program: INTERREG ALCOTRA
Project acronym: myMed
Project title: " a peer-to-peer programmable social network and cloud platform"
Duration: January 2010-march2014
Coordinator: Luigi Liquori
Other partners: Uni, Turin, POlitech Turin, Univ. Piemonte Orientale, UNIVE
Founded 1.3Meur on 3 year.
Abstract: see above

## 7.2. International Initiatives

### *7.2.1. Inria International Partners*

University of Udine, collaboration, common paper and visits since 1990.

## 7.3. International Research Visitors

### *7.3.1. Visits of International Scientists*

- Mariangiola Dezani, fullprof. Univ Turin,
- Luca Paolini, Assistant professor, Univ. Turin,
- Claudio Casetti, Assistant professor, Univ. Piemonte Orientale,
- Massimo Canonico, Assistant professor, Univ. Piemonte Orientale,
- Luigi Alfredo Grieco, Assistant professor, Politech Bari,
- Erol Gelembe, Full professor, Imperial College.

*7.3.1.1. Internships*

- David Da Silva, "Développement d'une application mobile d'aide aux personnes atteinte d'Alzheimer sur la plate-forme MyMed", Projet de stage de fin d'année: Licence Info Miage, UNICE, 2012.
- Romain Fritz, "Surveillance des réseaux pair à pair par la réputation", Projet de stage de fin d'étude: M2 IFI CSSR, UNICE, 2012.
- Romain Fritz, "Security mechanism applicable on Distributed Hash Table", Projet de stage de fin d'études: M2 IFI CSSR, UNICE, 2012.
- Francesca Guglielmino, "Aide à la constitution d'un bassin d'usagers potentiels du réseau social myMed", Projet de stage de fin d'études: Master Langues et Affaires Internationales Relations franco-italienne, UNICE, 2012.
- Sarah Breda, "Mise en place d'une application Smartphone dans le cadre du projet Interreg Alcotra myMed", Projet de stage de fin d'études: Master Langues et Affaires Internationales Relations franco-italienne, UNICE, 2012.
- Elisa Pellicciari, "Assistance et aide à la conception des services myMed, premier réseau informatique transfrontalier", Projet de stage de fin d'études: Master Langues et Affaires Internationales Relations franco-italienne, UNICE, 2012.
- Guillaume Villena, "A primer on PhP", Projet de Stage, étudiant Collège.

**MYRIADS Project-Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### *8.1.1. HOCL4WS (2010-2012)*

**Participants:** Thierry Priol, Cédric Tedeschi, Marko Obrovac.

The objective of the HOCL4WS project is to develop a prototype of a middleware system for the distributed execution of chemical programs (targeted for large scale platforms). It partially funds Marko Obrovac's PhD grant.

### *8.1.2. ASYST (2010-2013)*

**Participants:** Djawida Dib, 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).

In 2012, we have worked on the design and implementation of a PaaS framework for scaling up and down virtual clusters under SLA constraints (price and completion time).

## 8.2. National Initiatives

### *8.2.1. ECO-GRAPPE ANR ARPEGE Project (2008-2012)*

**Participants:** Eugen Feller, Christine Morin.

The goal of the ECO-GRAPPE project (http://ecograppe.inria.fr/) 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.

In 2012, we completed the implementation of the energy saving algorithms and mechanisms in Snooze and evaluated them experimentally with an elastic web service [39], [26], [48], [24], [8]. We also studied a fully decentralize approach to VM consolidation [47], [23]

### *8.2.2. COOP ANR COSINUS Project (2009-2013)*

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

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 XtreemOS 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).

In 2012, we completed the design and implementation of the modifications needed in XtreemOS Grid distributed operating system in order to integrate the CooRM architecture defined by the Avalon Inria team to support dynamic applications.

### 8.2.3. CLOUD ANR project (October 2011 - September 2012)

**Participants:** Sajith Kalathingal, 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. It funds a research engineer.

In 2012, we augmented XtreemOS Grid distributed system with the capability to acquire virtual resources from cloud service providers. To this end, we enable XtreemOS to provision and configure cloud resources both on behalf of a user and of a virtual organization. We implemented our approach as a set of extension modules for XtreemOS and we evaluated the prototype on Grid'5000 experimentation platform using cloud resources provisioned from a private OpenNebula cloud [58], [60].

### 8.2.4. MIHMES ANR Investissements d'Avenir (January 2012 - December 2018)

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

The MIMHES project (http://www.inra.fr/mihmes) led by INRA/BioEpAR aims at producing scientific knowledge and methods for the management of endemic infectious animal diseases and veterinary public health risks. Myriads team will provide software tools to efficiently manage and ease the use of a distributed computing infrastructure for the execution of different simulation applications.

In 2012, we collected the requirements from the bio-informatics applications and defined a workplan to experiment them on top of the cloud technologies developed by Myriads project-team.

### 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.

In 2012, several members of Myriads project-team performed large scale experiments to evaluate the systems and services they proposed. The results obtained are described in our publications.

### 8.2.6. Inria ADT Aladdin (2008-2012)

**Participants:** Ghislain Charrier, Yvon Jégou, David Margery, Pascal Morillon.

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.

[2]The SED is the INRIA Experimentation and Development Service.

### *8.2.7. Inria ADT XtreemOS Easy (2010-2012)*

**Participants:** Amine Belhaj, Rémy Garrigue, Yvon Jégou, David Margery, Christine Morin.

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.

In 2012, we completed a major release of XtreemOS system for the OpenSuse Linux distribution. We operated the open testbed and built ready-to-use virtual machine images to ease the use of the system. We also provided support to the user community.

### *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 project-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 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 Triskell EPI

Project Coordinator: Noël Plouzeau, Triskell INRIA Project.

Participants: Myriads, Triskell.

### *8.2.9. Inria ADT Snooze (2012-2014)*

**Participants:** Yvon Jégou, David Margery, Christine Morin, Anne-Cécile Orgerie, Matthieu Simonin.

The Snooze technological development action funded by INRIA aims at developing an IaaS cloud environment based on the Snooze virtual machine framework developed by the team (http://snooze.inria.fr) and to make this new environment available to a wider community.

In 2012, we validated Snooze on top of Xen hypervisor. We also started re-implementing Snooze based on the Akka library providing asynchronous data communication. We studied how to re-use in Snooze some OpenStack components such as the image repository storage. We deployed Snooze on multiple sites of the Grid'5000 platform. We implemented the libcloud driver for Snooze.

### *8.2.10. CNRS GDS EcoInfo*

**Participant:** Anne-Cécile Orgerie.

The EcoInfo group deals with reducing environmental and societal impacts of Information and Communications Technologies from hardware to software aspects. This group aims at providing critical studies, lifecycle analyses and best practicies in order to improve the energy efficiency of printers, servers, datacenters, and any ICT equipment in use in public research organizations.

### *8.2.11. Competitivity Clusters*

The COOP ANR project is recognized by the Images & Réseaux cluster.

## 8.3. European Initiatives

### *8.3.1. FP7 Projects*

*8.3.1.1. S-CUBE*

**Participants:** Erwan Daubert, Guillaume Gauvrit, André Lage, Jean-Louis Pazat, Chen Wang.

Title: S-CUBE

Type: COOPERATION (ICT)

Defi: Service & SW architectures, infrastructures and engineering

Instrument: Network of Excellence (NoE)

Duration: March 2008 - February 2012

Coordinator: Universität Duisburg-Essen (Germany)

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 r

*8.3.1.2. CONTRAIL*

**Participants:** Roberto-Gioacchino Cascella, Florian Dudouet, Filippo Gaudenzi, Piyush Harsh, Yvon Jégou, Christine Morin.

Title: Contrail

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.

See also: http://contrail-project.eu/

Abstract: The goal of the Contrail project is to design, implement, evaluate and promote an open source system for Cloud Federations. Resources that belong to different operators will be integrated into a single homogeneous federated Cloud that users can access seamlessly. The Contrail project will provide a complete Cloud platform which integrates Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS) offerings [44], [55].

In 2012, we led the revision of Contrail overall architecture [42]. We also progressed on the design and implementation of VEP advanced features such as the reservation manager and scheduler [43]. We defined a revised version of the API. We worked on the integration of VEP with the other Contrail components. We set up an open permanent testbed for VEP and a testbed running Contrail software stack for internal use by consortium members to allow extensive tests with applications. Christine Morin is the coordinator of Contrail project and Roberto Cascella is the technical manager. She leads WP 10. Yvon Jégou leads WP 5 on VEP and WP 13 on testbeds.

*8.3.1.3. HARNESS*

**Participant:** Guillaume Pierre.

Title: Hardware- and Network-Enhanced Software Systems for Cloud Computing

Type: COOPERATION (ICT)

Defi: Pervasive and Trusted Network and Service Infrastructures

Instrument: STREP

Duration: October 2012 - September 2015

Coordinator: Imperial College (United Kingdom)

Others partners: École Polytechnique Fédérale de Lausanne, Konrad-Zuse-Zentrum für Informationstechnik Berlin, Maxeler Technologies and SAP AG.

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

Abstract: Cloud computing systems are currently composed of large numbers of relatively inexpensive computers, interconnected by standard IP routers and supported by stock disk drives. However, many demanding applications have now reached a fundamental limit in their ability to scale out using traditional machines. Future performance improvements will derive from the use of high-end specialized equipment in addition to standard hardware: GPUs of course, but also FPGAs, programmable routers, and advanced storage technologies. In this context the European project HARNESS investigates: (i) how cloud providers may offer such extremely heterogeneous hardware to its users; and (ii) how cloud customers may make use of these heterogeneous resources to run their applications such that they exhibit the best possible price-performance tradeoff.

*8.3.1.4. PaaSage*

**Participants:** Christine Morin, Nikos Parlavantzas.

Title: PaaSage - Model-Based Cloud Platform Upperware

Type: ICT

Instrument: Large Scale Integrated Project

Duration: October 2012 - September 2016

Coordinator: ERCIM

Other partners: SINTEF, STFC, University of Stuttgart, CETIC, FORTH, BE.Wan, EVRY Solutions, SysFera, Flexiant, Lufthansa Systems AG, GWDG, Automotive Simulation Center Stuttgart

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

Abstract: Software developers targeting the Cloud want an easy way to develop their software in a fashion that exploits the full potential of the clouds, and still is able to run on any of the available offerings. Current platforms are heterogeneous and tend to impose a specific architecture on deployed applications. Accordingly, there is a significant dependency between client applications and the services provided by the platform. It is generally up to the developer to specify and exploit platform services to her best knowledge. However, the typical developer will neither know how to use these characteristics, nor how they impact on the overall behaviour and, what is more, how they relate to a given Cloud infrastructure. To address this complexity, PaaSage will deliver an open and integrated platform to support model-based lifecycle management of Cloud applications. The platform and the accompanying methodology will allow model-based development, configuration, optimisation, and deployment of existing and new applications independently of the existing Cloud infrastructures.

In 2012, we studied the state of the art and worked on the system requirements and specifications.

*8.3.1.5. Eco2Clouds*

**Participants:** David Margery, Christine Morin, Anne-Cécile Orgerie, Nicolas Lebreton.

Title: Experimental Awareness of CO2 in Federated Cloud Sourcing

Type: ICT

Instrument: STREP

Duration: October 2012 - September 2014

Coordinator: ATOS

Other partners: The University of Manchester, EPCC, HLRS, Politecnico Di Milano, Inria.

See also: http://eco2clouds.eu

Abstract: The ECO2CLOUD project tackles $CO_2$ emission awarness in virtualized infrastructures, applying its results to the BonFIRE facility. We specifically tackle the question of predicatable costs for the user despite the varying load on the infrastructure and tractable cost models and APIs to enable application deployment optimization and adaptation.

*8.3.1.6. BonFire*

**Participants:** Maxence Dunnewind, Eric Poupart, Nicolas Lebreton, David Margery, Cyril Rohr.

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 Foaerung 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 Technologico 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:he 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.

*8.3.1.7. FED4FIRE*

**Participants:** Nicolas Lebreton, David Margery.

Title: Federation for Future Internet Research and Experimentation

Type: ICT

Instrument: Integrated Project

Duration: October 2012 - September 2016

Coordinator: iMinds

Other partners: IT Innovation, UPMC, Fraunhofer, TUB, UEDIN, Inria, NICTA, ATOS, UTH, NTUA, UNIVBRIS, i2CAT, EUR, DANTE Limited, UC, NIA.

See also: http://www.fed4fire.eu

Abstract: The key outcome of Fed4FIRE will be an open federation solution supporting all stakeholders of FIRE. Fed4FIRE is bringing together key players in Europe in the field of experimentation facilities and tool development who play a major role in the European testbeds of the FIRE initiative projects.

*8.3.1.8. SCALUS Marie Curie Initial Training Networks (MCITN) (2009-2013)*

**Participant:** 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.

### 8.3.2. Collaborations in European Programs, except FP7

*8.3.2.1. ICT COST*

**Participants:** Eugen Feller, Christine Morin, Anne-Cécile Orgerie.

- Program: ICT COST
- Project acronym: IC0804
- Project title: Energy efficiency in large scale distributed systems
- Duration: 23/01/2009 - 04/05/2013
- Coordinator: Professor Jean-Marc PIERSON, IRIT, France, http://www.irit.fr/cost804/
- Other partners: 22 COST countries and 7 non-COST institutions
- Abstract: The COST Action IC0804 proposes 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 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 characterizes the energy consumption and energy efficiencies of distributed applications. Then based on the current hardware adaptation possibilities and innovative algorithms it proposes adaptive and alternative approaches taking into account the energy saving dimension of the problem. The Action characterizes the trade-off between energy savings and functional and non-functional parameters, including the economic dimension.

In March 2012, Eugen Feller organized a meeting for the participants in the focus group on "Energy and QoS-Aware Workload Management in Clouds" in Rennes.

*8.3.2.2. RMAC*

**Participants:** Ancuta Iordache, Yvon Jégou, Christine Morin, Nikos Parlavantzas.

Program: EIT ICT Labs

Project acronym: RMAC

Project title: Resource Management Across Clouds

Duration: January-December 2012

Coordinator: Dick Epema, TU Delft and TU Eindhoven

Other partners: Institut Telecom, KTH, TU Delft and TU Eindhoven

See also: http://www.pds.ewi.tudelft.nl/ghit/projects/rmac/

Abstract: The main goal of this activity is to provide solutions for effective, efficient, elastic resource management across multiple clouds at the IaaS level for a wide range of application types (e.g., applications that fit the MapReduce paradigm and data-intensive applications) in federated public and private cloud infrastructures as extensions of the current systems of the partners.

In 2012, we implemented a new version of Resilin, a software which provides the Amazon Elastic MapReduce API and allows users to leverage resources from one or multiple public and/or private clouds. Resilin is now implemented as a distributed and loosely-coupled system whose business logic is separated into distinct services that can be distributed over the network, combined and reused. We also performed an extensive experimental evaluation conducted on multiple clusters of the Grid'5000 experimentation testbed [59], [31].

## 8.4. International Initiatives

### 8.4.1. Inria Associate Teams

#### 8.4.1.1. DataCloud@Work

**Participants:** Alexandra Carpen-Amarie, Christine Morin.

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. Participation In International Programs

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) headed by Deb Agarwal. She is actively engaged in three research collaborations with ACS personnel including data management frameworks for scientific applications in cloud environments (with Lavanya Ramakrishnan), use of data-mining and machine-learning techniques to improve resource and failure management in large-scale infrastructures (with Taghrid Samak), and providing community access to MODIS Satellite Reprojection and Reduction Pipeline and Data Sets [30](with Valerie Hendrix and Lavanya Ramakrishnan). During her 2-year sabbatical visit at the Lawrence Berkeley National Laboratory, Christine Morin is the scientific manager of the Inria@SiliconValley program [54]. Deb Agarwal visited Myriads team in May 2012. The Dalhis associate team proposal was submitted in September 2012.

## 8.5. International Research Visitors

### 8.5.1. Visits to International Teams

Eugen Feller did a 3-month internship at the Lawrence Berkeley National Laboratory from July to Septmeber 2012. This internship was partially funded by a fellowship from Ecole Doctorale Matisse. E. Feller has worked with L. Ramakrishnan and C. Morin on the evaluation of Hadoop MapReduce jobs in a virtualized environment.

Héctor Fernández did a 1-month internship at Vrije University in November 2011. This internship was funded by the S-Cube network of Excellence. H. Fernández worked with P. Lago on the simulation through the use of the chemical programming model of Agile Software engineering.

**OASIS Project-Team**

# 7. Partnerships and Cooperations

## 7.1. National Initiatives

### *7.1.1. ANR OMD2*

Title: MultiDisciplinary Distributed Optimization

Program: Conception and Simulation 2008

Duration: July 2009 - September 2012

Coordinator: Renault

Others partners: SMEs: CD-adapco, SIREHNA, ACTIVEEON, academics: Inria, ENSM-SE, UTC, ECP, IRCCyN, ENS CACHAN, and consortium DIGITEO.

See also: http://omd2.scilab.org/

Abstract: OMD2 (MultiDisciplinary Distributed Optimization) is a national research project led by Renault and gathering several academics and industrial partners which aims at developing methods and tools to generalize the use of optimization on large scale engineering problems. Scilab is the chosen generic programming tool to gather the different developments in a unique optimization environment. ProActive Parallel Suite is used to execute the Workflows in parallel, and to manage the Grid and Cloud resources

### *7.1.2. ANR MCorePhP*

Title: Multi-Core Parallel Heterogeneous Programming

Program: Blanc international

Duration: January 2010 - December 2012

Coordinator: Inria Oasis

Others partners: Tsinghua University Beijing (China)

See also: http://www-sop.inria.fr/oasis/mcorephp_home.htm

Abstract: McorePhP is dedicated to programming models and middleware for large-scale, multilevel infrastructures including multi-core, clusters, and large scale grid/cloud resources. We will ensure the compatibility of the new programming model with the China Grid specifications, and will assess the viability and efficiency of the approach on a large example from the area of bioinformatics.

### *7.1.3. ANR Soceda*

Title: SOCial Event Driven Architecture

Program: Platform

Duration: July 2009 - September 2012

Coordinator: Linagora (ex EBM Web Sourcing)

Others partners: SMEs: ACTIVEEON, industry: Thales, OrangeLabs, academics: Inria, CNRS IMAG, LIRIS, ARMINES

See also: http://www.soceda.org/display/soceda/

Abstract: SocEDA is an ANR project of type Platform, also labelled by two competitiveness clusters, PEGASE and SCS. The aim is to provide a "Cloud based platform for large scale social aware Event-Driven Architecture (EDA)". OASIS is in charge of managing the storage and publication/subscription of events on the cloud.

### 7.1.4. ANR Songs

Title: Simulation of Next Generation Systems

Program: Infra 13

Duration: January 2012 - December 2015

Coordinator: Inria (Nancy, Grenoble, Bordeaux)

Others partners: IN2P3 Villeurbanne, LSIIT Strasbourg, I3S Sophia-Antipolis, LINA Nantes

See also: http://infra-songs.gforge.inria.fr/

Abstract: SONGS (2012-2015) is the continuity of SIMGRID project (2009-2012), in the ANR INFRA program. The aim of SONGS is to continue the development of the SimGrid simulation platform for the study of large distributed architectures, including data grids, cloud computing facilities, peer-to-peer applications and HPC/exascale architectures.

### 7.1.5. CPER PacaGrid

Duration: January 2010 - December 2012

See also: http://www-sop.inria.fr/oasis/pacagrid/

Abstract: ProActive PacaGrid is a set of machines deployed at Inria Sophia Antipolis (1400 cores, 150 TB storage) accessible via Graphical Interactive interfaces based on ProActive Parallel Suite. This Grid is available for Inria, UNS, and PACA (regional) labs, as well as for SMEs for R&D purpose, and international partners in R&D projects. It has been funded by EU FEDER, PACA and Alpes Maritimes Landers, and EIT ICT Labs (about 1.7 MEuros in total). Users include for instance INRA (Institut de recherche en Agronomie), IPMC INSERM (Institut de Pharmacologie Moléculaire et Cellulaire), LCMBA (Laboratoire de Chimie des Molécules Bioactives et des Arômes), IGS (Laboratoire Information Génomique et Structurale, Marseille), LIFM (Laboratoire d'Informatique Fondamentale de Marseille), K-Epsilon SME, Renault, Sirehna DCNS, Poznań Supercomputing and Networking Center (Poland), National University of Singapore.

### 7.1.6. FUI CompatibleOne

Title: The Open Source Cloud Broker

Program: Conception and Simulation 2008

Duration: July 2009 - September 2012

Coordinator: OW2

Others partners: industry: ActiveEon, Bull, CityPassenger, eNovance, Eureva, Mandriva, Nexedi, Nuxeo, XWiki, Prologue; academic: Inria, Institut Telecom

See also: http://www.compatibleone.org

Abstract: CompatibleOne is an open source project which provides a model, CORDS (CompatibleOne Resource Description System), and a platform, ACCORDS (Advanced Capabilities for CORDS), for the description and federation of different clouds comprising resources provisioned by heterogeneous cloud service providers. CompatibleOne's flexible service architecture makes it independent from any Cloud Service Provider (from OpenStack to OpenNebula, from Azure to Vcloud) and can address all types of cloud services (IaaS, PaaS, SaaS , XaaS, BpaaS, ...) and any type of cloud service deployment (public, private, community and hybrid).

### 7.1.7. FUI CloudForce (now OpenCloudWare)

Program: FSN, labelled by Minalogic, Systematic and SCS.

Duration: January 2012 - December 2014

Coordinator: France-Telecom Research

Others partners: ActiveEon, Armines, Bull, eNovance, eXo Platform, France Telecom (coordinator), Inria, IRIT – INP Toulouse, Linagora, OW2, Peergreen, Télécom Paris Tech, Télécom Saint Etienne, Thales Communications, Thales Services, Université Joseph Fourier, Université de Savoie – LISTIC, UShareSoft

See also: http://www.opencloudware.org/

Abstract: The OpenCloudware project aims at building an open software engineering platform, for the collaborative development of distributed applications to be deployed on multiple Cloud infrastructures.

The results of OpenCloudware will contain a set of software components to manage the lifecycle of such applications, from modelling (Think), developing and building images (Build), to a multi-IaaS compliant PaaS platform (Run) for their deployment, orchestration, performance testing, self-management (elasticity, green IT optimisation) and provisioning. Applications will be deployed potentially on multi IaaS (supporting either one IaaS at a time, or hybrid scenarios).The results of the project will be made available as open source components through the OW2 Open Source Cloudware initiative.

### *7.1.8. Oseo-Isis Spinnaker*

Duration: June 2011 - May 2014

Coordinator: Tagsys-RFID

Others partners: SMEs: Inside-Secure, STIC, Legrand; Academic: IPG, ENS des Mines de St Etienne, Un. du Maine, Un, F. Rabelais Tours, AETS ESEO Angers, Un. Marne la Vallée, Un. Paris 6, Un. Rennes 1, Inria.

See also: http://www.spinnaker-rfid.com/

Abstract: The objective of Spinnaker is to really allow RFID technology to be widely and easily deployed. The role of the OASIS team in this project is to allow the wide scale deployment and management of the specific RFID application servers in the cloud, so to build an end-to-end robust and flexible solution using GCM technology.

## 7.2. European Initiatives

### *7.2.1. FP7 Projects*

#### *7.2.1.1. 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 (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: TEFIS will support Future Internet of Services Research by offering a single access point to different testing and experimental facilities for communities of software and business developers to test, experiment, and collaboratively elaborate knowledge.

The project develops an open platform to access heterogeneous and complementary experimental facilities addressing the full development lifecycle of innovative services with the appropriate tools and testing methodologies. Through the TEFIS platform users will be supported throughout the whole experiment lifecycle by access to different testing tools covering most of the software development-cycle activities such as software build and packaging, compliance tests, system integration, SLA dimensioning, large-scale deployment, and user evaluation of run-time services. The platform will provide the necessary services that will allow the management of underlying testbeds resources. In particular, it will handle generic resource management, resource access scheduling, software deployment, matching and identification of resources that can be activated, and measurement services for a variety of testbeds.

*7.2.1.2. 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.

*7.2.1.3. FI-WARE*

Title: Morphus

Type: COOPERATION (ICT)

Defi: PPP FI: Technology Foundation: Future Internet Core Platform

Instrument: Integrated Project (IP)

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners:Thales, SAP, Inria

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

Abstract: FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications ? building a true foundation for the Future Internet.

## 7.3. International Initiatives

### *7.3.1. Inria Associate Teams*

*7.3.1.1. SCADA*

Title: Safe Composition of Autonomic Distributed Applications

Inria principal investigator: Ludovic Henrio

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - NIC Chile Research Labs - Mario Leyton

Duration: 2012 - 2014

See also: http://team.inria.fr/scada

The SCADA project aims at promoting the collaboration between NIC LABS (Santiago - Chile) and OASIS team (Inria Sophia Antipolis - France) in the domain of the safe composition of applications. More precisely the project will extend existing composition patterns dedicated to parallel or distributed computing to ease the reliable composition of applications. The strong interactions between formal aspects and practical implementation are a key feature of that projects, where formal methods, and language theory will contribute to the practical implementation of execution platforms, development and debugging tools, and verification environments. The composition models we focus on are algorithmic skeletons, and distributed components; and we will particularly focus on the programming and verification of non-functional features. Overall, from formal specification and proofs, this project should lead to the implementation of tools for the design and execution of distributed and parallel applications with a guaranteed behavior.

*7.3.1.2. DAESD*

Title: Distributed/Asynchronous, Embedded/synchronous System Development

Inria principal investigator: Eric Madelaine

International Partner (Institution - Laboratory - Researcher):

East China Normal University (ECNU) Shanghai - SEI - Yixiang Chen

Duration: 2012 - 2014

See also: http://team.inria.fr/DAESD

The development of concurrent and parallel systems has traditionally been clearly split in two different families; distributed and asynchronous systems on one hand, now growing very fast with the recent progress of the Internet towards large scale services and clouds; embedded, reactive, or hybrid systems on the other hand, mostly of synchronous behaviour. The frontier between these families has attracted less attention, but recent trends, e.g. in industrial systems, in “Cyber-Physical systems”, or in the emerging “Internet of Things”, give a new importance to research combining them.

The aim of the DAESD associate team is to combine the expertise of the Oasis and Aoste teams at Inria, the SEI-Shone team at ECNU-Shanghai, and to build models, methods, and prototype tools inheriting from synchronous and asynchronous models. We plan to address modelling formalisms and tools, for this combined model; to establish a method to analyze temporal and spatial consistency of embedded distributed real-time systems; to develop scheduling strategies for multiple tasks in embedded and distributed systems with mixed constraints.

*7.3.1.3. Dissiminet*

Title: Web-Service approaches for simulation

Inria principal investigator: Olivier Dalle

International Partner (Institution - Laboratory - Researcher):

Carleton University (Ottawa, Canada) - Advanced Real-Time Simulation Laboratory - Gabriel Wainer

Duration: 2011 - 2013

See also: http://www.inria.fr/en/teams/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 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 (eg. on-line storage and repositories, weather forecast, traffic, etc.). One important expected outcome of this approach is to significantly enhance 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 both teams' discrete-event distributed simulators: 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 starting in December 2011.

### *7.3.2. Inria International Partners*

Fit4Green (http://fit4green.eu) is a FP7 project that aimed at creating an energy-aware layer of plug-in on top of the current data centres' management tools to orchestrate the placement of VMs with regards to energy-efficiency concerns. In 2012, the consortium decided to rely on Btrplace to compute the VM placement. Accordingly, Fabien Hermenier collaborated with them to integrate their work with BtrPlace.

### *7.3.3. Participation In International Programs*

#### *7.3.3.1. CIRIC Chili*

Ciric research line: Telecommunications

Inria principal investigator: Eric Madelaine

Duration: 2012 - 2021

Our activities with CIRIC have slowly been starting during this year, while CIRIC and Inria-Chile set-up their local organisations. We took the opportunity of our visit in July in Santiago de Chile (workshop if the SCADA associated Team), to discuss with Ciric, and to setup our plans. Later in November Tomas Barrós (PI on the Ciric side) visited us in Siophia-Antipolis, and we were able to pursue our plans.

The current state is that we have listed two chilean software companies, one in the area of telecommunications, the other in the area of banks, that have an interest in method for the development of safe large and complex applications. The role of Ciric in a first step is to set-up a first technical contact with these companies, discuss the use-cases, the common interests, and a preliminar workplan. The next step (in 2013) will involve the work of Ciric engineers on the case-study definition, and a longer visit of E. Madelaine (and possibly other Inria people) in Santiago to start concrete work on this line.

## 7.4. International Research Visitors

### *7.4.1. Visits of International Scientists*

#### *7.4.1.1. Visiting Scientists*

Min Zhang Sep. 15th to Dec. 15th. This visit is in the framework of out "DAESD" Associated Team with ECNU Shanghai. The subject is on contextual/parametric bisimulations for the pNets (Parameterized Networks of Synchronized automata).

Gabriel Wainer Jun. 15th - July 7th. This visit is in the context of the DISSIMINET Associate Team between Inria and Carleton University. The subject is on simulation in the Cloud and Handheld devices.

*7.4.1.2. Internships*

Yanwen CHEN: Cotutelle with ECNU Shanghai, visits in Inria planned 6 to 9 month each year.

Subject: Programmation d'applications hétérogènes embarquées et distribuées

Institution: UNS & East China Normal University (China)

Quirino ZAGARESE (from Jan 2012 until Aug 2012)

Subject: Lazy loading of data in service oriented and event oriented interaction software architecture models

Institution: University Sannio (Italy)

Michel Jackson DE SOUZA (from Jul 2012 until Aug 2013)

Subject: Distributed coherent snapshot solution for the P2P CAN-based Event Cloud

Institution: UFBA Federal University of Bahia (Brasil), Science sans Frontière brazilian mobility program

### *7.4.2. Visits to International Teams*

- Fabien Hermenier visited the Flux Team at the University of Utah from September to December 2012. This visit allowed us to enhance our collaboration on the study of the Utah' Emulab in order to improve testbed designs. [22]
- Ludovic Henrio, Eric Madelaine, and Cristian Ruz visited NIC-Labs and CIRIC center in Santiago de Chile in July 2012 (1 week visit); a workshop was also held during the week.

**PHOENIX Project-Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### *8.1.1. 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").

### *8.1.2. 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" reserach 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.

### *8.1.3. Certification of an open platform*

The purpose of this project is to define concepts and tools for developing certifying open platforms. This certification process must ensure a set of critical properties (*e.g.,* safety, confidentiality, security) by certifying each tier application. These guarantees are essential to ensure that openness does not come at the expense of the user's well-being. To preserve the innovation model of open platforms, this certification process should also be as automatic as possible. Indeed, the success of open platforms is mainly due to the low development cost of a new application. The case study of this thesis will be the domain of home automation. The results of this thesis will be put into practice in the DiaSuiteBox open platform.

This project is funded by the Aquitaine region.

## 8.2. National Initiatives

### *8.2.1. Objects' World: design-driven development of large-scale smart spaces*

The goal of this project is to develop an innovative communication technology, allowing the emergence of a new economic sector for large-scale smart spaces. Our objective is to propose concepts and tools for developing reliable applications orchestrating large-scale smart spaces of networked entities. The industrial partners of the Objects' World project will provide us with real-size case studies in various application domains (e.g., smart cities, tracking of vehicles, healthcare, energy management).

This work is funded by the OSEO national agency.

### *8.2.2. 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”).

### *8.2.3. 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 DIASUITE development methodology and will be evaluated by the Biomasud partners.

## 8.4. International Initiatives

### *8.4.1. Inria International Partners*

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

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

The Phoenix group has been visited by Tim Sheard for 3 months (January-March).

### *8.5.2. Visits to International Teams*

Charles Consel is on sabbatical for the academic year of 2012-2013 at the University of Mc Gill in Montreal.

**REGAL Project-Team**

# 7. Partnerships and Cooperations

## 7.1. National initiatives

### *7.1.1. InfraJVM - (2012–2015)*

Members: LIP6 (Regal), Ecole des Mines de Nanes (Constraint), IRISA (Triskell), LaBRI (LSR).

Funding: ANR Infra.

Objectives: The design of the Java Virtual Machine (JVM) was last revised in 1999, at a time when a single program running on a uniprocessor desktop machine was the norm. Today's computing environment, however, is radically different, being characterized by many different kinds of computing devices, which are often mobile and which need to interact within the context of a single application. Supporting such applications, involving multiple mutually untrusted devices, requires resource management and scheduling strategies that were not planned for in the 1999 JVM design. The goal of InfraJVM is to design strategies that can meet the needs of such applications and that provide the good performance that is required in an MRE.

The coordinator of InfraJVM is Gaël Thomas. Infra-JVM brings a grant of 202 000 euros from the ANR to UPMC over three years.

### *7.1.2. 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.

### *7.1.3. MyCloud - (2011–2014)*

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.

### *7.1.4. ConcoRDanT - (2010–2013)*

Members: Inria Regal, project leader; LORIA, Universdide Nova de Lisboa

Funding: ConcoRDanT 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.

### *7.1.5. SPADES - (2009–2012)*

Members: LIP, MIS (and LIP6/REGAL), Inria Rennes, Inria Saclay, LIG, LUG, CERFACS, IN2P3

Funding: ANR CONTINT

Objectives: The main goal of SPADES is to propose a non-intrusive but highly dynamic environment, able to take advantages to available resources over very large scale grids. 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”.

The principal investigator for Regal is Franck Petit. The project was initiated while he was with MIS (UPJV/Amiens) and a non-permanent researcher during 2008-2009 with Inria, within Graal Team (LIP, Lyon). The amount of the grant from ANR to MIS is 125 000 euros.

### *7.1.6. 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.

### *7.1.7. PROSE - (2009–2012)*

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.

### *7.1.8. ABL - (2009–2012)*

Members: Gilles Muller, Julia Lawall, Gaël Thomas, 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.

The main achievements of the ABL project in 2012 include the design of an approach to automatically generating a robust interface to the Linux kernel, which received a best paper award at ASE 2012, and the design of an approach to finding resource-release omission faults in systems software. The latter has led to over 60 patches for various systems software projects, including Linux and Python.

## 7.2. European Initiatives

### *7.2.1. FP7 Projects*

### *7.2.2. Collaborations in European Programs, except FP7*

*7.2.2.1. 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.

## 7.3. International Initiatives

### *7.3.1. Participation In International Programs*

*7.3.1.1. 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.

*7.3.1.2. 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.

## 7.4. International Research Visitors

### *7.4.1. Visits of International Scientists*

- Kenji Kono, Professor, University Keio, Japan, 1 year, 2012
- Nuno Preguia, Associate Professor, Universidade Nova de Lisboa; 6-month visit
- Valter Balegas, PhD Student, Universidade Nova de Lisboa; 3-month visit

### *7.4.2. Internships*

- David Navalho, PhD Student, Universidade Nova de Lisboa; 3-month visit
- Valter Balegas, PhD Student, Universidade Nova de Lisboa; 3-month visit

RMOD Project-Team

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

We have signed a convention with the CAR team led by Noury Bouraqadi of École des Mines de Douai. In such context we co-supervized 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. ANR*

*7.2.1.1. Cutter*

**Participants:** Stéphane Ducasse [Correspondant], Nicolas Anquetil, Damien Pollet, Muhammad Bhatti, Andre Hora.

This parternship is done with the following members from the LIRMM-D'OC-APR: Marianne Huchard, Roland Ducournau, Jean-Claude König, Rodokphe Giroudeau, Abdelhak-Djamel Seriai, and Rémi Watrigant.

CUTTER is a Basic Research project that addresses the problems of object-oriented system (re-)modularization by developing, combining, and evaluating new techniques for analyzing and modularizing code. In particular, it will: (i) use concurrently and collaboratively four package decomposition techniques; and (ii) take into account different levels of abstractions (packages, classes).

## 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 focusses 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. 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 - Laboratory - Researcher):

University of Chile (Chile) - 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 [32]. 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 [34]. 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 and Moose, 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.

**Research Visits to Chile**

- Benjamin van Ryseghem from May 28th until June 16th, 2012.
- Damien Pollet from November 1st until November 30th, 2012.
- Marcus Denker from November 5th until November 22nd, 2012

**Recent Results**

In the second year of execution of Plomo, work has focused on:

- Rizel: a performance evolution monitor.
- A book chapter on Roassal in the book Pharo By Example 2
- Roassal also won the third place award in the ESUG 2012 innovation technology awards.
- Athens, the graphic rendering engine developed by RMoD, is used by Roassal.
- Starting of the founding process of Synectique, a company based in Lille that offers solutions based on the Moose platform. ObjectProfile offers to Synectique a dedicated support of Roassal.

- Integration of profiling techniques into Jenkins, the continuous integration server used for Pharo. We expect to have a massive amount of profiling information.
- Opal debugging and development continued. The bytecode backend is ready for integration in Pharo 2.0.
- Gradualtalk: a gradually typed Smalltalk, built on Opal, has been implemented. It allows code in Pharo to be gradually and optionally typed.
- The Announcements framework to enable change and event tracking.
- Spec: a Framework for the Specification and Reuse of UIs and their Models. It uses the Announcements framework to enable fine-grained UI refreshes. Roassal makes use of Spec for its component
- Work on the DIE domain-specific language and the definition of IDE plugins using it, as well as work on change prediction models are still ongoing.

**Supervised PhD students**

- Vanessa Peña, PhD student Universidad de Chile. She is working on test coverage and domain specific analyses
- Juan Pablo Sandoval, PhD student Universidad de Chile.

**Companies Using our Results**

- Synectique is a company delivering dedicated software analysis. Synectique uses Roassal to visually report the analysis of customer source code. The founding process started in 2012, and is expected to be finished in 2013.
- ObjectProfile was founded in 2011 in Chile. Its business plan is essentially focused on Pharo and Roassal. Object Profile offers support of its products to RMoD and Synectique. A number of features of Roassal have been designed to meet Synectique's requirements (e.g., the navigation and scrolling options).

**Publications**

- Benjamin Van Ryseghem, Stéphane Ducasse, Johan Fabry, Spec: a Framework for the Specification and Reuse of UIs and their Models, in Proceedings of the 4th International Workshop on Smalltalk Technologies (IWST'12), Collocated with ESUG, August 2012. ACM Digital Library (To Appear). [20]
- Juan Pablo Sandoval, Tracking Down Software Changes Responsible for Performance Loss, in Proceedings of the 4th International Workshop on Smalltalk Technologies (IWST'12), Collocated with ESUG, August 2012. ACM Digital Library (To Appear)

## *7.4.2. Participation In International Programs*

*7.4.2.1. 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.

**Research Visits**

- Nicolas Anquetil, from August 6th to 11th.
- Andre Hora, from November 26th to January 4th.

### *7.4.3. Others*

We are building an ecosystem around Pharo with international research groups, universities and companies. Several research groups (such as Software Composition Group – Bern, and Pleaid – Santiago) are using Pharo. Many universities are teaching OOP using Pharo and its books. Several companies worldwide are deploying business solutions using Pharo.

## 7.5. International Research Visitors

### *7.5.1. Visits of International Scientists*

In the context of the PLOMO associated Team with the University of Chile:

- Johan Fabry from March 19th until March 23rd, 2012
- Johan Fabry from August 17th until Sept 2nd, 2012.
- Juan Pablo Sandoval from 9 November until 2 December 2012. The topic of the research visit is monitoring of performance evolution.

In the context of the Pequi project associated Team with the Federal University of Minas Gerais:

- Professor Marco Tulio Valente visited from February 7th to 13th.
- Ricardo Terra PhD student visited us for one week in begining of April 2012.

Other visits of international scientists:

- Fernando Olivero, PhD Student from the University of Lugano, Switzerland, visited RMoD in March 2012.
- Jurgen VinJu, group leader of SEN1 - Software Analysis & Transformation at CWI, visited us on May 10th and 11th.

*7.5.1.1. Internships*

Ezequiel La Mónica (from Apr 2012 until Jun 2012)

Subject: Rule checking for pharo

Institution: University of Buenos Aires (Argentina)

Cesar Couto (from December 2011 until February 2012)

Subject: Uncovering Causal Relationships between Software Metrics and Bugs

Institution: Federal University of Minas Gerais, Brazil

### *7.5.2. Visits to International Teams*

In the context of the PLOMO associated Team with the University of Chile:

- Marcus Denker from January 17th to February 1st.
- Benjamin van Ryseghem from May 28th to June 16th.
- Damien Pollet from October 31st to November 13th.
- Marcus Denker from November 5th to November 22nd.

In the context of the Pequi project associated Team with the Federal University of Minas Gerais:

- Nicolas Anquetil, from August 4th to 19th.
- Andre Hora, from November 26th to January 4th.

Many RMoDmembers did various visits at many occasions to, *e.g.*,, Bruxelles in Belgium, Cologne in Germany, Gand in Belgium, Bern in Switzerland, Riva del Garda, Italy, and Belo Horizonte in Brazil.

SARDES Project-Team

# 7. Partnerships and Cooperations

## 7.1. National Initiatives

### 7.1.1. Automatique pour l'informatique autonomique (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.

http://sardes.inrialpes.fr/~rutten/peps-api/

### 7.1.2. 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 eventdriven 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.

### 7.1.3. PiCoq (ANR project)

**Participants:** Damien Pous, Jean-Bernard Stefani.

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/.

### 7.1.4. Project MyCloud (ANR project)

**Participants:** Amit Sangroya, Sara Bouchenak, Damian Serrano-Garcia.

The objective of the MyCloud project is to define and implement a novel cloud model: *SLAaaS* (*SLAa*wa*r*e *S*ervice). 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 transparecy 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.

### 7.1.5. Famous (ANR project)

**Participants:** Eric Rutten, Xin An.

The FAMOUS project (FAst Modeling and Design FlOw 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.

### 7.1.6. REVER (ANR project)

**Participants:** Barbara Petit, Jean-Bernard Stefani.

The REVER project aims to develop semantically well-founded and composable abstractions for dependable distributed computing on the basis of a reversible programming model, where reversibility means the ability to undo any program execution and to revert it to a state consistent with the past execution. The critical assumption behind REVER is that by combining reversibility with notions of compensation and modularity, one can develop systematic and composable abstractions for dependable programming.

The REVER workprogramme is articulated around three major objectives:

- To investigate the semantics of reversible concurrent processes.
- To study the combination of reversibility with notions of compensation, isolation and modularity in a concurrent and distributed setting.
- To investigate how to support these features in a practical (typically, object-oriented and functional) programming language design.

The project partners are Inria (Sardes in Grenoble and Focus in Bologna), Université de Paris VII (PPS laboratory), and CEA (List laboratory).

The project runs from December 2011 to November 2015.

### 7.1.7. CtrlGreen (ANR project)

**Participants:** Fabienne Boyer, Noël De Palma, Eric Rutten, Soguy Mak-Kare Gueye.

The goal of the CtrlGreen project is to develop the control techniques and software infrastructure required to build energy-efficient data centers. Because resource management must meet performance, dependability and scalability objectives and as well as service level agreements, energy-efficiency must be considered as a multi-criteria control problem. CtrlGreen aims to develop an autonomic system approach, where multiple control loops may coexist and coordinate. Specifically, the work will proceed along four directions:

- The study of reactive control techniques including synchronous languages and discrete controller synthesis to program, verify and synthetize coordinating controllers.
- The development of a controllable platform that can provide system level support for the deployment and integration of the requuired controllers.
- The study of several green data center scenarios that involve the coordination between several controllers at different levels (hardware, operating system and middleware) and targetting different objectives (performance, availability, energy efficiency, etc).
- Experiments with an industrial data center to evaluate CtrlGreen techniques in a real world environment, with multiple running applications.

The project partners include Eolas, Inria Rennes, INPT/IRIT Toulouse, LIG (Sardes) and ScalAgent. The project runs from January 2012 to December 2014.

## 7.2. European Initiatives

### 7.2.1. FP7 Projects

#### 7.2.1.1. 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: 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 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 should enable the 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 will comprise in particular:

- A 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.
- A 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.

,

SCORE Team

# 7. Partnerships and Cooperations

## 7.1. National Initiatives

### *7.1.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010–2014)*

**Participants:** Pascal Urso [contact], Mehdi Ahmed-Nacer, Claudia-Lavinia 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.

Website: http://concordant.lip6.fr/

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 – apr. 2014) 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.

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

**Participants:** Gérald Oster [coordinator], Luc André, Claudia-Lavinia 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/

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 reduce 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.

### *7.1.3. Wiki 3.0 (2009–2012)*

**Participants:** Claudia-Lavinia 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 (december 2009 - june 2012) was sponsored by the call for projects "Innovative Web" launched by the French Ministry of Economy. The objective of this project was the development of an open-source platform based on XWiki (http://www.xwiki.org) that addressed 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. SCORE team was responsible with the design and integration of real-time editing features into the XWiki system. We designed solutions for a raw text editor as well as for a WYSIWYG editor for XWiki pages. The real-time wiki editor has been released as an extension of XWiki (http://extensions.xwiki.org/xwiki/bin/view/Extension/RealTime+Wiki+Editor).

### *7.1.4. 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.

### *7.1.5. FSN OpenPaaS (2012–2015)*

**Participants:** Olivier Perrin, Ahmed Bouchami.

Partners: Samovar team (Telecom SudParis), SCORE team (Université de Lorraine, Loria), ARMINES (Ecole des Mines d'Albi), Brake France, Linagora.

Website: http://www.open-paas.org

The OpenPaaS project aims at developing a PaaS (Platform as a Service) technology dedicated to enterprise collaborative applications deployed on hybrid clouds (private/public). OpenPaaS is a platform that allow to design and deploy applications based on proven technologies provided by partners such as collaborative messaging system, integration and workflow technologies that will be extended in order to address Cloud Computing requirements. Available as an open-source Enterprise Social Netwotk, the OpenPaaS project innovates both at the collaborative level and by its capacity to leverage heterogeneous cloud technologies at the IaaS level (Infrastructure as a Service). This project is funded under the French FSN umbrella (Fond National pour la société Numérique).

## 7.2. International Initiatives

### *7.2.1. GIS Interop Grande Région*

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

Follow-up the INTEROP Network of Excellence, the INTEROP V-Lab (International Virtual Laboratory on interoperability, http://www.interop-vlab.eu/ ) has been officially created in Brussels on March 2007 as an international non-profit making association (serving the international interest). 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 V-Lab pole (a partner of the INTEROP V-Lab): the Grande Region pole. The institutions that compose the Grande Region pole are University of Namur, University of Paris I La Sorbonne, University Lyon II, INSA Lyon, INSA Strasbourg, the former University Henri Poincaré Nancy 1 and the former University Nancy 2. The pole is legally defined as a Scientific (International) Interest Group (Groupement d'Intérèt Scientifique or GIS). Its attachment to the INTEROP V-Lab has been achieved in may 2009. The role of the GIS is to animate regional scientific cooperation amongg the French GIS partners and Luxembourg (Henri Tudor Public Research center) and Belgium (University of Namur) as well as international cooperation since the INTEROP V-Lab encompasses lot of partners coming from the European Union and from China. Nacer Boudjlida is the head of the management committee of the INTEROP Grande Region and he is also a member of its scientific committee.

### *7.2.2. Associate Team Inria VanaWeb*

SCORE is involved in the Associate Team Inria VanaWeb (with UTFSM Valparaìso, 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 Valparaìso, Chili) and Christophe Ringeissen (CASSIS).

## 7.3. International Research Visitors

### *7.3.1. Visits of International Scientists*

Valerie Shalin is an associate Professor in the Department of Psychology of Wright State University. She is a leading researcher in the domain of Human factors and she has a comprehensive expertise on empirical and analytic methods to support the design and evaluation of coordinated work. We are collaborating with her on an ongoing project that tries to understand the actual implications of real time collaboration.

TRISKELL Project-Team

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### *8.1.1. ANR GEMOC*

**Participants:** Benoit Combemale, Didier Vojtisek, Olivier Barais, Arnaud Blouin, Benoit Baudry.

Heterogeneous modeling, model driven engineering, executable metamodeling, models of computation, simulation.

The ANR project **GEMOC** (French Agency for Research, Program INS 2012) focuses on a generic framework for heterogeneous software model execution and dynamic analysis. This work has the ambition to propose an innovative environment for the design of complex software-intensive systems by providing:

- a formal framework that integrates state-of-the-art in model-driven engineering (MDE) to build domain-specific modeling languages (DSMLs), and models of computation (MoC) to reason over the composition of heterogeneous concerns;
- an open-source design and modeling environment associated to a well-defined method for the definition of DSMLs, MoCs and rigorous composition of all concerns for execution and analysis purposes.

This requires addressing two major scientific issues: the design and verification of a formal framework to combine several different DSMLs relying on distinct MoCs; the design and validation of a methodology for DSMLs and MoC development. GEMOC aims at participating in the development of next generation MDE environments through a rigorous, tool-supported process for the definition of executable DSMLs and the simulation of heterogeneous models.

Project duration: 2012-2016
Triskell budget share: 253 keuros
Number of person/years: 2.2
Project Coordinator: Inria (Triskell)
Participants: ENSTA Bretagne, Inria, IRIT, I3S, Obeo, Thales

### *8.1.2. ANR INFRA-JVM*

**Participants:** Johann Bourcier, Olivier Barais, Inti Gonzalez.

JVM, Kevoree, Models@Runtime

**INFRA-JVM** is an ANR project whose goal is to design and provide a new Java Virtual Machine dedicated to pervasive environments. This project focuses on designing a Java Virtual Machine for embedded computing platform offering dynamic reconfiguration capabilities. The project focuses on the three following parts:

- Defining new mechanisms to provide component-based support for provisionning I/O and memory guarantee
- Defining languages and runtime support for efficient process scheduling on multi-core platform
- Optimizing the memory allocation on multi-core platforms.

Triskell mainly works this year on VMkit (the integration platform of the project) and Kevoree (our Component Based platform) to run Kevoree on top of VMkit.

Project duration: 2012-2015
Triskell budget share: 193 keuros
Number of person/years: 2
Project Coordinator: Université Paris 6
Participants: Université Paris 6, Université Bordeaux 1, Université Rennes 1 (Triskell), Ecole des Mines de Nantes

### 8.1.3. BGLE2 CONNEXION

**Participants:** Benoit Baudry, Arnaud Blouin, Valéria Lelli, Nicolas Sannier.

requirement, software testing, critical system, HCI, MDE

The cluster CONNEXION (*digital command CONntrol for Nuclear EXport and renovatION*) aims to propose and validate an innovative architecture platforms suitable control systems for nuclear power plants in France and abroad. In this project the Triskell team investigates methods and tools to (i) automatically analyze and compare regulatory requirements evolutions and geographical differences; (ii) automatically generate test cases for critical interactive systems.

Project duration: 2012-2016

Triskell budget share: 515 keuros

Number of person/years: 3

Project Coordinator: EDF

Participants: Atos WorldGrid, Rolls-Royce Civil Nuclear, Corys TESS, Esterel Technologies, All4Tec, Predict, CEA, Inria, CNRS / CRAN, ENS Cachan, LIG, Telecom ParisTech

## 8.2. European Initiatives

### 8.2.1. FP7 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

### 8.2.2. FP7 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

### 8.2.3. 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 collaborateion 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.

### 8.2.4. Artemis CHESS

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

Real-Time Embedded systems, Component-based Development, Model Driven Engineering

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 2012 Triskell contributed to final phase of development of the model editor specially built for CHESS on top of Papyrus. Using its Kermeta platform, Triskell contributed to the design and implementation 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, Ericsonn, Fraunhofer, FZI, GMV, Inria (Triskell), INTECS, Thales Alenia Space, THALES Communications, UPM, University of Padua, X/Open

### *8.2.5. ITEA2 OPEES*

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 (AtlanMod/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.

### *8.2.6. Marie-Curie Relate*

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.

### *8.2.7. MERGE*

Program: ITEA2
Project acronym: Merge
Project title:Trans-European Research Training Network on Engineering and Provisioning of Service-Based Cloud Applications
Duration: December 2012 - December 2015
Triskell budget share: 250 keuros
Coordinator: Thales Research and Technology
Other partners: Thales Global Services, Thales Communications and Security, OBEO, ALL4TEC, Onera, Inria, Université Paris VI, Codenomicon, STUK - Radiation and Nuclear Safety Authority, POHTO nSense Oy, University of Oulu, University of Jyvaskyla, Space Applications Services NV, Melexis, E2S, Katholieke Universiteit Leuven
Abstract: MERgE stands for "Multi-Concerns Interactions System Engineering". Within the "Engineering support" theme of ITEA2 roadmap, the purpose of this project is to develop and demonstrate innovative concepts and design tools addressing in combination the "Safety" and "Security" concerns, targeting the elaboration of effective architectural solutions. MERgE will provide tools and solutions for combining safety and security concerns in systems development in a holistic way. It will provide academically solid and practice proven solutions and models for system developers and system owners to tackle the challenges of designing seamless optimal cost effective safe and secure solutions conformant to the model driven engineering paradigm. This will be done by tightly integrating the following paradigms: requirement engineering, safety, security and risk management in an over-all design process which is supported by adequate tools and methods. MERgE aims to bring a system engineering solution for Combined Safe & Secure system design. The main technical innovation of the project is the application of state of the art design tools tailorisation capabilities and "multi concern engineering" core technologies to the issue of interactions of "Safety" and "Security" concerns as well as other concerns like "Performance" or "Timing" in the design process.

## 8.3. International Initiatives

### *8.3.1. Inria International Partners*

Following the Diva STREP project, we keep an active collaboration with the SINTEF institute. Fran√ßois 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 Œ°-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 Œ°-Kevoree is a viable solution with strong benefits over adaptation through dynamic firmware upgrades.

Following the MoCAA Equipe associée, we keep an active collaboration with Colorado State University. Benoit Baudry and Benoit Combemale visited CSU in April 2012 and Philippa Bennett spent a 4-monhts internship in Triskell. We continue the collaboration with Prof. Sanjay Rajopadhye (from the optimizing compiler domain) to cross-fertilize both HPC and MDE. Results of this collaboration were published in the Journal of Software and Systems in October 2012.

### *8.3.2. Participation In International Programs*

*8.3.2.1. TAAS*

Program: Foundation Araucaria Inria Brazil

Title: Software testing for cloud computing

Inria principal investigator: Gerson SUNYE

International Partner (Institution - Laboratory - Researcher):

Federal University of Parana (Brazil)

Duration: Jul 2011 - Jun 2013

*8.3.2.2. SPLIT*

Program: PICS International Project of Scientific Cooperation

Title: Combiner les lignes de produits logicielles et le d√©veloppement logiciel orient√© aspects

Inria principal investigator: Jean-Marc JEZEQUEL

International Partner (Institution - Laboratory - Researcher):

University of Luxembourg (Luxembourg)

Duration: Jan 2009 - Dec 2012

## 8.4. International Research Visitors

### *8.4.1. Visits of International Scientists*

- Joerg Kienzle (http://www.cs.mcgill.ca/~joerg) - Robert France - Barrett Bryant

*8.4.1.1. Internships*

Phillipa BENNETT (from Apr 2012 until Sep 2012)

Subject: Model Transformation Testing

Institution: Colorado State University (United States)

Martin FAUNES (from Mar 2012 until May 2012)

Subject: Automated discovery of domain invariants

Institution: Carleton University (Canada)

**ALGORILLE Project-Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

CPER MISN, EDGE project (2010-2013, 468k€). M. Quinson and L. Nussbaum are leading a project of the regional CPER contract, called *Expérimentations et calculs distribués à grande échelle* (EDGE). It focuses on maintaining and improving the local Grid'5000 infrastructure, and animating both the research on experimental grids and the research community using these facilities. More information is available at http://misn.loria.fr/spip.php?rubrique8.
Other partners: EPI CARAMEL, VERIDIS

Lorraine Region (2011-2013, 30k€). The project *"Systèmes dynamiques : étude théorique et application à l'algorithmique parallèle pour la résolution d'équation aux dérivées partielles"* lead by S. Contassot-Vivier is the sequel of his research on dynamical systems and consists in designing more efficient algorithmic schemes for parallel iterative solvers. This project is closely linked to the collaboration with the Lemta as the real case application provided by F. Asllanaj will be the target of our future developments in this field.

## 8.2. National Initiatives

### *8.2.1. ANR*

Plate-form(E)$^3$ (2012-2015, 87k€) has been accepted in 2012 in the ANR SEED program. It deals with the design and implementation of a multi-scale computing and optimization platform for energetic efficiency in industrial environment. It gathers 7 partners either academic (LEMTA, Fédération Charles Hermite (including AlGorille), Mines Paris, INDEED) or industrial (IFP, EDF, CETIAT). We will contribute to the design and development of the platform.

USS-SimGrid (2009–2012, 840k€) Martin Quinson is the principal investigator, funded by the ANR ARPEGE program. USS-SimGrid (Ultra Scalable Simulation with SimGrid) 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 included 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. This project was successfuly completed this year.

ANR SONGS (2012–2015, 1800k€) Martin Quinson is also the principal investigator of a this project, funded by the ANR INFRA program. SONGS (Simulation Of Next Generation Systems) 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 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 this projects, which allows the improvement of our tool even further and set it as the reference in its domain (see Sections 6.3.1 and 6.3.2 ).

### *8.2.2. Inria financed projects and clusters*

AEN Hemera (2010-2013, 2k€) aims at demonstrating ambitious up-scaling techniques for large scale distributed computing by carrying out several dimensioning experiments on the Grid'5000 infrastructure, and at animating and enlarging the scientific community around the testbed. M. Quinson, L. Nussbaum and S. 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*.
Other partners: 20 research teams in France, see https://www.grid5000.fr/mediawiki/index.php/Hemera for details.

ADT Aladdin-G5K (2007-2015, 200k€ locally) aims at the construction of a scientific instrument for experiments on large-scale parallel and distributed systems, building on the Grid'5000 testbed (http://www.grid5000.fr/). It structures INRIA's leadership role (8 of the 9 Grid'5000 sites) concerning this platform. The technical team is now composed of 10 engineers, of which 2 are currently hosted in the AlGorille team. As a member of the executive committee, L. Nussbaum is in charge of following the work of the technical team, together with the Grid'5000 technical director.
Other partners: EPI DOLPHIN, GRAAL, MESCAL, MYRIADS, OASIS, REGAL, RESO, RUNTIME, IRIT (Toulouse), Université de Reims - Champagne Ardennes

ADT Kadeploy (2011-2013, AlGorille is the only partner, 90k€) focuses on the Kadeploy software, a tool for efficient, scalable and reliable cluster deployment. It is used on several clusters at INRIA and playing a key role on the Grid'5000 testbed. This ADT allows the continuation of the development to improve its performance, reliability and security, and aims at a larger distribution to industry and other INRIA platforms with similar needs.

ADT Solfége (2011-2013, AlGorille is the only partner, 100k€), for *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. E. Jeanvoine (SED) is delegated in the AlGorille team for the duration of this project.

INRIA Project Lab MC (2012-) Supporting multicore processors in an efficient way is still a scientific challenge. This project introduces a novel approach based on virtualization and dynamicity, in order to mask hardware heterogeneity, and to let performance scale with the number and nature of cores. Our main partner within this project is the Camus team on the Strasbourg site. The move of J. Gustedt there, will strengthen the collaboration within this project.

## 8.3. International Research Visitors

### *8.3.1. Visits of International Scientists*

*8.3.1.1. Internships*

Maximiliano GEIER (09/2012 - 03/2013)

Subject: Leveraging multiple experimentation methodologies to study P2P broadcast

Institution: University of Buenos Aires (Argentina)

### *8.3.2. Visits to International Teams*

Martin Quinson was hosted as a visiting professor at university of Hawai'i at Manoa for one month in April 2012. He was invited by Prof. Casanova to pursue the collaboration on SimGrid, originally started by Prof. Casanova.

**AVALON Team**

# 7. Partnerships and Cooperations

## 7.1. National Initiatives

### *7.1.1. FUI CompatibleOne Project, 2010-2012*

**Participants:** Laurent Lefevre, Julien Carpentier, Maxime Morel, Olivier Mornard.

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.

CompatibleOne is an open source project with the aim of providing interoperable middleware for the description and federation of heterogeneous clouds comprising resources provisioned by different cloud providers. Services provided by Inria 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. We 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.

In this project, our work 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. We lead the task T3.4 on energy management and will participate in activities on virtual machines design and migration [13].

### *7.1.2. FSN XLcloud, 2012-2014*

**Participants:** Jean-Patrick Gelas, Laurent Lefevre, Francois Rossigneux.

Focused on high-performance computing, the XLcloud collaborative project sets out to define and demonstrate a cloud platform based on *HPC-as-a-Service*. This is designed for computational intensive workloads, with interactive remote visualisation capabilities, thus allowing different users to work on a common platform. XLcloud project's members design, develop and integrate the software elements of a High Performance Cloud Computing (HPCC) System.

Expected results of the projects include : Functional and technical specification of the XLcloud platform architecture, open source API of the XLcloud platform, implementation of algorithms for 3D and video streaming display, prototype of the XLcloud platform including the support of on-demand virtual clusters and remote visualisation service, use cases for validation, illustrating the performance and suggesting future improvements.

XLcloud aims at overcoming some of the most important challenges of implementing operationally high performance applications in the Cloud. The goal is to allow partners of the project to take leadership position in the market, as cloud service providers, or as technology providers. XLcloud relies on a consortium of various partners (BULL (project leader), TSP, Silkan, EISTI, Ateme, Inria, CEA List, OW2, AMG.Lab).

In this project, the Avalon team investigates the issue of energy awareness and energy efficiency in OpenStack Cloud based platforms.

### 7.1.3. 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:** 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 MapReduce model is its inherently high degree of potential parallelism.

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

### 7.1.4. ANR grant: COOP (Multi Level Cooperative Resource Management), 3.5 years, ANR-09-COSI-001-01, 2009-2013

**Participants:** Frédéric Desprez, Cristian Klein, Christian Pérez.

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

The project is led by Christian Pérez.

### 7.1.5. ANR grant SPADES (Servicing Petascale Architectures and DistributEd System), 3.5 years, 08-ANR-SEGI-025, 2009-2012

**Participants:** Eddy Caron, Florent Chuffart, Frédéric Suter, 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.

### 7.1.6. ANR grant: USS SimGrid (Ultra Scalable Simulation with SimGrid), 3.8 years, ANR-08-SEGI-022, 2008-2012

**Participants:** Frédéric Desprez, Matthieu Imbert, Georges Markomanolis, Frédéric Suter.

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. The planned work is to improve the models used in SimGrid (increasing their scalability and easing their instantiation), provide associate tools for experimenters (result analysis assistants and test campaign managers), and increase the simulation kernel scalability by parallelization and optimization. The project also aims at producing a scientific instrument directly usable by a large community and is well adapted to the needs of various users.

### *7.1.7. ANR grant: SONGS (Simulation Of Next Generation Systems), 4 years, ANR-12-INFRA-11, 2012-2015*

**Participants:** Frédéric Desprez, Georges Markomanolis, Jonathan Rouzaud-Cornabas, Frédéric Suter.

The last decade has brought tremendous changes to the characteristics of large scale distributed computing platforms. Large grids processing terabytes of information a day and the peer-to-peer technology have become common even though understanding how to efficiently such platforms still raises many challenges. As demonstrated by the USS SimGrid project, simulation has proved to be a very effective approach for studying such platforms. Although even more challenging, we think the issues raised by petaflop/exaflop computers and emerging cloud infrastructures can be addressed using similar simulation methodology.

The goal of the SONGS project is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

Any sound study of such systems through simulations relies on the following pillars of simulation methodology: Efficient simulation kernel; Sound and validated models; Simulation analysis tools; Campaign simulation management.

### *7.1.8. 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 improved 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).

### *7.1.9. Inria 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.

### *7.1.10. Inria ADT Aladdin, 4 years, 2008-2014*

**Participants:** Simon Delamare, Frédéric Desprez, Matthieu Imbert, Laurent Lefèvre, Christian Pérez.

ADT ALADDIN is an Inria support action of technological development which supports the GRID'5000 instrument. Frédéric Desprez is leading this action (with David Margery from Rennes as the Technical Director).

### *7.1.11. Inria Large Scale Initiative HEMERA, 4 years, 2010-2013*

**Participants:** Daniel Balouek, Christian Pérez, Laurent Pouilloux.

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. The project involves around 24 teams located in all around France.

C. Pérez is leading the project; D. Balouek and L. Pouilloux are managing scientific challenges on GRID'5000.

## 7.2. European Initiatives

### *7.2.1. FP7 Projects*

*7.2.1.1. 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$\rightarrow$ DG $\rightarrow$ Cloud platforms for service provision and as a result EDGI will extend ARC, gLite and Unicore Grids with volunteer and institutional DG systems. In this project, G. Fedak is the Inria representative and lead the JRA2 work package which is responsible for providing QoS to Desktop Grids.

*7.2.1.2. 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, Vetenskapsradet, 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.

Inria participates to Work Package 12 which is about novel programming techniques.

*7.2.1.3. PaaSage*

Title: PaaSage: Model-based Cloud Platform Upperware

Type: Seventh Framework Programme

Instrument: Collaborative project

Duration: October 2012 - September 2016 (48 months)

Coordinator: Pierre Guisset (GEIE ERCIM)

Others partners: SINTEF, STFC, HLRS, University of Stuttgart, Inria, CETIC, FORTH, be.wan, EVRY, SysFera, Flexiant, Lufthansa Systems, AG GWDG, Automotive Simulation Center Stuttgart e.V.

See also: http://paasage.eu

Abstract: PaaSage will deliver an open and integrated platform, to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based development, configuration, optimization, and deployment of existing and new applications independently of the existing underlying Cloud infrastructures. Specifically it will deliver an IDE (Integrated Development Environment) incorporating modules for design time and execution time optimizations of applications specified in the CLOUD Modeling Language (CLOUD ML), execution-level mappers and interfaces and a metadata database.

### *7.2.2. Collaborations in European Programs, except FP7*

Program: Celtic-Plus

Project acronym: SEED4C

Project title: Security Embedded Element and Data privacy for the Cloud.

Duration: 2012-2015

Coordinator: Bertrand Marquet (Alcatel-Lucent lab)

Other partners: Gemalto, ENSI Bourges, Inria, Wallix, VTT Technical Research centre of Finland, Mikkelin Puhelin Oyj, Cygate, Nokia Siemens Networks, Finceptum OY (Novell), Solacia, Innovalia Association, Nextel, Software Quality Systems, Ikusi, Vicomtech, Biscaytik

Abstract: SEED4C is a Celtic-Plus project: an industry-driven European research initiative to define, perform and finance through public and private funding common research projects in the area of telecommunications, new media, future Internet, and applications and services focusing on a new "Smart Connected World" paradigm. Celtic-Plus is a EUREKA ICT cluster and is part of the intergovernmental EUREKA network.

The cloud security challenge not only reflects on the secure running of software on one single machine, but rather on managing and guaranteeing security of a computer group or cluster seen as a single entity. Seed4C focus is to evolve from cloud security with an isolated point or centralized points of enforcement for security to cloud security with cooperative points of enforcement for security.

Program: COST

Project acronym: COST IC804

Project title: : Energy efficiency in Large Scale Distributed Systems

Duration: 2009-2013

Coordinator: J.M. Pierson (IRIT)

Other partners: 26 research institute and countries

Abstract: The COST Action IC0804 proposes 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 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. This Action characterizes the energy consumption and energy efficiencies of distributed applications. Then based on the current hardware adaptation possibilities and innovative algorithms it proposes adaptive and alternative approaches taking into account the energy saving dimension of the problem. This Action also characterizes the trade-off between energy savings and functional and non-functional parameters, including the economic dimension. Deliverables includes workshop proceedings, books, good practice leaflets fostering consciousness rise at ICT researchers, scientists, managers and users levels. Finally, benefits addresses scientific and societal needs.

Program: COST

Project acronym: IC0805

Project title: Open Network for High-Performance Computing on Complex Environments (ComplexHPC)

Duration: 2009-2013

Coordinator: Emmanuel Jeannot (Inria Bordeaux - Sud Ouest)

Other partners: 26 research institute and countries

Abstract: The main objective of the Action is to develop an integrated approach for tackling the challenges associated with heterogeneous and hierarchical systems for High Performance Computing.

Program: Intelligent Energy in Europe

Project acronym: PrimeEnergyIT

Project title: PrimeEnergyIT: Efficient Data Centers

Duration: 2010-2012

Coordinator: B. Schappi (Austrian Energy Agency)

Other partners: organisme, labo (pays)

Abstract: The increasing use of powerful IT services in all public and private service sectors as for example administration, health services and entertainment has lead to a growing energy demand for centralized IT equipment in data centers and central IT units of companies. According to EU and US studies this trend will continue unless energy efficient technology and efficient operation of equipment is broadly implemented. Business-as-usual would lead to a doubling of energy consumption within a few years thereby also significantly increasing energy costs in data centers. The implementation of energy efficient technologies and optimized hardware operation however allows energy and cost savings of up to 60%. PrimeEnergyIT supports the market development and demand for energy efficient central IT hardware and infrastructure providing tools and services for IT and infrastructure managers, consultants and other relevant experts. The PrimeEnergyIT initiative is operated by an international consortium of national agencies and research institutions in cooperation with a number of associate partners from industry [44], [36].

## 7.3. International Initiatives

### *7.3.1. Participation In International Programs*

*7.3.1.1. Inria-UIUC-NCSA Joint Laboratory for Petascale Computing*

**Participants:** Eddy Caron, Frédéric Desprez, Mohammed El Mehdi Diouri, Olivier Glück, Cristian Klein, Vincent Lanore, Laurent Lefevre, Christian Pérez, Jonathan Rouzaud-Cornabas.

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.

*7.3.1.2. PICS CNRS 5473: Dimensioning through Simulation*

**Participants:** Frédéric Desprez, Georges Markomanolis, Frédéric Suter.

This International Scientific Collaboration Project with the University of Hawai'i at Manoa (2009-2012) aims at comparing, solidifying and integrating within a single framework, namely SimGrid, several approaches to dimension infrastructures thanks to simulation.

*7.3.1.3. GreenTouch*

**Participants:** Laurent Lefevre, Jean-Patrick Gelas.

GreenTouch is a consortium of leading Information and Communications Technology (ICT) industry, academic and non-governmental research experts dedicated to fundamentally transforming communications and data networks, including the Internet, and significantly reducing the carbon footprint of ICT devices, platforms and networks.

In this project, we explore the design of virtual home gateway at large scale [18], [29] and participate in the SEASON project.

## 7.4. International Research Visitors

### *7.4.1. Visits of International Scientists*

- L. Lefevre: Hosting Teferi Assefa, PhD student from Addis Abeba University Ethiopia (from sept to dec. 2012) - Joint work on Virtualization of Virtual Home Gateways in link with the GreenTouch initiative.
- G. Fedak: Hosting Matei Ripenau, ENS Visiting Professor from University of British Columbia (Canada). Joint work on large-scale data management. Hosting Mircea Moca, lecturer University of Babes Bolaj, Romania. Joint work on scheduling for hybrid distributed infrastructure.

*7.4.1.1. Internships*

- F. Suter: Hosting 2 Short Term Scientific Missions in the context of the COST Action IC0805. H. Arabnejab (University of Porto, Portugal) and Z. Papazachos (University of Thessaloniki, Greece).
- G. Fedak: Hosting Asma Ben Cheick (Msc, Faculté des sciences de Tunis), 1 month, Haidau Andrei, University of Cluj-Napoca, 3 months.
- F. Desprez, J. Rouzaud-Cornabas: Hosting Jose Luis Lucas, PhD student from Madrid (Spain), 3 months. Joint work on the resource provisioning in Clouds taking into account performance and cost.

**CEPAGE Project-Team**

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

+ **CRA Region** (participants: CEPAGE). This project, entitled "Services for large-scale distributed platforms", is an effort for the designing efficient algorithms for clustering and discovering resources in large scale distributed networks. This project provided the funding for the PhD thesis of Hubert Larcheveque.
+ **CRA Region** (participants: CEPAGE, RUNTIME (Bordeaux)). This project, entitled "Performance modeling for heterogeneous platforms", is an effort for the modeling of the behavior of applications on two different types of platforms: multicore architectures within the RUNTIME team, and large scale platforms within CEPAGE. This project provides the funding for the PhD thesis of Przemyslaw Uznanski.

## 7.2. National Initiatives

- **ANR ALADDIN** (Algorithm Design and Analysis for Implicitly and Incompletely Defined Interaction Networks; GANG and CEPAGE project-teams): the members of Cepage have been participating to the 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).
- **ANR USS-SIMGRID** (Ultra Scalable Simulations with SimGrid; participants: AlGorille (LORIA, Nancy), ASAP (Saclay), CEPAGE, Univ. of Hawai'i, GRAAL (LIP, ENS Lyon), MESCAL (Grenoble), MASCOTTE (Sophia Antipolis)). The members of CEPAGE were part of this project (2008-2011), whose goal was to extend the SimGrid simulation framework, originally developed for HPC, to provide a reasonable and quantifiable level of accuracy for the simulation of large scale application. This allowed to attend both the rising need for scalability of the HPC community and the need for simulation accuracy of the distributed computing community. SimGrid was extended to provide a family of models which offer different levels of accuracy at different simulation scales.
- **ANR SONGS** (Simulation of Next Generation Systems; participants: AlGorille (LORIA, Nancy), MESCAL (Grenoble), GRAAL (ENS Lyon), IN2P3 (Lyon), CEPAGE, HiePACS, RUNTIME (Bordeaux), LSIIT (Strasbourg), ASCOLA (Nantes), MASCOTTE, MODALIS (Sophia Antipolis)). This project started in 2012 as a follow-up of the USS-SIMGRID project. The aim is to further extend the domain of SimGrid, by designing a unified simulation framework for the four application domains: Grids, Peer-to-Peer systems, High Performance Computing, and Cloud systems. Achieving this goal mandates careful representation and modeling of the underlying concepts presented by each domain (memory, disks, energy, network and volatility) and of the interfaces specific to each domain. It also requires a transversal work on the simulation framework itself. CEPAGE is actively involved in this project, both for the peer-to-peer use cases and for the coordination of the modeling effort of the project.
- **ANR Displexity** (Calcul DIStribué: calculabilité et comPLEXITé; participants: CEPAGE, GANG and ASAP projects). The main goal of DISPLEXITY is to establish the scientific foundations of a theory of calculability and complexity for distributed computing. Displexity started in 2012.

- **ANR IDEA** ANR program “defis”: project IDEA (2009-2012). The goal of this ANR is the study of identifying codes in evolving graphs. Ralf Klasing is the overall leader of the project.
- **ANR “Jeunes chercheurs” EGOS - Embedded Graphs and their Oriented Structures** (2012-2014) (see http://www.lirmm.fr/egos/)

  Participants: CEPAGE/LaBRI(Bordeaux) LIRMM(Montpellier), LIX(Palaiseau) The goal of this project is the study oriented structures on graphs of arbitrary genus.
- **AMADEUS** (CNRS funding on “BIG DATA”: 2012- ): Analysis of MAssive Data in Earth and Universe Sciences. This a multidisciplinary research project between computer science teams (LIRMM: University of Montpellier, LIF: University of Marseille) and CEPAGE), earth and climate science (CEREGE: Montpellier and IRD: Aix) and astronomy (LAM: University of Marseille). The aim of the project is to propose effective techniques for mining large data by essentially using distributed computing, visualization, summarization and approximation.

## 7.3. European Initiatives

### *7.3.1. 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 Politecnica 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:

The underlying network is dynamic: many observations of bad configurations show the instability of BGP;

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);

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 projet, in collaboration with the MASCOTE Inria-project in Nice Sophia-Antipolis, makes the use of simulation, developed at both sites.

### 7.3.2. Collaborations in European Programs, except FP7

Program: European COST

Project acronym: Complex HPC IC0805.

Project title: Open Network for High-Performance Computing on Complex Environments

Duration: 2010-2013

Coordinator: Inria

Other partners: 26 countries, see list at http://www.cost.eu/domains_actions/ict/Actions/IC0805?parties

Abstract: The main objective of this COST action 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 (http://complexhpc.org/index.php).

## 7.4. International Initiatives

### 7.4.1. Participation In International Programs

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

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

- **Spanish program CLOUDS**: Cloud Computing for Scalable, Reliable and Ubiquitous Services (http://lsd.ls.fi.upm.es/clouds). This is a large scale program which aims at advancing research in the area of Cloud Computing. CEPAGE is more particularly in contact with the LaDyr team of Univ. Rey Juan Carlos in Madrid, on the topic of resource allocation problems for Cloud providers.

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

- **Collaboration with Canada.**

  Members of CEPAGE have a long-standing collaboration with researchers from the Chair of Distributed Computing at the University of Quebec in Outaouais and the Department of Computer Science at Carleton University. Sources of financing include: personal NSERC grants of Canadian professors (Prof. Andrzej Pelc, Prof. Jurek Czyzowicz, Prof. Evangelos Kranakis), funding from other Canadian grant agencies (a travel grant from Mitacs Inc.), and University of Bordeaux funding (a 3-month invited professorship for Prof. Jurek Czyzowicz).

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

- **Collaboration with Chile.**

  Adrian Kosowski is a foreign partner of the Chilean ministry grant (ANILLO CONICYT programme) entitled "Mathematical modeling for industrial and management science applications: a multidisciplinary approach". The Project Director is Eric Goles from Universidad Adolfo Ibañez, and collaborating researchers on the Chilean side include Karol Suchan and Ivan Rappaport. The collaboration has led to 2 joint papers.

  *Participants*: Adrian Kosowski.

## 7.5. International Research Visitors

### 7.5.1. Visits of International Scientists

*7.5.1.1. Visits to Cepage Members*

- Ljubomir Perkovic, De Paul University Chicago, (September 2011 – June 2012)
- Prosenjit Bose, Carleton University Ottawa, (25/11/12 – 29/11/12)
- George Mertzios, Durham University, UK, (15/06/12 – 14/07/12)
- Leszek Gasieniec, University of Liverpool, UK, (08/06 – 22/06/12)
- Jurek Czyzowicz, Université du Québec, Canada, (08/06 – 22/06/12)
- Darek Dareniowski, Gdansk University of Technology, Poland, (08/06 – 28/06/2012)
- Miroslaw Korzeniowski, Technical University of Wroclaw, (March 2012 – September 2012)

*7.5.1.2. Visits of Cepage Members*

- Cyril Gavoille, MicroSoft Research, Mountainview, CA, two weeks in April 2012.

**GRAND-LARGE Project-Team**

# 6. Partnerships and Cooperations

## 6.1. Regional Initiatives

### *6.1.1. Activities starting in 2009*

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

### *6.1.2. 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 mathematiciancs 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)
- **ANR Cosinus project PetaQCD - Towards PetaFlops for Lattice Quantum ChromoDynamics** (2009-2012) Collaboration with Lal (Orsay), Irisa Rennes (Caps/Alf), IRFU (CEA Saclay), LPT (Orsay), Caps Entreprise (Rennes), Kerlabs (Rennes), LPSC (Grenoble). About the design of architecture, software tools and algorithms for Lattice Quantum Chromodynamics. (Cédric Bastoul, Christine Eisenbeis, Michael Kruse)

  PI L. Grigori
- 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), http://hipcal.lri.fr/wakka.php?wiki=PagePrincipale, Franck Cappello

## 6.2. International Initiatives

### *6.2.1. 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 and postdoctoral researcher took place in the context of this associated team:
  - Visit of M. Jacquelin to UC Berkeley (August 2011, for 1 month).
  - Visit of S. Moufawad (November 2012, for 1 month).

## 6.3. European Initiatives

### *6.3.1. Collaborations in European Programs, except FP7*

Program: ITEA2

Project acronym: MANY

Project title: Many-core programming and Resource Management for High-Performance Embedded Systems

Duration: 01/09/2011 - 31/08/2014

Coordinator: XDIN AB (formerly ENEA)

Other partners: Universitat Auto`noma de Barcelona (UAB), CEPHIS group (Spain), CAPS-Entreprise, (France), Inria, Grand Large (France), Institut Mines-Te´le´com/Te´le´com Sud Paris (IMT/TSP), Computer Science Department (France), THALES Communications & Security, (France), XDIN AB, (Sweden), ETRI, (Korea), Seven Core Co, Ltd, (Korea), TestMidas Co, Ltd, (Korea), ST-Ericsson BV, (Netherlands), Vector Fabrics BV, (Netherlands), Technische Universiteit Eindhoven, (Netherlands), University of Mons (UMONS), POLE-TI (Belgium)

Abstract: The ability to reuse existing software code has grown in importance as software applications become more complex. With the arrival of many-core semiconductor architectures, application developers face an additional problem: how to rewrite software applications to exploit the increased parallel processing available. The MANY project is developing an improved programming environment for the embedded-systems realm; one which will facilitate faster development of applications for a variety of hardware platforms. (Cédric Bastoul, Léna”ic Bagnères, Taj Khan)

## 6.4. International Research Visitors

### *6.4.1. Internships*

German SCHINCA (*Date_begin_end ???*)

Subject: Minimizing communication in scientific computing

Institution: University of Buenos Aires (Argentina)

German SCHINCA (*Date_begin_end ???*)

Alessandro Ferreira Leite (October 2012-December 2012)

Subject: Energy issues in Cloud Computing

Institution: University of Brasilia (Brasil)

**HIEPACS Project-Team**

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### *8.1.1. ANR*

*8.1.1.1. 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 computiation. 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.

*8.1.1.2. 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.

*8.1.1.3. BOOST: Building the future Of numerical methOdS for iTer*

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

**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, CEAr/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, the implementation 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 Projects*

*8.2.1.1. MYPLANET*

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. FASTLA*

Title: Fast and Scalable Hierarchical Algorithms for Computational Linear Algebra

Inria principal investigator: Olivier Coulaud

International Partners (Institution - Laboratory - Researcher):

Stanford University (United States) - Institute for Computational and Mathematical Engineering - Eric Darve

Lawrence Berkeley National Laboratory (United States) - Scientific Computing Group - Esmond Ng

Duration: 2012 - 2014

See also: http://people.bordeaux.inria.fr/coulaud/projets/FastLA_Website/index.html.

In this project, we propose to study fast and scalable hierarchical numerical kernels and their implementations on heterogeneous manycore platforms for two major computational kernels in intensive challenging applications. Namely, fast multipole methods (FMM) and sparse hybrid linear solvers, that appear in many intensive numerical simulations in computational sciences. Regarding the FMM we plan to study novel generic formulations based on H-matrices techniques, that will be eventually validated in the field of material physics: the dislocation dynamics. For the hybrid solvers, new parallel preconditioning approaches will be designed and the use of H-matrices techniques will be first investigated in the framework of fast and monitored approximations on central components. Finally, the innovative algorithmic design will be essentially focused on heterogeneous manycore platforms. The partners, Inria HiePACS, Lawrence Berkeley Nat. Lab and Stanford University, have strong, complementary and recognized experiences and backgrounds in these fields.

#### *8.3.1.2. 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

See also: http://www.inria.fr/en/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. Participation In International Programs*

*8.3.2.1. 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 Urbanna 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).

## 8.4. International Research Visitors

### *8.4.1. Visits of International Scientists*

The following researchers have visited HiePACS in 2012

- George Bosilca, University of Tennessee at Knoxville visited from June 15 to December 31st.
- Yousef Saad, University of Minnesota from June 4 to June 15th.

#### *8.4.1.1. Internships*

Both Vincent Cohen and Homar Zenati share their internship time between Inria and UTK in the framework of the MORSE associate team. Pierre Ramet (BACCHUS team) contributed to the advisory of Homar Zenati's work.

**KERDATA Project-Team**

# 8. Partnerships and Cooperations

## 8.1. National Initiatives

### *8.1.1. ANR*

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/

### *8.1.2. Other National projects*

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).

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

## 8.2. European Initiatives

### *8.2.1. FP7 Projects*

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).

### *8.2.2. Collaborations in European Programs, except FP7*

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.

## 8.3. International Initiatives

### *8.3.1. Inria Associate Teams*

#### *8.3.1.1. DATACLOUD*

Title: Distributed data management for cloud services

Inria principal investigator: Gabriel Antoniu

International Partner (Institution - Laboratory - Researcher):

Politechnica University of Bucharest (Romania) - NCIT - Valentin Cristea

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).

The main results obtained in 2012 are described in Section 6.4 .

### *8.3.2. Inria International Partners*

Politehnica University of Bucharest

### *8.3.3. 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 inw Section 4.1 ). A joint project proposal with the team of Rob Ross (Argonne National Lab) has been accepted in 2012 at the FACCTS call for projects. It served to prepare the preparation of a project for an Associate Team with ANL and UIUC. The project, called Data@Exascale has been accepted for 2013-2015.

FP3C ANR-JST project (2010–2014). This project co-funded by ANR and by JST (Japan Science and Technology Agency) started in October 2010 for 42 months. It focuses on programming issues for Post-Petascale architectures. In this framework, KerData collaborates with the University of Tsukuba on data management issues.

## 8.4. International Research Visitors

### *8.4.1. Visits of International Scientists*

- Robert Ross and Dried Kimpe (Argonne National Lab) visited the KerData team for a week (June 2012) within the framework of our FACCTS project.
- Florin Pop and Ciprian Dobre (Politehnica University of Bucharest) visited the KerData team for a week (June 2012) within the framework of our DataCloud@work Associate Team.

### *8.4.2. Internships*

Elena Burceanu (from February 2012 until June 2012)

Subject: Distributed data storage for context-aware applications

Institution: Politehnica University of Bucharest (Romania)

Vlad Nicolae Serbanescu (from February 2012 until June 2012)

Subject: Distributed data aggregation using the BlobSeer cloud storage service

Institution: Politehnica University of Bucharest (Romania)

Bharath Vissapragada (from February 2012 until June 2012)

Subject: MapReduce data processing on hybrid (cloud/desktop grid) infrastructures

Institution: University of Hyderabad (India)

Mauricio De Oliveira de Diana (June 2012)

Subject: Performance modeling for the BlobSeer storage system

Institution: Master student from Brazil

Sergiu Vicol (June–August 2012)

Subject: Optimizing memory management in Damaris

Institution: Bachelor student from Oxford University. Former awardee of the ENS-Inria Excellence Award for the Laureates of the Romanian Olympiad in Informatics.

Alexandru Farcasanu(June–August 2012)

Subject: Optimizing the DStore in-memory storage system

Institution: Bachelor students from Politehnica University of Bucharest. Former awardee of the ENS-Inria Excellence Award for the Laureates of the Romanian Olympiad in Informatics.

### *8.4.3. Visits to International Teams*

- Viet-Trung Tran visited Microsoft Research Cambridge (Dushyanth Narayanan) for a 3-month internship, funded by MSR.
- Houssem-Eddine Chihoub visited the Polytechnical University of Madrid (Maria Perez) for 3 months, funded by the FP7 SCALUS MCITN project.
- Radu Tudoran visited the ATL Lab at European Microsoft Innovation Center (Aaachen Germany) for 3 months, funded by Microsoft.
- Matthieu Dorier visited ANL (Rob Ross, Tom Peterka, Phil Carns) and UIUC (Franck Cappello) for one month, funded by our FACCTS grant.

**MESCAL Project-Team**

# 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 con- trolled 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. ANR

- *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.

- *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.

- *ANR SONGS, 2012-2015*

Partners: Inria Nancy (Algorille), Inria Sophia (MASCOTTE), Inria Bordeaux (CEPAGE, HiePACS, RunTime), Inria Lyon (AVALON), University of Strasbourg, University of Nantes

The last decade has brought tremendous changes to the characteristics of large scale distributed computing platforms. Large grids processing terabytes of information a day and the peer-to-peer technology have become common even though understanding how to efficiently such platforms still raises many challenges. As demonstrated by the USS SimGrid project funded by the ANR in 2008, simulation has proved to be a very effective approach for studying such platforms. Although even more challenging, we think the issues raised by petaflop/exaflop computers and emerging cloud infrastructures can be addressed using similar simulation methodology.

The goal of the SONGS project (Simulation of Next Generation Systems) is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

Any sound study of such systems through simulations relies on the following pillars of simulation methodology: Efficient simulation kernel; Sound and validated models; Simulation analysis tools; Campaign simulation management.

## 8.3. European Initiatives

### *8.3.1. FP7 EDGI (European Desktop Grid Initiative)*

Partners: SZTAKI insitute (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 (Barcelone), 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. 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.

## 8.4. International Initiatives

### 8.4.1. Inria Associated 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: 2012 - 2013

See also: http://mescal.imag.fr/membres/derrick.kondo/ea/ea.html

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).

### 8.4.2. 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). Slim Bouguerra is visiting JLPC for an extended period (one year).
- MESCAL also has long lasting collaborations with University of California in Berkeley and a new one with Google. Bruno Gaujal, Derrick Kondo and Arnaud Legrand visited Berkeley in 2012.

### 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 for 2011-2012 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.
- 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. Slim Bougherra (Mescal Postdoc) is visiting JLPC for one year, starting Jan. 2012.

*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 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. National Initiatives

### *8.1.1. ANR*

- **ANR grant REPDYN (2010-2012).** High performance computing for structure and fluid computing. Partners: Inria Rhône-Alpes, CEA, ONERA, EDF, LaMSID lab from CNRS and LaMCoS lab from INSA Lyon.
- **ANR/JST grant PETAFLOW (2010-2012).** France/Japan international program. Peta-scale data intensive computing with transnational high-speed networking: application to upper airway flow. Inria Rhône-Alpes, Gipsa-lab from UJF, NITC (Japan), Cyber Center of Osaka, DITS (Osaka) and the Visualization Lab of Kyoto.
- **ANR grant EXAVIZ (2011-2015).** Large Scale Interactive Visual Analysis for Life Science. Partners: Inria Rhône-Alpes, Université d'Orléans, the LBT lab from IBPC, the LIMSI from Université d'Orsay, and the CEMHTI labs from CNRS.
- **ANR HPAC (2012-2015)**. High Performance Algebraic Computing. Coordinator: UJF (LJK/CASYS team). Partners: project-team MOAIS (Grenoble), project-team ARENAIRE (LIP, Lyon), project-team SALSA (LIP6, Paris), the ARITH group (LIRMM lab, Montpellier).
- **Equipex Kinovis (2012-2017)**. 2.6 Meuros. Large scale multi-camera platform (extension of the Grimage platform to 60 cameras, depth and X-ray cameras). Coordinator E Boyer, LJK Inria MORPHEO team. Partners: Inria Rhône-Alpes and the LJK, LIG, LADAF and GIPSA labs.

### *8.1.2. Competitivity Clusters*

- CILOE, 2008-2012, 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.
- 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 mumticore systems on chip. Leader: ST-Microelectonic. Partners: Inria (Mescal, Moais); UJF (TIMA, LIG/Hadas); Magilem, ProBayes. Moais contributes with technics and tools for visual aggregation of application traces. The contract funds 1 phD thesis and 1 year engineer.

## 8.2. European Initiatives

### *8.2.1. FP7 Projects*

*8.2.1.1. 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

Others partners: http://www.infra-visionair.eu/members.html

See also: http://www.infra-visionair.eu/

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.

### *8.2.2. Collaborations with Major European Organizations*

- **ADT Vcore (2011-2013)**. Partners: Fraunhofer IGD (Darmstad), Inria IMAGINE and MOAIS (Grenoble), SHAMAN and MINT (Lille), VR4i (Rennes), IN SITU (Saclay), SED Sophia Antipolis. This project is currently an ADT Inria (funds IJD). Software infrastructure for advanced applications in augnmented and virtual reality.

## 8.3. International Initiatives

### *8.3.1. Inria International Partners*

MOAIS has a long term collaboration with several universities in Brazil, and in particular with UFRGS, Porto Alegre and USP, Sao Paulo. Several mobility grants support these collaborations:

- Inria Diode-A associated team (2006-2011),
- CNRS/Cnpq (2011-2013).
- Inria/Cnpq (2008-2010),
- Capes/Cofecub (2006-2007, 2008-2009, 2010-2012),
- Associated International Laboratory LICIA (http://www.inf.ufrgs.br/licia) funded by CNRS (since 2011).

This collaboration is important to get access to high quality students. Classically students pursue their PhD in our team full or half time in "co-tutelle" (double graduation). These PhDs are almost all funded by Brazil. Over the 2008-2012 period, 5 PhD students (3 from UFRGS, 2 from USP) were advised at Moais. Initially based on experimented researcher exchanges, the increase of fundings enabled to involve Master students that usually stay 2-4 months in our team and often come back later for a PhD.

## 8.4. International Research Visitors

### *8.4.1. Visits of International Scientists*

- Wieslaw Kubiak (memorial Univiersity, New Foundland, Canada), invited prof UJF (2 months)
- Joseph Peters (SFU Vancouver, Canada, contract INP VOLVIC (3 months)

*8.4.1.1. Internships*

Julio TOSS (from Apr 2012 until Sep 2012)

Subject: A new programming paradigm for GPU

Institution: Universidade Federal do Rio Grande do Sul (Brazil)

Nikhil BANSAL (from Jun 2012 until Sep 2012)

Subject: Multi-objective optimization strategies for parallel multi-users applications

Institution: IIT Delhi (India)

**ROMA Team**

# 6. Partnerships and Cooperations

## 6.1. National Initiatives

### *6.1.1. ANR*

ANR White Project RESCUE (2010-2014), 4 years. The ANR White Project RESCUE was launched in November 2010, for a duration of 48 months. It gathers three Inria partners (ROMA, Grand-Large and Hiepacs) and is led by ROMA. 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.

## 6.2. International Initiatives

### *6.2.1. Inria Associate Teams*

The ALOHA associate-team is a joint project of the ROMA team and of the Information and Computer science Department of the University of Hawai'i (UH) at Mānoa, Honolulu, USA. Building on a vast array of theoretical techniques and expertise developed in the field of parallel and distributed computing, and more particularly application *scheduling*, we tackle database questions from a fresh perspective. To this end, this proposal includes:

- a group that specializes in database systems research and who has both industrial and academic experience, the group of Lipyeow Lim (UH);
- a group that specializes in practical aspects of scheduling problems and in simulation for emerging platforms and applications, and who has a long experience of multidisciplinary research, the group of Henri Casanova (UH);
- a group that specializes in the theoretical aspects of scheduling problems and resource management (the ROMA team).

The research work focuses on the following three thrusts:

1. Online, multi-criteria query optimization
2. Fault-Tolerance for distributed databases
3. Query scheduling for distributed databases

## 6.3. International Research Visitors

### *6.3.1. Visits of International Scientists*

Oliver Sinnen, senior lecturer at the Department of Electrical and Computer Engineering (ECE) of the University of Auckland, New Zealand, visited the ROMA team for three months (April-June, 2012). He worked with Loris Marchal and Frédéric Vivien on scheduling tree-shaped task graphs to minimize both the peak memory usage and the makespan (see Section 5.5 ).

### *6.3.2. 7th Scheduling for large scale systems workshop*

The University of Pittsburgh (Rami Melhem), the ROMA team (Yves Robert and Frédéric Vivien) and the University of Hawai'i at Manoa (Henri Casanova) have organized a workshop in Pittsburgh, on June 28-30, 2012. The workshop focused on scheduling and algorithms for large-scale systems. This was the seventh edition of this workshop series, after Aussois in August 2004, San Diego in November 2005, Aussois in May 2008, Knoxville in May 2009, Aussois in May 2010, and Aussois in May 2011. The next workshop will be held in Schloss Dagstuhl in September 2013.

**RUNTIME Project-Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

REGION AQUITAINE The Aquitaine Region Council is granting the PhD thesis of Andra Hugo about *Composability of parallel software over hybrid architectures*, from september 2011 to august 2014.

## 8.2. National Initiatives

### *8.2.1. ANR*

ANR COOP Multi-level Cooperative Resource Management (http://coop.gforge.inria.fr/).

ANR COSINUS 2009 Program, 12/2009 - 06/2013 (42 months)

Identification: ANR-09-COSI-001

Coordinator: Christian Pérez (Inria Rhône-Alpes)

Other partners: Inria Bordeaux, Inria Rennes, IRIT, EDF R&D.

Abstract: COOP 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.

ANR ProHMPT Programming Heterogeneous Multiprocessing Technologies (http://runtime.bordeaux.inria.fr/prohmpt/).

ANR COSINUS 2008 Program, 01/2009 - 06/2012 (42 months)

Identification: ANR-08-COSI-013

Coordinator: Olivier Aumage (Inria Bordeaux)

Other partners: CEA INAC, CEA CESTA, CAPS entreprise, Bull, UVSQ PRiSM, Inria Grenoble.

Abstract: ProHMPT aims at focusing the joint research work of several teams about compilers, runtimes and libraries as well as scientific application programmers on designing methods and tools for programming heterogeneous platforms such as GPU and accelerators.

Nomination: The project ProHMPT has been nominated for the first round of selection for the best ANR projects recently completed.

ANR MediaGPU Massive multimedia GPU-Based Processing (http://picoforge.int-evry.fr/projects/mediagpu/).

ANR CORD 2009 Program, 01/2010 - 12/2012 (36 months)

Identification: 2009-CORD-25-01

Coordinator: Pierre Pleven (Institut TELECOM)

Other partners: PLAY ALL, ATEME, HPC-Project, Inria Bordeaux

Abstract: The MediaGPU project 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 Hybrid CPU+GPU and GPGPU. Initial key target applications are very large still images processing, high definition video encoding, video post-production, real-time geometry 3D synthesis.

ANR Songs Simulation of next generation systems (http://infra-songs.gforge.inria.fr/).

ANR INFRA 2011, 01/2012 - 12/2015 (48 months)

Identification: ANR-11INFR01306

Coordinator: Martin Quinson (Inria Nancy)

Other partners: Inria Nancy, Inria Rhône-Alpes, IN2P3, LSIIT, Inria Rennes, I3S.

Abstract: The goal of the SONGS project is to extend the applicability of the SIMGRID simulation framework from Grids and Peer-to-Peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

## 8.3. European Initiatives

### *8.3.1. FP7 Projects*

PEPPHER FP7 Strep "Performance Portability and Programmability for Heterogeneous Many-core Architectures"

Specific Targeted Research Project (STREP), 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)

Abstract: PEPPHER aims at providing 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

### *8.3.2. Collaborations in European Programs, except FP7*

COST ComplexHPC complexhpc.org

Program: COST

Project acronym: ComplexHPC

Project title: ComplexHPC

Duration: may 2009 – june 2013

Coordinator: Emmanuel Jeannot

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. This Action gathers more than 26 countries and 50 partners in Europe. The budget for the whole action and the four years is 380 000 euros.

## 8.4. International Initiatives

### *8.4.1. Inria Associate Teams*

MORSE Matrices Over Runtime Systems at Exascale

Inria Associate-Teams program: 2011-2013

Coordinator: Emmanuel Agullo (Hiepacs)

Parners: Inria (Runtime & Hiepacs), University of Tennessee Knoxville, University of Colorado Denver and KAUST.

Abstract: The Matrices Over Runtime Systems at Exascale (MORSE) associate team has vocation 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. With Inria Hiepacs, University of Tennessee, Knoxville and University of Colorado, Denver.

### *8.4.2. Participation In International Programs*

ANR-JST FP3C Framework and Programming for Post Petascale Computing.

ANR-JST 2010 Program, 03/2010 - 02/2013 (36 months)

Identification: ANR-10-JST-002

Coordinator: Serge Petiton (Inria Saclay)

Other partners: CNRS IRIT, CEA DEN Saclay, Inria Bordeaux, CNRSPrism, Inria Rennes, University of Tsukuba, Tokyo Institute of Technology, University of Tokyo, Kyoto University.

Abstract: Post-petascale systems and future exascale computers are expected to have an ultra large-scale and highly hierarchical architecture with nodes of many-core processors and accelerators. That implies that existing systems, language, programming paradigms and parallel algorithms would have, at best, to be adapted. The overall structure of the FP3C project represents a vertical stack from a high level language for end users to low level architecture considerations, in addition to more horizontal runtime system researches.

HPC-GA High Performance Computing for Geophysics Applications (http://project.inria.fr/HPC-GA/)

European FP7 Programme, “Marie Curie” Action, PIRSES Scheme, 01/2012 - 12/2014 (36 months)

Identification: PIRSES-GA-2011-295217

Coordinator: Jean-François Méhaut (UJF)

Other Partners: Inria Grenoble, Inria Bordeaux, Basque Center for Applied Mathematics (BCAM, Bilbao, Spain), Federal University of Rio Grande do Sul (UFRGS, Porto Alegre, Brazil), Universidad Nacional Autónoma de México (UNAM, Mexico, Mexico), Bureau de Recherche Géologique et Minière (BRGM, Orléans, France), Grand Équipement National de Calcul Intensif (GENCI, France).

Abstract: The HPC-GA project is unique in gathering an international, pluridisciplinary consortium of leading European and South American researchers featuring complementary expertise to face the challenge of designing high performance geophysics simulations for parallel architectures: UFRGS, Inria, BCAM and UNAM. Results of this project will be validated using data collected from real sensor networks. Results will be widely disseminated through high-quality publications, workshops and summer-schools.

SEHLOC Scheduling evaluation in heterogeneous systems with hwloc

STIC-AmSud 2012 Program, 01/2013 - 12/2013 (12 months, renewable)

Coordinator: Brice Goglin

Other Partners: Universidad Nacional de San Luis (Argentina), Universidad de la Repúpublica (Uruguay).

Abstract: This project focuses on the development of runtime systems that combine application characteristics with topology information to automatically offer scheduling hints that try to respect hardware and software affinities. Additionally we want to analyze the convergence of the obtained performance from our algorithms with the recently proposed Multi-BSP model which considers nested levels of computations that correspond to natural layers of nowadays hardware architectures.

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

*8.5.1.1. Internships*

Satoshi OHSHIMA visited us in September and October 2012, and accelerated the FEM application of the University of Tokyo execution by using STARPU.

**DANTE Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

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. ANR*

- 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.
- Equipex FIT (Futur Internet of Things) FIt is one of 52 winning projects in the Equipex research grant program. It will set up a competitive and innovative experimental facility that brings France to the forefront of Future Internet research. FIT benefits from 5.8√¢¬Ç¬¨ million grant from the French government Running from 22.02.11 √¢¬Ä¬ì 31.12.2019. The main ambition is to create a first-class facility to promote experimentally driven research and to facilitate the emergence of the Internet of the future.
- 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.

- ANR RESCUE started in December 2010: 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 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/
- ANR PETAFLOW (Appel Blanc International) started in march 2010 and will end in october 2013. 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/

## 8.3. European Initiatives

### *8.3.1. Collaborations in European Programs, except FP7*

Program: Life Science Health Priority of the Sixth Framework Program

Project acronym: MOSAR

Project title: Mastering hOSpital Antimicrobial Resistance and its spread into the community.

Duration: 06 2008 - 07 2012

Coordinator: INSERM

Other partners: University of Antwerp, National Medicines Institute (NMI), August Pi i Sunyer biomedical research Institute (IDIBAPS), University Medical Center Utrecht (UMCU), University of Geneva Hospitals (UNIGE), Tel Aviv Medical Center (TASMC), Health Protection Agency (HPA), Medical school of Paris 12 University (UPVM), Pasteur Institute, Inserm-Transfert, Ingen Biosciences, BiologischeAnalysensystemGmbH (BAG), AmpTec GmbH, Array-On GmbH, Inria

Abstract: MOSAR brings together internationally recognized experts to address the issue of antimicrobial resistance in a comprehensive manner. MOSAR consideres the major issue of antimicrobial resistance in the perspective of a complex system and not only through the prism of a single discipline.

To achieve its objectives MOSAR builds on advances generated by basic sciences, through dedicated and trans-disciplinary cooperation. This project integrates studies from epidemiology and basic laboratory sciences, clinical medicine, statistical sciences, behavioural sciences, and health economics. MOSAR network is structured into 10 interacting groups centered on the patients.

MOSAR focuses on major endemic and epidemic nosocomial pathogens such as Methicillin-resistant Staphylococcus aureus (MRSA), Vancomycin-resistant Enterococci (VRE), Extended-Spectrum Beta-Lactamases (ESBL) Enterobacteriaeceae, and Carbapenem-resistant Acinetobacter spp, and in interventional trials in high-risk areas (Intensive Care Units, Surgery and Rehabilitation centers) of countries with high-level of resistance.

### *8.3.2. FP7 Projects*

#### *8.3.2.1. GEYSERS*

Title: Generalsed Architecture for dynamic infrastructure services

Type: COOPERATION (ICT)

Defi: The Network of the Future

Instrument: Integrated Project (IP)

Duration: January 2010 - march 2013

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), Telefonica I+D (Spain), Telekomunikacja Polska S.A. (Poland), Instytut Chemii Bioorganicznej PAN, Poznan Supercomputing and Networking Centre (Poland), Nextworks s.r.l (Italy), Fundacio i2CAT, Internet i Innovacio 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.

*8.3.2.2. 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), Telef$\sqrt{}$$\geq$nica Investigacion y Desarrollo (Spain), Telecom Italia (Italy), Portugal Telecom Inovation (Portugal), Swedish institute of Computer science (Sweden), Instituto Superior Tecnico Address (Portugal), Universitaet Paderborn (Germany), Aalto-Korkeakoulus ti (Finland), Kungliga Tekniska Hogskolan (Sweden), Fraunhofer Gesellschaft zur Forderung 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? 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.

## 8.4. International Initiatives

### *8.4.1. Participation In International Programs*

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.

PICS CNRS Combinatorial Structures for Complex Network Modeling DANTE 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.

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

- Phan Thi Ha Duong, Hanoï, Vietnam, May-June 2012.
- Renault Lambiotte, Namur, January 2012.
- Klaus Wehmuth, LNCC Brasil, April 2012.
- Prasan Kumar Sahoo, Chang Gung University, Taïwan, November 2012.

*8.5.1.1. Internships*

- Pranav Jindal, IIT Bombay, India, from May to July 2012

**DIONYSOS Project-Team**

# 7. Partnerships and Cooperations

## 7.1. Regional Initiatives

### *7.1.1. 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.

## 7.2. National Initiatives

### *7.2.1. ARC MENEUR*

**Participant:** Bruno Tuffin.

We coordinate an Inria Cooperative Research Action on Network Neutrality, called MENEUR ("Modélisation en Économie des rśeaux et NEUtRalité du Net"). This action runs over 2011–2012 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/

### *7.2.2. ANR CAPTURES*

**Participant:** Bruno Tuffin.

We coordinate the ANR Verso CAPTURES: Competition Among Providers for Telecommunication Users: Rivalry and Earning Stakes.
ANR project Dec. 2008- Nov. 2012, in cooperation with Telecom Bretagne and France Telecom R&D.

The goal of this project is to deal with competition among providers in telecommunications. We need to study the distribution of customers among providers as a first level of game, and then to focus on a second higher level, the price and QoS war. See http://captures.inria.fr/

### *7.2.3. ANR VIPEER*

**Participants:** Yassine Hadjadj-Aoul, Gerardo Rubino.

VIPEER is a 3-year ANR project (end 2009-end 2012). VIPEER stands for Video Traffic Engineering in an Intra-Domain Context using Peer-to-Peer Paradigms. The VIPEER project proposes to develop a distributed Content Delivery Network (dCDN) that combines classic CDN technologies with P2P concepts. Our main application in the project is IPTV. Dionysos will mainly cover the QoE assessments activities of VIPEER. Our partners are Télécom Bretagne, Eurecom, Envivio, Orange Labs and NDS Technologies.

## 7.3. European Initiatives

### *7.3.1. FP7 Projects*

#### *7.3.1.1. FP7 PROBE-IT*

**Participants:** César Viho, Nanxing Chen, Arulnambi Nandagoban, Anthony Baire.

PROBE-IT is a two years European project that aims at supporting exploitation of European research advances in IoT deployments. The work plan is split in three main areas : benchmarking, roadmap and interoperability testing. PROBE-IT comprises ten international partners from Europe, China, Brazil and Africa. Dionysos is leader of the work-package WP4 dedicated to testing roadmap and solutions to provide stakeholders with elements to validate technologies conformance and interoperability. See http://www.probe-it.eu.

### 7.3.2. Collaborations in European Programs, except FP7

*7.3.2.1. 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 ended 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.

*7.3.2.2. INNIS project*

**Participant:** Bruno Tuffin.

Program: Euro-NF NoE

Project acronym: INNIS

Project title: Impacts of Network Neutrality on the Internet Stakeholders

Duration: November 2011 – June 2012

Coordinator: Bruno Tuffin, Dionysos

Other partners: TELECOM Bretagne, the polytechnic University of Valencia (Spain), the University of Rome 2, and the Italian Data Protection Authority

### 7.3.3. Collaborations with Major European Organizations

Partner 1: FTW, Vienna (Austria)

We work with FTW on network economics.

Partner 1: Vrije University (The Netherlands)

We work with Vrije University on rare event simulation.

## 7.4. International Initiatives

### 7.4.1. Inria Associate Teams

*7.4.1.1. MOCQUASIN*

Title: Monte Carlo and Quasi-Monte Carlo for rare event simulation

Inria principal investigator: Bruno Tuffin

International Partner (Institution - Laboratory - Researcher):

University of Montreal (Canada) – Département d'informatique et recherche opérationnelle – Pierre L'Ecuyer

Duration: 2008 - 2013

See also: http://www.irisa.fr/dionysos/pages_perso/tuffin/MOCQUASIN/

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 analyse 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.

### *7.4.2. Inria International Partners*

Our other main international partners are:

- José Blanchet (from Columbia University) and Peter Glynn (from Stanford University), on rare event simulation
- Peter Reichl (from FTW, Vienna, Austria), on pricing and security issues
- Héctor Cancela and Franco Robledo (from Uniov. of the Republic, Montevideo, Uruguay), on simulation issues
- Tarik Taleb (from NEC Europe), on LTE issues
- Alan Krinik (from CalPoly, California, USA), on transient analysis of Markovian queues
- Reinaldo Vallejo (from UFSM, Valparaíso, Chile), on solving techniques for Markov models

### *7.4.3. CNRS/NFSC IRON*

Title: Ensuring Interoperability of new generation networks (IRON)

Principal investigator: César Viho

International Partner:

Institution: BUPT Beijing Univ. of Post and Telecommunication (China)

Inria: Dionysos

Researcher: Pr. Xiaohong Huang

Duration: 01/01/2012 - 31/12/2012

Abstract: Future networks will continue to be heterogeneous. The risk of non-interoperability will increase. This may lead to unavailability of some critical network services, for instance in emergency management, etc. It is important to guarantee that network components will interoperate. One important way among others is to provide efficient testing methodology that help in guaranteeing interoperability of the underlying protocols. The classical testing approach of a single testing system dealing with all tested components and the test execution is no more applicable. To be more confident in the real interoperability of these components, testing has to be done in a close to real operational environment that may be unreliable. Thus, this project aims at providing interoperability testing solutions for distributed communicating systems in unreliable environments.

### *7.4.4. Participation In International Programs*

#### *7.4.4.1. STIC Algérie*

Program: DGRSDT Inria Algeria

Title: Réseaux de capteurs

Inria principal investigator: Adlen Ksentini

International Partner (Institution - Laboratory - Researcher):

Centre de Recherche sur l'Information Scientifique et Technique (Algeria)

Duration: Jan 2011 - Dec 2012

## 7.5. International Research Visitors

### *7.5.1. Visits of International Scientists*

*7.5.1.1. Professors*

Pr. Xiaohong Huang

Subject: Ensuring Interoperability of new generation networks (IRON)

Institution: BUPT Beijing Univ. of Post and Telecommunication (China)

Duration: 15/09/2012 - 30/09/2012

*7.5.1.2. Internships*

Leila GHAZZAI (from Feb 2012 until Aug 2012)

Subject: Caching strategies for adaptive video streaming over Content Centric Networks

Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Abhimanyu PANWAR (from May 2012 until Jul 2012)

Subject: Video on Demand over a distributed Content Distribution Network

Institution: IIT Bhubaneswar (India)

**DISTRIBCOM Project-Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

### *8.1.1. ESTASE*

**Participant:** Axel Legay.

- Title: Estase
- Type: Regional project
- Defi: New techniques for statistical model checking
- Instrument: Regional project
- Duration: March 2011 - February 2014
- Coordinator: Inria Rennes

## 8.2. National Initiatives

### *8.2.1. ANR*

#### *8.2.1.1. IMPRO*

**Participant:** Loïc Hélouët.

Title: IMPRO

Type: ANR

Defi: Implementability and Robustness of Timed Systems

Duration: march 2011 - march 2014

Coordinator: IRCCYN Nantes

Others partners: IRCCyN (Nantes), IRISA (Rennes), LIP6 (Paris), LSV (Cachan), LIAFA (Paris), LIF (Marseilles)

See also: http://anr-impro.irccyn.ec-nantes.fr/

Abstract: 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.

## 8.3. European Initiatives

### *8.3.1. DISC*

**Participant:** Eric Fabre.

The DISC Eu project (STREP) officially ended in Dec. 2011, and the final review took place in Feb. 2012. This project was oriented toward the development of supervision and control methods for large systems. Inria was involved in particular for the diagnosis of stochastic systems, and for distributed planning methods. These activities are still going on, with several publications in 2012 and others in preparation. Among the salient facts related to DISC in 2012 were Loig Jezequel's PhD defense (Dec. 2012), and the contribution to 2 chapters of the book "Control of discrete-event systems" seatzu:silva:vanschuppen:2013, to appear in 2013.

### *8.3.2. Sys2SOFT*

**Participant:** Axel Legay.

Title: SyS2SOFT

Type: Grand emprunt

Defi: Designing for adaptability and evolution in systems of sytems engineering

Instrument: Grand emprunt

Duration: Juin 2012 - Mai 2015

Coordinator: DASSAULT

### *8.3.3. FP7 Projects*

#### *8.3.3.1. Dali*

**Participant:** Axel Legay.

- Title: Dali
- Type: COOPERATION (ICT)
- Defi: design of a device for assisted living.
- Instrument: Strep.
- Duration: November 2011 - October 2014
- Coordinator: Trento (Italy)

#### *8.3.3.2. DANSE*

**Participant:** Axel Legay.

Title: DANSE

Type: COOPERATION (ICT)

Defi: Designing for adaptability and evolution in systems of sytems engineering

Instrument: Integrated Project (IP)

Duration: November 2011 - October 2014

Coordinator: OFFIS (Germany)

Abstract: DANSE represents the next step in research about component based design and it is thus central in our research activities. The purpose of this project is the development of a new methodology for the design of Systems of Systems (SoS). SoS are modeled using the UPDM Language. In these settings, Statistical Model Checking is the solution to evaluate the SoS capabilities to ensure some properties. During the first period (Nov. 2011 - Nov. 2012), we and ALES company both worked to interface PLASMA and DESYRE to provide the first statistical model-checker tool for the UPDM modeling framework. PLASMA-DESYRE is available and run under the Eclipse environment. To obtain the first prototype of PLASMA-DESYRE we provide a new release of Plasma. It is specially designed to perform SMC using different simulation engines, by reducing the adaptation effort: it can be connected to DESYRE, SciLab, MatLab, and some simulators dedicated to Bio or Prism languages. We also extended UPDML specification with a new contract language designed to specify some requirements. These requirements are viewed as behavioral objectives that lead the system architect for designing some good strategies of the SoS. These requirements (called contracts) are written in English using some patterns that are simple to handle and have a strong semantics

expressed with the Bounded Linear-Temporal-Logic (B-LTL), the property language of PLASMA. This new language is defined using the standard OCL language to define state constraints of the SoS, English temporal patterns that overlay the state constraints to specify some contracts about the behavior of the SoS. It adds the time support that is not initially provided by OCL. These contracts are then compiled into B-LTL formulas and checked by PLASMA-DESYRE, the SoS Statistical Model Checker, against a compiled implementation of the UPDM model. The result estimates the satisfiability of the contract, e.g. the probability that the model satisfies the contract.

*8.3.3.3. Univerself*

**Participant:** Eric Fabre.

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:

Universiteit Twente,

Alcatel Lucent Ireland,

Alcatel Lucent Deutschland,

Valtion Teknillinen Tutkimuskeskus (Finland),

University of Piraeus,

France Telecom,

Telecom Italia,

National University of Athens,

Fraunhofer-Gesellschaft zur F$\sqrt{\partial}$rderung der Angewandten Forschung,

Interdisciplinary Institute for Broadband Technology,

Telefonica Investigacion y Desarrollo,

Thales Communications,

Inria,

Nec Europe,

University of Surrey,

University College London

IBBT (Belgium).
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. Univerself has been launched in October 2010 and is scheduled for four years.

*8.3.3.4. SENSATION*

**Participant:** Axel Legay.

- Title: Sensation
- Type: COOPERATION (ICT)
- Defi: Study of new techniques for energy saving
- Instrument: Strep.
- Duration: October 2012 - September 2015
- Coordinator: Aalborg (Denmark)

## 8.4. International Initiatives

### 8.4.1. Inria Associate Teams

#### 8.4.1.1. FOSSA

**Participants:** Claude Jard, Albert Benveniste.

The associated team FOSSA studies the **formalization of service orchestrations in the open world** of the Internet. The original FOSSA consortium involved two teams on the Inria side, namely Distribcom (Albert Benveniste and Claude Jard, Rennes, leader of FOSSA) and Mexico (Stefan Haar, Saclay). In early 2011, both teams agreed that Mexico did not have the resources to participate in FOSSA at an appropriate level. So they agreed that Mexico would no longer participate in FOSSA. The team of Cook and Misra at the Computer Science Department, University of Texas at Austin, is among the leading teams on wide area distributed systems and programming. Jayadev Misra [1] has a long record of results tracing back to the 1980's with his work on the Unity language. Since 2000, he and William Cook are committed to the design and development of the ORC[2] script language for composite services over the Web. This team is therefore the premier player in this area, combining both a strong theoretical research and a professional tool development. Since his launching in 2004, the DistribCom [3] Inria team, with Albert Benveniste, Claude Jard, and Loïc Hélouët, is involved in the study of Quality of Service (QoS) issues in service orchestrations as well as document based workflows. FOSSA was started with the overall objective of enhancing ORC with the advances performed by DistribCom on the above two subjects.

FOSSA has lived from 2010 to 2012. QoS weaving was the main topic developed in 2012. John Thywissen (Austin side), Ajay Kattepur and Claude Jard (Inria side) were the principal contributors. The strategy was to first focus on causality tracking. This has been implemented in ORC using transformations in the OIL intermediate form. Causality has then been extended with QoS and implemented. A joint paper is under finalization. This year, we have also worked on a joint general paper on the overall approach. On the topic of Active XML and ORC integration, the team has decided to put energy on the development of the AXML REST platform developed by Loïc Hélouët and Benoît Masson (post-doctorate). This platform is a natural candidate for integrating AXML+ORC, as we think. But the cooperative work has not really started, due to overload of the corresponding teams.

### 8.4.2. Inria International Partners

Distribcom has lively collaboration with the National University of Singapore, where Blaise Genest spent the last 3 years. We also have long lasting collaboration with the Chennai Mathematical Institute.

### 8.4.3. Participation In International Programs

#### 8.4.3.1. Danish-French collaboration

Program: Action des ambassades de France

Title: Modular design and verification of stochastic systems

Inria principal investigator: Axel LEGAY

International Partner (Institution - Laboratory - Researcher):

University of Aalborg (Denmark)

Duration: Jan 2010 - Dec 2012

#### 8.4.3.2. Tournesol (Belgium)

Program: PHC

Title: Vérification de lignes de produits logiciels

Inria principal investigator: Axel LEGAY

[1] http://www.cs.utexas.edu/~misra/
[2] http://orc.csres.utexas.edu
[3] http://www.irisa.fr/distribcom/

International Partner (Institution - Laboratory - Researcher):

University of Namur (Belgium)

Duration: Jan 2011 - Dec 2012

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

Narayan K. Kumar and Madhavan Mukund from the Chennai mathematical institute visited Dostribcom in april (1 week each) to continue working on session models in web services, and to launch new research on robustness in distributed systems.

Danilo Ardagna visited Distribcom in October 2012

Prof. Michele Pinna (niv. Cagliari) visited DistribCom from Sept. 1 to Sept. 30.

Andrzej Wasowski visited Distribcom in February 2012 Jan Kretiensky visited Distribcom in September 2012

*8.5.1.1. Internships*

Guillaume Aucher supervised the internship of Himani Rajora (IIT, Delhi, India) entitled “Distances between Kripke models”.

Axel Legay supervised the internship of Alessio Colombu (Trento), Hoa Lee (Trento), and Fabrizio Biondi (ITU Copenhagen).

### *8.5.2. Visits to International Teams*

Guillaume Aucher has visited Thomas Bolander (DTU, Copenhagen) the last week of August 2012. The collaboration was very fruitful and has resulted in significant results related to epistemic planning (DEL) (to be submitted).

Guillaume Aucher visited Leon van der Torre at the university of Luxembourg in November 2012. This visit was scheduled at the same time Samir Chopra and Guido Boella were in Luxembourg. Guido Boella is specialist of law and computer science and Samir Chopra is a logician who recently published a book on law and autonomous agents together with the jurist Laurence White. The visit was very instructive and profitable.

Guillaume Aucher was invited (his travel and accommodation expenses have been reimbursed) by Sonja Smets and Alexandru Baltag at the University of Amsterdam the last week of September 2012 to give two seminars at the ILLC and to work in collaboration with them.

Guillaume Aucher was an invited speaker of the workshop "dynamics in logic II" (Lille, March 2012).

Loïc Hélouët spent 10 days in march 2012 at the Chennai Mathematical Institute to pursue collaboration on verification of session models.

Axel Legay was invited researcher at Namur University multiple times. He was also an invited researcher at ITU Copenhagen.

Eric Fabre visited MIT (LIDS) from June 16 to June 20.

**FUN Team**

# 7. Partnerships and Cooperations

## 7.1. International Initiatives

Tahiry Razafindralambo is researcher on leave at Inria Chile from Sept. 2012 to Aug. 2013 investigating *Integration of wireless sensor network deployed in mines into the Internet*.

## 7.2. Regional Initiatives

### *7.2.1. DECARTE*

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

Title: Developpement de Carton électronique

Type: FUI

Duration: November 2008 - Avril 2013

Coordinator: Cartonneries de Gondardennes

Others partners: Inria FUN IEMN CTP Cascades IER TagSys

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

### *7.2.2. Tracaverre*

**Participant:** Nathalie Mitton [correspondant].

Title: Tracaverre

Type: FUI

Duration: November 2012 - Avril 2015

Coordinator: Saver Glass

Others partners: Inria FUN IEMN Courbon Camus La Grande Marque LIRIS DISP

Abstract: ___Tracaverre studies the use of RFID for traceability of prestigious bottles.___

### *7.2.3. IDC*

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

Title: Intelligent Data Center

Type: IPER

Duration: November 2010 - June 2012

Coordinator: NooliTic

Others partners: Inria FUN CIV

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

## 7.3. National Initiatives

### *7.3.1. ANR*

*7.3.1.1. RESCUE*

**Participants:** Milan Erdelj, Nathalie Mitton, Kalypso Magklara, Karen Miranda, Tahiry Razafindralambo [correspondant].

Title: Reseau Coordonne de substitution mobile
Type: VERSO
Duration: December 2010 - December 2013
Coordinator: Inria FUN
Other 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 scientic 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.

*7.3.1.2. 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
Other partners: Inria FUN UPMC France Telecom AFNIC GREYC
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. ___

*7.3.1.3. F-Lab*

**Participants:** Nathalie Mitton [correspondant], Priyanka Rawat, Tahiry Razafindralambo.

Title: Federating Computing Resources
Type: VERSO
Duration: November 2010 - November 2013
Coordinator: UPMC
Other partners: Inria DNet, Planete, FUN Thales ALU
See also: ___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. ___

*7.3.1.4. BinThatThinks*

**Participants:** Tony Ducrocq, Nathalie Mitton [correspondant].

Title: BinThatThinks

Type: ECOTECH

Duration: November 2010 - November 2013

Coordinator: Inria ACES (Rennes)

Other partners: Etineo Veolia

See also: ___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. ___

### *7.3.2. ADT*

*7.3.2.1. SenSas*

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

Title: Sensor Network Applications (SensAS)

Type: ADT

Duration: November 2010 - November 2014

Coordinator: Inria D-NET

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

See also: ___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.___

*7.3.2.2. SensLille*

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

Title: SensLille

Type: ADT

Duration: November 2011 - November 2013

Coordinator: Inria FUN

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.___

*7.3.2.3. MiAOU*

**Participants:** Ibrahim Amadou, Rim Driss, Nathalie Mitton [correspondant], Loic Schmidt, Julien Vandaele.

Title: Middleware Application to Optimal Use (MiAOU)

Type: ADT

Duration: December 2012 - November 2014

Coordinator: Inria FUN

Abstract: ___Miaou is an ADT that aims to promote the AspireRFID middleware to a new level of manageability and usability.___

### 7.3.3. Equipements d'Excellence

#### 7.3.3.1. FIT

**Participants:** Nathalie Mitton [correspondant], Anne-Sophie Tonneau, Tahiry Razafindralambo, Loic Schmidt, David Simplot-Ryl, Julien Vandaele.

Title: Future Internet of Things

Type: EquipEx

Duration: March 2010 - December 2019

Coordinator: UPMC

See also: ___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.___

## 7.4. European Initiatives

### 7.4.1. Collaborations in European Programs, except FP7

Program: ICT Labs

Project acronym: FiTTING

Project title: FiTTING

Duration: January 2012 - December 2012

Coordinator: UPMC

Other partners: Inria, IBBT, Fraunhoffer, University of Budapest

Abstract: The FITTING facility is about developing the tools needed to create the Future Internet of Things. The experimenters (both academic and industrial) who are developing this new technology require access to experimental platforms (testbeds) whey they can try out their ideas before releasing them to the general public. FITTING facilitates their innovation by federating Europe's next-generation testbeds.

## 7.5. International Initiatives

### 7.5.1. Participation In International Programs

Program: CoperLink

Project acronym: Palmares

Project title: Palmares

Duration: January 2012 - April 2013

Coordinator: Universita degli Studi Mediterranea, Italy

Other partners: Inria, Stellebosch University (South Africa)

Abstract: Internet of things, VANET and substitution networks.

## 7.6. International Research Visitors

### 7.6.1. Visits of International Scientists

Oswald Jumira (from June 2012 until July 2012)

Institution: Stellenbosch University (South Africa)

Essia Hamouda (from June 2012 until July 2012)

Institution: University of Riverside (USA)

Danping He (from August 2012 until October 2012)

Subject: Range and frequency adaptation in neighbor discovery in mobile wireless networks.

Institution: Universidad de Madrid (Spain)

Pr Ian Akyiliz (July 2012)

Institution: GeorgiaTech (USA)

#### *7.6.1.1. Internships*

Natale GUZZO (from May 2012 until Oct 2012)

Subject: Quality of Service and Energy Efficiency in Wireless Networks

Institution: Universita di Roma La Sapienza (Italy)

Kalypso Magklara (from Apr 2012 until Sep 2012)

Subject: Pickup and delivery problems in wireless sensor and actuator networks

Institution: University of Piraeus (Greece)

Jaco Du Toit (from Sept 2012 to Jan 2013)

Subject: Application of the Principles of Erasure Resilient Channel Coding Strategies in Distributed Wireless Network Environments

Institution: Stellenbosch University (South Africa)

Johan Pieterse (from Sept 2012 to Jan 2013)

Subject: Investigation of Handover Techniques in a IPv6 Mobile Wireless Network

Institution: Stellenbosch University (South Africa)

Rim Driss (from Apr 2012 to Sept 2012)

Subject: Analysis of the impact of error on geographic positions in neighbor discovery in wireless networks.

Institution: Université de Sfax (Tunisia)

### 7.6.2. Visits to International Teams

- Tahiry Razafindralambo is made available from Sept 1st 2012 to Aug 21 2013 at Universidad de Santiago, Chili.
- Nathalie Mitton visited for 2 weeks Stellebosch University (Aug-Sept 2012) in South Africa.

GANG Project-Team

# 6. Partnerships and Cooperations

## 6.1. Regional Initiatives

### *6.1.1. PEFICAMO*

**Participants:** Carole Delporte-Gallet, Hugues Fauconnier, 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 SONGS*

**Participant:** Fabien Mathieu.

The goal of the SONGS project is to extend the applicability of the SimGrid simulation framework from Grids and Peer-to-peer systems to Clouds and High Performance Computation systems. Each type of large-scale computing system will be addressed through a set of use cases and lead by researchers recognized as experts in this area.

### *6.2.2. ANR Prose*

**Participants:** Pierre Fraigniaud, Amos Korman, Laurent Viennot.

Managed by University Paris Diderot, P. Fraigniaud.

Online social networks are among the most popular sites on the Web and continue to grow rapidly. They provide mechanisms to establish identities, share content and information, and create relationships. With the emergence of a new generation of powerful mobile devices that enable wireless ad hoc communication, it is time to extend social networking to the mobile world. Such an ad hoc social networking environment is full of opportunities. As opposed to the use of personal computers, a mobile phone is a strictly personal device, always on, with several wireless interfaces that include a short range communication with nearby nodes. Applications such as notification of status updates, sharing of user generated content, documents tagging, rating/recommendation and bookkeeping can be deployed "on the move" on top of contacts established through short range communication. It requires to deploy social networking applications in a delay tolerant manner using opportunistic social contacts as in a peer to peer network, as well as new advanced content recommendation engines.

The Prose project is a collective and multi-disciplinary effort to design opportunistic contact sharing schemes, and characterizes the environmental conditions, the usage constraint, as well as the algorithmic and architecture principles that let them operate. The partners of the Prose project will engage in this exploration through various expertise: network measurement, traffic monitoring from a real application, system design, behavioral study, analysis of distributed algorithms, theory of dynamic graph, networking modeling, and performance evaluation. As part of this project, the partners will be involved in the analysis of the content received and accessed by users of a real commercial application (PlayAdz), and will participate to the design of a new promotion advertisement service.

### *6.2.3. ANR Shaman*

**Participants:** Carole Delporte-Gallet, Hugues Fauconnier, Hung Tran-The.

SHAMAN (Self-organizing and Healing Architectures for Malicious and Adversarial Networks) is an ANR VERSO Project (2009-2012).

Managed by University Paris Diderot, H. Fauconnier leads this project that grants Ph. D. H. Tran-The.

SHAMAN focuses on the algorithmic foundations of resource-constrained autonomous large scale systems, dedicated to enabling the sustainability of network functions in spite of abrupt system evolutions, component failures, and attacks. We foresee original solutions in the general frameworks of self-stabilization, failure detection, and robust protocols. Our first objective is the design of obligate but realistic models encompassing anonymity, dynamism, and/or malicious behavior. Our second objective is to evaluate both the theoretical power, and the practical functionality, of these models, by confronting them to their ability of designing efficient algorithms and protocols for dynamic and malicious environments. This evaluation will be tackled in two complementary application domains: wireless sensor networks, and peer-to-peer systems. The primary outcome of SHAMAN should be the demonstration of reliable middleware bricks that could be integrated in real distributed platforms.

### *6.2.4. ANR Displexity*

**Participants:** Carole Delporte-Gallet, Hugues Fauconnier, Pierre Fraigniaud, Arfoui Heger, 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.

Distributed computation keep raising new questions concerning computability and complexity. For instance, as far as fault-tolerant distributed computing is concerned, impossibility results do not depend on the computational power of the processes, demonstrating a form of undecidability which is significantly different from the one encountered in sequential computing. In the same way, as far as network computing is concerned, the impossibility of solving certain tasks locally does not depend on the computational power of the individual processes.

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.

One difficulty to be faced by DISPLEXITY is to reconcile the different sub-communities corresponding to a variety of classes of distributed computing models. The current distributed computing community may indeed be viewed as two not necessarily disjoint sub-communities, one focusing on the impact of temporal issues, while the other focusing on the impact of spatial issues. The different working frameworks tackled by these two communities induce different objectives: computability is the main concern of the former, while complexity is the main concern of the latter.

Within DISPLEXITY, the reconciliation between the two communities will be achieved by focusing on the same class of problems, those for which the distributed outputs are interpreted as a single binary output: yes or no. Those are known as the yes/no-problems. The strength of DISPLEXITY is to gather specialists of the two main streams of distributed computing. Hence, DISPLEXITY will take advantage of the experience gained over the last decade by both communities concerning the challenges to be faced when building up a complexity theory encompassing more than a fragment of the field.

In order to reach its objectives, DISPLEXITY aims at achieving the following tasks:

- Formalizing yes/no-problems (decision problems) in the context of distributed computing. Such problems are expected to play an analogous role in the field of distributed computing as that played by decision problems in the context of sequential computing.
- Formalizing decision problems (yes/no-problems) in the context of distributed computing. Such problems are expected to play an analogous role in the field of distributed computing as that played by decision problems in the context of sequential computing.
- Revisiting the various explicit (e.g., failure-detectors) or implicit (e.g., a priori information) notions of oracles used in the context of distributed computing allowing us to express them in terms of decidability/complexity classes based on oracles.

- Identifying the impact of non-determinism on complexity in distributed computing. In particular, DISPLEXITY aims at a better understanding of the apparent lack of impact of non-determinism in the context of fault-tolerant computing, to be contrasted with the apparent huge impact of non-determinism in the context of network computing. Also, it is foreseen that non-determinism will enable the comparison of complexity classes defined in the context of fault-tolerance with complexity classes defined in the context of network computing.
- Last but not least, DISPLEXITY will focus on new computational paradigms and frameworks, including, but not limited to distributed quantum computing and algorithmic game theory (e.g., network formation games).

The project will have to face and solve a number of challenging problems. Hence, we have built the DISPLEXITY consortium so as to coordinate the efforts of those worldwide leaders in Distributed Computing who are working in our country. A successful execution of the project will result in a tremendous increase in the current knowledge and understanding of decentralized computing and place us in a unique position in the field.

## 6.3. European Initiatives

### *6.3.1. FP7 Projects*

#### *6.3.1.1. 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 PolitÃ¨cnica 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:

The underlying network is dynamic: many observations of bad configurations show the instability of BGP;

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);

The impact of the policies is so important that the many packets can oscillated between two Autonomous Systems.

Description: In this collaboration, we mainly 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.

## 6.4. International Initiatives

### *6.4.1. Internet Technologies and Architectures*

**Participant:** Fabien Mathieu.

The aim of this project is to build a community of researchers focusing on fundamental theoretical issues of future networking, including such topics as communication theory, network information theory, distributed algorithms, self-organization and game theory, modeling of large random and complex networks and structures. Partners Inria, VTT, Aalto University, Eindhoven University are gathered under EIT ICT Labs Project Fundamentals of Networking (FUN). http://eit.ictlabs.eu/ict-labs/all-events/article/fundamentals-of-future-networking-workshop/.

**HIPERCOM Project-Team**

# 7. Partnerships and Cooperations

## 7.1. National Initiatives

### *7.1.1. ANR: GETRF*

**Participants:** Paul Mühlethaler, Pascale Minet, Cédric Adjih, Emmanuel Baccelli, Salman Malik.

Period: 2012 - 2014.

Partners: DGA/MI, Inria.

The GETRF project aims at improving the effectiveness of communications mechanisms and technologies capable of functioning in extreme conditions and GETRF also aims at opening ways for solutions that are close to the optimum. The following areas will be addressed:

- Compromise time / maximum efficiency for coloring (TDMA), which can be used to take into account the asymmetry of traffic delays to optimize routing.
- Significant energy savings for opportunistic routing (in power saving mode) even where traffic control is limited and where the nodes are idle most of the time ("low-duty cycle")
- From a completely different point of view, the finding optimal network capacity for opportunistic routing variants when designed for mobile networks
- Robustness to mobility and to changes in network conditions (difficult connectivity, foes, ...) extreme network coding - which is moreover an innovative technology in itself applied here in MANETs, at the network and/or application layer, rather than at the physical/or theoretical level as in other proposals.

The project will focus on four technical approaches which are:

- Coloring for the development of a TDMA system for energy saving and delay control,
- Cross-layer (MAC/routing) mechanism for "low-duty-cycle" mode
- Network coding,
- Opportunistic routing and mobile mobility to use relays to minimize retransmissions of packets with a target time.

The first two approaches are intended to provide energy efficient sensor networks. The second two approaches try to provide mechanisms for building ad hoc networks capable of handling high node mobility.

### *7.1.2. Competitivity Clusters*

#### *7.1.2.1. SAHARA*

**Participants:** Pascale Minet, Cédric Adjih, Ridha Soua, Erwan Livolant.

Period: 2011 - 2014.

Partners: EADS, Astrium, BeanAir, Eurocopter, Inria, Oktal SE, Reflex CES, Safran Engineering Systems, CNES, ECE, EPMI,LIMOS.

SAHARA is a FUI project, labelled by ASTECH and PEGASE, which aims at designing a wireless sensor network embedded in an aircraft. The proposed solution should improve the embedded mass, the end-to-end delays, the cost and performance in the transfers of non critical data. Inria is in charge of coordinating the academic partners. During year 2012, we took part to the specification of application requirements. We also defined the functional architecture and made measurements within the plane of SAFRAN.

*7.1.2.2. CONNEXION*

**Participants:** Pascale Minet, Cédric Adjih, Saoucene Mahfoudh Ridene, Ines Khoufi.

Period: 2012 - 2016.

Partners: All4Tec, ALSTOM, AREVA, Atos WorldGrid, CEA, CNRS / CRAN, Corys TESS, EDF, ENS Cachan, Esterel Technologies, Inria, LIG, Predict, Rolls-Royce Civil Nuclear, Telecom ParisTech.

The Cluster CONNECTION (Digital Command Control for Nuclear EXport and renovation) project aims to propose and validate an innovative architecture platforms suitable control systems for nuclear power plants in France and abroad. This architecture integrates a set of technological components developed by the academic partners (CEA, Inria, CNRS / CRAN, ENS Cachan, LIG, Telecom ParisTech) and based on collaborations between major integrators such as ALSTOM and AREVA, the operator EDF in France and "techno-providers" of embedded software (Atos WorldGrid, Rolls-Royce Civil Nuclear, Corys TESS, Esterel Technologies, All4Tec, Predict). With the support of the competitiveness clusters System@tic, Minalogic and Burgundy Nuclear Partnership,the project started in April 2012. The key deliverables of the project covered several topics related demonstration concern-driven engineering models for the design and validation of large technical systems, design environments and evaluation of HMI, the implementation of Wireless Sensor Network context-nuclear, buses business object or real-time middleware facilitating the exchange of heterogeneous data and distributed data models standardized to ensure consistency of digital systems.

The HIPERCOM project-team is involved in wireless sensor networks coping with node mobility. We focused on deployment and redeployment algorithms for mobile wireless sensor networks after a disaster. We began with a state of the art. Many works in the literatures deal with this issue. We can classify these works in several ways:

- First classification:
  - Centralized Algorithms as Practical swarm optimization (PSO), Centralized virtual forces...These algorithms minimize the moves done by nodes since each sensor moves only to its final position computed by the specific node. However, they rely on assumption that may be unrealistic (e.g. network connectivity). Furthermore, they are not scalable.
  - Distributed Algorithms as Distributed Self Spreading algorithm (DSSA), Force-based Genetic Algorithm (FGA), Mass-Sprig -Relaxation Algorithm... These algorithms are more relistic: they adapt to the knowledge progressively acquired during the redeployment. However, there are still pending issues such as nodes oscillation, coverage computation, point of interest...
- Second classification:
  - Grid based approach: sensors will redeploy according to a predetermined grid.
  - The computational geometry based approach uses the Voronoi diagram and the Delaunay triangulation.
  - The virtual force based approach is based on virtual forces to move sensors.

The latter (virtual force based approach) presents many advantages such as simplicity and fast coverage. That is why we adopt this appraoch.

*7.1.2.3. SensLab and FIT*

**Participants:** Cédric Adjih, Emmanuel Baccelli, Ala Eddin Weslati.

Period: 2011 - 2021

Partners: Inria (Lille, Sophia-Antipolis, Grenoble), INSA, UPMC, Institut Télécom Paris, Institut Télécom Evry, LSIIT Strasbourg.

The HIPERCOM team started the development of a testbed for SensLab in 2010. This testbed located in building 21 at Rocqquencourt Inria center consists now of 128 wireless SensLab nodes.
A location has been found for the new testbed of the EQUIPEX FIT: the basement of building 1 at Rocquencourt. An engineer has been recruited for this project.

*7.1.2.4. ACRON*

**Participant:** Cédric Adjih.

Period: 2011 - 2014

Partners: Supélec (Télécommunications), Inria, ENS TREC, Inria HIPERCOM, Université Paris-Sud, IEF.

ACRON is a DIMLSC DIGITEO project. It deals with analysis and design of self-organized wireless networks. The HIPERCOM team project will study the theoretical limits of wireless networking.

*7.1.2.5. SWAN*

**Participants:** Cédric Adjih, Salman Malik.

Period: 2011 - 2014

Partners: CNRS, Supélec, Université Paris-Sud (L2S), LTCI, LRI, Inria Hipercom and IEF.

SWAN, Source-aWAre Network coding, is a DIMLSC DIGITEO project. It deals with network coding for multimedia.

*7.1.2.6. MOBSIM*

**Participants:** Cédric Adjih, Paul Mühlethaler, Hana Baccouch.

Period: 2011 - 2013

Partners: Inria Sophia, Inria Genoble.

MOBSIM is an ADT, Action of Technology Development. It aims at developping the NS3 simulation tool. The HIPERCOM team focuses on routing protocols and MAC protocol (namely the EY-NPMA protocol Elimination Yield Non-Preemptive Multiple Access). An engineer has been recruited for this project.

### *7.1.3. OCARI2*

**Participants:** Ichrak Amdouni, Pascale Minet, Cédric Adjih, Ridha Soua.

Partners: EDF, LIMOS, TELIT.

At the end of the OCARI (Optimization of Ad hoc Communications in Industrial networks) project, funded by ANR, started in February 2007 and ended in 2010, EDF the coordinator decided to continue the project with a restricted number of partners: TELIT, LIMOS (Clermont Ferrand university) and Inria. The goal was to prove the feasibility on commercially available cards of the OCARI stack designed during the ANR project and to make a public demonstration of this product. During the year 2011, the OCARI stack has been improved and implemented on the ZE51 module of TELIT based on the Texas Instrument CC2530 Chipset. During 2012, we made several demonstrations of the energy-efficient routing protocol EOLSR and the node coloring algorithm OSERENA to save energy.
The OCARI project deals with wireless sensor networks in an industrial environment. It aims at responding to the following requirements which are particularly important in power generation industry and in warship construction and maintenance:

- Support of deterministic MAC layer for time-constrained communication,
- Support of optimized energy consumption routing strategy in order to maximize the network lifetime,
- Support of human walking speed mobility for some particular network nodes, (e.g. sinks).

The development of OCARI targets the following industrial applications:

- Real time centralized supervision of personal dose in electrical power plants,
- Condition Based Maintenance of mechanical and electrical components in power plants as well as in warships,
- Environmental monitoring in and around power plants,
- Structure monitoring of hydroelectric dams.

To meet the requirements of supported applications (remote command of actuators, tele-diagnostic...), new solutions will be brought to manage several communication modes, ranging from deterministic data transfers to delay tolerant transfers. A key issue is how to adapt routing algorithms to the industrial environment, taking into account more particularly limited network resources (e.g.; bandwidth), node mobility and hostile environment reducing radio range.
The OCARI project aims at developing a wireless sensor communication module, based on IEEE 802.15.4 PHY layer and supporting EDDL and HART application layer. The Inria contribution concerns more particularly energy efficient routing and node activity scheduling.

- The energy efficient extension of OLSR, called EOLSR, is implemented on top of the MAC protocol defined by LATTIS and LIMOS. The MAC protocol is a variant of ZigBee ensuring some determinism and quality of service and allowing leave nodes (e.g. sensor, actuator) as well as router nodes to sleep. The EOLSR protocol avoids nodes with low residual energy and selects the routes minimizing the energy consumed by an end-to-end transmission.
- SERENA, the protocol used to schedule router node activity, is based on three-hop coloring. It allows any node to sleep during the slots that are attributed neither to its color nor to its one-hop neighbors. SERENA contributes to a more efficient use of energy: less energy is spent in the idle and interference states. Hence, network lifetime is considerably increased. SERENA has been optimized for the specific context of OCARI (i.e.; very limited bandwidth 250kbps, small size messages 127 bytes, limited memory and limited processing power) have been delivered.

These protocols have been implemented in the OCARI stack, operating on a ZE51 module of TELIT.

## 7.2. European Initiatives

### *7.2.1. Collaborations in European Programs, except FP7*

Program: CSOSG

Project acronym: SAFEST

Project title:

Duration: May 2012-April 2015

Coordinator: Emmanuel Baccelli

Other partners: Freie Universitat Berlin, Hamburg University, Sagem, Daviko, FOS, Fraunhofer

Abstract: Public spaces, such as airports, railway stations, or stadiums bring together large numbers of people on limited space to use security-sensitive infrastructure. These spaces pose two distinct challenges to public security: (a) detecting unauthorized intrusions and (b) monitoring large crowds in order to provide guidance in case of unexpected events (e.g., mass panic). To ensure the safety of the general public as well as individuals, we thus require a flexible and intelligent method for area surveillance. One example in which current monitoring systems proved to be dangerously inefficient is the Love Parade music festival in Duisburg, Germany, July 2010. Crowd control failed to provide guidance to a large crowd, resulting in a mass panic with 21 deaths and several hundred injured. In this particular case, overloaded communication infrastructure led to a lack of information about the density and the movement of the crowd, which in turn resulted in misjudgments on appropriate strategies to resolve the situation. This incident highlights the need for more sophisticated and reliable methods for area surveillance. The SAFEST project aims to analyse the social context of area surveillance and to develop a system that can fulfill this task, both in terms of technology as well as

acceptance by the general public. The system will operate in distributed way, collect anonymised data, securely transfer this data to a central location for evaluation, and if necessary notify the operator and/or issue alerts directly to the general public. SAFEST addresses the following topics: (i) it proposes a solution for crisis management, addressing social, technical, and economic issues, (ii) it enhances the protection of the population against risks and dangers, including the evaluation of acceptance of said solution, and (iii) it addresses the protection of critical infrastructures by the means of a comprehensive technical solution.

## 7.3. International Initiatives

### *7.3.1. IT-SG-WN*

Title: Information Theory, Stochastic Geometry, Wireless Networks

Inria principal investigator: Paul Muhlethaler

International Partner (Institution - Laboratory - Researcher):

Stanford University (United States) - Information Systems Laboratory, Department of Electrical Engineering - Abbas El Gamal

Duration: 2011 - 2013

See also: 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, whith a particular emphasis on wireless networks. In terms of research, three main lines of thought will be pursued:1. Error exponents and stochastic geometry2. Stochastic geometry and network Information Theory3. Cognitive radio and stochastic geometry

### *7.3.2. Participation In International Programs*

#### *7.3.2.1. AWSN2012*

Program: Euromediterranean 3+3

Title: Auto-adaptivity in Wireless Sensor Networks

Inria principal investigator: Pascale Minet

International Partners (Institution - Laboratory - Researcher):

University of Catania (Italy) - DIEEI - Lucia Lo Bello

Ecole Nationale Supérieure d'Informatique et d'Analyse des Systèmes (Morocco) - ND-SRG - Mohamed Erradi

Ecole Nationale des Sciences de l'Informatique (Tunisia) - CRISTAL - Leila Azouz Saidane

Duration: Jan 2012 - Dec 2015

See also: euromed

Wireless sensor networks (WSNs) allow the development of numerous applications in various domains, such as security and surveillance, environment protection, precision agriculture, intelligent transportation, homecare of elderly and disabled people...

Communication in such WSNs has to cope with limited capacity resources, energy depletion of sensor nodes, important fluctuations of traffic in the network, changes in the network topology (radio link breakage, interferences ...) or new application requirements.

In the AWSN project, we focus on the different techniques to be introduced in the WSNs to make them auto-adaptive with regard to these various changes while meeting the application requirements. Thus, we will address:

- network deployment and redeployment in order to fulfill the application requirements,

- QoS (Quality of Service) optimization taking into account real-time traffic and dynamic bandwidth allocation,
- energy efficiency and replacement of failed sensor node,
- component generation and dynamic adaptation of the application.

After a kick-off meeting in Paris in February, we organized three workshops where each team presented its works:

- a workshop in Rabat in October 2012, where each team presented its works,
- a workshop in Tunis in November 2012. This workshop was open to non-members and was preceded by a call for paper. It was held in conjunction with the IEEE NoF 2012 conference (Network of the Future).
- a workshop in Catania in December 2012, where new results have been presented.

## 7.4. International Research Visitors

### *7.4.1. Visits of International Scientists*

- **Mauro Fonseca**, Pontifical Catholic University of Paraná, Curitiba, Brazil, July 2012-June 2013 (Saclay),
- **Anelise Munaretto**, Federal Technological University of Paraná, Curitiba, Brazil, July 2012-June 2013 (Saclay),
- **Leila Saidane**, ENSI, Tunis, Tunisia, February and July 2012 (Rocquencourt),
- **Lucia Lo Bello**, UniCT, Catania, Italy, February 2012 (Rocquencourt),
- **Mohammed Erradi**, ENSIAS, Rabat, Morocco, February 2012 (Rocquencourt),
- **Bernard Mans**, Macquarie University, March-August 2012 (Rocquencourt).

*7.4.1.1. Internships*

**Kanchana Thilakarathna**, NICTA/University of New South Wales, Sydney, Australia, March-September 2012 (Saclay)

MADYNES Project-Team

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

In 2012, the team was involved in the following initiative:

- CPER-SSS: in this initiative, the team did work on Scada networks security and P2P monitoring.

## 8.2. National Initiatives

### *8.2.1. ANR*

The team did coordinate the VAMPIRE ANR Project which ended in october 2012. VAMPIRE is a research project funded by the French Research Agency (ANR, VERSO ANR-08-VERS-017) coordinated by the team. The goal of the project to investigate new thread security issues induced by Voice Over IP (VoIP) protocols and web2.0. Madynes has the lead on this project.

### *8.2.2. Actions d'Envergure Nationale*

The Inria Large-scale initiative action AEN PAL project (http://pal.inria.fr) aims at providing technologies and services for improving the autonomy and quality of life for elderly and fragile persons. Communication is one of the key components for ensuring real-time data gathering and exchange between heterogeneous sensors and actuators (robots). Within PAL and thanks to the associated ADT PERCEE project, we extended MPIGate (http://mpigate.loria.fr), a multi-protocol interface and gateway, by integrating a publisher-subscriber data distribution model of standard middleware (DDS and ROS). The first experimentations showed its good performance and its easy-to-use interface for transparent heterogenous data access (through either programmer API or end-user web interface) [12]. The development and tests are conducted using LORIA's smart apartment platform developed within CPER MISN Informatique située project (http://infositu.loria.fr). The adoption of ROS (Robotic Operating System) also facilitates the interoperability of our services with the services of the other PAL partners since the new PALGate is based on ROS.

## 8.3. European Initiatives

### *8.3.1. FP7 Projects*

#### *8.3.1.1. 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:

Universiteit Twente,

Alcatel Lucent Ireland,

Alcatel Lucent Deutschland,

Valtion Teknillinen Tutkimuskeskus (Finland),

University of Piraeus,

France Telecom,

Telecom Italia,

National University of Athens,

Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung,

Interdisciplinary Institute for Broadband Technology,

Telefonica Investigacion y Desarrollo,

Thales Communications,

Inria,

Nec Europe,

University of Surrey,

University College London

IBBT (Belgium).

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. Univerself has been launched in October 2010 and is scheduled for four years.

*8.3.1.2. FI-WARE*

Type: COOPERATION (ICT)

Defi: PPP FI: Technology Foundation: Future Internet Core Platform

Instrument: Integrated Project (IP)

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners:Thales, SAP, Inria

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

Abstract: FI-WARE will deliver a novel service infrastructure, building upon elements (called Generic Enablers) which offer reusable and commonly shared functions making it easier to develop Future Internet Applications in multiple sectors. This infrastructure will bring significant and quantifiable improvements in the performance, reliability and production costs linked to Internet Applications ? building a true foundation for the Future Internet.

The key deliverables of FI-WARE will be an open architecture and a reference implementation of a novel service infrastructure, building upon generic and reusable building blocks developed in earlier research projects. We will demonstrate how this infrastructure supports emerging Future Internet (FI) services 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:

- Sicslowfuzzer, a fuzzing framework for the Internet of Things, that allows to assess the robustness of IoT OSes and applications, networkwise. More specifically, the tool uses the Scapy library for packet manipulation, allows users to define interaction scenarios in XML and provides multiple mutation algorithms;
- Flowoid, a netflow probe for Android-based devices, which also provides a netflow location template to convey location information of the device;
- XOvaldi4Android, an OVAL interpreter for Android-based devices, that is able to retrieve OVAL definitions using a web service, use them to check the current status of the system, and publish a result, using a second web service;

- coordination between the Security Work Package and the Inria teams involved in it. This included attending to weekly audio conferences, face to face meetings, and making sure deliverables and tasks were addressed in a timely manner.

### *8.3.2. Collaborations with Major European Organizations*

Partner 1: Univeristy of Luxembourg (Luxembourg)

We have two ongoing PhD candidates with the SnT at Univeristy of Luxembourg. We do collaborate on Large Scale Monitoring for Security Management. Target services are: P2P Networks, Virtual Coordinates Systems and DNS Services.

## 8.4. International Research Visitors

### *8.4.1. Visits of International Scientists*

*8.4.1.1. Internships*

Maroua BOUMESSOUER (from Mar 2012 until Aug 2012)

Subject: Etude des vulnérabilités et des attaques dans le protocole de routage RPL

Institution: Sup'Com Tunis (Tunisia)

Ayoub SOURY (from Mar 2012 until Aug 2012)

Subject: Vulnerabilities Prevention in Industrial Control Systems

Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Bernardo LAMAS (from Mar 2012 until Aug 2012)

Subject: Offensive Security for Industrial Control Systems

Institution: National University of Rosario (Argentina)

Tarang CHUGH (from Mar 2012 until Aug 2012)

Subject: Fairness Incentives for Multi-Protocol Cooperation in P2P Networks

Institution: Indraprastha Institute of Information Technology (India)

**MAESTRO Project-Team**

# 7. Partnerships and Cooperations

## 7.1. National Initiatives

### *7.1.1. ANR Verso ECOSCELLS (11/2009–10/2012)*

**Participants:** Eitan Altman, Konstantin Avrachenkov, Philippe Nain.

ANRVERSOECOSCELLS (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 (Univ. 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

### *7.1.2. Inria Cooperative Research Initiative (ARC) OCOQS (2011-2012)*

**Participant:** Alain Jean-Marie.

The finishing ARCOCOQS (Optimal threshold policies in COntrolled Queuing Systems) was 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 was the extension of the model solved in [27]. This project also involved 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/

## 7.2. European Initiatives

### *7.2.1. FP7 Projects*

#### *7.2.1.1. CONGAS*

**Participants:** Eitan Altman, Konstantin Avrachenkov, Alexandre Reiffers.

Title: Dynamics and coevolution in multi level strategic interaction games
Type: Collaborative project
Subprogramme Area: FET Proactive: Dynamics of Multi-Level Complex Systems
Instrument: Specific Targeted Research Project (STREP)
Duration: October 1, 2012 – September 30, 2015
Coordinator: Center for Research and Telecommunication Experimentation for Network Communities (CREATE-NET) (Italy)
Other partners:

- Université D'Avignon et des Pays de Vaucluse (UAPV) (France)
- Technische Universiteit Delft (TUDelft) (The Netherlands)
- Imperial College of Science, Technology and Medicine (IMPERIAL) (United Kingdom)
- Universityá di Pisa (UNIPI) (Italy)
- Technion - Israel Institute of Techonology (TECH) (Israel)

Abstract: CONGAS will develop new mathematical models and tools, rooted in game theory, for the analysis, prediction and control of dynamical processes in complex systems. It will provide a coherent theoretical framework for understanding the emergence of structure and patterns in these systems, accounting for interactions spanning various scales in time and space, and acting at different structural and aggregation levels.

MAESTRO's task is to develop game theoretic models to model (a) the formation of technological and social network; (b) the routing for competing agents; and (b) the competition of information in social networks.

K. Avrachenkov is the coordinator for INRIA. E. Altman is a scientific coordinator of the project.

*7.2.1.2. TREND*

**Participants:** Sara Alouf, Delia Ciullo.

Title: Towards Real Energy-efficient Network Design

Subprogramme Area: ICT-2009.1.1 The Network of the Future

Instrument: Network of Excellence (NoE)

Duration: September 1, 2010 – August 31, 2013

Coordinator: Politecnico di Torino (PoliTO) (Italy)

Other partners:

- Alcatel-Lucent Bell Labs (France)
- Huawei Technologies Dusseldorf GmbH (HWDU) (Germany)
- Telefonica Investigacion y Desarrollo (TID) (Spain)
- France Telecom - Orange (FT) (France)
- Fastweb (FW) (Italy)
- Universidad Carlos III (UC3M) (Spain)
- iMinds (Belgium)
- Technical University of Berlin (TUB) (Germany)
- Ecole Polytechnique Fédérale de Lausanne (EPFL) (Switzerland)
- Consorzio Nazionale Interuniversitario per le Telecomunicazioni (CNIT) (Italy)
- Panepistimio Thessalias - University of Thessaly (UTH) (Greece)

Collaborating institutions:

- Fondazione Ugo Bordoni (Italy)
- Technische Universitat Dresden (Germany)
- Deutsche Telekom Laboratories (Germany)
- Institute IMDEA Networks (Spain)
- CNR Institute for High Performance Computing and Networking (ICAR-CNR) (Italy)
- International Hellenic University (Greece)
- Institut National de Recherche en Informatique et en Automatique (Inria) (France)
- Boston University (United States)

See also: http://www.fp7-trend.eu/

Abstract: TREND aims at integrating the activities of major European players in networking, including manufacturers, operators, research centers, to quantitatively assess the energy demand of current and future telecom infrastructures, and to design energy-efficient, scalable and sustainable future networks.

MAESTRO's task is to propose and analyze energy-aware network cellular network design and management, in collaboration with the other partners.

## 7.3. International Initiatives

### 7.3.1. Inria Associate Teams

#### 7.3.1.1. GANESH

Title: GAmes, OptimizatioN and Analysis of NEtworkS THeory and Applications

Inria principal investigator: Eitan Altman

International Partners (Institution - Laboratory - Researcher):

IISc Bangalore (India) - Electrical Communication Engineering - Anurag Kumar

IIT Mumbai (India) - Department of Electrical Engineering - D. Manjunath

IIT Madras (India) - Electrical Engineering - Venkatesh Ramaiyan

Duration: 2012 - 2014

See also: http://www-sop.inria.fr/members/Eitan.Altman/Ganesh/Home.html

This project aims at producing outstanding contributionis to the foundations of the theory of networks, in game theory, team theory, optimization and analysis. Three areas in networkiing will be used to apply these: (i) economy of networks and network neutrality, (2) schedulling in wireless networks, and (3) distributed optimization issues in ad-hoc networks.

### 7.3.2. Inria International Partners

#### 7.3.2.1. St. Petersburg State Univ.

**Participant:** Konstantin Avrachenkov.

MAESTRO has a continuing collaboration with St. Petersburg State Univ.. St. Petersburg State Univ. is a partner in INRIA Internship International programme. In particular, MAESTRO hosts every year several intern students from St. Petersburg State Univ.. 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.

### 7.3.3. Participation In International Programs

#### 7.3.3.1. 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.

#### 7.3.3.2. Indo-French Centre for the Promotion of Advanced Research (IFCPAR)

**Participants:** Eitan Altman, Konstantin Avrachenkov, Manjesh Kumar Hanawal.

Within project 4000-IT on "Emerging Strategies for Wireless Communication Networks," K. Avrachenkov, E. Altman and M. K. Hanawal (also with Univ. Avignon/LIA) have been collaborating with V. Borkar and V. Kavitha (IIT Mumbai, India), A. Kumar, 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.

## 7.4. International Research Visitors

### *7.4.1. Visits of International Scientists*

*7.4.1.1. Professors / Researchers*

Abdelfettah Belghith (from October 15, 2012 until October 20, 2012)
Institution: ENSI, Univ. of Manouba (Tunisia)

Amel Ben Slimane (from October 15, 2012 until October 20, 2012)
Institution: ENSI, Univ. of Manouba (Tunisia)

Vivek Borkar (from June 3, 2012 until June 23, 2012)
Institution: Indian Institute of Technology Bombay (India)

Ananthanarayanan Chockalingam (from June 11, 2012 until June 22, 2012)
Institution: Indian Institute of Science (India)

Jerzy Filar (from June 21 2012 until July 7 2012)
Institution: Flinders Univ. (Australia)

David Hay (from June 25, 2012 until June 26, 2012)
Institution: Hebrew Univ. of Jerusalem (Israel)

Nelly Litvak (from November 4, 2012 until November 8, 2012)
Institution: Univ. of Twente (Netherlands)

Issam Mabrouki (from October 15, 2012 until October 20, 2012)
Institution: Univ. of Manouba (Tunisia)

Evsey Morozov (from September 18, 2012 until September 23, 2012)
Institution: Petrozavodsk State Univ. (Russian Federation)

Balakrishna Prabhu (from November 21, 2012 until November 23, 2012)
Institution: LAAS-CNRS (France)

Rajesh Sundaresan (from May 24 until June 14, 2012)
Institution: Indian Institute of Science (India)

Uri Yechiali (from April 10, 2012 until April 25, 2012)
Institution: Tel Aviv Univ. (Israel)

*7.4.1.2. Post-doctoral fellows*

Andrey Lukyanenko (from November 16, 2012 until December 15, 2012)
Institution: Aalto Univ. (Finland)

Ali Jahromi (from June 24, 2012 until June 30, 2012)
Institution: Univ. of Adelaide (Australia)

Bruno Ribeiro (from February 4, 2012 until March 7, 2012)
Institution: BBN Technologies (USA)

*7.4.1.3. Ph.D. students*

Mohammad Abdel Rahman (from June 27, 2012 until August 14, 2012)
Subject: Elaborating new mobility models for ad hoc networks
Institution: Univ. of Arizona (USA)

Nicolas Accettura (from February 2012 until August 2012)
Subject: Population size estimation
Institution: Politecnico di Bari (Italy)

Rodrigo Vaca Ramirez (from November 23, 2012 until February 20, 2013)

Subject: Vertical handover framework towards energy efficiency

Institution: Univ. of Edinburgh

*7.4.1.4. Graduate students*

Imen Mahjri (from October 1, 2012 until December 31, 2012)

Subject: Road Traffic Mobility Models in Complex Systems

Institution: ENSI, Univ. of Manouba (Tunisia)

Yonathan Portilla (From April 23, 2012 until July 6, 2012)

Subject: Analyzing the evolution of written language in Twitter

Institution: Univ. of Avignon

*7.4.1.5. Internships*

Sushma Hanawal (from August 2012 until February 2013)

Subject: Creation, Simulation and Multidiscipline Evaluation of Dynamic Mobility Models in Complex Systems

Institution: SJCE Mysore (India)

Vasily Medyanikov (from June 20, 2012 until September 29, 2012)

Subject: Monte Carlo Methods for Centrality Measures in Online Social Networks

Institution: St. Petersburg State Univ. (Russian Federation)

### *7.4.2. Visits to International Teams*

MAESTRO members have visited (the)

- Basque Center for Applied Mathematics (BCAM), Bilbao, Spain in the period June 19–20, 2012 (**S. Alouf**);
- BBN Technologies, Cambridge, MA, USA in the periods November 12–13 and 15–16, 2012 (**G. Neglia**);
- École polytechnique fédérale de Lausanne (EPFL), Switzerland in the period November 5–9, 2012 (**D. Ciullo**);
- Fordham Univ. at Rose Hill campus, Bronx, NY, USA in the period November 19–21, 2012 (**G. Neglia**);
- GERAD, Univ. Montreal, Canada in the period April 16–May 11, 2012 (**A. Jean-Marie**);
- Indian Institute of Science (IISc), Bangalore, India in the periods January 10–20, 2012 and July 12–19, 2012 (**E. Altman**);
- Politecnico di Torino, Italy in the period July 23–27, 2012 (**D. Ciullo**);
- Univ. of Liverpool, UK in the period May 14–18 (**K. Avrachenkov**);
- Univ. of Massachusetts at Amherst, USA in the periods February 13–15 and November 20–28, 2012 (**P. Nain**) and on November 14, 2012 (**G. Neglia**);
- Univ. of Palermo, Italy in the period December 17–21, 2012 (**G. Neglia**);
- Univ. of Twente, Enschede, The Netherlands in the period March 26–30 (**K. Avrachenkov**).

**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, Joanna Moulierac, Nicolas Nisse, Truong Khoa Phan, Issam Tahiri.

The objectives of the project DIMAGREEN (DesIgn and MAnagement 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*

**Participants:** David Coudert, Frédéric Havet, František Kardoš, Ana Karolinna Maia, Grégory Morel, Nicolas Nisse, Stéphane Pérennes, Michel Syska.

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. Action ResCom, ongoing (since 2006)*

Réseaux de communications, working group of GDR ASR, CNRS.

(http://citi.insa-lyon.fr/rescom/)

### *8.1.5. 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 Projects

*8.2.1.1. EULER*

**Participants:** David Coudert, Luc Hogie, Aurélien Lancin, Bi Li, Nicolas Nisse, Stéphane Pérennes, Issam Tahiri.

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 Politecnica de Catalunya, Barcelona and University of Girona, Spain

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

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, Grece), 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:** Frédéric Havet, František Kardoš, Leonardo Sampaio.

Bilateral collaboration funded by the french CNRS. The funding covers scientific visits and workshops.

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.

Bilateral collaboration funded by the french ministry of foreign affairs (MAE), the french ministry of research and education (MESR), and the Deutscher Akademischer Austauschdienst (DAAD). The funding covers scientific visits.

"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. ANR International Taiwan GRATEL, 01/2010 – 12/2013*

**Participants:** Jean-Claude Bermond, Frédéric Havet, František Kardoš, Leonardo Sampaio.

GRATEL (Graphs and Telecomunications) 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. Participation In International Programs*

Inria FUNCAP (Inria-FAP): ALERTE (ALgorithmes Efficaces pour les Réseaux de TElécommunications), with Pargo Team, Universidade Federal do Ceará, Brazil, accepted in June 2011.

## 8.4. International Research Visitors

### *8.4.1. Visits of International Scientists*

Jørgen Bang-Jensen: University of Southern Denmark, Odensee, Denmark, May 1-31, 2012 (1 month);

Tom Bouvier: Université Bordeaux 1, Bordeaux, France, May 21-25, 2012 (1 week);

Xavier Defago: JAIST, School of Information Science, Ishikawa, Japan, March 5-23, last week of June, September 12 - 30, 2012 (2 months);

Michele Flammini: University of L'Aquila, Italy, June 18 - July 13 (3 weeks);

Ararat Harutyunyan: Simon Fraser University, Vancouver, Canada, May 19-27, 2012 (1 week);

Brigitte Jaumard: Concordia University, Montréal, Canada, April 23 - May 5, 2012 (3 weeks);

Mejdi Kaddour: University of Oran, Algeria, April 22 - 28, November 21-28, 2012 (2 weeks);

Takako Kodate: Tokyo Woman's Christian University, Suginami-ku, Tokyo, Japan, March 19-29 (2 weeks);

Uéverton Souza Dos Santos: Fluminense Federal University, Brazil, July 13-30, 2012 (3 weeks);

Amel Tandjaoui: University of Oran, Algeria, October 16 - November 16, 2012 (1 month);

Martin Tieves: RWTH Aachen University, Germany, December 16-21, 2012 (1 week);

Joseph Yu: Abbotsford and SFU, Vancouver, Canada, March 1 - April 20, 2012 (1 month 1/2).

### *8.4.2. Visits to International Teams*

J.-C. Bermond: Orsay (March 23, 2012); Athens (May 20-29, 2012);

C. Caillouet: FUN Team, Inria Lille Nord Europe (July 1-6, 2012); Mathematics departement of RWTH Aachen, Germany (July 29-August 5, 2012);

D. Coudert: Alcatel-Lucent Bell labs, Antwerpeen, Belgium (January 10-12, 2012); Mathematics departement of RWTH Aachen, Germany (July 24-27, 2012);

F. Giroire: LIP, ENS Lyon (January 23-27, 2012);

F. Havet: LIP, ENS Lyon (January 23-27, 2012); Federal University of Ceara, Brasil (April 21-28, 2012); LABRI, University of Bordeaux 1 (July 9-11 2012);

A. Lancin: LABRI, University of Bordeaux 1 (March 5-7, 2012);

N. Nisse: LIP, ENS Lyon (January 23-27, 2012); LIF, Univ. Marseille (February 20-22, 2012); LRI, Univ. Paris-Sud 11 (March 19-20, 2012); Adolfo Ibanez University, Santiago, Chile (August 4-20, 2012);

T. K. Phan: Mathematics departement of RWTH Aachen, Aachen, Germany (August 26 -September 01, October 14 - December 06, 2012);

R. Soares: LABRI, University of Bordeaux 1 (March 5-10, 2012).

**PLANETE Project-Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

PFT (2011-2014) : DGCIS funded project, in the context of the competitivity 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 (2011-2108): 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. 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.

*8.3.1.2. Fed4Fire*

Title: Federation for Future Internet Research and Experimentation

Type: COOPERATION (ICT)

Defi: FIRE programme.

Instrument: Integrating Project (IP)

Duration: October 2012 - October 2016

Coordinator: iMinds (Belgium)

Others partners: 17 european partners including iMinds, IT Innovation, UPMC, Fraunhofer, TUB, UEDIN, NICTA, etc.

See also: http://www.fed4fire.eu/

Abstract: Fed4FIRE will deliver open and easily accessible facilities to the FIRE experimentation communities, which focus on fixed and wireless infrastructures, services and applications, and combinations thereof. The project will develop a demand-driven common federation framework, based on an open architecture and specification. It will be widely adopted by facilities and promoted internationally. This framework will provide simple, efficient, and cost effective experimental processes built around experimenters' and facility owners' requirements. Insight into technical and socio-economic metrics, and how the introduction of new technologies into Future Internet facilities influences them, will be provided by harmonized and comprehensive measurement techniques. Tools and services supporting dynamic federated identities, access control, and SLA management will increase the trustworthiness of the federation and its facilities. A FIRE portal will offer brokering, user access management and measurements. Professional technical staff will offer first-line and second-line support to make the federation simple to use. The project will use open calls to support innovative experiments from academia and industry and to adapt additional experimentation facilities for compliance with Fed4FIRE specifications. A federation authority will be established to approve facilities and to promote desirable operational policies that simplify federation. A Federation Standardization Task Force will prepare for sustainable standardization beyond the end of the project. The adoption of the Fed4FIRE common federation framework by the FIRE facilities, the widespread usage by both academic and industrial experimenters, and the strong links with other national and international initiatives such as the FI-PPP, will pave the way to sustainability towards Horizon 2020.

*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.OpenLad 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.t wireless 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. FI-WARE*

Title: Future Internet Ware.

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: SAP (Germany), IBM (Israel, Switzerland), Thales Communications (France), Telecom Italia (Italy), France Telecom (France), Nokia Siemens Networks (Germany, Hungary, Finland), Deutsche Telekom (Germany), Technicolor (France), Ericsson (Sweden), Atos Origin (Spain), Ingeneria Informatica (Italy), Alcatel-Lucent (Italy, Germany), Siemens (Germany), Intel (Ireland), NEC (United Kingdom), Fraunhofer Institute (Germany), University of Madrid (Spain), University of Duisburg (Germany), University of Roma La Sapienza (Italy), University of Surrey (United Kingdom).

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) services 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.

### *8.3.2. EIT KIC funded activities*

Our project team was involved in 2012 in **six activities** funded by the EIT ICT Labs KIC:

Title: **Fitting**, Future InterneT (of ThINGs) facility

Activity Number: 12340

Duration: 2011-2013

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. The FITTING activity is mentioned as a "success story" by the EIT ICT Labs KIC [1]. In fact, after an initial funding in 2010, the french partners succeded to get the FIT Equipment of Excellence project accepted with a total budget of 5.8 MEuros to develop a testbed federation in France.

**Mobile Privacy**

This activity deals with privacy issues in mobile and geo-based systems.

**Smart-Space Privacy**

This activity deals with privacy issues in smart environments, with a particular issue on smart metering systems.

**Software-Defined Networking (SDN)**

The objective of this activity is to explore software-defined networking at different positions on the axis between basic flow-level processing (using OpenFlow for end-to-end flows) in controlled fixed networks and cooperation between mobile end nodes in the open wireless Internet (using opportunistic networking for resources communicated hop-by-hop).

**Information-centric networking (ICN) experimentation**

The goal of this activity is to define and implement an early validation environment for ICN proposals.

**Seamless P2P video streaming for the web**

In this activity, we will extend the current capabilities of the P2P network to distribute content to collaborators. We will analyze privacy concerns in this domain and propose design guidelines to mitigate them.

## 8.4. International Initiatives

### *8.4.1. Inria Associate Teams*

#### *8.4.1.1. COMMUNITY*

Title: Message delivery in heterogeneous networks

Inria principal investigator: Thierry Turletti

International Partner (Institution - Laboratory - Researcher):

University of California Santa Cruz (United States) - School of Engineering - Katia Obraczka

Duration: 2009 - 2014

See also: http://inrg.cse.ucsc.edu/community/

During the first three years of the COMMUNITY associate team, we have explored solutions to enable efficient delivery mechanisms for disruption-prone and heterogeneous networks (i.e. challenged networks). In particular, we have designed the MeDeHa framework along with the Henna naming scheme, which allow communication in infrastructure and infrastructure-less networks with varying degrees of connectivity. We have also proposed efficient routing strategies adapted to environment with episodic connectivity that take into account the utility of nodes to relay messages. The various solutions have been evaluated using both simulations and real experimentations in testbeds located at Inria and UCSC. These solutions have demonstrated good performance in challenged networks. However, the ossification of the Internet prevents the deployment of such solutions in large scale. We have decided to extend our collaboration in two research directions: (1) the exploration of the software-defined networking paradigm to facilitate the implementation and large scale deployment of new network architectures to infrastructure-less network environments; and (2) the design of innovative information-centric communication mechanisms adapted to challenged networks.

[1] See http://eit.europa.eu/kics1/stories-archiv/stories-single-view/article/fitting-from-eit-ict-labs-the-next-generation-testbeds.html

*8.4.1.2. SIMULBED*

Title: SIMULBED: Large-Scale Simulation Testbed for Realistic Evaluation of Network Protocols and Architectures

Inria principal investigator: Walid DABBOUS

International Partner (Institution - Laboratory - Researcher):

Keio University (Japan) - Shonan-Fujisawa Campus - Osamu Nakamura

Duration: 2012 - 2014

See also: http://planete.inria.fr/Simulbed

Simulators and experimental testbeds are two different approaches for the evaluation of network protocols and they provide a varying degree of repeatability, scalability, instrumentation and realism. Network simulators allow fine grained control of experimentation parameters, easy instrumentation and good scalability, but they usually lack realism. However, there is a growing need to conduct realistic experiments involving complex cross-layer interactions between many layers of the communication stack and this has led network researchers to evaluate network protocols on experimental testbeds.

The use of both simulators and testbeds to conduct experiments grants a better insight on the behavior of the evaluated network protocols and applications. In this project, we focus on the design of SIMULBED, an experimentation platform that aims to provide the best of both worlds. Our project builds on the following state-of-the-art tools and platforms: the open source ns-3 network simulator and the PlanetLab testbed. ns-3 is the first network simulator that includes a mechanism to execute directly within the simulator existing real-world Linux protocol implementations and applications. Furthermore, it can be used as a real-time emulator for mixed (simulation-experimentation) network scenarios. PlanetLab is the well-known international experimental testbed that supports the development and the evaluation of new network services. It is composed of nodes connected to the Internet across the world, and uses container-based virtualization to allow multiple experiments running independently on the same node while sharing its resources.

The overall objective of the project is to make available to networking research community, the SIMULBED platform that will: (1) allow to conduct easily mixed simulation-experimentation evaluation of networking protocols and (2) scale up the size of the PlanetLab experimental testbed, while maintaining a high degree of realism and increasing controllability and reproducibility. We will use the NEPI unified programming environment recently developed in the Planète project-team to help in simplifying the configuration, deployment and run of network scenarios on the platform.

*8.4.1.3. CLOUDY*

Title: Secure and Private Distributed Data Storage and Publication in the Future Internet

Inria principal investigator: ClaudeCastelluccia

International Partners (Institution - Laboratory - Researcher):

University of California Berkeley (United States) - Electrical Engineering and Computer Science Department - Edward Lee

University of California Irvine (United States) - Donald Bren School of Information and Computer Sciences - Gene Tsudik

Duration: 2012 - 2014

See also: http://planete.inrialpes.fr/cloudy-associated-team/

Cloud computing is a form of computing where general purpose clients (typically equipped with a web browser) are used to access resources and applications managed and stored on a remote server. Cloud applications are increasingly relied upon to provide basic services like e-mail clients, instant messaging and office applications. The customers of cloud applications benefit from outsourcing the management of their computing infrastructure to a third-party cloud provider. However, this places

the customers in a situation of blind trust towards the cloud provider. The customer has to assume that the "cloud" always remains confidential, available, fault-tolerant, well managed, properly backed-up and protected from natural accidents as well as intentional attacks. An inherent reason for today's limitations of commercial cloud solutions is that end users cannot verify that servers in the cloud and the network in between are hosting and disseminating tasks and content without deleting, disclosing or modifying any content. This project seeks to develop novel technical solutions to allow customers to verify that cloud providers guarantee the confidentiality, availability and fault-tolerance of the stored data and infrastructure.

### *8.4.2. Participation In International Programs*

- 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.

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

Mostafa Ammar, Visiting Professor (one month in June 2012)

Subject: Investigating fundamenal properties of wireless and mobile networks

Institution: Georgia Institure of Technology (United States)

Paul de Hert, Visiting Professor (one month in June 2012)

Subject: Benefits and limitations of the legal notion of "reasonable expection of privacy"

Institution: Free University of Brussels (Belgium)

Katia Obraczka, Visiting Professor (one week in June 2012)

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 2012 until Dec 2012)

Subject: Software-Defined Networking in Heterogeneous Networked Environments

Institution: University of California at Santa Cruz (United States)

Ilaria Cianci, Visiting PhD student (from Nov 2012 until Aug 2013)

Subject: Content Centric Networking

Institution: Politecnico di Bari, Italy

### *8.5.2. Visits to International teams*

Mohamed Ali Kaafar, spending a sabbatical at NICTA Australia in Sydney (since February 2012)

Subject: Online Privacy Enhancing Technologies: measuring the risks and designing countermeasures

Thierry Turletti, Visiting researcher to University of California at Santa Cruz (one week in February 2012)

Subject: Community Associated team

Thierry Turletti, Alina Quereilhac and Frederic Urbani, Visitors to NICT, Japan (one week in December 2012)

Subject: Simulbed Associated team

*8.5.2.1. Internships*

Riccardo Ravaioli (from Mar 2012 until Aug 2012)

Subject: Is the Internet neutral or content-aware? Handling the question by measurements

Institution: Master Ubinet - Sophia Antipolis

Tessema Mindaye (from Mar 2012 until Aug 2012)

Subject: Increasing the space of applications for statistical traffic classification methods

Institution: Master Ubinet - Sophia Antipolis

Francisco Santos (from Mar 2012 until Aug 2012)

Subject: Content management in mobile wireless networks

Institution: EPFL - Lausanne

Lucia Guevgeozian Odizzio (from May 2012 until Oct 2012)

Subject: Automatic IP address and routing table assignment for heterogeneous network topologies

Institution: Universitad de la Republica Oriental del Uruguay

Xuan-Nam Nguyen (from March 2012 until Aug 2012)

Subject: Software Defined Networking in Hybrid Networks

Institution: Université de Nice Sophia Antipolis (France)

Sumit BANSAL (from Feb 2012 until Jul 2012)

Subject: Attacks and Defenses for Secure Virtual Coordinate Systems

Institution: IIT Ropar (India)

**RAP Project-Team**

# 6. Partnerships and Cooperations

## 6.1. International Research Visitors

RAP team has received the following people:

- Louigi Addario-Berry (McGill)
- Vida Dujmovic (Carleton)
- Matthieu Jonckheere (CONICET, Buenos Aires, Argentina)
- Liudmila Rozanova (CNR — IIT, University of Pisa)
- Iraj Saniée (Alcatel-Lucent Bell Labs)
- Hamed Amini (EPFL)
- Christina Goldschmidt (Oxford)
- Ross Kang (CWI)
- Stefan Langerman (UL Bruxelles)
- Henning Sulzbach (Frankfurt)

## 6.2. National Research Visitors

RAP team has received the following people:

- Bernard Arzur (Orange Labs)
- Thomas Bonald (Telecom ParisTech, Paris)
- Emilie Coupechoux (Inria, TREC)
- Davide Cuda (Orange Labs)
- Fabrice Guillemin (Orange Labs)
- Raluca Indre (Orange Labs)
- Esther le Rouzic (Orange Labs)
- Patrick Loiseau (Eurecom)

# SOCRATE Team (section vide)

TREC Project-Team

# 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.

### *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. ANR CMON*

**Participants:** François Baccelli, Florence Bénézit, Darryl Veitch.

The ANR project CMON, jointly with Technicolor, LIP6, the Inria project-team Planète and the community http://wiki.grenouille.com/index.php/CMON was continued for 6 months. This project is focused on the development of end-to-end measurement for Internet that can be deployed by end-users, without any support from ISP. Our work over this period focused on wireless network tomography.

### *8.2.2. ANR PEGASE*

**Participants:** Abir Benabid, Anne Bouillard.

TREC is a partner of the 3-year ANR project called PEGASE, jointly with ENS Lyon, the Inria project-team MESCAL, ONERA, Real-Time-at-Work (start-up) and Thalès. This project is focused on the analysis of critical embedded networks using algebraic tools. The aim is to apply these techniques to AFDX and Spacewire architectures. Abir Benabid was hired until January 2012.

### *8.2.3. ANR GAP*

**Participants:** Marc Lelarge, Emilie Coupechoux, Mathieu Leconte.

Over the last few years, several research areas have witnessed important progress through the fruitful collaboration of mathematicians, theoretical physicists and computer scientists. One of them is the cavity method. Originating from the theory of mean field spin glasses, it is key to understanding the structure of Gibbs measures on diluted random graphs, which play a key role in many applications, ranging from statistical inference to optimization, coding and social sciences.

The objective of this project (2012-2016) is to develop mathematical tools in order to contribute to a rigorous formalization of the cavity method. We intend to launch two new research lines:

- From local to global, the cavity method on diluted graphs. We will study the extent to which the global properties of a random process defined on some graph are determined by the local properties of interactions on this graph. To this end, we will relate the cavity method to the analysis of the complex zeros of the partition function, an approach that also comes from statistical mechanics. This will allow us to apply new techniques to the study of random processes on large diluted graphs and associated random matrices.
- Combinatorial optimization, network algorithms, statistical inference and social sciences. Motivated by combinatorial optimization problems, we will attack long-standing open questions in theoretical computer science with the new tools developed in the first project. We expect to design new distributed algorithms for communication networks and new algorithms for inference in graphical models. We will also analyze networks from an economic perspective by studying games on complex networks.

### *8.2.4. ANR MAGNUM*

**Participant:** Ana Bušić.

Ana Bušić is participating (pôle de rattachement: LIP6, UPMC) in the 4-year ANR project MAGNUM (Méthodes Algorithmiques pour la Génération aléatoire Non Uniforme: Modèles et applications), 2010–2014; http://www.lix.polytechnique.fr/~rossin/ANR/Magnum/www/. The central theme of the MAGNUM project is the elaboration of complex discrete models that are of broad applicability in several areas of computer science. A major motivation for the development of such models is the design and analysis of efficient algorithms dedicated to simulation of large discrete systems and random generation of large combinatorial structures.

### *8.2.5. GdR Stochastic Geometry*

**Participants:** François Baccelli, Bartłomiej Błaszczyszyn.

TREC is a member of the Research Group GeoSto (Groupement de recherche, GdR 3477) http://gdr-geostoch.math.cnrs.fr/ on Stochastic Geometry led by Pierre Calka (Université de Rouen). This is a collaboration framework for all French research teams working in the domain of *spatial stochastic modeling*, both on theory development and in applications. The kickoff meeting was organized this year in March at the University of Rouen; http://gdr-geostoch.math.cnrs.fr/workshop_Rouen. It brought together more than 80 researchers from France and Europe.

### *8.2.6. ARC OCOQS*

**Participant:** Ana Bušić.

Two-year Inria Collaborative action *Action de recherche collaborative (ARC)* OCOQS "Optimal threshold policies in COntrolled 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. A one-day workshop on Structural Properties in Markov Decision Processes was organized this year in January at Inria, Paris; http://www.di.ens.fr/~busic/OCOQS/workshop.html.

## 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*

*8.3.2.1. EIT ICT Labs*

**Participants:** François Baccelli, Fabien Mathieu, Mir Omid Mirsadeghi, Rémi Varloot.

This grant in collaboration with Fabien Mathieu (GANG) was focused on the analysis of P2P systems, primarily in the context of wireless. Our partner Ilkka Norros (VTT) visited several times to work on the matter. We hired an Intern from ENS (Rémi Varloot). Our efforts led to a joint paper accepted at Infocom'13. In spite of the success of this collaboration, the grant will not be continued (due to the lack of proper 'Catalyst' with EIT ICT Labs).

## 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
- The activity of this proposal is centered on the inter-play between stochastic geometry and network information theory, whith a particular emphasis on wireless networks. In terms of research, three main lines of thought will be pursued:1. Error exponents and stochastic geometry2. Stochastic geometry and network Information Theory3. Cognitive radio and stochastic geometry

## 8.5. International Research Visitors

### *8.5.1. Visits of International Scientists*

- Venkat Anantharam (University of Berkeley),
- Daryl Daley (University of Melbourne),
- Christian Hirsch (University of Ulm),
- Guenter Last (KIT Germany),
- Ravi Mazumdar (University of Waterloo, Inria visiting professor),
- Naoto Miyoshi (Tokyo Institute of Technology),
- Ilkka Norros (VTT, Finland).

### *8.5.2. Internships*

- Julieta BOLLATI (from Apr 2012 until Jun 2012)

  Subject: Optimal threshold computation in controlled queueing systems

  Institution: National University of Rosario (Argentina)

### *8.5.3. Visits to International Teams*

- François Baccelli is one of the two recipients of the Simons Math+X Chair (https://simonsfoundation.org/funding/funding-opportunities/mathematics-physical-sciences/mathx/mathx-encouraging-interactions-2011-chair-recipients/ and is now on the faculty at UT Austin. He keeps a part time position in TREC.

**URBANET Team**

# 8. Partnerships and Cooperations

## 8.1. Regional Initiatives

- ARC 7 PhD Grant on Urban mobility measurement for citizen-oriented services cartography.
  Participants: Trista Lin (PhD), Marco Fiore, Hervé Rivano, Fabrice Valois. In collaboration with Frédéric Le Mouel (CITI) and Lyon Urbanism Agency.
- ARC 7 animation grant for organizing the "Digital Cities days".
- BQR INSA 3 years project on "Network architecture for Buildings and Energy" (ARBRE).
  Participants: Hervé Rivano, Fabrice Valois. In collaboration with CETHIL (energetic modeling), LIRIS (database management) and EVS (social science).

## 8.2. National Initiatives

### *8.2.1. ANR*

- ANR Verso ECOScells 10/2009-12/2012
  Participants: Anis Ouni, Hervé Rivano, Fabrice Valois
  The objective of ECOScells is to study energy efficient microcells networks. Hervé Rivano is leader for Inria side and of the work package focusing on energy efficient wireless backhauling.
- ANR ARESA2 03/2010-08/2013.
  Participants: Alexandre Mouradian, Isabelle Augé-Blum, Fabrice Valois
  The partners in the ANR ARESA2 project are: Orange Labs, Coronis, Inria, LIG, Télécom Bretagne, VERIMAG. Our contributions focus on: resiliency of routing protocols in WSN; how to exploit the heterogeneity in wireless multi-hop network; real-time and QoS support in routing protocols for WSN. This project will end in August 2013. Alexandre Mouradian (Ph.D student) is funded by ARESA2.

### *8.2.2. Pôle ResCom*

- Ongoing participation (since 2006)
  Communication networks, working groups of GDR ASR, CNRS (http://rescom.inrialpes.fr). Hervé Rivano is member of the scientific committee of Rescom.

## 8.3. International Initiatives

### *8.3.1. Inria International Partners*

- Universidade Federal do Ceara (Brazil): Joint publication [6] with Claudia Linhares Sales on proportional coloring for wireless mesh networks.
- University of Waterloo (Canada): Collaboration with Catherine Rosenberg on optimization of wireless mesh networks.
- Politecnico di Torino (Italy): Multiple publications [4], [5], [7], [18] co-authored with members of the Telecommunication Networks Group.
- Universidade Federal de Minas Gerais (Brazil): Collaboration with Pedro Vaz de Melo on mobility analysis [26].
- Ecole Polytechnique Fédérale de Lausanne (Switzerland): Collaboration with Florian Huc on proportional coloring for wireless mesh networks [6].

- A new collaboration started with Université of Yaoundé 1 into the LIRIMA framework. Fabrice Valois works with Prof. Maurice Tchuente and a joint Ph.D. thesis started: the research topics of M. Rodrigue Domga Komguem focus on the use of wireless sensor networks for intelligent transport systems (ITS).

## 8.4. International Research Visitors

### *8.4.1. Visits of International Scientists*

Delia Ciullo (04/2012)

Subject: Sleep Mode Effectiveness in Cellular Networks

Institution: Politecnico di Torino (Italy)

Catherine Rosenberg (06/2012)

Subject: Resource Allocation, Transmission Coordination and User Association in Heterogeneous Cellular Networks

Institution: University of Waterloo (Canada)

Prasan Kumar Sahoo (11/2012)

Subject: Wireless Sensor Networks: Applications and Research Issues

Institution: University Chang Gung (Taiwan)

### *8.4.2. Visits to International Teams*

- Marco Fiore visited with monthly frequency the Telecommunication Networks Group of the Politecnico di Torino, Italy. The cooperation focused on the topics of content download in vehicular environments and mobile user position verification.
- Marco Fiore visited the Hamilton Institute, Ireland, on October 2012. He gave an invited talk and discussed possible cooperation between UrbaNet and the Hamilton Institute.
- In last August, in the frame of the "Saisons Croisées France-Afrique du Sud", with the collaboration of the French Foreign Office and with the support of the Inria foreign office, Fabrice Valois participated to a common workshop on the use of wireless sensor networks for South-African applications. This workshop was held in Stellenbosch University, and was organized jointly by the communications group of Stellenboch University and the Inria project FUN (Dr. Nathalie Mitton). In this context, Fabrice Valois gave lectures and participated to a tutorial on Senslab. In September, a project proposal was submitted with these collaborators. Last November, a new research meeting was held in Inria Lille, hosted by the FUN team.
- In November, Hervé Rivano, Fabrice Valois, Razvan Stanica and Quentin Lampin participated to the Wireless Days conference in Dublin, Ireland. As Dublin academic institutions are very active in the area of urban networking and applications, we extended our stay and met with research teams from the Hamilton Institute and Dublin City University, as well as with French Embassy staff, to discuss possible collaborative activities.