RESEARCH CENTER

FIELD
Networks, Systems and Services, Distributed Computing

Activity Report 2013

Section Partnerships and Cooperations

Edition: 2014-03-20

ACES Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. 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: December 2013

BinThatThinks is an ANR project funded by the ANR Ecotech program, that is ended in December 2013. It aimed 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 introduced 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.

An infrastructure of smart bins was designed. This infrastructure leverage on waste identification mechanism based on self describing objects, helping user to sort their waste correctly, using either QR codes or RFID technologies. Wastes are grouped in smart bags, that can be read to determine their content. A given bin can accept or rejet wastes depending on the sorting policy, or to prevent hazardous conditions to happen. Waste identification and wastes/bins interactions were the main focus of ACES in the project. The second important aspect of the project is the communication infrastructure, which was studies by Inria Fun. Smart bins are connected together using ambient networks taking advantage of the city streets topology: this allow the balanced use of short range and low power communication interface between the nodes and cellular communication interface, prolonging the life of the network. A thesis on this topic was defended in November 2013. A prototype was implemented and integrated as a demonstrator Etineo, a company specialized in M2M communications.

7.1.2. Pervasive_RFID

- Partner: IETR
- Starting: July 2013; ending: July 2016

Pervasive_RFID is a joint effort (within the CominLabs initiative, see http://www.cominlabs.ueb.eu/) started in July 2013 with IETR (institut d'électronique et de télécommunications de Rennes) to study and design innovative RFID reading protocols in the context of pervasive computing applications. Some limitations of existing RFID technology become challenging: unlike standard RFID application scenarios, pervasive computing often involves uncontrolled environment for RFID, where tags and reader have to operate in much more difficult situations that those usually encountered or expected for classical RFID systems.

RFID technology is to avoid missing tags when reading multiple objects, as reading reliability is affected by various effects such shadowing or wave power absorption by some materials. The usual applications of RFID operate in a controlled environment in order to reduce the risk of missing tags while scanning objects.

In pervasive computing applications, a controlled reading environment is extremely difficult to achieve, as one of the principle is to enhance existing processes "in situ", unlike the controlled conditions that can be found in industrial processes. Consider for example a logistic application, where RFID tags could be used on items inside a package in order to check for its integrity along the shipping process. Tags would likely be placed randomly on items inside the package, and reading conditions would be variable depending on where the package is checked.

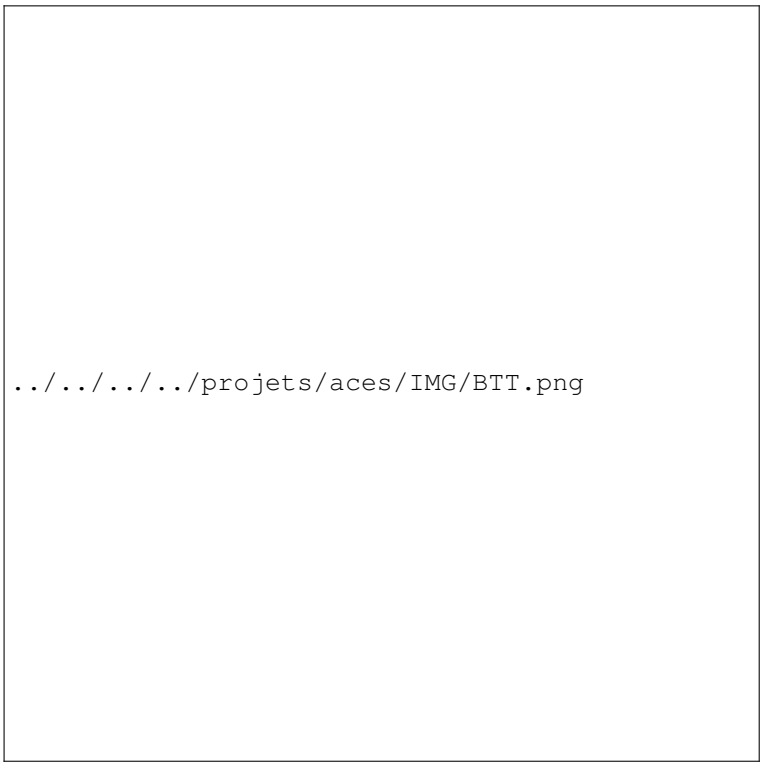

Figure 4. BinThatThink general architecture

RFID operation in uncontrolled environments is challenging because RFID performance is affected by multiple parameters, in particular:

- Objects materials (on which tags are attached to),
- Materials in the surrounding environment,
- RFID frequency spectrum,
- Antenna nature and placement with respect to the tags.

In controlled environment, the difficulty to read tags can be limited by using the appropriate parameters to maximize the RFID performance for the application. But in many cases, it is needed to read large number of objects of various nature, arranged randomly in a given area or container. Most pervasive computing applications fall in this context.

At the software level, RFID inventory reliability issue is usually addressed by anti-collisions mechanisms and redundancy mechanisms. Anti-collisions protocols limit the risk of data corruption when multiples tags have to reply to an inventory request. Redundancy is often implemented in RFID readers by aggregating the results of multiple inventory requests over a time frame, to give the tags multiple opportunities to reply. While useful, these strategies cannot ensure that a given inventory is valid or not (in other words, one or more tags may be missing without being noticed). We propose to address this issue with an original approach based on integrity checking, developed by ACES.

In situations where we have to read large collection of objects of various types, the performance is difficult to predict but may still be adequate for a given application. For example, some application can tolerate missing some tags, provided that miss read probability could be characterized. In some cases, read reliability could be improved using mechanical approaches, such as introducing movements in objects or antenna to introduce radio diversity during read. Finally, distributed data structure can be used over a set of tags to be used to mitigate the impact of mis-read (by using data redundancy) and to help the reading protocol by integrating hints about the tag set collection being read.

Our objective is to study extensively by experimentation the behavior of existing RFID solutions in the context of uncontrolled environment (meaning, random placement of tags on objects mixing various materials) in order to characterize their real-world performance regarding the parameters of such as tags numbers, density, frequencies, reader antenna design, dynamicity of objects (movements), etc. From these experimentations, we would like to identify the conditions that are favorable to acceptable performance, and the way where there are hopes of improvement with specific design for these difficult environments. These results should also allow improving the performance : high level integrity checks can guide low level operations by determining whether inventories are complete or not. This cross layer strategy should enable faster are more efficient inventory protocols, as we have shown in [3] where some first results of this approach are presented.

The first step in the project is the implementation of an experiment test bed in order to support the experiment campaign. This task involves a significant engineering effort, which is ongoing. The following figures shows the elements of the testbed being built, featuring multi-axis mobile RFID antenna that we will driven by the high level protocols to use radio diversity, and a target container which will support custom designed arrangement of tags that are challenging to read by standard RFID configurations.

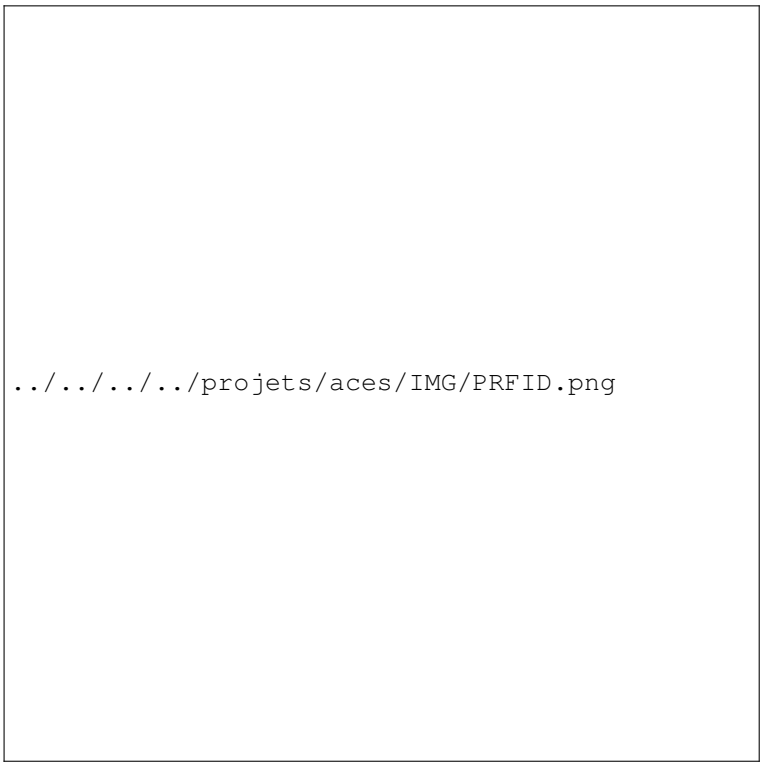

Figure 5. Overview of the Pervasive RFID testbed

ADAM Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. ADT eSurgeon

Participants: Maxime Colmant, Lo√øc Huertas, Romain Rouvoy [correspondant].

ADT eSurgeon (2013–15) is a technology development initiative supported by the Inria Lille - Nord Europe Center that aims at supporting the development of the POWERAPI software library (see Section 5.3) for measuring and monitoring the energy consumption of middleware and software systems.

8.1.2. ADT Adapt

Participants: Gwenaël Cattez, Philippe Merle [correspondant].

ADT Adapt (2011–13) is a technology development initiative supported by the Inria Lille - Nord Europe Center that 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 5.2), *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. Gwenaël Cattez (recent graduated engineer) has been recruited in the context of this ADT.

8.1.3. North European Lab SOCS

Participants: María Gómez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy [correspondant], Lionel Seinturier.

North European Lab SOCS (2013–15) is an international initiative supported by the Inria Lille - Nord Europe Center that takes place in the context of a well-established collaboration between Inria and *Universitetet i Oslo* (UiO) initiated in 2008. SOCS focuses on the self-optimization issues in cyber-physical systems. Cyber-Physical Systems (CPS) are complex systems-of-systems that blend hardware and software to fulfill specific missions. However, traditional CPS are statically configured to achieve predefined goals, which not only limit their sharing and their reuse, but also hinder their sustainability. We believe that this waste of resources stems from the lack of agility of CPS to adapt to change in their environment or objectives. The SOCS Inria Lab (Self-Optimization of Cyber-physical Systems) therefore intends to extend the technologies developed as part of the SEAS associate team and more recently the APISENSE platform (see Section 5.1) to leverage the development of agile CPS.

8.1.4. LEDA

Participants: Gwenaël Cattez, Philippe Merle [correspondant].

LEDA (2013–16) Laboratoire d'Expérimentation et de Démonstrations Ambiantes is a demonstration space allocated by the Inria Lille - Nord Europe Center whose goal is to show the scientific results of the ADAM project-team in the domains of distributed systems, adaptable middleware, software product lines, green computing, and ambiant computing. These results are illustrated around the scenario of a mock digital home.

- **North European Lab SOCS** (2013–2015) is an international initiative supported by the Inria Lille - Nord Europe Center that takes place in the context of a well-established collaboration between Inria and *Universitetet i Oslo* (UiO) initiated in 2008. SOCS focuses on the self-optimization issues in cyber-physical systems. Cyber-Physical Systems (CPS) are complex systems-of-systems that blend hardware and software to fulfill specific missions. However, traditional CPS are statically configured to achieve predefined goals, which not only limit their sharing and their reuse, but also hinder their sustainability. We believe that this waste of resources stems from the lack of agility of CPS to adapt to change in their environment or objectives. The SOCS Inria Lab (Self-Optimization of Cyber-physical Systems) therefore intends to extend the technologies developed as part of the SEAS associate team and more recently the APISENSE® platform (see Section 5.3) to leverage the development of agile CPS.
  Participants: Maria Gomez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy, Lionel Seinturier.

8.2. National Initiatives

8.2.1. ANR SocEDA

Participants: Nabil Djarallah, Fawaz Paraïso, Romain Rouvoy, Lionel Seinturier [correspondant].

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.

8.2.2. ANR MOANO

Participants: Nabil Djarallah, Laurence Duchien [correspondant], Nicolas Petitprez.

MOANO (Models & Tools for Pervasive Applications focusing on Territory Discovery) is a 46-month project of the ANR CONTINT program which started in December 2010. 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.

8.2.3. ANR YourCast

Participants: Laurence Duchien [correspondant], Clément Quinton, Daniel Romero.

YourCast (Software Product Lines for Broadcasting Systems) is a 36-month ANR Emergence project that started in January 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.

8.2.4. FUI Macchiato

Participants: Nabil Djarallah, Laurence Duchien [correspondant], Nicolas Petitprez, Romain Rouvoy.

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 [79].

8.2.5. FUI EconHome

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

EconHome is a 40-month project funded by FUI and labelized by the Minalogic and Systematic competitivity clusters. The project started in July 2010. 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.

8.2.6. FUI Hermes

Participants: Laurence Duchien, Romain Rouvoy, Lionel Seinturier [correspondant].

Hermes is a 41-month project funded by FUI and labelized by the PICOM (Pôle des Industries du COMmerce) competitivity cluster which has started in August 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.

8.2.7. FSN PIA Datalyse

Participants: Filip Křikava, Romain Rouvoy, Lionel Seinturier [correspondant], Bo Zhang.

Datalyse is a 36-month project of the FSN Programme Investissement d'Avenir Cloud Computing 3rd call for projects. The project started in May 2013. The partners are Business & Decision Eolas, Groupement des Mousquetaires, Université Grenoble 1, Université Lille 1, Inria, Université Montpellier 2. The project aims at defining an elastic cloud computing infrastructure for processing big volumes of data. The originality of the project is to consider jointly data generated by users and by the infrastructure, and to correlated data at these two levels.

8.2.8. Inria ARC SERUS

Participants: Laurence Duchien [correspondant], Alexandre Feugas, Lionel Seinturier.

ARC SERUS (2011–13) (Software Engineering for Resilient Ubiquitous Systems) is funded 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.

8.2.9. Inria ADT AntDroid

Participants: María Gómez Lacruz, Nicolas Haderer, Christophe Ribeiro, Romain Rouvoy [correspondant].

ADT AntDroid (2012–14) 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 APISENSE® software platform to the public and to support the users of the platform. APISENSE® is a distributed platform dedicated to crowd-sensing activities. APISENSE® 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.

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, Clément Quinton, Daniel Romero [correspondant], Romain Rouvoy, Lionel Seinturier.

Program: FP7 FET
Project acronym: DIVERSIFY
Project title: More software diversity. More adaptivity in CAS.
Duration: 36 months (2013-16)
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 (*Collective Adaptive Systems*). 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 [correspondant], Matias Martinez.

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:
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.

Participants: Nicolas Haderer, Russel Nzekwa, Daniel Romero, Romain Rouvoy [correspondant], Lionel Seinturier.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

8.4.2.1.1. 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 [86][43] and in the PhD thesis document itself [85].
Participants: Laurence Duchien [correspondant], Clément Quinton, Daniel Romero, Romain Rouvoy, Lionel Seinturier.

8.4.2.1.2. University of Oslo, Norway

The scientific collaboration with this international partner deals with complex distributed systems that have to seamlessly adapt to a wide variety of deployment targets. This is due to the fact that developers cannot anticipate all the runtime conditions under which these systems are immersed. A major challenge for these software systems is to develop their capability to continuously reason about themselves and to take appropriate decisions and actions on the optimizations they can apply to improve themselves. This challenge encompasses research contributions in different areas, from environmental monitoring to real-time symptoms diagnosis, to automated decision making. The SEAS associated team (see Section 8.4.1.1) contributes to this collaboration.
Participants: Nicolas Haderer, Russel Nzekwa, Daniel Romero, Romain Rouvoy [correspondant], Lionel Seinturier.

8.4.2.2. Informal International Partners

8.4.2.2.1. Université du Québec à Montréal

The ADAM project-team has established a new collaboration with UQÀM (*Université du Québec à Montréal*) to improve the software quality of distributed systems. This collaboration has been initied with a joint PhD thesis (Geoffrey Hecht) that intends to empirically identify design patterns and anti-patterns in Cloud-based applications. The objective of this work is to leverage the development of *Software-as-a-Service* (SaaS) to build modular yet efficient solutions to be deployed in the Cloud.
Participants: Laurence Duchien, Geoffrey Hecht, Romain Rouvoy.

8.4.3. Participation in Other International Programs

8.4.3.1. OW2

Participants: Gwenaël Cattez, Philippe Merle [correspondant], Fawaz Paraïso, Romain Rouvoy, Lionel Seinturier.

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.

8.4.3.2. ERCIM Working Group on Software Evolution

Participant: Laurence Duchien [correspondant].

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.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Favio Demarco

Subject: Automated Software Repair

Date: from Apr 2013 until Sep 2013

Institution: University of Buenos Aires (Argentina)

Gabriel Moyano

Subject: Crowd-driven Automatic Inference of Traffic Maps

Date: from Mar 2013 until Aug 2013

Institution: University Los Andes (Colombia)

Herman Mekontso

Subject: An SOA Approach for the Design of Information Systems: The Case of the PPR FTH Platform in Central Africa

Date: Oct 2013

Institution: University of Yaoundé (Cameroon)

ARLES Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR

7.1.1.1. ANR MURPHY

Participant: Animesh Pathak [correspondent].

- **Name:** MURPHY – *Dependability-focused Evaluation of Sensor Networks*
- **URL:** http://cedric.cnam.fr/~sailhanf/murphy/
- **Related activities:** § 6.5
- **Period:** [January 2011 – September 2014]
- **Partners:** CNAM (**Coordinator**), 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 that 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 enable the dynamic and distributed insertion of faults and hide from the end user the complexity related to this task; and
- 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 ADT iConnect

Participant: Valérie Issarny [correspondent].

- **Name:** iConnect – *Emergent Middleware Enablers*
- **Related activities:** § 6.2 and 6.3
- **Period:** [October 2013 – September 2015]
- **Partners:** Inria ARLES.

The pervasive computing vision is hampered by the extreme level of heterogeneity in the underlying infrastructure, which impacts on the ability to seamlessly interoperate. Further, the fast pace at which technology evolves at all abstraction layers increasingly challenges the lifetime of networked systems in the digital environment.

Overcoming the interoperability challenge in pervasive computing systems has been at the heart of the FP7 FET IP CONNECT project (http://www.connect-forever.eu/), which ran from 2009 to 2012, and was coordinated by Inria ARLES. Specifically, CONNECT has been investigating the paradigm of *Emergent middleware*, where protocol mediators are dynamically synthesized so as to allow networked systems that provide complementary functionalities to successfully coordinate. The CONNECT project has in particular delivered prototype implementation of key enablers for emergent middleware, spanning discovery, protocol learning, and mediator synthesis and deployment. Further, while CONNECT focused on learning and reconciling interaction protocols at the application layer, the FP7 project CHOReOS (http://www.choreos.eu) to which ARLES contributed as well, investigated a complementary enabler that supports interoperability across systems implementing heterogeneous interaction paradigms (i.e., client-service, event-based and shared memory). The proposed enabler introduces the concept of XSB - eXtensible Service Bus, which revisits the notion of Enterprise Service Bus and features an end-to-end interaction protocol that preserves the interaction paradigms of the individual components, while still allowing interoperability.

The objective of the Inria iConnect ADT is to leverage and integrate the above complementary results, packaging and further enhancing enabler prototypes, for take-up of the results by the relevant open source community. The work will involve development effort focused on the following core enablers:

- Universal discovery of resources composing legacy discovery protocols,
- Dynamic synthesis and deployment of mediators specified as enhanced labelled transition systems,
- XSB as underlying run-time support for mediators so as to support interoperability across systems based on heterogeneous interaction paradigms,
- Experiment in the area of federated social networking.

We intend to release the software prototypes through the newly created OW2 open source initiative FISSi (Future Internet Software and Services initiative – http://www.ow2.org/view/Future_Internet/) as our solutions are of direct relevance to sustaining interoperability in the future Internet.

7.1.2.2. Inria ADT Yarta

Participant: Animesh Pathak [correspondent].

- **Name:** Yarta – *Middleware for mobile social ecosystems*
- **Period:** [October 2012 – September 2014]
- **Partners:** Inria ARLES.

Yarta is 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 supports 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 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

Period: [October 2010 - September 2013]

Partners: NoMagic Europe (Lithuania), CEFRIEL (Italy), CNR (Italy), Linagora (France), Inria ARLES [**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 composition 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 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.

7.2.1.2. 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 2014]

Partners: Atos Origin (Spain), CNR (Italy) [**coordinator**], ETH Zürich (Switzerland), IMDEA Software (Spain), Inria (EPIs 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 NESSoS on "Engineering Secure Future Internet Software Services and Systems" 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.

7.2.1.3. 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) [**coordinator**], 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 (CA) 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 are used to conduct a successful CA.

7.2.1.4. 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: § 6.7

Period: [May 2011 - May 2013]

Partners: Inria ARLES.

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.

7.2.2. Collaborations in European Programs, except FP7

7.2.2.1. EIT ICT Labs TravelDashboard

Participant: Animesh Pathak [correspondent].

Name: TravelDashboard – *Personalized Mobility to Urban Travelers*

URL: https://www.rocq.inria.fr/arles/traveldashboard/

Period: [January 2013 - December 2013]

Partners: Alcatel/Lucent (Ir and Be), Ambientic (F), Inria (CRI Paris-Rocquencourt), Systḿeatic (F), Thales [**coordinator**], Transport for London (UK), UC London (UK).

With over 70% of the world's entire population expected to be living in cities by 2050, supporting citizens' mobility within the urban environment is a priority for municipalities worldwide. Although public multi-modal transit systems, coupled with integrated fare management and road user charging, are necessary to better manage mobility, they are not sufficient. Citizens must be offered personalized travel information, where and when such information is needed to take decisions that will make their journeys more efficient and enjoyable. Notably, such information is not purely qualitative (e.g., bus timetable, live bus tracking), but crucially subjective (e.g., crowdedness of trains, heat of tube platforms, sociability of the coaches). The perception and value attached to this information varies substantially, not only across people (e.g., different tolerance to delays, different perception of crowdedness, different taste in the social environment), but also for the same person in different contexts (e.g., work commute, leisure trip with the family). Thanks to the increased abundance of smart phones (equipped with various types of physical sensors, as well as enabling the users to easily report phenomena), the field of mobile participatory sensing has emerged recently, and can be leveraged towards providing a more fine-grain and up-to-date view of the city's transportation system. In that direction, the TravelDashboard project works towards an open source middleware platform, enriched with personalized mobility services for urban travelers, evaluated via real-life demonstrators assessment, and accompanied by novel business models.

7.3. International Initiatives

7.3.1. Inria International Labs

Valérie Issarny acts as scientific manager of the Inria@Silicon Valley program (https://project.inria.fr/inria-siliconvalley/) for the academic year 2013-14, and is on leave at UC Berkeley since August 2013.

7.3.2. Participation in other International Programs

7.3.2.1. International scientific cooperation program Inria/Brazil – Project M@TURE

Participant: Nikolaos Georgantas [correspondent].

Name: M@TURE – *Models @ runtime for self-adaptive pervasive systems*

Instrument: Inria-Brazil cooperation programme

Period: [October 2012 - September 2014]

Partners: Institute of Informatics of Federal University of Goias (Brazil), Inria ARLES.

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 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 are 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

Prof. Peter Sawyer from Lancaster University (UK), visited the ARLES team during Q1 2013, where he investigated how to leverage requirements engineering in the context of distributed software systems, with a special emphasis on the exploitation of requirements@runtime.

7.4.1.1. Internships

Aness Bajia (from Feb. 2013 until Jul. 2013)

Subject: *Fault Tolerance in Sensor Network Macroprogramming*

Institution: Faculté des sciences de Tunis (Tunisia)

Amel Belaggoun (from Jan. 2013 until Aug. 2013)

Subject: *Runtime and Representation of Requirements in Self-Adaptive Systems*

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

Ankur Gautam (from Jan. 2013 until Feb. 2013)

Subject: *Semantic Composition of Services in the Internet of Things*

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

Yijun Liu (from Jun. 2013 until Sep. 2013)

Subject: *Smartphone-supported Indoor Location System*

Institution: Stanford University (USA)

Akash Nawani (from Jan. 2013 until Mar. 2013)

Subject: *Middleware Support for Federated Social Networking*

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

Dimitrios Soukaras (from Feb. 2013 until Apr. 2013)

Subject: *Enabling High-level Application Development in the Internet of Things*

Institution: University of Peloponnese (Greece)

LOGNET Team

8. Partnerships and Cooperations

8.1. European Initiatives

8.1.1. 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: University of Turin, Politech of Turin, Univ. of Piemonte Orientale

Founded 1.3Meur on 3 year (2010-2013)

Abstract: see above

8.2. International Initiatives

8.2.1. Inria International Partners

- University of Udine, Italy, collaborations, common papers and projects and visits since 1990.
- Politecnico di Torino, Italy, collaborations, common papers and visits since 2000.
- Politecnica de Valencia, Spain, collaborations and projects and teaching and visits since 2004.
- University of Novi Sad, Serbia, collaboration, common projects and papers and visits since 2004.

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Demis Ballis, Assistant Professor, Politecnica Valencia, one week,
- Marina Ribaudo, Associate professor, Università di Genova, 2 days,
- Giovanni Chiola, Full Professor, Università di Genova, 2 days,
- Seif Aridi, Full Professor, KTH Stocholm, 3 days,
- Nguyen Huu Thanh, Associate Professor, Hanoi University of Science and Technology, one week.

8.3.1.1. Internships

- Nicolas Gauche, IUT NIce, from Apr 2013 until Jun 2013: "conception et implémentation d'un réseau social appellé myCarPooling";
- Benjamin Lissillour, IUT Nice, from Apr 2013 until Jun 2013: "portage de la base de donnée noSQL Cassandra 0.7 versus la nouvelle release 1.2";
- Romain Guillot, IUT Nice, from Apr 2013 until Jun 2013: "conception et implémentation d'un système de monitoring pour un cloud de PC distribués, appellé ProtectYourself".

ASAP Project-Team

8. Partnerships and Cooperations

8.1. National initiatives

8.1.1. LABEX CominLabs

Participants: Anne-Marie Kermarrec, Davide Frey, Michel Raynal, François Taïani.

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. In this context, ASAP received funding for DeSeNt (a collaborative project with the Université de Nantes / LINA).

8.1.2. ANR ARPÈGE project Streams

Participants: Marin Bertier, Michel Raynal.

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 project SocioPlug

Participants: Anne-Marie Kermarrec, Davide Frey, Michel Raynal, François Taïani.

SocioPlug is a collaborative ANR project involving Inria (ASAP team), the université de Nantes, and LIRIS (INSA Lyon and Universite Claude Bernard Lyon). The project emerges from the observation that the features offered by the Web 2.0 or by social media do not come for free. Rather they bring the implicit cost of privacy. Users are more of less consciously selling personal data for services. SocioPlug aims to provide an alternative for this model by proposing a novel architecture for large-scale, user centric applications. Instead of concentrating information of cloud platforms owned by a few economic players, we envision services made possible by cheap low-end plug computers available in every home or workplace. This will make it possible to provide a high amount of transparency to users, who will be able to decide their own optimal balance between data sharing and privacy.

8.1.4. DeSceNt CominLabs

Participants: Resmi Ariyattu Chandrasekharannair, Davide Frey, Michel Raynal, François Taïani.

The DeSceNt project aims to ease the writing of distributed programs on a federation of plug computers. Plug computers are a new generation of low-cost computers, such as Raspberry pi (25$), VIA- APC (49$), and ZERO Devices Z802 (75$), which offer a cheap and readily available infrastructure to deploy domestic on-line software. Plug computers open the opportunity for everyone to create cheap nano-clusters of domestic servers, host data and services and federate these resources with their friends, colleagues, and families based on social links. More particularly we will seek in this project to develop novel decentralized protocols than can encapsulate the notion of privacy-preserving federation in plug-based infrastructures. The vision is to use these protocols to provide a programming toolkit that can support the convergent data types being developed by our partner GDD (Grande Données Distribuées) at Université de Nantes.

8.1.5. 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/MEDIEGO) 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 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. Our MEDIEGO software is now applied to centralized systems for recommendations.

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 focuses 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 (ITN)

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 I 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, and the Google Focused Award Web-Alter-Egos.

Foundation for Research and Technology Hellas ICS FORTH Greece; collaboration on Transform

8.3. International initiatives

8.3.1. Inria associate teams

8.3.1.1. RADCON

Title: Randomized Algorithms for Distributed Computing and Networks

Inria principal investigator: George Giakkoupis

International Partner:

University of Calgary (Canada) - Department of Computer Science - Philipp Woelfel

Duration: 2013 - 2015

See also: http://www.irisa.fr/asap/radcon

Over recent years, computing systems have seen a massive increase in parallelism and interconnectivity. Peer-to-peer systems, ad-hoc networks, sensor networks, or the "cloud" are based on highly connected and volatile networks. Individual nodes such as cell phones, desktop computers or high performance computing systems rely on parallel processing power achieved through multiple processing units. To exploit the power of massive networks or multiple processors, algorithms must cope with the scale and asynchrony of these systems, and their inherent instability, e.g., due to node, link, or processor failures. In this research project we explore randomized algorithms for large-scale networks of distributed systems, and for shared memory multi-processor systems. For large-scale networks, decentralized gossip protocols have emerged as a standard approach to achieving fault-tolerant communication between nodes with simple and scalable algorithms. We will devise new gossip protocols for various complex distributed tasks, and we will explore the power and limits of gossip protocols in various settings. For shared memory systems, randomized algorithms have proved extremely useful to deal with asynchrony and failures. Sometimes probabilistic algorithms provide the only solution to a problem; sometimes they are more efficient; sometimes they are simply easier to implement. We will devise efficient algorithms for some of the fundamental problems of shared memory computing, such as mutual exclusion, renaming, and consensus.

8.3.2. Inria international partners

University of Calgary

Universidad Nacional Autonoma de Mexico

University of Glasgow

8.3.3. Participation in international programs

8.3.3.1. 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

8.4.1. Visits of international scientists

Zarah Aghazadeh, University of Calgary, from 6 to 27 July 2013

Laurent Fournier, Cup Foundation Toulouse, 13 November 2013

Roy Friedman, Technion University Tel Aviv, 20 December 2013

Christian Grothoff, TU Munich, 26 November 2013

Jean-Loup Guillaume, Lip6 Paris, 12 March 2013

Gilles Tredan, Laass Toulouse, from 2 to 10 September 2013

Philipp Woelfel, University of Calgary, from 6 to 14 July 2013

8.4.2. Internships

Hoël Kervadec; 1 July 2013 to 6 September 2013. "Construction décentralisée de topologies informatiques réparties à mémoire de forme." Supervised by François Taïani.

Nabil Kmihi; 16 May 2013 to 8 November 2013. "Offline social networks." Supervised by Anne-Marie Kermarrec.

Olivier Ruas; 1 February 2013 to 30 June 2013. "Degree-based routing in small world networks." Supervised by George Giakkoupis and Anne-Marie Kermarrec.

Sylvain Fabre; 1 July 2013 to 31 August 2013. "Elaboration d'un overlay qui prend en compte la localisation des noeuds." Supervised by Marin Bertier.

Vincent L'Honore; 10 July 2013 to 2 August 2013. "The development of the mobile-based Android application of MEDIEGO Dashboard." Supervised by Antoine Boutet.

Yahya Benkaouz; 1 December 2013 to 28 February 2014. "La conception et la mise en œuvre d'un réseau social décentralisé respectant la vie privée des utilisateurs et son intégration dans le système Gossple." Supervised by Anne-Marie Kermarrec.

8.4.3. Visits to international teams

George Giakkoupis visited University of Calgary, Canada, twice, from 15 April to 6 May and from 23 November to 14 December. He also visited MPI, Saarbrücken, Germany, from 3 to 9 August.

Anne-Marie Kermarrec was a part-time visiting professor at EPFL, Lausanne.

Anne-Marie Kermarrec visited University of Sydney and NICTA, Australia, Jan 2014.

ATLANMOD Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

Program: Pole Images et Reseaux - Appel Projets PME 2011

Project title: StreamMaster

Duration: 2012 - 2014

Coordinator: Data Syscom

Other partners: Research and University (University of 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.

Program: Pays de la Loire regional funding. Call: Creation of new teams

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.

8.2. National Initiatives

8.2.1. FUI

Program: FUI - AAP 15

Project acronym: MoNoGe

Project title: Atelier de Modélisation de Nouvelle Génération

Duration: 2013 - 2016

Coordinator: Softeam

Other partners: Industry (DCNS), Research and University (ARMINES AtlanMod, LIP6) and Vendors and service providers (Softeam, Soft-Maint, Mia-Software)

Abstract: There is currently in companies a wide diversity of models and modeling tools according to the application domains, services or contexts which are concerned. This implies different problems forbidding their plain exploitation: traceability, global coherence, continuity between works, knowledge management, etc. All are largely penalized by this situation that harms the mastering of the complexity of the related systems and software. The MoNoGe project has for objective to bring innovative solutions allowing to ensure the agility of the models and modeling tools. The term agility is here referring to the properties of interoperability, extensibility and evolution of models. The dynamic extension mechanism to be developed in MoNoGe, potentially inspiring from the OMG MEF standard currently under definition, is intended to preserve the original metamodel which can be conserved, partially hidden or extended. Thus, the legacy data and models can stay operational with the extended metamodel. The user does not have to deal with heavy migration or conversion operations, and can this way focus on its modeling activities while continuously exploiting past models.

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.

Program: FUI - AAP 13

Project acronym: ITM Factory

Project title: Information Technology Modernisation Factory

Duration: 04/2012 - 10/2014

Coordinator: Soft-Maint (Groupe SODIFRANCE)

Other partners: Mia-Software (Groupe SODIFRANCE), ACAPNOS, MMA and Inria AtlanMod.

Abstract: Application maintenance represents about 80 per cent of the computer market (at the French and global level). The challenge of software maintenance is to keep running applications with technologies that are no longer required to be maintained and with changing development teams and whose skills are not always validated on ancient languages. The main goal of the ITM Factory is to propose a software modernization framework, based on the ModDisco project and including: (i) an integrated workbench for software modernization engineers and (ii) a set of ready to use modernization cartirdges, i.e., a solution brick that meets a business challenge level, as opposed to a technical bricks that provides technical solutions that are integrated into a business solution.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. ARTIST

Type: COOPERATION

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

Instrument: Integrated Project

Duration: October 2012 - September 2015

Coordinator: Clara Pezuela (ATOS Spain)

Partner: ATOS and TECNALIA (Spain), Inria AtlanMod (France), Fraunhofer (Germany), TU Wien and Sparks (Austria), ENGINEERING (Italy), Spikes (Belgium), ATC and ICCS (Greece)

Inria contact: Hugo Bruneliere

Abstract: Nowadays Cloud Computing is considered as the ideal environment for engineering, hosting and provisioning applications. A continuously increasing set of cloud-based solutions is available to application owners and developers to tailor their applications exploiting the advanced features of this paradigm for elasticity, high availability and performance. Even though these offerings provide many benefits to new applications, they often incorporate constrains to the modernization and migration of legacy applications by obliging the use of specific development technologies and explicit architectural design approaches. The modernization and adaptation of legacy applications to cloud environments is a great challenge for all involved stakeholders, not only from the technical perspective, but also in business level with the need to adapt the business processes and models of the modernized application that will be offered from now on, as a service. The purpose of the ARTIST project is to propose and develop a novel model-driven approach for the migration of legacy applications in modern cloud environments which covers all aspects and phases of the migration process, as well as an integrated framework that supports all migration process.

8.3.1.2. MONDO

Title: Scalable Modelling and Model Management on the Cloud

Type: COOPERATION (ICT)

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

Instrument: Small or medium-scale focused research project (STREP)

Duration: November 2013 - May 2016

Coordinator: The Open Group - X/Open Company

Partners: The Open Group - X/Open Company (United Kingdom), University of York (United Kingdom), Universidad Autonoma de Madrid (Spain), Budapest University of Technology and Economics (Hungary), IKERLAN (Spain), MIA Software (France), Cassidian (Germany)

Inria contact: Massimo Tisi

Abstract: As Model Driven Engineering (MDE) is increasingly applied to larger and more complex systems, the current generation of modelling and model management technologies are being pushed to their limits in terms of capacity and efficiency, and as such, additional research is imperative in order to enable MDE to remain relevant with industrial practice and continue delivering its widely recognised productivity, quality, and maintainability benefits. The aim of MONDO is to tackle the increasingly important challenge of scalability in MDE in a comprehensive manner. Achieving scalability in modelling and MDE involves being able to construct large models and domain specific languages in a systematic manner, enabling teams of modellers to construct and refine large models in a collaborative manner, advancing the state-of-the-art in model querying and transformations tools so that they can cope with large models (of the scale of millions of model elements), and providing an infrastructure for efficient storage, indexing and retrieval of large models. To address these challenges, MONDO brings together partners with a long track record in performing internationally-leading research on software modelling and MDE, and delivering research results in the form of robust, widely-used and sustainable open-source software, with industrial partners active in the fields of reverse engineering and systems integration, and a global consortium including more than 400 organisations from all sectors of IT.

8.3.1.3. Automobile

Title: Automated Mobile App Development

Type: Research For SMEs

Duration: November 2013 - October 2015

Coordinator: WebRatio s.r.l.

Partners: WebRatio, Politecnico di Milano (ITaly), AtlanMod-Armines, Moon Submarine (UK), ForwardSoftware (Rumania).

Inria contact: Jordi Cabot

Abstract:The AutoMobile project aims at designing and bringing to the market innovative methodologies, software tools, and vertical applications for the cost-effective implementation of cross-platform, multi-device mobile applications, i.e. business applications that can be accessed by users on a variety of devices and operating systems, including PC, cellular / smart phones and tablets.

Cross-platform and multi-device design, implementation and deployment is a barrier for today's IT solution providers, especially SME providers, due to the high cost and technical complexity of targeting development to a wide spectrum of devices, which differ in format, interaction paradigm, and software architecture.

AutoMobile will exploit the modern paradigm of Model-Driven Engineering and code generation to dramatically simplify multi-device development, reducing substantially cost and development times, so as to increase the profit of SME solution providers and at the same time reduce the price and total cost of ownership for end-customers.

AutoMobile will rely on modeling languages such as IFML (Interaction Flow Modeling Languages) and on tools like WebRatio.

8.3.2. Collaborations in European Programs, except FP7

Program: CORE Multi-annual thematic research programme. Fonds National de la Recherche Luxembourg.

Project acronym: TOOM

Project title: Testing Orders of Magnitude

Duration: September 2013 - August 2015

Coordinator: SnT/University of Luxembourg

Other partners: the iTrust company, EBRC, Inria Rennes/University of Nantes and the UFPR (Brazil).

Abstract: Over the last decade, large-scale systems drew much attention due to scalability and resiliency features. Many popular large-scale data-oriented systems (i.e., BigData), including, Peer-to-peer (P2P) and MapReduce, reached millions of users and processed petabytes of data, such as: Hadoop, Skype, Bittorrent, and Gnutella. The main reason is due to a decentralized manner to remove potential performance bottlenecks and centralized points of failure. Recently, cloud computing is gathering all these BigData systems underneath its layers (e.g. Paas, Saas, Iaas) to free developers from large-scale issues, such as: deployment, distribution, resiliency, security, and performance. Several companies around the globe rely on cloud computing to build robust and reliable services for their business operations (e.g. eBay, Amazon, Skype) mainly to handle heavy load conditions (e.g. seasonal sales, Internet-scale malicious attacks). Testing robustness and reliability of cloud computing services is a hard activity, the state of the art shows that the existing testing techniques suffer to handle aspects, such as: the scale of the cloud, the dynamism of the nodes, and the amount of data and load. In general, these testing techniques rely on a combination of unit tests with some mocking approach that may hide the cloud aspects and may not be suited for large-scale testing. The TOOM project is planned to present a solution for testing robustness of cloud computing services built on top of P2P technology to address scalability and dynamism aspects. The main contributions lie on two main steps. The first one is to validate the overall resilience and reliability of cloud services. The second one is to reproduce large-scale stress loads, such as Distributed Denial of Service (DDoS) and peak loads, either gathered from the real load traces or synthetically generated. We plan to leverage data warehouse technology to house real load traces and use them during testing. To generate synthetic loads, we plan to use known load patterns or adapt them to new load trends. To assess the effectiveness of the TOOM outcomes, we will reproduce stress loads submitted by P2P technology across the cloud infrastructure on top of step-stress testing methodologies. In this manner, we can progressively increase the load in orders of magnitude up to a peak load. Then, we will measure the effectiveness either by code coverage whether the SUT is open-source, by the quality of service (QoS) of the SUT, or by the coverage of network and computing components used by the cloud computing services.

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal 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

8.5. International Research Visitors

8.5.1. Visits of International Scientists

This year, the following visitors did a research stay with AtlanMod:

- Galina Besova (University of Paderborn, Germany), May-July
- Javier Criado (University of Almeria, Spain), October

8.5.1.1. Internships

Camilo Alvarez

Subject: Transformations from Legacy Models to the Cloud

Date: from Apr 2013 until Aug 2013

Institution: University of Los Andes (Colombia)

Matthieu Allon

Subject: Interoperability and traceability between modeling languages and standards

Date: from February 2013 until Aug 2013

Institution: University of Science and Technology of Nantes (France)

8.5.2. Visits to International Teams

No long term visits.

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 shared 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 project is conducted in cooperation with Télécom Bretagne and Université de Rennes I. The PhD of Julien Lolive (co-supervised by Sébastien Gambs and Caroline Fontaine), which deals with the entwining of identification and privacy mechanisms, is funded by the POSEIDON project.
- **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). Deepak Subramanian is doing his PhD in the context of this project.
- **Labex COMINLAB contract (2013-2016): "DeSceNt"**

  In DeSceNt, we propose to investigate how decentralized home-based networks of plug computers can support personal clouds according to sound architectural principles, mechanisms, and programming abstractions. To fulfill this vision we see three core scientific challenges, which we think must be overcome. The first challenge, decentralized churn-poor design, arises from the nature of plug federations, which show much lower levels of churn than traditional peer-to-peer environments. The

second challenge, quasi-causal consistency, is caused by the simultaneous needs to produce a highly scalable environment (potentially numbering millions of users), that also offers collaborative editing capabilities of mutable data-structures (to offer rich social interactions). The third and final challenge, intuitive data structures for plug programming, arises from the need by programmers for intuitive and readily reusable data-structures to rapidly construct rich and robust decentralized personal cloud applications.

This study is conducted in cooperation with other teams (GDD Team (University of Nantes), EPI ASAP)

8.2. National Initiatives

8.2.1. ANR

- **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 I, 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 I.

8.2.2. Inria Project Labs

- **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, LAAS-CNRS, Université de Rennes I, 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 I, Inria and Supélec.

8.2.4. Competitivity Clusters

The AMORES project (ANR INS 2011, http://www.images-et-reseaux.com/en/content/amores) is recognized by the Images & Réseaux cluster.

8.3. European Initiatives

8.3.1. FP7 Projects

The **PANOPTESEC** project started on the 1st of November 2013. It deals with the automated and assisted security management of SCADA system. The main objective of PANOPTESEC is to provide an integrated solution that will allow to efficiently monitor SCADA systems, detect intrusions and react to them. To that end, it encompasses many of the research topics that are addressed by the CIDre team: alerts aggregation and correlation, policy-aware intrusion detection, architecture-aware intrusion detection, automated trust management, trust-based automated reaction and visualization. The CIDre team is envolved in the project on all of these aspects. The partners are REHA, Alcatel-Lucent Bell Labs France, Epistematica, The university of Rome, the university of Hamburg, the institut Mines-Telecom, ACEA and Supelec.

8.3.2. Collaborations in European Programs, except FP7

Program: EIT ICT labs

Project acronym: “Privacy, security and trust in information society” action line

Project title: “Security and privacy for location-based services” activity

Duration: January 2012 - December 2013

Coordinator: Sébastien Gambs

Other partners: KTH (Sweden), Privatics Inria team (France), Alcatel-Lucent (France), University of Trento (Italy), DFKI (Germany).

Abstract: The main objective of this activity is to address the issues of privacy and security for location-based services. More precisely, the main outcomes of this activity are (1) secure and privacy-preserving implementations of location-based services (for instance traffic monitoring), (2) tools to raise the public awareness about the privacy issues in such context but also to help a user to prevent/limit privacy leaks (thus contributing to the protection of privacy), (3) demonstrators to secure the position of an individual and (4) the application of the results and findings of the activity to other thematic Action Lines of EIT ICT labs.

MYRIADS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. 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 propose building distributed operating systems as sets of adaptable services. This project funds 50% of a PhD grant (Djawida Dib). In 2013, we have worked on the design and implementation of Meryn [24], a flexible PaaS system that supports dynamically resizing virtual clusters to satisfy SLAs involving completion time and prices.

8.2. National Initiatives

8.2.1. 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 were 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 AVALON and RUNTIME INRIA EPI, IRIT and EDF R&D. This project funds a research engineer (Yann Radenac). In 2013, 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.

8.2.2. MIHMES ANR Investissements d'Avenir (2012 - 2018)

Participants: Yvon Jégou, Christine Morin.

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 2013, we interacted with the INRA/BioEpAR research team in order to improve the initial software prototype and to make it ready for parallelisation. The code has been re-written in C++. In 2014, Inria is in charge of developing a parallel version of the code.

8.2.3. HEMERA Inria AEN (2010-2013)

Participants: Bogdan Florin Cornea, Yvon Jégou, Christine Morin, Anne-Cécile Orgerie.

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. Anne-Cécile Orgerie is involved in the "Energy" working group which is currently looking at making energy-aware experiments on Grid'5000 easier for the users. This project funds Bodgan Florin Cornea's postdoc.

8.2.4. Inria ADT Aladdin (2008-2013)

Participants: 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).

As governing body of Grid'5000, it was superseded by a national GIS (Scientific interest group) that was signed in 2012.

As the host of engineers contributed to Grid'5000's technical team by INRIA, it finished operating in 2013. Two engineers of this technical team who are SED [7] members are still hosted in the Myriads team: David Margery, technical director and Pascal Morillon. Pascal Morillon is the chief engineer for all tasks automating Grid'5000 administration.

8.2.5. Inria ADT Snooze (2012-2014)

Participants: Eugen Feller, 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 wide community.

In 2013, we validated Snooze at large scale on the Grid'5000 testbed. A poster was presented at CCGRID 2013 [35] and the results of the study were awarded the second prize at CCGRID2013 scale challenge [26]. We introduced the Apache Casssandra system as database backend in Snooze. We have also started to refactor some parts of the code to enable the use of plugins. We implemented an EC2 interface and a web GUI. Puppet recipes were also released as well as a capistrano based deployment script for Grid'5000.

8.2.6. 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, data centers, and any ICT equipment in use in public research organizations.

8.2.7. CominLabs EPOC project (2013-2016)

Participants: Sabbir Hasan, Yunbo Li, Anne-Cécile Orgerie, Jean-Louis Pazat.

In this project, partners aim at focusing on energy-aware task execution from the hardware to application's components in the context of a mono-site data center (all resources are in the same physical location) which is connected to the regular electric Grid and to renewable energy sources (such as windmills or solar cells). In this context, we tackle three major challenges:

- Optimizing the energy consumption of distributed infrastructures and service compositions in the presence of ever more dynamic service applications and ever more stringent availability requirements for services.
- Designing a clever cloud's resource management which takes advantage of renewable energy availability to perform opportunistic tasks, then exploring the trade-off between energy saving and performance aspects in large-scale distributed systems.
- Investigating energy-aware optical ultra high-speed interconnection networks to exchange large volumes of data (VM memory and storage) over very short periods of time.

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

8.2.8. IRT B-Com

Participants: Yvon Jégou, Jean-Louis Pazat, Édouard Outin.

Yvon Jégou and Jean-Louis Pazat are at IRT B-Com [8] one day per week, Yvon Jégou since October 1st and Jean-Louis Pazat since September 1st. With Édouard Outin, B-com phd student, they contribute to the B-Com Indeed project which aims at developing a distributed cloud software stack with a high degree of adaptability.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. CONTRAIL

Type: COOPERATION

Defi: Internet of Services, Software & Virtualisation

Instrument: Integrated Project

Objectif: Internet of Services, Software and Virtualisation

Duration: October 2010 - September 2013

Coordinator: Inria

Partner: 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; Linagora, France.

Inria contact: Christine Morin

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 [39].

In 2013, we led the evaluation of Contrail software stack [57]. We also completed the design and implementation of VEP [56], [51] advanced features such as the reservation manager and scheduler. We defined a revised version of the API and implemented the CIMI interface. We ported VEP on top of the OpenStack IaaS management system. 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. Christine Morin leads WP 10 on Contrail global architecture. Yvon Jégou leads WP 5 on VEP and WP 13 on testbeds.

8.3.1.2. BonFIRE

Type: COOPERATION

Defi: Future internet experimental facility and experimentally-driven research

Instrument: Integrated Project

Objectif: ICT-2009.1.6

Duration: June 2010 - December 2013

Coordinator: Atos Spain SA (Spain)

[8] http://b-com.org/wp/

Partner: 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.);

Inria contact: David Margery

Abstract: The BonFIRE (Building service testbeds for Future Internet Research and Experimentation) project has designed, built and operated 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.

8.3.1.3. PaaSage

Type: COOPERATION

Objectif: ICT-2011.1.2 Cloud Computing, Internet of Services and Advanced Software Engineering

Instrument: Collaborative Project

Duration: October 2012 - September 2016

Coordinator: GEIE ERCIM (France)

Partner: SINTEF (Norway), Science and Technology Facilities Council (UK), University of Stuttgart (Germany), Inria (France), Centre d'Excellence en Technologies de l'Information et de la Communication (Belgium), Foundation for Research and Technology Hellas (Greece), BE.Wan SPRL (Belgium), EVRY AS (Norway), SysFera SAS (France), Flexiant Limited (UK), Lufthansa Systems AG (Germany), Gesellschaft fur Wissenschaftliche Datenverarbeitung MBH Gottingen (Germany), Automotive Simulation Center Stuttgart (Germany), University of Ulm (Germany), Akademia Górniczo-Hutnicza im. Stanisława Staszica (Poland), University of Cyprus (Cyprus), IBSAC-Intelligent Business Solutions ltd (Cyprus), University of Oslo (Norway)

Inria contact: Nikos Parlavantzas

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

Abstract: PaaSage aims to deliver an open and integrated platform to support both deployment and design of Cloud applications, together with an accompanying methodology that allows model-based application development, configuration, optimisation, and deployment on multiple Cloud infrastructures.

8.3.1.4. Fed4FIRE

Type: COOPERATION

Defi: Future internet experimental facility and experimentally-driven research

Instrument: Integrated Project

Objectif: ICT-2011.1.6 Future Internet Research and Experimentation (FIRE) with a specific focus on b) FIRE Federation

Duration: June 2010 - December 2013

Coordinator: ATOS SPAIN SA (Spain)

Partner: Interdisciplinary institute for broadband technology (iMinds, Belgium), University of Southampton (It Innovation, United Kingdom) Universite Pierre et Marie Curie - paris 6 (UPMC, France) Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung e.v (Fraunhofer, Germany) Technische Universitat Berlin (TUB, Germany) The University of Edinburgh (UEDIN, United Kingdom) National Ict Australia Limited (NICTA, Australia) Atos Spain SA (Atos, Spain) Panepistimio Thessalias (University of Thessaly) (UTH, Greece) National Technical University of Athens (NTUA, Greece) University of Bristol (UNIVBRIS, United Kingdom) Fundacio Privada i2cat, Internet I Innovacio Digital a Catalunya (i2cat, Spain) Eurescom-European Institute for Research and Strategic Studies in Telecommunications (EUR, Gmbh Germany) Delivery of Advanced Network Technology to Europe limited (DANTE limited, United Kingdom) Universidad de Cantabria (UC, Spain) National Information Society agency (NIA, Korea (republic of))

Inria contact: David Margery

Abstract: In Fed4FIRE, we investigate the means by which our experimental platforms (BonFIRE, and in a secondary way Grid'5000) could be made interoperable with a wider eco-system of experimental plateforms in Europe and beyond. The baseline architectural choice for this project is to use the key concepts of the Slice Federation Architecture (SFA) to provision resources on experimental platforms, a Control and Management Framework for Networking Testbeds named OMF for experiment control and OML, the OMF Measurment library for data collection. We investigate whether these can be used to run experiments on BonFIRE and how they need to be extended to support to operating model of BonFIRE.

8.3.1.5. ECO2Clouds

Type: COOPERATION

Defi: Future internet experimental facility and experimentally-driven research

Instrument: Specific Targeted Research Project

Objectif: ICT-2011.1.6 – Target outcome c) FIRE Experimentation

Duration: October 2012 - September 2014

Coordinator: Atos Spain SA (Spain)

Partner: Atos Spain SA (ATOS, Spain) The University of Manchester (UNIMAN, United Kingdom) The University of Edinburgh (UEDIN, United Kingdom) Universitaet Stuttgart (USTUTT, Germany) Politecnico di Milano (POLIMI, Italy)

Inria contact: David Margery

Abstract: In ECO_2Clouds, we add to BonFIRE energy probes to be able to measure power consumption of the infrastructure, combine it with information about energy sources used to produce the power so as to be able to bill Co_2 usage to experimenters running VMs. To allow for scheduling and adaptation of running applications, CO_2 usage is not only billed after the fact but also quoted in advance for a given period for according to resource usage units.

8.3.1.6. HARNESS

Type: COOPERATION

Defi: Pervasive and Trusted Network and Service Infrastructures

Instrument: Small or medium-scale focused research project

Objectif: ICT-2011.1.2 Cloud Computing, Internet of Services and Advanced Software Engineering

Duration: October 2012 - September 2015

Coordinator: Imperial College London (IMP, United Kingdom)

Partner: Ecole polytechnique fédérale de Lausanne (EPFL, Switzerland), Université de Rennes 1 (UR1, France), Konrad-Zuse-Zentrum für Informationtechniek Berlin (ZIB, Germany), Maxeler Technologies (MAX, United Kingdom), SAP AG (SAP, Germany)

UR1 contact: Guillaume Pierre

Abstract: The HARNESS FP7 project aims to incorporate innovative hardware and network technologies seamlessly into data centres that provide platform-as-a-service cloud infrastructures.

The dominant approach in offering cloud services today is based on homogeneous commodity resources: large numbers of inexpensive machines, interconnected by off-the-shelf networking equipment, supported by stock disk drives. However, cloud service providers are unable to use this platform to satisfy the requirements of many important and high-value classes of applications.

Today's cloud platforms are missing out on the revolution in new hardware and network technologies for realising vastly richer computational, communication, and storage resources. Technologies such as Field Programmable Gate Arrays (FPGA), General-Purpose Graphics Processing Units (GPGPU), programmable network routers, and solid-state disks promise increased performance, reduced energy consumption, and lower cost profiles. However, their heterogeneity and complexity makes integrating them into the standard Platform as a Service (PaaS) framework a fundamental challenge.

The HARNESS project brings innovative and heterogeneous resources into cloud platforms through a rich programme of research, validated by commercial and open source case studies.

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 April 2013, Anne-Cécile Orgerie presented a demonstration of Snooze system at the final COST workshop [36].

8.3.2.2. MC-DATA

Program: EIT ICT Labs

Project acronym: MC-DATA

Project title: Multi-Cloud Data Management

Duration: Jan 2013 - Dec 2014

Coordinator: Imperial College London (IMP, United Kingdom)

Other partners: Université de Rennes 1 (UR1, France), Konrad-Zuse-Zentrum für Informationtechniek Berlin (ZIB, Germany), Swedish Institute of Computer Science (SICS, Sweden), Vodafone (Germany)

Abstract: the MC-DATA project has two main innovation objectives: (a) to provide and release a novel open-source Platform-as-a-Service (PaaS) cloud computing software stack (MC-ConPaaS) that explicitly targets cloud application deployments across multiple data centers; (b) to demonstrate the business value of the MC-ConPaaS platform through a use case of cloud-assisted real-time smartphone applications, thus affecting the future business models of mobile operators.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. DALHIS

Title: Data Analysis on Large Heterogeneous Infrastructures for Science

Inria principal investigator: Christine Morin

International Partner:

Lawrence Berkeley National Laboratory (United States) - Advanced Computing for Science department led by Deb Agarwal

Duration: 2013 - 2015

See also: http://project.inria.fr/dalhis

The worldwide scientific community is generating large datasets at increasing rates causing data analysis to emerge as one of the primary modes of science. Existing data analysis methods, tools and infrastructure are often difficult to use and unable to handle the "data deluge". A scientific data analysis environment needs to address three key challenges: a) programmability: easily user composable and reusable programming environments for analysis algorithms and pipeline execution, b) agility: software that can adapt quickly to changing demands and resources, and, c) scalability: take advantage of all available resource environments including desktops, clusters, grids, clouds and HPC environments. The goal of the DALHIS associated team is to coordinate research and create together a software ecosystem to facilitate data analysis seamlessly across desktops, HPC and cloud environments. Specifically, our end goal is to build a dynamic environment that is user-friendly, scalable, energy-efficient and fault tolerant through coordination of existing projects. We plan to design a programming environment for scientific data analysis workflows that will allow users to easily compose their workflows in a programming environment such as Python and execute them on diverse high-performance computing (HPC) and cloud resources. We will develop an orchestration layer for coordinating resource and application characteristics. The adaptation model will use real-time data mining to support elasticity, fault-tolerance, energy efficiency and provenance. We will investigate how to provide execution environments that allow users to seamlessly execute their dynamic data analysis workflows in various research environments.

8.4.2. Inria International Partners

8.4.2.1. Informal International Partners

We collaborate on cloud computing with Stephen Scott, Professor at Tennessee Tech University (TTU) and researcher at Oak Ridge National Laboratory (ORNL). He visited Myriads team in September 2013 to investigate research directions for future joint work on cloud computing for scientific applications. We also collaborate on cloud computing with Kate Keahey from Argonne National Laboratory. She chairs the Contrail European project scientific advisory board. Nikos Parlavantzas is involved in an informal collaboration with Héctor Duran Limon, Professor at the University of Guadalajara, Mexico, who came for a 1 week visit in February 2013.

8.4.3. Inria International Labs

Christine Morin was the Inria@Silicon Valley scientific manager until August 2013. She co-organized with Eric Darve, professor at Stanford University and the Inria international relations department the Berkeley-Inria-Stanford workshop (BIS 2013) held at Stanford University in May 2013. Several Myriads team members (Eugen Feller, Christine Morin, Anne-Cécile Orgerie, Cédric Tedeschi) are involved in the DALHIS associate team on data analysis on large-scale heterogeneous infrastructures for science, which is part of the Inria@SiliconValley program. She was also involved in an informal collaboration with the CITRIS Social Apps Lab, led by James Holston and Greg Niemeyer from UC Berkeley. Collaboration opportunities between Inria and the Social Apps Lab on smart cities and social sustainability were investigated.

8.5. International Research Visitors

8.5.1. Visits to International Teams

Christine Morin was on sabbatical until August 2013 in the Advanced Computing for Science department at the Lawrence Berkeley National Laboratory (USA). Eugen Feller has been a post-doc in the Advanced Computing for Science department at the Lawrence Berkeley National Laboratory (USA) as part of the Inria@Silicon Valley program since February 2013. He is involved in the DALHIS associate team.

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. Nuage - (2012–2014)

Members: Non Stop Systems (NSS), Oodrive, Alphalink (Init SYS), CELESTE, DotRiver, NewGeneration, LIP6 (Regal et Phare)

Funding: Fonds National pour la Société Numérique, CDC

Objectives: The Nuage project aims at designing and building an open source, energy-aware, cloud based on OpenStack. In this project, the Regal group contributes on the storage axis. In clouds, virtualization forms the basis to ensure flexibility, portability and isolation. However, the price to pay for flexibility and isolation is memory fragmentation. We thus propose to pool unused memory by allowing nodes to use memory of other nodes to extend their cache, at the kernel level.

It involves a grant of 153 000 euros over 2,5 years.

7.1.3. ODISEA - (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.

7.1.4. Richelieu - (2012–2014)

Members: LIP6 (Regal), Scilab Entreprise, Silkan, OCaml Pro, Inria Saclay, Arcelor Mittal, CNES, Dassault Aviation.

Funding: FUI.

Objectives: The goal of Richelieu is to design a new runtime for the Scilab language based on VMKit. Scilab is a scientific language and its runtime relies on a costly interpretation loop. In the Richelieu project, we propose to replace the interpretation loop by VMKit, which provides both an efficient Just In Time Compiler and advanced memory management techniques.

It involves a grant of 135 000 euros from Region Ile de France over two years.

7.1.5. 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. It involves a grant of 155 000 euros from ANR to LIP6 over three years.

7.1.6. ConcoRDanT (2010–2014)

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. ConcoRDanT involves a grant of 192 637 euros from ANR to Inria over three and a half years.

7.1.7. STREAMS (2010–2014)

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. It involves a grant of 57 000 euros from ANR to Inria over three and a half years.

7.1.8. ABL - (2009–2013)

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

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.

ABL concluded in 2013 with the defense of the PhD thesis of Suman Saha in March and the publication of Saha's PhD work at the IEEE conference Dependable Systems and Networks (DSN) in June. At DSN, Saha received the William C. Carter Award for best student paper. This is the only best paper award given at DSN and was the first time that the recipient was from a French university. Saha has since taken a postdoc position jointly at Harvard and Lehigh Universities.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. SyncFree

Type: COOPERATION

Challenge: Pervasive and Trusted Network and Service Infrastructures

Instrument: Specific Targeted Research Project

Objectives: ICT-2013.1.2 "Software Engineering, Services and Cloud Computing," ICT-2013.1.6 "Connected and Social Media"

Duration: October 2013 - September 2016

Coordinator: Marc Shapiro (Inria)

Partners: Inria (Regal & Score), Basho Technologies Inc., Trifork A/S, Rovio Entertainment Oy, U. Nova de Lisboa, U. Catholique de Louvain, Koç U., Technische U. Kaiserslautern.

Inria contact: Marc Shapiro

Abstract: The goal of SyncFree is to enable large-scale distributed applications *without global synchronisation*, by exploiting the recent concept of *Conflict-free Replicated Data Types* (CRDTs). CRDTs allow unsynchronised concurrent updates, yet ensure data consistency. This radical new approach maximises responsiveness and availability; it enables locating data near its users, in decentralised clouds.

Global-scale applications, such as virtual wallets, advertising platforms, social networks, online games, or collaboration networks, require consistency across distributed data items. As networked users, objects, devices, and sensors proliferate, the consistency issue is increasingly acute for the software industry. Current alternatives are both unsatisfactory: either to rely on synchronisation

to ensure strong consistency, or to forfeit synchronisation and consistency altogether with ad-hoc eventual consistency. The former approach does not scale beyond a single data centre and is expensive. The latter is extremely difficult to understand, and remains error-prone, even for highly-skilled programmers.

SyncFree avoids both global synchronisation and the complexities of ad-hoc eventual consistency by leveraging the formal properties of CRDTs. CRDTs are designed so that unsynchronised concurrent updates do not conflict and have well-defined semantics. By combining CRDT objects from a standard library of proven datatypes (counters, sets, graphs, sequences, etc.), large-scale distributed programming is simpler and less error-prone. CRDTs are a practical and cost-effective approach.

The SyncFree project will develop both theoretical and practical understanding of large-scale synchronisation-free programming based on CRDTs. Project results will be new industrial applications, new application architectures, large-scale evaluation of both, programming models and algorithms for large-scale applications, and advanced scientific understanding.

7.2.2. Collaborations in European Programs, except FP7

Program: COST Action IC1001

Project acronym: Euro-TM

Project title: Transactional Memories: Foundations, Algorithms, Tools, and Applications

Duration: 2011–2014

Coordinator: Dr. Paolo Romano (INESC)

Other partners: Austria, Czech Republic, Denmark, France, Germany, Greece, Israel, Italy, Norway, Poland, Portugal, Serbia, Spain, Sweden, Switzerland, Turkey, United Kingdom.

Inria contact: Marc Shapiro

Abstract: Parallel programming (PP) used to be an area once confined to a few niches, such as scientific and high-performance computing applications. However, with the proliferation of multicore processors, and the emergence of new, inherently parallel and distributed deployment platforms, such as those provided by cloud computing, parallel programming has definitely become a mainstream concern. Transactional Memories (TMs) answer the need to find a better programming model for PP, capable of boosting developers' productivity and allowing ordinary programmers to unleash the power of parallel and distributed architectures avoiding the pitfalls of manual, lock based synchronization. It is therefore no surprise that TM has been subject to intense research in the last years. This Action aims at consolidating European research on this important field, by coordinating the European research groups working on the development of complementary, interdisciplinary aspects of Transactional Memories, including theoretical foundations, algorithms, hardware and operating system support, language integration and development tools, and applications.

7.2.3. Collaborations with Major European Organizations

Center for Informatics and Information Technologies (CITI) of Universidade Nova de Lisboa

Commutative Replicated Data Type (CRDT)

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Declared Inria International Partners

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

Members: Inria Paris Rocquencourt (REGAL), Inria Rhone-Alpes (Avalon), 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.

7.3.1.1.2. 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.

7.3.2. Participation in other International Programs

7.3.2.1. Improving Clone Detection for Systems Software, Merlion Project - (2013)

Members: Julia Lawall, Gilles Muller, Lisong Guo, Peter Senna Tschudin.

Funding: Institut Français de Singapour.

Objectives: Clone detection is a technique for finding similar code fragments scattered across a code base. Clone detection is potentially very relevant to operating systems code, as many operating system services, such as drivers for related devices, have similar functionalities, and thus similar implementations. Nevertheless, the application of clone detection to systems code has achieved only moderate success, finding clone rates of only 10-20% in Linux kernel code. The purpose of this project is to consider how clone detection can be more effectively used in systems code development, for *e.g.*, code understanding or bug finding.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

- Rachid Guerraoui, Professor, 1 month from EPFL, Switzerland.
- Kenji Kono, Professor, 3 months from University Keio, Japan.
- David Lo, Assistant Professor, 1 week, and Yuan Tian, PhD student, 1 month, both from Singapore Management University, in the context of a Merlion France-Singapore collaboration grant.
- Luis R. Rodriguez, 2 months, from Qualcomm, USA.

7.4.2. Internships

Participant: Dang Nhan Nguyen.
Subject: Scalable old-generation garbage collection for NUMA multicores.
Date: from Jan 2013 until Jun 2013
Institution: Chalmers U. (Sweden)

Participant: Mudit Verma.
Subject: Relaxed synchronization for library datatypes in NUMA multicores.
Date: from Jan 2013 until Jun 2013
Institution: Int. Masters in Distr. Computing / KTH (Sweden)

Participant: Burcu Külahçioglu Özkan.
Subject: Verifying distributed systems based on CRDTs
Date: from Jan 2013 until Jun 2013
Institution: Koç U., Turquie.

7.4.3. Visits to International Teams

- Julia Lawall, 2 weeks, to Singapore Management University, in the context of a Merlion France-Singapore collaboration grant.

SCORE Team

6. Partnerships and Cooperations

6.1. National Initiatives

6.1.1. 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, 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 metadata).

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.

6.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2014)

Participants: Gérald Oster [coordinator], Luc André, Claudia-Lavinia Ignat, Stéphane Martin, 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 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 issue 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.

6.1.3. 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. Our work in the Kolflow project focus on implementing knowledge base testing strategies [23].

6.1.4. 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 allows to design and deploy applications based on proven technologies provided by partners such as collaborative messaging systems, integration and workflow technologies that will be extended in order to address Cloud Computing requirements. Available as an open-source Enterprise Social Network, 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).

6.2. European Initiatives

6.2.1. FP7 Projects

6.2.1.1. SyncFree FP7-ICT 609551 (2013–2016)

Participants: Pascal Urso [contact], Jordi Martori.

Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), SCORE team, Trifork A/S (Denmark), Universidade Nova de Lisboa (Portugal), Technische Universität Kaiserslautern (Germany), Basho Technologies (United Kingdom), Rovio Entertainment (Finland), Université Catholique de Louvain (Belgium), Koç Üniversitesi (Turkey)

Website: https://syncfree.lip6.fr/

SyncFree FP7-ICT project brings together academic researchers and industrial practitioners to explore new approaches to data consistency at a massive scale. On-line services including social networks and multi-player games handle huge quantities of frequently changing shared data. Maintaining its consistency is simple in a centralised cloud, but no longer possible due to increased scalability requirements. Instead, data must be replicated across several distributed data centers, requiring new principled approaches.

In this context, SCORE team is interested in designing new and useful replicated data types and in evaluating their performance and behaviour using the massive corpus of real-usage data provided by industrial partners.

6.2.2. Collaborations in European Programs, except FP7

Program: EIT ICT Labs

Project acronym: CityCrowdSource

Project title:

Duration: 12 months 2013 - 2013

Coordinator: Thomas Silverston

Other partners: BMU (Hungary), Imperial College London (UK), SAP (Germany), Cap Digital (France)

Abstract: This activity aims at leveraging the potential of crowd-based applications in urban contexts. Crowd-based data collection in combination with official data will lead to a vastly improved coverage and quality of digital information for urban areas.The added-value of the proposal is in : (1) the three services: trust, privacy and crowd processes modelling that are not present in any crowd-sourcing platform available today, (2) the deployment and of these services on top of different crowd-sourcing platforms and (3) the experimentation of these platforms in real life city scenarios. To this end, the activity combines Test bed, Open Source and Living labs catalysts.

6.3. International Initiatives

6.3.1. Inria Associate Teams

6.3.1.1. USCOAST

Title: User Studies on Trustworthy Collaborative Systems

Inria principal investigator: Claudia-Lavinia Ignat

International Partner:

Wright State University (United States of America) - Department of Psychology - Valerie SHALIN

Duration: 2013 - 2015

See also: http://uscoast.loria.fr/

USCoast has, as main objective, the validation of trustworthy collaborative systems using experimental user studies. This type of validation requires the expertise of both computer scientists that designed the systems and social scientists for conceptualizing and measuring human behaviour in collaborative work. The project focuses on the real-time requirements and trust policies in collaborative editing, resulting in a theory for the effect of real-time constraints in collaborative editing and awareness management for the coordination of work in the presence of conflict and disruption. The project includes also validation of proposed light security mechanisms for decentralised collaboration, based on posted measures of voluntary compliance with data sharing restrictions. We will develop new methods for the cost-effective evaluation of collaborative work to compensate for otherwise unrealistic sample sizes and costly engineering, using game theory to inspire task analogues and simulated users along with human users.

6.4. International Research Visitors

6.4.1. Visits of International Scientists

6.4.1.1. Internships

Meagan Aldridge

Subject: Experimental user studies of real-time collaborative systems

Date: from June 2013 until October 2013

Institution: Wright State University, Department of Psychology, United States of America

6.4.1.2. Invited researchers

Participant: Valerie Shalin.

Subject: Experimental user studies of real-time collaborative editing and trust-based collaboration

Date: from May 2013 until June 2013 and from October 2013 until May 2014 (sabbatical)

Institution: Wright State University, Department of Psychology, United States of America

Participant: Weihai Yu.

Subject: Collaborative editing algorithms

Date: from September 2013 until July 2014 (sabbatical)

Institution: University of Tromsø, Department of Computer Science, Norway

ALGORILLE Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

CPER MISN, EDGE project (2010-2013, 518k€). 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.

7.2. National Initiatives

7.2.1. 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.

ANR SONGS (2012–2015, 1800k€) Martin Quinson is also the principal investigator of 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 sets it as the reference in its domain (see Section 6.3.1).

7.2.2. 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.

ADT Cosette (2013-2015, AlGorille is the only partner, 120k€), for *COherent SET of Tools for Experimentation* aims at developing or improving a tool suite for experimentation at large scale on testbeds such as Grid'5000. Specifically, we will work on (1) the development of Ruby-CUTE, a library gathering features useful when performing such experiments; (2) the porting of Kadeploy, Distem and XPFlow on top of Ruby-CUTE; (3) the release of XPFlow, developed in the context of Tomasz Buchert's PhD; (4) the improvement of the Distem emulator to address new scientific challenges in Cloud and HPC. 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.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. FED4FIRE

Participant: Lucas Nussbaum.

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.

Lucas Nussbaum started participating in the project in September 2013, mainly with an expert role.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Internships

Maximiliano Geier

Subject: Leveraging multiple experimentation methodologies to study P2P broadcast

Date: from Sep 2012 until Mar 2013

Institution: University of Buenos Aires (Argentina)

Ahmed Bessifi

Subject: Reliability and Scalability improvements in Kadeploy

Date: from Mar 2013 until Aug 2013

Institution: Université de Tunis El Manar - Faculté des Sciences (Tunisia)

Luis Esteban Campostrini

Subject: Formal Verification of Distributed Algorithms

Date: from May 2013 to Oct 2013

Institution: Universidad National de Rosario (Argentina)

Rodrigo Campos

Subject: Ordered Read-Write Locks on Multicore Architectures

Date: from Mar 2013 until Aug 2013

Institution: University of Buenos Aires (Argentina)

ALPINES Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. PETALh

ANR Cosinus project - *PETascale ALgorithms for preconditioning for scientific applications* January 2011 - September 2013 (http://petal.saclay.inria.fr/). The global cost of the project is $1,350,910$, the funding from ANR is $304,232$. The total personne.mois is 140. Collaboration with Laboratoire Lions - UPMC, IFPEN, Inria Bordeaux and CEA, UC Berkeley. This project can be seen as a continuation of ANR funded PETAL project, the goal is to design parallel algorithms for the preconditioning techniques proposed during PETAL suitable for heterogeneous architectures based on multicore processors and accelerators.

8.1.1.2. Medimax

ANR-MN (Modèles Numériques) October 2013 - September 2017

The main goal is the methodological and numerical development of a new robust inversion tool, associated with the numerical solution of the electromagnetic forward problem, including the benchmarking of different other existing approaches (Time Reverse Absorbing Condition, Method of Small-Volume Expansions, Level Set Method). This project involves the development of a general parallel open source simulation code, based on the high-level integrated development environment of FreeFEm++, for modeling an electromagnetic direct problem, the scattering of arbitrary electromagnetic waves in highly heterogeneous media, over a wide frequency range in the microwave domain. The first applications considered here will be medical applications: microwave tomographic images of brain stroke, brain injuries, from both synthetic and experimental data in collaboration with EMTensor GmbH, Vienna (Austria), an Electromagnetic Medical Imaging company.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. EXA2CT

Type: COOPERATION

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: September 2013 - August 2016

Coordinator: Imec, Belgium

Partner: UA Belgium, USI Switzerland, Intel France, NAG England, UVSQ France, T-Systems SfR Germany, IT4Inovations Czech Republic.

Inria contact: Luc Giraud

Abstract: The goal of this project is to develop novel algorithms and programming models to tackle what will otherwise be a series of major obstacles to using a crucial component of many scientific codes at exascale, namely solvers and their constituents. The results of this work will be combined in running programs that demonstrate the application-targeted use of these algorithms and programming models in the form of proto-applications. The application targeting will be done by an analysis of a representative selection of scientific applications using solvers and/or the constituent parts that we target. The results of the project will be disseminated to the reference application owners through a scientific and industrial board (SIB), and board-partner specific code targeting

activities, to help generate momentum behind our approach in the HPC community. The proto-applications will serve as a proof-of-concept, a benchmark for doing machine/software co-design, and as a basis for constructing future exascale full applications. In addition, the use of the SIB is a means to extract the commonalities of a range of HPC problems from different scientific domains and different industrial sectors to be able to concentrate on maximising the impact of the project by improving precisely those parts that are common across different simulation needs.

Alpines role: in charge of the Task "Preconditioners" in the working group focusing on numerical algorithms.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. COALA Inria associated team, Alpines and UC Berkeley

COALA associated team https://who.rocq.inria.fr/Laura.Grigori/COALA2010/coala.html focuses on communication optimal algorithms for linear algebra. We have a long term collaboration with Prof. J. Demmel, which focuses currently on communication avoiding algorithms. Since 2010, this collaboration takes place in the context of COALA Inria Associated team, and every year students visit our groups in both directions.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

A collaboration focused on the theoretical and numerical analysis for the simulation of wave scattering by means of boundary integral formulation has been in place for several years between Xavier Claeys and the group of Ralf Hiptmair from the Seminar of Applied Mathematics at ETH Zürich.

8.3.3. Inria International Labs

Joint Laboratory for Petascale Computing, JLPC Etats-Unis. We take part in this joint effort, in the numerical libraries aspects of the joint laboratory. We collaborate and interact in particular with B. Gropp, UIUC, and J. Brown and M. Knepley, Argonne.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Euan Spence from the University of Bath visited Xavier Claeys for one week to discuss about his work on high frequency wave scatering, and to see wether this work could apply to the formulations developed by Xavier Claeys.
- Grey Ballard from U.C. Berkeley, USA, visit of 2 weeks in January 2013. In the context of COALA Inria associated team, Grey has visited us to finalize our joint work on the publication [6].

8.4.1.1. Internships

- Sebastien Cayrols, Master 2 student Paris 11 University, March - August 2013, supervisor L. Grigori. Sebastien worked on communication avoiding ILU0 preconditioner.
- Antoine Liandrat, Ecole Centrale Lyon 2nd year, June-July 2013, supervisor L. Grigori. Antoine has worked in the context of Petalh project.
- Clement Guerin, ENS Lyon, L3 student, Mai-Juin 2013, supervisor L. Grigori. Clement's objective was to understand some of the numerical problems in communication avoiding algorithms.

8.4.2. Visits to International Teams

- L. Grigori, visit to U.C. Berkeley for 1 month (August 2013) in the context of COALA Inria associated team.

AVALON Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. French National Fund for the Digital Society Project (FSN)

7.1.1.1. FSN XLcloud, 2012-2014

Participants: Jean-Patrick Gelas, Laurent Lefèvre, François 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.

7.1.2. French National Research Agency Projects (ANR)

7.1.2.1. ANR INFRA MOEBUS, Multi-objective scheduling for large computing platforms, 4 years, ANR-13-INFR-000, 2013-2016

Participants: Christian Perez, Laurent Lefèvre, Frédéric Suter.

The ever growing evolution of computing platforms leads to a highly diversified and dynamic landscape. The most significant classes of parallel and distributed systems are supercomputers, grids, clouds and large hierarchical multi-core machines. They are all characterized by an increasing complexity for managing the jobs and the resources. Such complexity stems from the various hardware characteristics and from the applications characteristics. The MOEBUS project focuses on the efficient execution of parallel applications submitted by various users and sharing resources in large-scale high-performance computing environments.

We propose to investigate new functionalities to add at low cost in actual large scale schedulers and programming standards, for a better use of the resources according to various objectives and criteria. We propose to revisit the principles of existing schedulers after studying the main factors impacted by job submissions. Then, we will propose novel efficient algorithms for optimizing the schedule for unconventional objectives like energy consumption and to design provable approximation multi-objective optimization algorithms for some relevant combinations of objectives. An important characteristic of the project is its right balance between theoretical analysis and practical implementation. The most promising ideas will lead to integration in reference systems such as SLURM and OAR as well as new features in programming standards implementations such as MPI or OpenMP.

7.1.2.2. 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 Perez, 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.

7.1.2.3. ANR COSINUS COOP, Multi Level Cooperative Resource Management, 3.5 years, ANR-09-COSI-001-01, 2009-2013
Participants: Frédéric Desprez, Christian Perez, Noua Toukourou.

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 Perez.

7.1.2.4. ANR INFRA SONGS, Simulation Of Next Generation Systems, 4 years, ANR-12-INFRA-11, 2012-2015
Participants: Frédéric Desprez, Georgios 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.

7.1.3. Inria Large Scale Initiative

7.1.3.1. HEMERA, 4 years, 2010-2014
Participants: Christian Perez, Laurent Pouilloux, Laurent Lefèvre.

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; L. Lefevre and L. Pouilloux are managing scientific challenges on GRID'5000.

7.1.3.2. C2S@Exa, Computer and Computational Sciences at Exascale, 4 years, 2013-2017
Participants: Frédéric Desprez, Christian Perez, Laurent Lefèvre.

Since January 2013, the team is participating to the C2S@Exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

7.1.4. Inria ADT

7.1.4.1. Inria ADT Aladdin, 4 years, 2008-2014

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

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). More information at Section 5.8 .

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. PRACE 2IP

Participants: Zhengxiong Hou, Vincent Lanore, Christian Perez.

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 2014

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.

7.2.1.2. PaaSage

Participants: Amine Bsila, Christian Perez, Jonathan Rouzaud-Cornabas.

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

7.2.2.1. SEED4C

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.

7.2.2.2. COST IC804

Participants: Ghislain Landry Tsafack Chetsa, Mohammed El Mehdi Diouri, Laurent Lefèvre.

Program: COST

Project acronym: IC804

Project title: : Energy efficiency in Large Scale Distributed Systems

Duration: 2009-2013

Coordinator: J.M. Pierson (IRIT Toulouse)

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.

7.2.2.3. COST IC0805

Participants: Ghislain Landry Tsafack Chetsa, Mohammed El Mehdi Diouri, Laurent Lefèvre.

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.

7.2.2.4. CHIST-ERA STAR

Participants: Laurent Lefèvre, Olivier Glück.

Title: SwiTching And tRansmission project

Type: CHIST-ERA (European Coordinated Research on Long-term Challenges in Information and Communication Sciences & Technologies ERA-Net)

Duration: 2013-2015

Coordinator: Jaafar Elmirghani (University of Leeds - UK)

Others partners: Inria ,University of Cambridge (UK), University of Leeds (UK), AGH University of Science and Technology Department of Telecommunications (Poland)

See also: http://www.chistera.eu/projects/star

Abstract: The Internet power consumption has continued to increase over the last decade as a result of a bandwidth growth of at least 50 to 100 times. Further bandwidth growth between 40% and 300% is predicted in the next 3 years as a result of the growing popularity of bandwidth intensive applications. Energy efficiency is therefore increasingly becoming a key priority for ICT organizations given the obvious ecological and economic drivers. In this project we adopt the GreenTouch energy saving target of a factor of a 100 for Core Switching and Routing and believe this ambitious target is achievable should the research in this proposal prove successful. A key observation in core networks is that most of the power is consumed in the IP layer while optical transmission and optical switching are power efficient in comparison, hence the inspiration for this project. Initial studies by the applicants show that physical topology choices in networks have the potential to significantly reduce the power consumption, however network optimization and the consideration of traffic and the opportunities afforded by large, low power photonic switch architectures will lead to further power savings. Networks are typically over provisioned at present to maintain quality of service. We

will study optimum resource allocation to reduce the overprovisioning factor while maintaining the quality of service. Protection is currently provided in networks through the allocation of redundant paths and resources, and for full protection there is a protection route for every working route. Avalon is contributing to STAR in terms of software network protocols and services optimizations which will be combined with more efficient photonic switches in order to obtain a factor of 100 power saving in core networks can be realised through this project with significant potential for resulting impact on how core photonic networks are designed and implemented.

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. GreenTouch

Participants: Laurent Lefèvre, 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 [62], [72] and participate in the SEASON project.

7.3.2. Inria International Labs

7.3.2.1. Inria-UIUC-NCSA Joint Laboratory for Petascale Computing

Participants: Eddy Caron, Frédéric Desprez, Mohammed El Mehdi Diouri, Olivier Glück, Vincent Lanore, Laurent Lefèvre, Christian Perez, 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.

CEPAGE Project-Team

7. Partnerships and Cooperations

7.1. 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 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.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. EULER

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), UniversitÃÂ© Pierre Marie Curie (UPMC), France
  Department of Mathematical Engineering (INMA) UniversitÃÂ© 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.

7.2.2. 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).

7.3. International Initiatives

7.3.1. Inria International Partners

- **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.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Tomasz Radzik, King's College London, UK, 02/12-06/12/2013

Miroslaw Korzeniowski, TU Wroclaw, Poland, 09/13-10/2013

Petra Berenbrink, Simon Fraser University, Burnaby, Canada, 22/10-26/10/2013

Joseph G. Peters, Simon Fraser University, Burnaby, Canada (Invited professor Bdx1) 24/01-24/02/2013

Carlos Ordonez, the University of Houston, USA (06-07/2013) supported by CNRS.

Dariusz Dereniowski, Gdansk University of Technology, Poland, 26/04-31/05/2013

Lukasz Kuszner, Gdansk University of Technology, Poland, 24/04-02/06/2013

Marcin Markiewicz, University of Gdansk, Poland, 02/09-15/09/2013

Leszek Gasieniec, University of Liverpool, UK, 24/09-27/09/2013

Jakub Lacki, University of Warsaw, Poland, 25/11-30/11/2013

Przemyslaw Uznanski, Universite de Marseille, France, 25/11-30/11/2013

7.4.1.1. Internships

Siddharth Mandal

Subject: Reliability Issues in Cloud Computing

Date: from May 2013 until Jul 2013

Institution: IIT Delhi (India)

Rohit Kumar

Subject: Robust Dynamic Allocation in Cloud Computing

Date: from May 2013 until Aug 2013

Institution: IIT Delhi (India)

GRAND-LARGE Project-Team

6. Partnerships and Cooperations

6.1. Regional Initiatives

- **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)

6.2. National Initiatives

6.2.1. ANR

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

6.3. European Initiatives

6.3.1. Collaborations in European Programs, except FP7

Program: ITEA

Project acronym: MANY

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

Duration: 09/2011 - 08/2014

Coordinator: XDIN

Other partners: France: Thales Communications and Security, CAPS Entreprise, Telecom SudParis; Spain: UAB; Sweden: XDIN; Korea: ETRI, TestMidas, SevenCore; Netherlands: Vector Fabrics, ST-Ericsson, TU Eindhoven; Belgium: UMONS.

Abstract: Adapting Industry for the for the disruptive landing of many-core processors in Embedded Systems in order to provide scalable, reusable and very fast sofware development.

6.4. International Initiatives

6.4.1. Inria International Labs

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

6.4.2. Participation In other International Programs

Stic AmSud: BioCloud-EEAmSud **Participants:** Christine Eisenbeis, Alessandro Ferreira Leite, Claude Tadonki.

BioCloud-EEAmSud is a cooperation project integrated by Brazil, Chile and France following the 2012 STIC-AmSud call. Partners in Brazil are Universidade de Brasilia, Universidade Federal Fluminense, and EMBRAPA-Genetic Resources and Biotechnology (CENARGEN), through the support of the Coordination of Improvement of Senior Staff of the Ministry of Education in Brazil (CAPES). In Chile, the main partner is Universidad de Santiago de Chile, through the support of the National Commission for Scientific and Technological Research of Chile (CONICYT). In France, the institutions involved are Mines ParisTech (CRI) and Inria-Saclay, through the support of the Ministry of Foreign and European Affairs (MAEE). The international project coordinator is Pr. Maria Emília Machado Telles Walter (UnB). Alessandro Ferreira Leite' thesis work is a joint University of Brazilia - université Paris-Sud 11 thesis and is partially supported by BioCloud-EEAmSud. Maria Emilia Machado Telles Walter and Alba Cristian de Melo visited Grand-Large in 2013, as well as Taina Rajol.

6.5. International Research Visitors

6.5.1. Internships

German Schinca

Subject: Minimizing communication in scientific computing

Date: from Sep 2012 until Mar 2013

Institution: University of Buenos Aires (Argentina)

HIEPACS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

8.1.1. PlaFRIM: an experimental parallel computing platform

PlaFRIM is an experimental platforme for research in modeling, simulations and high performance computing. This platform has been set up from 2009 under the leadership of Inria Bordeaux Sud-Ouest in collaboration with computer science and mathematics aboratories, respectively Labri and IMB with a strong support in the region Aquitaine.

It aggregates different kinds of computational resources for research and development purposes. The latest technologies in terms of processors, memories and architecture are added when they are available on the market. It is now more than 1,000 cores (excluding GPU and Xeon Phi) that are available for all research teams of Inria Bordeaux, Labri and IMB. This computer is in particular used by all the engineers who work in HiePACS and are advised by F. Rue from the SED.

The PlaFRIM platform initiative is coordinated by O. Coulaud and an application for its upgrade has been accepted.

8.1.2. Innovative simulation methods for large scale numeric prototypes on emerging architectures computers

Participants: Emmanuel Agullo, Olivier Coulaud, Aurélien Esnard, Mathieu Faverge, Luc Giraud, Abdou Guermouche, Pierre Ramet, Jean Roman.

Grant: Regional council
Dates: 2013 – 2015
Partners: EPIs REALOPT, RUNTIME from Inria Bordeaux Sud-Ouest, CEA-CESTA and l'Institut pluridisciplinaire de recherche sur l'environnement et les matériaux (IPREM) .
Overview: Numerical simulation is now integrated into all the design levels and the scientific studies for both academic and industrial contexts. Given the increasing size and sophistication of the simulations carried out, the use of parallel computing is inescapable. The complexity of such achievements requires collaboration of multidisciplinary teams capable of mastering all the necessary scientific skills for each component constituting the chain of expertise. In this project we consider each of these elements as well as efficient methods for parallel codes coupling. All these works is intended to contribute to the design large scale parallel multi-physics simulations. In addition to this research human activities the regional council also support some innovative computing equipment that will be embedded in the PlaFRIM experimental plateform, project led by Olivier Coulaud.

8.2. National Initiatives

8.2.1. Inria Project Lab

8.2.1.1. C2S@Exa - Computer and Computational Sciences at Exascale

Since January 2013, the team is participating to the C2S@EXA Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@EXA is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2.2. ANR

8.2.2.1. SOLHAR: SOLvers for Heterogeneous Architectures over Runtime systems

Participants: Emmanuel Agullo, Mathieu Faverge, Andra Hugo, Abdou Guermouche, Xavier Lacoste, Pierre Ramet, Jean Roman, Guillaume Sylvand.

Grant: ANR-MONU
Dates: 2013 – 2017
Partners: Inria (REALOPT, RUNTIME Bordeaux Sud-Ouest et ROMA Rhone-Alpes), IRIT/INPT, CEA-CESTA et EADS-IW.
Overview:

During the last five years, the interest of the scientific computing community towards accelerating devices has been rapidly growing. The reason for this interest lies in the massive computational power delivered by these devices. Several software libraries for dense linear algebra have been produced; the related algorithms are extremely rich in computation and exhibit a very regular pattern of access to data which makes them extremely good candidates for GPU execution. On the contrary, methods for the direct solution of sparse linear systems have irregular, indirect memory access patterns that adversely interact with typical GPU throughput optimizations.

This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computer equipped with accelerators. The ultimate aim of this project is to achieve the implementation of a software package providing a solver based on direct methods for sparse linear systems of equations. To date, the approaches proposed to achieve this objective are mostly based on a simple offloading of some computational tasks to the accelerators and rely on fine hand-tuning of the code and accurate performance modeling to achieve efficiency. This project proposes an innovative approach which relies on the efficiency and portability of runtime systems. The development of a production-quality, sparse direct solver requires a considerable research effort along three distinct axis:

- linear algebra: algorithms have to be adapted or redesigned in order to exhibit properties that make their implementation and execution on heterogeneous computing platforms efficient and reliable. This may require the development of novel methods for defining data access patterns that are more suitable for the dynamic scheduling of computational tasks on processing units with considerably different capabilities as well as techniques for guaranteeing a reliable and robust behavior and accurate solutions. In addition, it will be necessary to develop novel and efficient accelerator

implementations of the specific dense linear algebra kernels that are used within sparse, direct solvers;

- runtime systems: tools such as the StarPU runtime system proved to be extremely efficient and robust for the implementation of dense linear algebra algorithms. Sparse linear algebra algorithms, however, are commonly characterized by complicated data access patterns, computational tasks with extremely variable granularity and complex dependencies. Therefore, a substantial research effort is necessary to design and implement features as well as interfaces to comply with the needs formalized by the research activity on direct methods;
- scheduling: executing a heterogeneous workload with complex dependencies on a heterogeneous architecture is a very challenging problem that demands the development of effective scheduling algorithms. These will be confronted with possibly limited views of dependencies among tasks and multiple, and potentially conflicting objectives, such as minimizing the makespan, maximizing the locality of data or, where it applies, minimizing the memory consumption.

Given the wide availability of computing platforms equipped with accelerators and the numerical robustness of direct solution methods for sparse linear systems, it is reasonable to expect that the outcome of this project will have a considerable impact on both academic and industrial scientific computing. This project will moreover provide a substantial contribution to the computational science and high-performance computing communities, as it will deliver an unprecedented example of a complex numerical code whose parallelization completely relies on runtime scheduling systems and which is, therefore, extremely portable, maintainable and evolvable towards future computing architectures.

8.2.2.2. SONGS: Simulation Of Next Generation Systems

Participant: Abdou Guermouche.

Grant: ANR 11 INFRA 13
Dates: 2011 – 2015
Partners: Inria (Bordeaux Sud-Ouest, Nancy - Grand Est, Rhone-Alpes, Sophia Antipolis - Méditerranée), I3S, LSIIT
Overview:

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 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.

8.2.2.3. ANEMOS: Advanced Numeric for ELMs : Modeling and Optimized Schemes

Participants: Xavier Lacoste, Guillaume Latu, Pierre Ramet.

Grant: ANR-MN
Dates: 2012 – 2016
Partners: Univ. Nice, CEA/IRFM, CNRS/MDS.

Overview: The main goal of the project is to make a significant progress in understanding of largely unknown at present physics of active control methods of plasma edge MHD instabilities Edge Localized Modes (ELMs) wich represent particular danger with respect to heat and particle loads for Plasma Facing Components (PFC) in ITER. Project is focused in particular on the numerical modelling study of such ELM control methods as Resonant Magnetic Perturbations (RMPs) and pellet ELM pacing both foreseen in ITER. The goals of the project are to improve understanding of the related physics and propose possible new strategies to improve effectiveness of ELM control techniques. The tool for the non-linear MHD modeling is the JOREK code which was essentially developed within previous ANR ASTER. JOREK will be largerly developed within the present project to include corresponding new physical models in conjunction with new developments in mathematics and computer science strategy. The present project will put the non-linear MHD modeling of ELMs and ELM control on the solid ground theoretically, computationally, and applications-wise in order to progress in urgently needed solutions for ITER.

Regarding our contributions, the JOREK code is mainly composed of numerical computations on 3D data. The toroidal dimension of the tokamak is treated in Fourier space, while the poloidal plane is decomposed in Bezier patches. The numerical scheme used involves a direct solver on a large sparse matrix as a main computation of one time step. Two main costs are clearly identified: the assembly of the sparse matrix, and the direct factorization and solve of the system that includes communications between all processors. The efficient parallelization of JOREK is one of our main goals, to do so we will reconsider: data distribution, computation distribution or GMRES implementation. The quality of the sparse solver is also crucial, both in term of performance and accuracy. In the current release of JOREK, the memory scaling is not satisfactory to solve problems listed above , since at present as one increases the number of processes for a given problem size, the memory footprint on each process does not reduce as much as one can expect. In order to access finer meshes on available supercomputers, memory savings have to be done in the whole code. Another key point for improving parallelization is to carefully profile the application to understand the regions of the code that do not scale well. Depending on the timings obtained, strategies to diminish communication overheads will be evaluated and schemes that improve load balancing will be initiated. JOREK uses PaStiX sparse matrix library for matrix inversion. However, large number of toroidal harmonics and particular thin structures to resolve for realistic plasma parameters and ITER machine size still require more aggressive optimisation in numeric dealing with numerical stability, adaptive meshes etc. However many possible applications of JOREK code we proposed here which represent urgent ITER relevant issues related to ELM control by RMPs and pellets remain to be solved.

8.2.2.4. OPTIDIS: OPTImisation d'un code de dynamique des DISlocations

Participants: Olivier Coulaud, Aurélien Esnard, Arnaud Etcheverry, Luc Giraud.

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 behavior of a single dislocation segment is perfectly understood since 1960 and analytical formulations are available in the literature. However, to understand the behavior of a large population of dislocations (inducing complex dislocations interactions) and its effect on plastic deformation, massive numerical computation is necessary. Since 1990, simulation codes have been developed by French researchers. Among these codes, the code TRIDIS developed by the SIMAP laboratory in Grenoble is the pioneer dynamic dislocation code. In 2007, the project called NUMODIS had been set up as team collaboration between the SIMAP and the SRMA CEA Saclay in order to develop a new dynamics dislocation code using modern computer architecture and advanced numerical methods. The objective was to overcome the numerical and physical limits of the previous code TRIDIS. The version NUMODIS 1.0 came out in December 2009, which confirms the feasibility of the project. The project OPTIDIS is initiated when the code NUMODIS is mature enough to consider parallel computation. The objective of the project in to develop and validate the algorithms in order to optimize the numerical and performance efficiency 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 plastic deformation after irradiation. These kinds of studies

where “local mechanisms" are correlated with macroscopic behavior is a key issue for nuclear industry in order to understand material aging under irradiation, and hence predict power plant secured service life. To carry out such studies, massive numerical optimizations 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.

8.2.2.5. 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 ROMA (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.

8.2.2.6. 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 (leader); Laboratoire d’Analyse, Topologie, Probabilités in Marseilles; Institut de Recherche sur la Fusion Magnétique, CEAr/IRFM and 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.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. EXA2CT

Type: COOPERATION

Defi: Exascale computation

Instrument: Specific Targeted Research Project

Duration: September 2013 - August 2016

See also: https://projects.imec.be/exa2ct/.

Coordinator: Wilfried Verachtert, IMEC (Interuniversitair Micro-Electronica Centrum), Belgium

Partner: Universiteit Antwerpen, Belgium; Università della Svizzera italiana, Switzerland; Inria (ALPINES, HIEPACS, SAGE teams); Université de Versailles Saint-Quentin-en-Yvelines, France; T-Systems, Germany; Fraunhofer-Gesellschaft, Germany; Intel, France; NAG, UK.

Inria contact: Luc Giraud

Abstract: Numerical simulation is a crucial part of science and industry in Europe. The advancement of simulation as a discipline relies on increasingly compute intensive models that require more computational resources to run. This is the driver for the evolution to exascale. Due to limits in the increase in single processor performance, exascale machines will rely on massive parallelism on and off chip, with a complex hierarchy of resources. The large number of components and the machine complexity introduce severe problems for reliability and programmability. The former of these will require novel fault-aware algorithms and support software. In addition, the scale of the numerical models exacerbates the difficulties by making the use of more complex simulation algorithms necessary, for numerical stability reasons. A key example of this is increased relience on linear solvers. Such solvers require global communication, which impacts scalability, and are often used with preconditioners, increasing complexity again. Unless there is a major rethink of the design of solver algorithms, components and software structure, a large class of important numerical simulations will not scale beyond petascale. This in turn will hold back the development of European science and industry that will not reap the benefits from exascale.

The EXA2CT project brings together experts at the cutting edge of the development of solvers, related algorithmic techniques, and HPC software architects for programming models and communication. It will take a revolutionary approach to exascale solvers and programming models, rather than

the incremental approach of other projects. We will produce modular open source proto-applications that demonstrate the algorithms and programming techniques developed in the project, to help bootstrap the creation of genuine exascale codes.

Inria is involved in that project through the IPL C2S@EXA initiative.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. MORSE

Title: Matrices Over Runtime Systems at Exascale

Inria principal investigator: Emmanuel Agullo

International Partner:

Institution: University of Tennessee Knoxville (United States)

Laboratory: Innovative Computing Lab

Researcher: George Bosilca

International Partner:

Institution: University of Colorado Denver (United States)

Laboratory: Department of Mathematics and Statistical Sciences

Researcher: Julien Langou

Duration: 2011 - 2013

See also: http://icl.cs.utk.edu/projectsdev/morse.

The goal of MORSE (Matrices Over Runtime Systems at Exascale) 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.

8.4.1.2. FASTLA

Title: Fast and Scalable Hierarchical Algorithms for Computational Linear Algebra

Inria principal investigator: Olivier Coulaud

International Partners (Institution - Laboratory - Researcher):

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

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

Duration: 2012 - 2014

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

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.

8.4.2. Participation In other International Programs

8.4.2.1. HOSCAR

We are involved in the Inria-CNPq HOSCAR project led by Stéphane Lanteri.

The general objective of the project is to setup a multidisciplinary Brazil-France collaborative effort for taking full benefits of future high-performance massively parallel architectures. The targets are the very large-scale datasets and numerical simulations relevant to a selected set of applications in natural sciences: (i) resource prospection, (ii) reservoir simulation, (iii) ecological modeling, (iv) astronomy data management, and (v) simulation data management. The project involves computer scientists and numerical mathematicians divided in 3 fundamental research groups: (i) numerical schemes for PDE models (Group 1), (ii) scientific data management (Group 2), and (iii) high-performance software systems (Group 3).

We organized the 2013 annual meeting in Bordeaux on September 2-6, 2013 and are contributing to the Group 3 activities.

8.4.2.2. G8-ECS

Title: Enabling Climate Simulations at Extreme Scale

Inria principal investigator: Luc Giraud

International Partners (Institution - Researcher):

Univ. Illinois at Urbanna Champaign & Argonne National Lab. - Franck Cappello,

Univ. Tennessee at Knoxville - George Bosilca,

German Research School for Simulation Sciences - Felix Wolf,

Univ. Victoria - Andrew Weaver,

Titech - Satoshi Matsuoka,

Univ. Tsukuba - Mitsuhisa Sato,

NCAR - Rich Loft,

Barcelona Supercomputing Center - Jesus Labarta.

Duration: 2011 - 2014

See also: https://wiki.engr.illinois.edu/display/G8/G8+ESC++–+Enabling+Climate+Simulations+at+Extreme+Scale

Exascale systems will allow unprecedented reduction of the uncertainties in climate change predictions via ultra-high resolution models, fewer simplifying assumptions, large climate ensembles and simulation at a scale needed to predict local effects. This is essential given the cost and consequences of inaction or wrong actions about climate change. To achieve this, we need careful co-design of future exascale systems and climate codes, to handle lower reliability, increased heterogeneity, and increased importance of locality. Our effort will initiate an international collaboration of climate and computer scientists that will identify the main roadblocks and analyze and test initial solutions for

the execution of climate codes at extreme scale. This work will provide guidance to the future evolution of climate codes. We will pursue research projects to handle known roadblocks on resilience, scalability, and use of accelerators and organize international, interdisciplinary workshops to gather and disseminate information. The global nature of the climate challenge and the magnitude of the task strongly favor an international collaboration. The consortium gathers senior and early career researchers from USA, France, Germany, Spain, Japan and Canada and involves teams working on four major climate codes (CESM1, EC-EARTH, ECSM, NICAM).

KERDATA 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, which focuses 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 a daily basis.

8.2. European Initiatives

8.2.1. FP7 Projects

The SCALUS FP7 Marie Curie Initial Training Network (2009–2013). Coordinator: André Brinkmann. Partners: Universidad Politécnica de Madrid (Spain), Barcelona Supercomputing Center (Spain), University of Paderborn (Germany), Ruprecht-Karls-Universität Heidelberg (Germany), Durham University (United Kingdom), FORTH (Greece), École des Mines de Nantes (France), XLAB (Slovenia), CERN (Switzerland), NEC (Germany), Microsoft Research (United Kingdom), Fujitsu (Germany), Sun Microsystems (Germany). Topic: scalable distributed storage. 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 this exciting area with a focus on cluster, grid, and cloud storage. The vision of this MCITN is to deliver the foundation for ubiquitous storage systems, which can be scaled in arbitrary directions (capacity, performance, distance, security). We mainly collaborate with UPM (2 co-advised PhD theses).

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. DATA@EXASCALE

Title: Ulta-scalable I/O and storage for Exascale systems

Inria principal investigator: Gabriel Antoniu

International Partners (Institution - Laboratory - Researcher):

Argonne National Laboratory (United States) - Mathematics and Computer Science Division - Rob Ross

University of Illinois at Urbana Champaign (United States) - Marc Snir

Duration: 2013 - 2015

See also: http://www.irisa.fr/kerdata/data-at-exascale/

Description: as the computational power used by large-scale scientific applications increases, the amount of data manipulated for subsequent analysis increases as well. Rapidly storing this data, protecting it from loss and analyzing it to understand the results are significant challenges, made more difficult by decades of improvements in computation capabilities that have been unmatched in storage. For many applications, the overall performance and scalability becomes clearly driven by the performance of the I/O subsystem. As we anticipate Exascale systems in 2020, there is a growing consensus in the scientific community that revolutionary new approaches are needed in computational science storage. These challenges are at the center of the activities of the Joint Inria-UIUC Lab for Petascale Computing, recently extended to Argonne National Lab. This project gathers researchers from Inria, Argonne National Lab and the University of Illinois at Urbana Champaign to address 3 goals: 1) investigate new storage architectures for Exascale systems; 2) investigate new approaches to the design of I/O middleware for Exascale systems to optimize data processing and visualization, leveraging dedicated I/O cores and I/O forwarding techniques; 3) explore techniques enabling adaptive cloud data services for HPC.

8.3.2. Inria International Partners

8.3.2.1. Declared Inria International Partners

Politehnica University of Bucharest (since 1 January 2013, just after the end of our former Data-Cloud@work Associate Team).

8.3.3. Inria International Labs

Joint Inria-UIUC Lab for Petascale Computing (JLPC), since 2009. Collaboration on concurrency-optimized I/O for post-Petascale platforms (see details in Section 4.1). A joint project proposal with the team of Rob Ross (Argonne National Lab) has been completed in 2012. It served to prepare the creation of the Data@Exascale Associate Team with ANL and UIUC (2013-2015).

8.3.4. Participation In other International Programs

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

- Maria S. Perez (Universidad Politecnica de Madrid) and Toni Cortes (Universitat Politecnica de Catalunya) visited the KerData team for three days (December 2013) within the framework of the SCALUS project.

8.4.2. Internships

Participant: Mihaela Catalina Nita.

Subject: Smart Data Management for High-Performance Supercomputing

Date: from March 2013 until July 2013

Institution: Politehnica University of Bucharest (Romania)

Participant: Ana-Ruxandra Ion.

Subject: Enabling Map-Reduce-based Data-intensive Processing on Hybrid Cloud/Desktop Grid infrastructures

Date: from Mar 2013 until Jul 2013

Institution: Politehnica University of Bucharest (Romania)

Participant: Yue Li.

Subject: Energy Measurements for Cassandra Cloud Storage System: Exploring and improving Energy-Consistency Tradeoff

Date: from Feb 2013 until June 2013

Institution: Master student from Telecom Bretagne, Rennes (France)

Participant: Rui Wang.

Subject: Designing An Environment-Aware System for Geographically Distributed Data Transfers on Public Clouds

Date: from Feb 2013 until August 2013

Institution: Master student from Telecom Bretagne, Rennes (France)

8.4.3. Visits to International Teams

- Radu Tudoran visited ANL (Kate Keahey) for 3 months, funded by the Data@Exascale Associate Team.
- Matthieu Dorier visited ANL (Rob Ross, Tom Peterka, Phil Carns) for 2 months, funded by the Data@Exascale Associate Team.
- Radu Tudoran visited the ATL Lab at European Microsoft Innovation Center (Munich Germany) for 3 months, funded by Microsoft.

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.

The Digitalis and IDPot clusters and the Bull Machine are integrated in the CIMENT Grid. More precisely, their unused resources may be exploited to execute jobs from partners of the CIMENT project. Mescal is also involved in CIMENT through the development or OAR and CiGri.

8.2. National Initiatives

8.2.1. Inria Large Scale Initiative

- *HEMERA, 2010-2012* Leading action "Completing challenging experiments on Grid'5000 (Methodology)" (see https://www.grid5000.fr/Hemera).

  Experimental platforms like Grid'5000 or PlanetLab provide an invaluable help to the scientific community, by making it possible to run very large-scale experiments in controlled environment. However, while performing relatively simple experiments is generally easy, it has been shown that the complexity of completing more challenging experiments (involving a large number of nodes, changes to the environment to introduce heterogeneity or faults, or instrumentation of the platform to extract data during the experiment) is often underestimated.

  This working group explores different complementary approaches, that are the basic building blocks for building the next level of experimentation on large scale experimental platforms.

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*. Partners: Inria Grenoble (MESCAL, MOAIS), Inria Lyon (GRAAL), Inria Saclay (GRAND-LARGE).

  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.

- *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 exploit 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 led 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.

- *ANR MARMOTE, 2013-2016*. Partners: Inria Sophia (MAESTRO), Inria Rocquencourt (DIOGEN), PRiSM laboratory from University of Versailles-Saint-Quentin, Telecom SudParis (SAMOVAR), University Paris-Est Créteil (*Spécification et vérification de systèmes*), Université Pierre-et-Marie-Curie/LIP6.

  The project aims at realizing a software prototype dedicated to Markov chain modeling. It gathers seven teams that will develop advanced resolution algorithms and apply them to various domains (reliability, distributed systems, biology, physics, economy).

- *ANR NETLEARN, 2013-2015*. Partners: PRiSM laboratory from University of Versailles-Saint-Quentin, Telecom ParisTech, Orange Labs, LAMSADE/University Paris Dauphine, Alcatel-Lucent, Inria (MESCAL).

  The main objective of the project is to propose a novel approach of distributed, scalable, dynamic and energy efficient algorithms for managing resources in a mobile network. This new approach relies on the design of an orchestration mechanism of a portfolio of algorithms. The ultimate goal of the proposed mechanism is to enhance the user experience, while at the same time to better utilize the operator resources. User mobility and new services are key elements to take into account if the operator wants to improve the user quality of experience. Future autonomous network management and control algorithms will thus have to deal with a real-time dynamicity due to user mobility and to traffic variations resulting from various usages. To achieve this goal, we focus on two central aspects of mobile networks (the management of radio resources at the Radio Access Network level and the management of the popular contents users want to get access to) and intend to design distributed learning mechanisms in non-stationary environments, as well as an orchestration mechanism that applies the best algorithms depending on the situation.

8.2.4. National Organizations

Jean-Marc Vincent is member of the scientific committees of the CIST (Centre International des Sciences du Territoire).

8.3. European Initiatives

8.3.1. FP7 Projects

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

Type: FP7 Programme

Objectif: ICT-2011.9.13 Exa-scale computing, software and simulation

Duration: October 2011 - October 2014

Coordinator: Alex Ramirez

Partner: BSC (Barcelone), Bull, ARM (UK), Julich (Germany), Genci, CINECA (Italy), CNRS (LIRMM, LIG)

Inria contact: Arnaud Legrand

Abstract: There is a continued need for higher computing 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 1.7 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.

8.3.1.2. Network of Excellence in Wireless COMmunications

Type: FP7 Programme

Objectif: 1.1 Future Networks

Duration: November 2012 - October 2015

Coordinator: Marco Louise

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

Inria contact: Panayotis Mertikopoulos

Abstract: The NEWCOM researchers will pursue long-term, interdisciplinary research on the most advanced aspects of wireless communications like Finding the Ultimate Limits of Communication Networks, Opportunistic and Cooperative Communications, Energy- and Bandwidth-Efficient Communications and Networking.

8.3.2. Collaborations in European Programs, except FP7

8.3.2.1. ESPON

Program: ESPON

Project acronym: HyperATLAS

Duration: 2007-2013

Coordinator: European Community

Abstract: 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.

8.3.2.2. CROWN

Program: European Community and Greek General Secretariat for Research and Technology

Project acronym: CROWN

Project title: Optimal Control of Self Organized Wireless Networks

Duration: 2012-2015

Coordinator: Tassiulas Leandros

Other partners: Thales, University of Thessaly, National and Kapodistrian University of Athens, Athens University of Economics and Business

Abstract: Wireless networks are rapidly becoming highly complex systems with large numbers of heterogeneous devices interacting with each other, often in a harsh environment. In the absence of central control, network entities need to self-organize to reach an efficient operating state, while operating in a distributed fashion. Depending on whether the operating criteria are individual or global, nodes interact in an autonomic or coordinated way. Despite recent progress in autonomic networks, the fundamental understanding of the operational behaviour of large-scale networks is still lacking. This project will address these emergent network properties, by introducing new tools and concepts from other disciplines.

We will first analyze how imperfect network state information can be harvested and distributed efficiently through the network using machine learning techniques. We will design flexible methodologies to shape the competition between autonomous nodes for resources, with aim to maintain robust social optimality. Both cooperating and non-cooperating game-theoretic models will be used. We also consider networks with nodes coordinating to achieve a joint task, e.g., global optimization. Using algorithms inspired from statistical physics, we will address two representative paradigms in the context of wireless ad hoc networks, namely connectivity optimization and the localization of a network of primary sources from a sensor network.

Finally, we will explore delay tolerant networks as a case study of an emerging class of networks that, while sharing most of the characteristics of traditional autonomic or coordinated networks, they present unique challenges, due to the intermittency and constant fluctuations of the connectivity. We will study tradeoffs involving delay, the impact of mobility on information transfer, and the optimal usage of resources by using tools from information theory and stochastic evolution theory.

8.3.3. Collaborations with Major European Organizations

University of Athens: Panayotis Mertikopoulos was an invited professor for 4 months.

EPFL: Laboratoire pour les communications informatiques et leurs applications 2, Institut de systèmes de communication ISC, Ecole polytechnique fédérale de Lausanne (Switzerland). We collaborate with Jean-Yves Leboudec and Nicolas Gast on fluid limits.

BCAM: Basque Center for Applied Mathematics, Bilbao (Spain). Bruno gaujal was invited to teach several time and collaborates with Jonatha Anselmi on perfect simulation.

TU Wien: Research Group Parallel Computing, Technische Universität Wien (Austria). We collaborate with Sascha Hunold on experimental methodology and reproducibility of experiments in HPC.

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. CLOUDSHARE

Title: Guaranteed Application Performance on Idle Data Center Resources

Inria principal investigator: Arnaud Legrand

International Partner (Institution - Laboratory - Researcher):

Walfredo Cirne (Google Inc. (United States))

David P. Anderson (University of California Berkeley - Space Sciences Laboratory)

Duration: 2009 - 2014

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

Data centers are often 85% idle as they must over-provision to ensure service level agreements. At the same time, high data center utilization is essential for efficient resource usage and optimal revenue. One way to improve utilization is for low-priority applications to use the idle resources of data centers, allowing high-priority applications to preempt them at any time. While users benefit from the lower costs of using these idle resources, parallel applications such as Map-Reduce can suffer severe overheads and unpredictable performance due to unexpected preemption and unavailability. The goal of this project is to enable complex applications to utilize idle data center resources with guaranteed performance. Our approach will be as follows. First, we will investigate novel statistical methods to predict the execution time of complex batch applications. Second, we will apply machine learning methods to predict idleness in data centers. Third, we will craft fair scheduling algorithms for multiple applications that compete for idle data center resources. The collaboration bridges experts in statistical modeling and simulation from the Inria MESCAL team with system and scheduling experts in the Berkeley BOINC team and the Google Infrastructure team.

8.4.2. Inria International Partners

8.4.2.1. Declared Inria International Partners

- MESCAL has strong connections with both UFRGS (Porto Alegre, Brazil) and USP (Sao Paulo, Brazil). The creation of the LICIA common laboratory (see next section) has made this collaboration even tighter.
- MESCAL has strong bounds with the University of Illinois Urbana Champaign, within the (Joint Laboratory on Petascale Computing (see next section).
- MESCAL also has long lasting collaborations with University of California in Berkeley and a new one with Google. Arnaud Legrand visited Berkeley and the Inria Grenoble hosted the yearly BOINC workshop in 2013.

8.4.3. Inria International Labs

8.4.3.1. North America

- 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 done several visits to Urbana-Champaign or NCSA. One Mescal Postdoc (Slim Bougherra) spent one year in Urbana-Champaign.
- Associated Team with Berkeley. MESCAL is thus involved in the Inria@SiliconValley program.

8.4.4. Participation In other International Programs

8.4.4.1. 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, both from the MESCAL team.

  The main themes are artificial intelligence, high performance computing, information representation, interfaces and visualization as well as distributed systems.

  More information can be found at http://www.ufrgs.br/sisinfo/?ai1ec_event=terceira-reuniao-do-licia&instance_id=.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Wenjing Wu (Chinese Academy of Science) visited MESCAL for two weeks in September.
- Sergio Gelvez Cortes (Universidad Industrial de Santander Bucaramanga, Colombia) visited MESCAL for two months.

8.5.1.1. Internships

- Wagner Kolberg (MSc UFRGS) made a 4 months internship in MESCAL.

8.5.2. Visits to International Teams

- Panayotis Mertikopoulos was invited to work for 3 weeks at Universidade de Chile (14/01 -> 2/02)
- Panayotis Mertikopoulos was invited to work for 4 months at University of Athens (01/03 -> 30/06)
- Jean-Marc Vincent was invited to work for 3 weeks at UFRGS and PUC-RS, Porto Alegre

MOAIS Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- Action OCA : Combinatorial Optimization on Accelerator. Funding by Labex PERSYVAL Grenoble.

8.2. National Initiatives

8.2.1. ANR

- **ANR grant REPDYN (2010-2013).** 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 (2010-2013).** 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.
- **ANR-11-LABX-0025 PERSYVAL-Lab** funds the following PhD in collaboration with other labs:
  - in collaboration with Verimag: Multi-objective optimization for resource management on multicore systems, (PhD Abhinav Srivastav, since 9/2012)
  - In collaboration with Gipsa-lab and Inria BiBop: Simulations of Fibrous Materials. (PhD Gilles Daviet, since 9/2013)
  - in collaboration with Inria Privatics and Verimag: Secure Outsourcing (PhD Amrit Kumar, since 11/2013)

8.2.2. Competitivity Clusters

- 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 (Damien Dosimont) and 1 year engineer.

8.2.3. National ADT

- ADT K'STAR with cooperation between EPIs MOAIS and RUNTIME (Bordeaux). Coordinator: T. Gautier. https://gforge.inria.fr/projects/kstar. The main objective is to provide OpenMP-3.1 with some extension from OpenMP-4.0 standard to perform OpenMP programs on multi-CPUs multi-GPUs by using Kaapi and StarPU runtimes.

8.2.4. Inria Project Lab

8.2.4.1. C2S@Exa - Computer and Computational Scienecs at Exascale

Participants: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest], Jocelyne Erhel [SAGE project-team, Inria Rennes - Bretagne Atlantique], Philippe Helluy [TONUS project-team, Inria Nancy - Grand-Est], Laura Grigori [ALPINE project-team, Inria Saclay - Île-de-France], Jean-Yves L'excellent [ROMA project-team, Inria Grenoble - Rhône-Alpes], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhône-Alpes], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Michel Kern [POMDAPI project-team, Inria Paris - Rocquencourt], Stéphane Lanteri [Coordinator of the project], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Christian Perez [AVALON project-team, Inria Grenoble - Rhône-Alpes], Frédéric Vivien [ROMA project-team, Inria Grenoble - Rhône-Alpes].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

T. Gautier is coordinator of the Pole 4: Programming Models.

8.3. European Initiatives

8.3.1. FP7 Projects

8.3.1.1. VISIONAIR

Type: CAPACITIES

Defi: INFRA-2010-1.1.29

Instrument: Combination of COLLABORATIVE PROJECTS and COORDINATION and SUPPORT ACTIONS

Objectif: NC

Duration: February 2011 - January 2015

Coordinator: Frédéric Noël (Inpg)

Partner: Inria (France)

Inria contact: G. Dumont

Abstract: Visionair calls for the creation of a European infrastructure for high level visualisation facilities that are open to research communities across Europe and around the world. By integrating existing facilities, Visionair aims to create a world-class research infrastructure for conducting state-of-the-art research in visualisation, thus significantly enhancing the attractiveness and visibility of the European Research Area (ERA). With over 20 members across Europe participating, VISIONAIR offers facilities for Virtual Reality, Scientific Visualisation, Ultra High Definition, Augmented Reality and Virtual Services.

8.4. International Initiatives

8.4.1. Participation In other International Programs

- The MOAIS EPI is activiley participating to the international LICIA lab supporting collaborations with the UFRGG, Brazil. Bruno Raffin is member of the LICIA scientific comittee.
- Moais is also leading a CAPES/COFECUB program (2013-2014) with UFRGS, Brazil.
- Moais is also leading a CAPES/COFECUB program (2013-2014) with USP, Brazil.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

- Jacek Blazewicz (Professor, Polish Academy of Sciences, Poznań), invited prof INP (2 months)
- Afredo Goldman (Professor, USP Sao Paulo) (1 month)
- Daniel Cordeiro (Postdoc, USP Sao Paulo) (1 month)
- Mario Cesar Lopez Loces (UFRGS) (1 month)
- Adel Essafi (ISIG Kairouan, Tunis) (2 month)

8.5.2. Visits to International Teams

- Damien Dosimont, Oct-Dec 2013, UFRGS, Brazil
- Clement Pernet, sabbatical, Sept-Dec 2013, LIP Lyon, Aric Team

ROMA Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. 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.

ANR Project SOLHAR (2013-2017), 4 years. The ANR Project SOLHAR was launched in November 2013, for a duration of 48 months. It gathers five academic partners (the HiePACS, Cepage, ROMA and Runtime Inria project-teams, and CNRS-IRIT) and two industrial partners (CEA/CESTA and EADS-IW). This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computers equipped with accelerators.

The proposed research is organized along three distinct research thrusts. The first objective deals with linear algebra kernels suitable for heterogeneous computing platforms. The second one focuses on runtime systems to provide efficient and robust implementation of dense linear algebra algorithms. The third one is concerned with scheduling this particular application on a heterogeneous and dynamic environment.

8.1.2. Inria Project Lab C2S@Exa - Computer and Computational Scienecs at Exascale

Participants: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest], Jocelyne Erhel [SAGE project-team, Inria Rennes - Bretagne Atlantique], Philippe Helluy [TONUS project-team, Inria Nancy - Grand-Est], Laura Grigori [ALPINE project-team, Inria Saclay - Île-de-France], Jean-Yves L'excellent [ROMA project-team, Inria Grenoble - Rhône-Alpes], Thierry Gautier [MOAIS project-team, Inria Grenoble - Rhône-Alpes], Luc Giraud [HIEPACS project-team, Inria Bordeaux - Sud-Ouest], Michel Kern [POMDAPI project-team, Inria Paris - Rocquencourt], Stéphane Lanteri [Coordinator of the project], François Pellegrini [BACCHUS project-team, Inria Bordeaux - Sud-Ouest], Christian Perez [AVALON project-team, Inria Grenoble - Rhône-Alpes], Frédéric Vivien [ROMA project-team, Inria Grenoble - Rhône-Alpes].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues

in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. SCORPIO

Type: COOPERATION
Instrument: Specific Targeted Research Project
Duration: June 2013 - May 2016
Coordinator: Nikolaos Bellas
Partners: CERTH, Greece; EPFL, Switzerland; RWTH Aachen University, Germany; The Queen's University of Belfast, UK; IMEC, Belgium
Inria contact: Frédéric Vivien
Abstract: A new computing paradigm that exploits uncertainty to design systems that are energy-efficient and scale gracefully under hardware errors by operating below the nominal operating point, in a controlled way, without inducing massive or fatal errors.

8.3. International Initiatives

8.3.1. 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

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Ana Gainaru (from UIUC and Argonne National Laboratory) has visited our team for three weeks in October and November 2013. She initiated a collaboration with Guillaume Aupy, Anne Benoit, Franck Cappello and Yves Robert on scheduling I/O activity to avoid congestion and increase performance when executing several scientific applications on large-scale platforms.

8.4.2. Visits to International Teams

Yves Robert has been appointed as a visiting scientist by the ICL laboratory (headed by Jack Dongarra) at the University of Tennessee Knoxville. He collaborates with several ICL researchers on high-performance linear algebra and resilience methods at scale.

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.

REGION AQUITAINE The Aquitaine Region Council is granting the PhD thesis of Bertrand Putigny about *Performance Models for Heterogeneous Parallel Architectures*.

REGION AQUITAINE - CEA The Aquitaine Region Council together with CEA is funding PhD thesis of Marc Sergent (2013-2016) on *Scalability for Task-based Runtimes* (See also Section Bilateral Grants with Industry)

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 SOLHAR (http://solhar.gforge.inria.fr/doku.php?id=start).

ANR MONU 2013 Program, 2013 - 2016 (36 months)

Identification: ANR-13-MONU-0007

Coordinator: Inria Bordeaux/LaBRI

Other partners: CNRS-IRIT, Inria-LIP Lyon, CEA/CESTA, EADS-IW

Abstract: This project aims at studying and designing algorithms and parallel programming models for implementing direct methods for the solution of sparse linear systems on emerging computers equipped with accelerators. The ultimate aim of this project is to achieve the implementation of a software package providing a solver based on direct methods for sparse linear systems of equations. Several attempts have been made to accomplish the porting of these methods on such architectures; the proposed approaches are mostly based on a simple offloading of some computational tasks (the coarsest grained ones) to the accelerators and rely on fine hand-tuning of the code and accurate performance modeling to achieve efficiency. This project proposes an innovative approach which relies on the efficiency and portability of runtime systems, such as the StarPU tool developed in the runtime team (Bordeaux). Although the SOLHAR project will focus on heterogeneous computers equipped with GPUs due to their wide availability and affordable cost, the research accomplished on algorithms, methods and programming models will be readily applicable to other accelerator devices such as ClearSpeed boards or Cell processors.

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.

ANR MOEBUS Sceduling in HPC (http://moebus.gforge.inria.fr/doku.php).

ANR INFRA 2013, 10/2013 - 9/2017 (48 months)

Coordinator: Denis Trystram (Inria Rhône-Alpes)

Other partners: Inria Bordeaux.

Abstract: This project focuses on the efficient execution of parallel applications submitted by various users and sharing resources in large-scale high-performance computing environments

8.2.2. Inria Project Lab

8.2.2.1. C2S@Exa - Computer and Computational Scienecs at Exascale

Participant: Olivier Aumage [RUNTIME project-team, Inria Bordeaux - Sud-Ouest].

Since January 2013, the team is participating to the C2S@Exa http://www-sop.inria.fr/c2s_at_exa Inria Project Lab (IPL). This national initiative aims at the development of numerical modeling methodologies that fully exploit the processing capabilities of modern massively parallel architectures in the context of a number of selected applications related to important scientific and technological challenges for the quality and the security of life in our society. At the current state of the art in technologies and methodologies, a multidisciplinary approach is required to overcome the challenges raised by the development of highly scalable numerical simulation software that can exploit computing platforms offering several hundreds of thousands of cores. Hence, the main objective of C2S@Exa is the establishment of a continuum of expertise in the computer science and numerical mathematics domains, by gathering researchers from Inria project-teams whose research and development activities are tightly linked to high performance computing issues in these domains. More precisely, this collaborative effort involves computer scientists that are experts of programming models, environments and tools for harnessing massively parallel systems, algorithmists that propose algorithms and contribute to generic libraries and core solvers in order to take benefit from all the parallelism levels with the main goal of optimal scaling on very large numbers of computing entities and, numerical mathematicians that are studying numerical schemes and scalable solvers for systems of partial differential equations in view of the simulation of very large-scale problems.

8.2.2.2. MULTICORE - Large scale multicore virtualization for performance scaling and portability

Participant: Emmanuel Jeannot [RUNTIME project-team, Inria Bordeaux - Sud-Ouest].

Multicore processors are becoming the norm in most computing systems. However supporting them in an efficient way is still a scientific challenge. This large-scale initiative 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. It aims to build collaborative virtualization mechanisms that achieve essential tasks related to parallel execution and data management. We want to unify the analysis and transformation processes of programs and accompanying data into one unique virtual machine. We hope delivering a solution for compute-intensive applications running on general-purpose standard computers.

8.3. European Initiatives

8.3.1. FP7 Projects

HPC-GA

Program: FP7 IRSES Marie-Curie

Project acronym: HPC-GA

Project title: High Performance Computing for Geophysics Applications

Duration: Jan 2012 - Dec 2014

Coordinator: Jean-François Méhaut (UJF, France)

Other partners: UFRGS, Inria, BCAM et UNAM.

Abstract: The design and implementation of geophysics applications on top of nowadays supercomputers requires a strong expertise in parallel programming and the use of appropriate runtime systems able to efficiently deal with heterogeneous architectures featuring many-core nodes typically equipped with GPU accelerators. The HPC-GA project aims at evaluating the functionalities provided by current runtime systems in order to point out their limitations. It also aims at designing new methods and mechanisms for an efficient scheduling of processes/threads and a clever data distribution on such platforms. 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.

MontBlanc2

Program: FP7 ICT-2013, Exascale Computing Platforms

Project acronym: MontBlanc2

Project title: European scalable and power efficient HPC platform based on low-power embedded technology

Duration: Oct 2013 - Nov 2016

Coordinator: Alex Ramirez (BSC, Spain)

Other partners: Inria, Bull, ST, ARM, Gnodal, Juelich, BADW-LRZ, HLRS, CNRS, CEA, CINECA, Bristol, Allinea

Abstract: The Mont-Blanc project aims to develop a European Exascale approach leveraging on commodity power-efficient embedded technologies. The project has developed a HPC system software stack on ARM, and will deploy the first integrated ARM-based HPC prototype by 2014, and is also working on a set of 11 scientific applications to be ported and tuned to the prototype system. The rapid progress of Mont-Blanc towards defining a scalable power efficient Exascale platform has revealed a number of challenges and opportunities to broaden the scope of investigations and developments. Particularly, the growing interest of the HPC community in accessing the Mont-Blanc platform calls for increased efforts to setup a production-ready environment. The Mont-Blanc 2 proposal has 4 objectives:

1. To complement the effort on the Mont-Blanc system software stack, with emphasis on programmer tools (debugger, performance analysis), system resiliency (from applications to architecture support), and ARM 64-bit support
2. To produce a first definition of the Mont-Blanc Exascale architecture, exploring different alternatives for the compute node (from low-power mobile sockets to special-purpose high-end ARM chips), and its implications on the rest of the system

3. To track the evolution of ARM-based systems, deploying small cluster systems to test new processors that were not available for the original Mont-Blanc prototype (both mobile processors and ARM server chips)
4. To provide continued support for the Mont-Blanc consortium, namely operations of the original Mont-Blanc prototype, the new small scale prototypes and hands-on support for our application developers

Mont-Blanc 2 contributes to the development of extreme scale energy-efficient platforms, with potential for Exascale computing, addressing the challenges of massive parallelism, heterogeneous computing, and resiliency. Mont-Blanc 2 has great potential to create new market opportunities for successful EU technology, by placing embedded architectures in servers and HPC..

8.3.2. Collaborations in European Programs, except FP7

COST ComplexHPC http://complexhpc.org

Program: COST Action IC0805

Project acronym: ComplexHPC

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

Duration: May 2009 - June 2013

Coordinator: Emmanuel Jeannot

Other partners: This Action gathers more than 20 countries and 30 partners in Europe.

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. The network will aim at contributing to exchange information, identify synergies and pursue common research activities, therefore reinforcing the strength of European research groups and the leadership of Europe in this field.

8.4. International Initiatives

8.4.1. Inria Associate Teams

MORSE Matrices Over Runtime Systems at Exascale

Inria Associate-Teams program: 2011-2016

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. Inria International Labs

JLPC on Petascale Computing Inria joint-Lab

Coordinators: Franck Cappello and Marc Snir.

Other partners: Argonne National Lab, Inria, University of Urbanna Champaign.

Abstract: he Joint Laboratory is based at Illinois and includes researchers from Inria, Illinois' Center for Extreme-Scale Computation, and the National Center for Supercomputing Applications. It focuses on software challenges found in complex high-performance computers.

8.4.3. Participation in other International Programs

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

ANR-JST 2010 Program, 01/09/2010 - 31/03/2014

Identification: ANR-10-JST-002

Coordinator: Serge Petiton (Inria Saclay)

Other partners: CNRS IRIT, CEA DEN Saclay, Inria Bordeaux, CNRS-Prism, 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 - 12/2014 (24 months)

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.

NextGN Preparing for Next Generation Numerical Simulation Platforms

PUF (Partner University Fund) - France USA, 01/2013 - 12-2016 (3 years)

Coordinator: Franck Capello, Marc Snir and Yves Robert

Other Partners: Inria, Argonne National Lab and University of Urbanna Chapaign

This PUF proposal builds on the existing successful joint laboratory between Inria and UIUC that has produced in past three years and half many top-level publications, some of which resulted in student awards; and several software packages that are making their way to production in Europe and USA. The proposal extends the collaboration to Argonne National Laboratory (ANL) and CNRS researchers who will bring their unique expertise and their skills to help addressing the scalability issue of simulation platforms.

ASCOLA Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. CominLabs laboratory of excellence

8.1.1.1. EPOC

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

The project EPOC (Energy Proportional and Opportunistic Computing system) is an (academic) Labex CominLabs project running for 4 years. Four other partners collaborate within the project that is coordinated by ASCOLA: Myriads team, ENIB, ENSTB and University of Nantes. In this project, partners aim at focusing on energy-aware task execution from the hardware to application's components in the context of a *mono-site* data center (all resources are in the same physical location) which is connected to the *regular electric Grid and to renewable energy sources* (such as windmills or solar cells). Three major challenges are addressed in this context: Optimize the energy consumption of distributed infrastructures and service compositions in the presence of ever more dynamic service applications and ever more stringent availability requirements for services; Design a clever cloud's resource management which takes advantage of renewable energy availability to perform opportunistic tasks, then exploring the trade-off between energy saving and performance aspects in large-scale distributed system; Investigate energy-aware optical ultra high-speed interconnection networks to exchange large volumes of data (VM memory and storage) over very short periods of time.

One of the strengths of the proposal is to provide a systematic approach, and use a single model for the system (from hard to soft) by mixing constraint programming and behavioral models to manage energy consumption in data centers.

8.1.1.2. SecCloud

Participants: Jacques Noyé [coordinator], Florent Marchand de Kerchove de Denterghem, Mario Südholt.

The high-level objective of the 3-year SecCloud (Secure Scripting for the Cloud) project is to enhance the security of devices on which web applications can be downloaded, i.e. to enhance client-side security in the context of the Cloud. In order to do so, the project relies on a language-based approach, focusing on three related issues:

- The definition of security policies for web architectures, especially on the client-side.
- Formally-proven analyses of web programming languages.
- Multi-level enforcement mechanisms for the security policies (based on static and dynamic analysis encompassing application-level and system-level software).

ASCOLA members are mainly interested in JavaScript as a programming language as well as the use of aspects as a seamless path from the definition of security policies and their composition to their implementation.

This year we have proposed new means for the modularization of JavaScript-based security mechanisms and policies (see 6.1).

8.1.2. ANR

8.1.2.1. CESSA (ANR/ARPEGE)

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

The project CESSA (Compositional Evolution of Secure Services with Aspects) 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 (see 6.1).

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

8.1.2.2. 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 [45], [50]. 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) SCAling, an auto-scaling approach driven by SLA and based on a MAPE-K control loop framework [39]; (ii) RightCapacity, a cross-layer (application-resource) Cloud elasticity approach based on queueing network model, taking into account the SLA concept and the Cloud economic model [17].

8.1.2.3. SONGS (ANR/INFRA)

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

The SONGS project (Simulation of Next Generation Systems) is an ANR/INFRA project running for 48 months (starting in 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. Between January and December 2013, we have hosted Takahiro Hirofuchi, Researcher at AIST (Japan). During his stay, we have extended the Simgrid toolkit with VM abtractions [35]. In addition to elementary functionalities such as VM start/stop, we have delivered the first accurate model of live migration operations within IaaS systems [36].

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). In 2013, the team has developed btrCloudStack, a private cloud based on the OpenSource CloudStack and integrating the work on placement rules and energy optimization.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. A4Cloud (IP)

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

The A4Cloud project (Accountability for the Cloud) 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 focuses on accountability properties for the cloud and other future internet services as the most critical prerequisite for effective governance and control of corporate and private data processed by cloud-based IT services. The research being conducted in the project will increase trust in cloud computing by devising methods and tools, through which cloud stakeholders can be made accountable for the privacy and confidentiality of information held in the cloud. These methods and tools will combine risk analysis, policy enforcement, monitoring and compliance auditing. They will contribute to the governance of cloud activities, providing transparency and assisting legal, regulatory and socio-economic policy enforcement. For further information, see http://www.a4cloud.eu.

ASCOLA is mainly involved in the sub-projects on the enforcement of accountability and security policies, as well as tool validation efforts.

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. SCALUS (MC ITN)

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

The vision of the Scalus (SCALing by means of Ubiquitous Storage) (MC international training network) was 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. During the four last years, the consortium proceeded into this direction by building the first interdisciplinary teaching and research network on storage issues. It consisted of top European institutes and companies in storage and cluster technology, building a demanding but rewarding interdisciplinary environment for young researchers.

The network involved 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 was closed to 3,3 MEUR. ASCOLA's share amounts to 200 KEUR. The project ended in October.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. REAL

Title: Reasoning about Effects in Aspect Languages

Inria principal investigator: Jacques Noyé

International Partner (Institution - Laboratory - Researcher):

University of Chile (Chile) - PLEIAD - Éric Tanter

Duration: 2013 - 2015

See also: http://real.gforge.inria.fr

The scientific goals of this collaboration are twofold. On the one hand, we plan to develop a theory to reason about aspect interference in general, i.e. covering both base/aspect and aspect/aspect composition and, more precisely, to reason about effects that can be used by aspects. This provides foundations for secure aspects. On the other hand, we plan to study how secure aspects can help construct security aspects, i.e. aspects ensuring security policies. Our case study is web applications built with web scripting languages such as JavaScript.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

ASCOLA is closely cooperating with several other international partners:

- **AIST, Japan; Dr. Takahiro Hirofuchi.** This year we have started a cooperation on the simulation of Cloud infrastructures and new scheduling algorithms for virtual environments 6.3 . Dr. Takahiro Hirofuchi has visited the team in 2013 in the context of this collaboration.
- **Soft team, VU Brussel, Belgium; Prof. Wolfgang De Meuter.** In the context of a joint PhD thesis that started in Dec. 2013, we are working on new means for the declarative definition and efficient implementation of event-based systems.
- **Software Technology Group, TU Darmstadt, Germany; Prof. Mira Mezini.** In the context of a joint PhD thesis we are working on a common model for object-oriented programming, event-based programming and aspect-oriented programming, see 6.2 .

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Éric Tanter (University of Chile), 2-12 July 2013, in the context of the Associate Team REAL.
- Takahiro Hirofuchi (AIST, Japan), 1 Jan-31 Dec 2013, in the context and with the financial support of the ANR SONGS project.

8.4.1.1. Internships

Ismael FIGUEROA (from Apr 2013 until Jun 2013)

Compositional Reasoning About Aspect Interference (this leads to a publication in Modularity'14 [33]).

Institution: University of Chile (Chile)

FOCUS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

- AEOLUS (Mastering the Cloud Complexity) is an ANR-ARPEGE project started on December 2010 that will finish on December 2014. 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 dependencies of packages and the inter-relationships among the services, in such a way that starting from a declarative description of the application to be deployed on the cloud, it is possible to automatically compute the resources (ie. virtual machines) to be acquired, and the allocation of such resources to the software services needed to run the application. Main persons involved: Gabbrielli, Lascu, Mauro, Sangiorgi, Zavattaro.
- 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 started 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

- ENVISAGE (Engineering Virtualized Services) is a EU FP7 project, with starting date October 1st, 2013, and with a 3-year duration. The project is about model-based development of virtualized services, including tool support for resource analysis. Most Focus members are involved.
- 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 correspond to exhibiting a certification of its resource consumption.

  Gaboardi has been in Philadelphia till July 2013, and then in Bologna till October 2013. (He has then moved to Dundee, where he has obtained a tenure-track position.)

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, Mauro, Sangiorgi, Zavattaro.
- In the context of the EIT activity "HCI Technologies for the Digital World", funded with 23000 euro, we have worked to the technical part of the EIT ICT Labs Summer School, Intelligent Services for Digital Cities (ISDC-2013), which has been held in Trento in September 2003 (http://www.trentorise.eu/education/intelligent-services-digital-cities-isdc-2013-summer-school).

  In particular we developed a SaaS component, called WSOA, to our cloud oriented framework JSOA. WSOA can publish a set of APIs for external usage which are selected from those deployed into the PaaS layer (PaaSSOA). APIs are collected by exploiting the aggregation mechanism of Jolie and then deployed into a Jolie web server (Leonardo). They can be published by defining different protocols/formats such as http/soap, http/json, http/POST/xml, and so on. Thanks to WSOA we also developed a plugin for the SATIN project where the published APIs can be automatically imporyed into SATIN console and used for creating web based mobile applications.

  To provide a comprehensive tool for the students of the smart city summer school, we developed a wrapper for the CKAN platform in order to import all the CKAN APIs into PaaSSOA. In such a way, it is now possible to perform calls to the CKAN platfrom by exploiting Jolie services deployed into PaaSSOA.

  Main persons involved: Gabbrielli, Guidi.

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. Some visit exchanges during the year, in both directions. One joint PhD supervision (J.-M. Madiot).
- Inria EPI Spades (on models and languages for components, reversibility). Contact person(s) in Focus: Lanese.
- 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. Some 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: Lascu, Mauro, Zavattaro. Some short visits in both directions during the year.
- EPI Carte, Inria-Nancy Grand Est and LORIA (on implicit computational complexity). Contact person(s) in Focus: Dal Lago,Gaboardi. Some visits during 2013.
- 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. Some visits during 2003.
- Facultad de Informatica, Universidad Complutense de Madrid (on web services). Contact person(s) in Focus: Bravetti. Bravetti is an external collaborator in the project "ESTuDIo: ESpecificacion y Testing de sistemas altamente DIstribuidos" (Specification and Testing of Highly Distributed Systems) January 1, 2013 - December 31, 2015 (3 years). Funded by the Spanish Ministerio de Economia y Competitividad

7.3. International Initiatives

7.3.1. Inria International Partners

7.3.1.1. Informal 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 the sabbatical year of Xian Xu, from East China University of Science and Technology, Shanghai (paid a scholarship from the Chinese Science Foundation).

- Xian Xu has completed in May a year sabbatical in Focus. He is lecturer at the East China University of Science and Technology in Shanghai.
- Marco Bernardo, Universita' Urbino. A couple of 2 or 3 day visits during the year. Topic: probabilistic process models.
- Simon Gay, University Glasgow. A 1-month visit, March-April. Topic: session types.
- Andrei Dorman, Paris 13. One 3-day visit in May. Topic: Concurrent Interaction Nets and Graph Rewriting
- Patrick Baillot, ENS Lyon, and Gilles Barthe, IMDEA Madrid. One joint 4-day visit in May. Topic: Security and Cryptography
- Matthew Hennessy, University College Dublin. One 3-day visit in June. Topic: probabilistic bisimulations.
- Ramyaa Ramyaa, LMU Munich. One 1-week visit in June.
- Lionel Vaux and Emmanuel Beffara, Marseille. One 3-day visit in October. Topic: Linear Logic.
- Ludovic Henrio, Inria Sophia Antipolis. One 2-day visit in December. Topic: deadlock-analysis and asynchronous object-oriented languages.
- Stefano Zacchiroli, from Paris 7, has visited us various times for a few days during the year.

7.4.2. Visits to International Teams

We only report visits that were longer than 1 month.

- Roberto Amadini: 6 months at the Optimisation Research Group of NICTA in Melbourne (http://optimisation.nicta.com.au/).
- Ornela Dardha: 1 year (1 November 2012 - 1 November 2013) at IT University of Copenhagen, Denmark, visiting Prof. Marco Carbone (topic: type systems for processes)
- Giulio Pellitta: 6 months at Laboratoire d'Informatique, Université Paris Nord (November 2012 - May 2013). Topic: abstract machines for resouce control in the λ-calculus.
- Tudor Alexandru Lascu: 3 months at Paris 7 (PPS team). Topic: cloud computing.

OASIS Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR SocEDA

Title: SOCial Event Driven Architecture

Program: Platform

Duration: July 2009 - October 2013

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.

7.1.2. 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.

7.1.3. 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.

7.1.4. Oseo-Isis Spinnaker

Duration: June 2011 - May 2015

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. PLAY

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

Type: COOPERATION

Defi: Internet of Services, Software & Virtualisation

Instrument: Specific Targeted Research Project

Objectif: Internet of Services, Software and Virtualisation

Duration: October 2010 - September 2013

Coordinator: FZI (Germany)

Other Partners: EBM WebSourcing (Fr), Inria (OASIS and SARDES) (Fr), France Telecom/OrangeLabs (Fr), ICCS (Gr), Ecole des Mines Albi/Armines (Fr), CIM (Serbia).

Inria contact: Françoise Baude

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

Abstract: The PLAY project aims to 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 enables 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.

7.2.1.2. FI-WARE

Type: COOPERATION

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

Instrument: Integrated Project

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

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Others partners: Thales, SAP, Inria

Inria contact: Olivier Festor

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.

7.2.1.3. DC4Cities

Type: COOPERATION

Defi: FP7 Smartcities 2013

Instrument: Specific Targeted REsearch Project

Objectif: ICT-2013.6.2: Data Centers in an energy-efficientand environmentally friendly Internet

Duration: September 2013 - February 2016

Coordinator: Freemind Consulting (BE)

Partners: U. Mannheim (DE), U. Passau (DE), HP Italy Innovation Center (IT), Create-Net (IT), ENEA (IT), CESCA Catalunia (ES), Gas Natural SA (ES), Inst. Munic. Informatica Barcelona (ES), Inria (FR)

Inria contact: Eric Madelaine

See also:

Abstract: Data centres play two different and complementary roles in Smart Cities' energy policies: as ICT infrastructures supporting Smart City resource optimization systems - more in general, delivering ICT services to the citizens - and as large energy consumers. Therefore there are huge expectations on data centres being able to run at the highest levels of renewable energy sources: this is the great challenge of DC4Cities project.
The goal of DC4Cities is to make existing and new data centres energy adaptive, without requiring any modification to the logistics, and without impacting the quality of the services provided to their users. Finally new energy metrics, benchmarks, and measurement methodologies will be developed and proposed for the definition of new related standards. DC4Cities will promote the data centres role as an "eco-friendly" key player in the Smart Cities energy policies, and will foster the integration of a network of local renewable energy providers (also interconnected with local Smart Grids and Micro Grids) to support the pursued increase of renewable energy share.

7.2.2. Collaborations in European Programs, except FP7

Program: EIT ICTLabs

Project acronym: Activity 13 052 from Intelligent Mobility and Transportation Systems action line (IMS), renamed Future Urban Life and Mobility (ULM) mid 2013

Project title: Multimodal Mobility

Duration: 2013, January to December

Coordinator: F. Baude and B. Kwella (Fraunhofer Gesellschaft)

Other partners: Inria, BME (Hungary), TUBerlin, U. Bologna, Telecom Italia, Siemens/VMZ (Germany), DFKI (Germany)

Abstract: The activity seeks to specify the building blocks, a platform and a prototype for the provision of multimodal mobility. The main motivation is to facilitate the use of ICT to support the efficient organization of Accessible Mobility (support for people with special needs, economical optimization of mobility and transportation, trip planning, information on available transport modes, etc). It therefore provides the basis for sustainable future mobility

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. DISSIMINET

Title: Web-Service approaches for simulation

Inria principal investigator: Olivier Dalle

International Partner (Institution - Laboratory - Researcher):

Carleton University (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 improve 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.

7.3.1.2. 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. 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 - Javier Bustos

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 project, 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.

7.3.2. Inria International Labs

7.3.2.1. CIRIC Chili

Ciric research line: Telecommunications

Inria principal investigator: Eric Madelaine

Duration: 2012 - 2021

This CIRIC activity is loosely coupled with our SCADA associated team with the Universidad de Chile (UdC). We have had some contacts with a software company in Santiago, and starting exploring some possible collaboration in the area of formal specification of distributed applications for Android systems, and generation of “safe by construction” android code. But the effective involvment of CIRIC manpower in this activity has not yet started.

7.3.2.2. LIAMA Shanghai

Liama project: HADES

Inria principal investigator: Robert de Simone

Oasis researchers involved: Eric Madelaine, Ludovic Henrio

Duration: 2013 - 2016

Modern computing architectures are becoming increasingly parallel, at all levels. Meanwhile, typical applications also display increasing concurrency aspects, specially streaming applications involving data and task parallelism. Cyber physical system interactions also add extra-functional requirements to this high degree of concurrency. The goal of best fitting applications onto architectures becomes a crucial problem, which must be tackled from any possible angle. Our position in the HADES LIAMA project is to consider modeling of applications using formal models of concurrent computation, and specialized model-driven engineering approaches to embody the design flow for such models (analysis, verification, mapping allocation, representation of non-functional properties and constraints). We build on various previous domains of expertise : synchronous languages for embedded system design, asynchronous languages for high-performance cloud computing, and real-time specification languages for cyber-physical interaction aspects.

In 2013, HADES and the DAESD associated team organised a joint "Spring School" at ECNU Shanghai, held in cunjunction with the official inaugural LIAMA Shanghai Open day.

7.4. International Research Visitors

7.4.1. Visits of International Scientists

Participant: Ass. Pr. Xavier Défago.

Date: from 16 Sep. 2013 to 31 Jan. 2014

Institution: Dependable Distributed Systems Lab., Japan Advanced Institute of Science and Technology (JAIST), Nomi, Ishikawa, Japan

This visit is founded by CNRS and shared between the OASIS and COATI teams.

Participant: Pr. Gabriel Wainer.

Date: from 14 Jun. to 13 Jul. 2013

Institution: Carleton University, Ottawa (CA)

This visit is in the context of our DISSIMINET associated team

Participant: Pr. Yixiang Chen.

Date: 14-17 Oct. 2013

Institution: East China Normal University, Shanghai (CN)

This visit is in the context of our DAESD associated team

Participant: Ass. Pr. Min Zhang.

Date: 11-16 Sep. 2013

Institution: East China Normal University, Shanghai (CN)

This visit is in the context of our DAESD associated team

Participant: Elena Giachino.

Date: 27-29 Mar. 2013

Institution: Univ. of Bologna

Subject: Collaborative work on deadlock analysis for ABS and ASP

Participant: Pr. Mizuhito Ogawa.

Date: 26-29 Mar. 2013

Institution: Dependable Distributed Systems Lab., Japan Advanced Institute of Science and Technology (JAIST), Nomi, Ishikawa, Japan.

Subject: Collaborative work on fundamental aspects of distributed computing and theorem proving techniques.

7.4.1.1. Internships

Yanwen Chen

Subject: Programmation d'applications hétérogènes embarquées et distribuées

Date: from Jan. 2013 until Jun. 2013

Institution: East China Normal University (China)

This visit is in the context of the cotutelle PhD of Yanwen Chen, under the direction of E. Madelaine.

Dongqian Liu

Subject: Generation of behavioural models in the VerCors platform

Date: from Oct. 2013 until Dec. 2013

Institution: East China Normal University (China)

This visit is in the context of the DAESD associated team.

Michel Jackson de Souza

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

Date: from July 2012 until Aug. 2013

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

This visit is organized after spontaneous contacts, as a complementary work for the student bachelor studies.

PHOENIX Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. HomeAssist: Platform for Assisted Living

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 includes a need analysis, the development of assistive applications and their experimental validation.

This work is funded by CARSAT Aquitaine ("Caisse d'Assurance Retraite et de la Santé au Travail"), Aquitaine Region and Conseil Général de la Gironde.

7.1.2. 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.

7.1.3. 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 Aquitaine Region.

7.2. National Initiatives

7.2.1. 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.

7.2.2. 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.

7.3. European Initiatives

7.3.1. FP7 Projects

Program: FP7 - ICT - 2013.5.3

Project acronym: RAPP

Project title: Robotic Applications for Delivering Smart User Empowering Applications

Duration: From Dec-2013 until Dec-2016

Coordinator: Center For Research and Technology Hellas, CERTH/ITI, Greece

Other partners:

- Politechnika Warszarwska, WUT, Poland
- Sigma Orionis SA, France
- Ortelio LTD, United Kingdom
- Idryma Ormylia, Greece
- Fundacion Instituto Gerontologico Matia - Ingema, spain

Abstract: RAPP will provide a software platform in order to support the creation and delivery of robotics applications (RAPPs) targeted to people at risk of exclusion, especially older people. The open-source software platform will provide an API that contains the functionalities for implementing RAPPs and accessing the robot's sensors and actuators using higher level commands, by adding a middleware stack with added functionalities suitable for different kinds of robots. RAPP will expand the computational and storage capabilities of robots and enable machine learning operations, distributed data collection and processing, and knowledge sharing among robots in order to provide personalized applications based on adaptation to individuals. The use of a common API will assist developers is creating improved applications for different types of robots that target to people with different needs, capabilities and expectations, while at the same time respect their privacy and autonomy, thus the proposed RAPP Store will have a profound effect in the robotic application market. The results of RAPP will be evaluated through the development and benchmarking of social assistive RAPPs, which exploit the innovative features (RAPP API, RAPP Store, knowledge reuse, etc.) introduced by the proposed paradigm.

7.3.2. 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.

7.4. International Initiatives

7.4.1. Inria Associate Teams

7.4.1.1. OPALI

Title: OPen Assistive-technology platform for independent LIving

Inria principal investigator: Emilie Balland

International Partner (Institution - Laboratory - Researcher): University of Québec Trois-Rivières (Canada) - TSA Research Chair - Dany Lussier-Desrochers

Duration: 2013 - 2015

See also: http://phoenix.inria.fr/opali

The goal of the OPALI project is to develop an Open Platform for Assisted Living targeting users with cognitive disabilities. It is a cross-disciplinary project combining expertise in (1) Computer Science focusing in development of applications orchestrating networked devices and (2) Psychology focusing in assistive technologies for users with cognitive disabilities. Furthermore, this project will leverage a unique research vehicle created by the University of Trois-Rivières consisting of a full-fledged apartment equipped with a range of networked devices and dedicated to experimental studies. The outcome of the project will include a large catalog of assistive applications allowing to match each user's project life.

7.5. International Research Visitors

7.5.1. Visits to International Teams

- Charles Consel, sabbatical year at McGill University, Montreal, Canada (From August 2012 to July 2013)

RMOD Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. Cutter

Participants: Stéphane Ducasse [Correspondant], Nicolas Anquetil, Damien Pollet, Muhammad Bhatti, Andre Calvante 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 remodularization 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).

8.3. European Initiatives

8.3.1. 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.

8.3.2. 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.

8.3.3. MEALS FP7 Marie Curie Research Staff Exchange Scheme

MEALS (Mobility between Europe and Argentina applying Logics to Systems) is a mobility project financed by the 7th Framework programme under Marie Curie's International Research Staff Exchange Scheme. It involves seven academic institutions from Europe and four from Argentina, and a total of about 80 researchers to be exchanged. The project started on the 1st of October, 2011, and it has a duration of 4 years. Nr: FP7-PEOPEL-2011-IRSES

http://www.meals-project.eu

Visits in the context of MEALS

- Guido Chari visited RMoD from 29/11/2013 to 22/12/2013
- Diego Garbervetsky visited RMoD from 16/12/2013 to 17/12/2013
- Camillo Bruni visited UBA (Buenos Aires, Argentina): 2012-09-01 - 2012-09-30

8.4. International Initiatives

8.4.1. Inria Associate Teams

8.4.1.1. 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 [50]. 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 [52]. 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 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.

2013 was the third and final year of PLOMO. Due to the success of PLOMO, we have requested a prolongation for another three years (PLOMO2). The *PLOMO Associate Team Final Report* is available online [37].

In the following, we present the results from 2013:

Research Visits From RMoD to PLEIAD

- Stéphane Ducasse from November 4 until November 15, 2013.

From PLEIAD to RMoD

- Johan Fabry on 15th of July, 18th and 19th of September 2013
- Alexandre Bergel from December 12 until December 29, 2013
- Alejandro Infante from September 13 until September 21, 2013
- Ronie Salgado in January 2014

Recent Results

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

- GradualTalk Paper accepted at Science of Computer Programming.
- Performance Evolution Blueprint paper at VISSOFT.
- Work on the DIE domain-specific language and the definition of IDE plugins using it was submitted to a journal and is in a second round of revisions.
- Organization of a coding sprint at Santiago in January 2013 (12 participants)
- Participated to three Moose releases (4.7-4.9) (http://www.moosetechnology.org)
- Integrated the Opal Compiler in the Pharo3 development branch.

Future of the Partnership We really hope that the team will be prolongated for a second three year period. The synergy between the two teams is working really well - in terms of exchanges, results and future collaborations.

For more information, we refer to the report *PLOMO Associate Team Final Report* [37].

8.4.2. Inria International Partners

8.4.2.1. Uqbar - Argentina

Participants: Marcus Denker [correspondant], Stéphane Ducasse [RMoD], Nicolas Anquetil [RMoD], Diego Garbervetsky [UBA,LAFHIS], Gabriela Arevalo [Universidad Nacional de Quilmes)], Nicolas Passerini [Uqbar].

Uqbar is a foundation of researchers teaching in several universities of the Buenos Aires area. Universidad Tecnologica Nacional (FRBA) Universidad Nacional de Quilmes, Universidad Nacional de San Martin,Universidad Nacional del Oeste. LAFHIS is a research laboratory from the University of Buenos Aires. More information at (http://www.uqbar-project.org).

8.4.2.2. Informal International Partners

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.

8.4.3. Participation In other International Programs

8.4.3.1. 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 lasted 24 months and ended June 2013.

8.5. International Research Visitors

8.5.1. Visits of International Scientists

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

- Johan Fabry on 15th of July, 18th and 19th of September 2013
- Alexandre Bergel from December 12 until December 29, 2013
- Alejandro Infante from September 13 until September 21, 2013
- Ronie Salgado in January 2014

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

- Marco Tulio Valente from 21/01/2013 to 25/01/2013
- Marco Tulio Valente from 22/07/2013 to 26/07/2013

In the context of MEALS:

- Guido Chari visited RMoD from 29/11/2014 to 22/12/2013.
- Diego Garbervetsky visited RMoD 16 and 17 December.

Other visitors:

- Hani Abdeen, Research Associate at Computer Science Department - Qatar University (January 2013)
- Michele Lanza, Professor at the University of Lugano (2nd of May, 2013)
- Hayatou Oumarou, Assistant Departement d'Informatique ENS Maroua Cameroun (March 2013 for 1 Month
- David Chisnall, Research Associate at University of Cambridge, (4-5 February)
- Tommaso Dal Sasso, University of Lugano, (16-22 December)
- Yuriy Tymchuk, University of Lugano, (16-22 December)
- Roberto Minelli, University of Lugano, (16-22 December)
- Andrei Vasile, University of Bern, Switzerland (18-21 December)
- Jan Kurs, University of Bern, Switzerland, (18-21 December)

8.5.1.1. Internships

Pablo Herrero, University of Buenos Aires (Argentina): *Compressed ASTs for Pharo*, from Oct 2013.

Sebastian Tleye, University of Buenos Aires (Argentina): *A new Trait Implementation*, from Mar until Aug 2013.

Gustavo Jansen De Souza Santos, Federal University of Minas Gerais (Brasil): *Integration of Semantic Clustering in Moose*, September until November 2013.

Gisela Decuzzi, Universidad Tecnolo´gica Nacional FRBA (Argentina): *AST Navigation for Pharo*, from March to May 2013.

Yuriy Tymchuk, Ivan Franko National University of Lviv (Ukraine): *Extending FAMIX metamodel to generate ASTs for Java and Smalltalk applications*, from January to April 2013.

Erwan Douaille, University of Lille 1: *Automatic validation of contributions from Pharo community*, From April to Jun 2013

8.5.2. Visits to International Teams

- Stéphane Ducasse from November 4 until November 15, 2013. (PLOMO).
- Stéphane Ducasse from November to University of Buenos Aires (Argentina) (MEALS).
- Stéphane Ducasse and Igor Stasenko visited the University of Lviv, Ukraine.
- Camillo Bruni visited UBA (Buenos Aires, Argentina): September (1 Month)
- Marcus Denker visited *Universitat Politecnica de Catalunya*, Barcelona, Spain, 1 week in October 2013.
- Stéphane Ducasse visted the University of Prag for one week in December, 2013

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, Erwan Bousse, 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 Herrera, Erwan Daubert, Walter Rudametkin Ivey.

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, Fabien Coulon, Valéria Lelli Leitão Dantas, 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 Projects

8.2.1.1. NeSSoS

Type: COOPERATION

Defi: Trustworthy ICT

Instrument: Network of Excellence

Objectif: Trustworthy ICT

Duration: October 2010 - March 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/

Inria contact: V. Issarny

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

8.2.1.2. DIVERSIFY

Type: COOPERATION

Defi: Foundation of Collaborative Adaptive Systems

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: February 2013 - January 2016

Coordinator: Inria

Partner: SINTEF (Norway), Trinity College Dublin (Ireland), Université de Rennes 1 (France)

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

Inria contact: Benoît Baudry

Abstract: DIVERSIFY aims at favoring spontaneous diversification in software systems in order to increase their adaptive capacities. This objective is founded on three observations: software has to constantly evolve to face unpredictable changes in its requirements, execution environment or to respond to failure (bugs, attacks, etc.); the emergence and maintenance of high levels of diversity are essential to provide adaptive capacities to many forms of complex systems, ranging from ecological and biological systems to social and economical systems; diversity levels tend to be very low in software systems.

DIVERSIFY explores how the biological evolutionary mechanisms, which sustain high levels of biodiversity in ecosystems (speciation, phenotypic plasticity and natural selection) can be translated in software evolution principles. In this work, we consider evolution as a driver for diversity as a means to increase resilience in software systems. In particular, we are inspired by bipartite ecological relationships to investigate the automatic diversification of the server side of a client-server architecture. This type of software diversity aims at mitigating the risks of software monoculture. The consortium gathers researchers from the software-intensive, distributed systems and the ecology areas in order to transfer ecological concepts and processes as software design principles.

Triskell budget share: 500 keuros

8.2.1.3. HEADS

Type: COOPERATION

Defi:

Instrument: Specific Targeted Research Project

Objectif: NC

Duration: October 2013 - September 2016

Coordinator :SINTEF (Norway)

Partner: SINTEF (Norway), M2MZone (Ireland), TellU (Norway), SoftwareAG (Germany), ATC (Greece), Inria (France)

Inria contact: Benoît Baudry

Abstract: The idea of the HEADS project is to leverage model-driven software engineering and generative programming techniques to provide a new integrated software engineering approach which allow advanced exploitation the full range of diversity and specificity of the future computing continuum. The goal is to empower the software and services industry to better take advantage of the opportunities of the future computing continuum and to effectively provide new innovative services that are seamlessly integrated to the physical world making them more pervasive, more robust, more reactive and closer (physically, socially, emotionally, etc.) to their users.

Triskell budget share: 400 keuros

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. 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.

8.2.2.2. 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. Participation In other International Programs

8.3.1.1. 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) - Gerson SUNYE

Duration: Jul 2011 - Jun 2013

8.3.1.2. SPLIT

Program: International joint supervision of PhD agreement

Title: Aspect-oriented modeling and software product line

Inria principal investigator: Jean-Marc JEZEQUEL

International Partner (Institution - Laboratory - Researcher):

University of Luxembourg (Luxembourg) - Jean-Marc JEZEQUEL

Duration: Apr 2010 - Mar 2013

See also: http://www.fnr.lu/fr/Research-Programmes/Research-Programmes/Projects/Combine-Software-Product-Line-and-Aspect-Oriented-Software-Development-SPLIT

Combine Software Product Line and Aspect-Oriented Software Development - SPLIT

8.3.1.3. MBSAR

Program: CNRS PICS

Title: Model-Based Security Analysis at Runtime (MBSAR)

Inria principal investigator: Benoit Combemale

International Partner (Institution - Laboratory - Researcher):

Colorado State University (USA) - Software Assurance Lab - Robert B. France

Duration: Jan 2013 - Dec 2015

See also: http://gemoc.org/mbsar/

MBSAR develop model-based techniques for runtime analysis and enforcement of security policies in adaptive software systems.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Internships

Ioannis Kavvouras

Subject: Spontaneous diversification in software components

Date: from Mar 2013 until Jul 2013

Institution: Université Nationale Capodistrienne d'Athènes (Greece)

Marianela Ciolfi Felice

Subject: Draw your Products! A Model-based Approach

Date: from Mar 2013 until Aug 2013

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

Wuliang Sun

Subject: Synthesis of Feature-based Model Templates

Date: from Jun 2013 until Jul 2013

Institution: Colorado State University (United States)

8.4.2. Visits to International Teams

Participant: Arnaud Blouin.

Date: May 2013

Visited Institution: the laboratory for research on technology for ecommerce (LATECE) at the University of Québec at Montréal (UQÀM), Canada

8.4.3. Inria International Chair

Prof. Robert B. France [11] was granted by an Inria international chair for the period 2013-2017. Prof. France collaborate intensively with many members of the Triskell team on various joint work, e.g., the Familiar project and the GEMOC initiative. The Inria International Chair will allow Prof. France to make different long visits in the team along the period.

8.4.4. International initiative GEMOC

International initiative GEMOC

The GEMOC initiative (cf. http://www.gemoc.org) is an open and international initiative launched in 2013 that coordinate research partners worldwide to develop breakthrough software language engineering (SLE) approaches that support global software engineering through the use of multiple domain-specific languages. GEMOC members aim to provide effective SLE solutions to problems associated with the design and implementation of collaborative, interoperable and composable modeling languages.

The GEMOC initiative aims to provide a framework that facilitates collaborative work on the challenges of using of multiple domain-specific languages in software development projects. The framework consists of mechanisms for coordinating the work of members, and for disseminating research results and other related information on GEMOC activities. The framework also provides the required infrastructure for sharing artifacts produced by members, including publications, case studies, and tools.

The governance of the GEMOC initiative is ensured by the Advisory Board. The role of the Advisory Board is to coordinate the GEMOC work and to ensure proper dissemination of work products and information about GEMOC events (e.g., meetings, workshops).

Benoit Combemale is the co-founder and currently acts as principal coordinator of the GEMOC initiative. Benoit Combemale and Jean-Marc Jézéquel are part of the Advisory Board, and 9 Triskell members are part of the GEMOC initiative.

[11] Colorado State University, USA. See. http://www.cs.colostate.edu/~france/

COATI Project-Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. ANR Blanc AGAPE, 10/2009-09/2013

Participants: David Coudert, Frédéric Havet, Ana Karolinna Maia de Oliveira, Nicolas Nisse, Stéphane Pérennes, Michel Syska.

The project AGAPE (Parameterized and exact graph algorithms) is led by COATI 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 consider 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)

8.1.2. GDR Actions

8.1.2.1. Action ResCom, ongoing (since 2006)

Réseaux de communications, working group of GDR ASR, CNRS.

(http://rescom.asr.cnrs.fr/)

8.1.2.2. 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 - June 2014

Partners: Alcatel-Lucent Bell (leader) (Antwerp, Belgique), iMind (Ghent, Belgium), UCL (Louvain, Belgium), RACTI (Patras, Grece), UPC (Barcelona, Spain), UPMC (ComplexNetworks, Paris 6), Inria (COATI, GANG, CEPAGE).Coordinator: ALCATEL-LUCENT (Belgium)

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. COATI is the leader of WP3 on Topology Modelling and Routing scheme experimental analysis.

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

8.2.2. Collaborations in European Programs, except FP7

8.2.2.1. PHC PROCOPE (with Discrete Optimization group of RWTH Aachen University), 01/2011-06/2013

Participants: Christelle Molle-Caillouet, David Coudert, Alvinice Kodjo, Issam Tahiri, Truong Khoa Phan.

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 COATI 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. AlDyNet

Title: Algorithm for large and Dynamic Networks

Inria principal investigator: Nicolas Nisse

International Partner (Institution - Laboratory - Researcher):

Universidad Adolfo Ibañez, Santiago, Chile
Facultad de Ingeniería y Ciencias
Karol Suchan

Duration: 2013 - 2015

See also: http://team.inria.fr/coati/projects/aldynet/

The main goal of this Associate Team is to study the structure of networks (modeled by graphs) to design both efficient distributed algorithms and reliable network topologies suitable to applications. We are interested both in large-scale (Facebook, Internet, etc.) and in smaller networks (e.g., WDM) that handle heavy traffic. More precisely, we aim at designing new techniques of distributed and localized computing to test structural properties of networks and to compute structures (e.g., decompositions) to be used in applications. Concerning the applications, we will first focus on routing and subgraph packing problems.

There are two main objectives:

- Find efficient localized algorithms to test certain graph properties or to prove that no such algorithms exist. We will formalize several distributed computing models and analyze which properties can and which cannot be tested in them.
- Define graph properties – computable or approximable in distributed systems – such as structures/decompositions/representations. The driving idea is to combine several well studied graph properties in order to obtain more specific structures which we hope to be more easily computable.

To verify the practical efficiency of our results, the designed algorithms will be implemented and compared to existing ones. For this purpose, a particular effort will be put to design and implement algorithms to generate graphs that satisfy properties of interest, in order to use them to test the algorithms.

The originality of the proposal is to combine powerful tools of graphs theory (e.g., FPT complexity) and of combinatorial optimization (Mixed Integer Programming) with distributed computing. One challenge here is to balance between the degree of locality of desired algorithms and the relevance of properties that may be computed.

8.3.2. Inria International Partners

8.3.2.1. ANR International Taiwan GRATEL, 01/2010 – 12/2013

Participants: Jean-Claude Bermond, Frédéric Havet.

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)

8.3.3. Participation In other International Programs

Inria FUNCAP (Inria-FAP): ALERTE (ALgorithmes Efficaces pour les Réseaux de TElécommunications), with Pargo Team, Universidade Federal do Ceará, Brazil, 07/2011-07/2013.

Action ECOS-SUD: ALgorithmes Distribués pour le calcul de la structure des réseaux, with Chile, 2013-2015.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

Jørgen Bang-Jensen: Univ. Southern Denmark, Odensee, Denmark, from October 11 to November 2, 2013 (3 weeks);

Gianlorenzo D'Angelo: Univ. degli studi di Perugia, Italy, September 9-17, 2013 (2 weeks);

Xavier Défago: Japan Advanced Institute of Science and Technology, Nomi, Ishikawa, Japan, from September 16, 2013 to January 31, 2014 (4.5 months);

Mattia D'Emidio: Univ. L'aquila, Italy, from March 1 to April 30, 2013 (2 months);

Michele Flammini: Univ. of L'Aquila, Italy, from June 22 to July 13, 2013 (3 weeks);

Brigitte Jaumard: Concordia Univ., Montréal, Canada, February 11-22, 2013 (2 weeks);

Mejdi Kaddour: Univ. Oran, Algeria, December 6-13, 2013 (1 week);

Takako Kodate: Tokyo Woman's Christian Univ., Suginami-ku, Tokyo, Japan, from March 21 to April 4, 2013 (2 weeks);

Arie M.C.A. Koster: RWTH Aachen Univ., Germany, February 11-15, 2013 (1 week);

Claudia Linhares-Sales: UFC Fortaleza, Brazil, November 5-11, 2013 (1 week);

Euripides Markou: Univ. Thessaly, Volos, Greece, March 24th-31th (1 week);

Gianpiero Monaco: Univ. L'Aquila, Italy, September 1-8, 2013 (1 week);

Joseph Peters: Simon Frasier Univ., Vancouver, Canada, from January 20 to June 14, 2013 (5 months);

Guido Proietti: Univ. L'Aquila, Italy, September 1-9, 2013 (1 week);

Esteban H. Roman Catafau: Univ. Adolfo Ibañez, Chile, from September 7 to October 6, 2013 (1 month);

Karol Suchan: Univ. Adolfo Ibáñez, Chile, September 7-21, 2013 (2 weeks);

Amel Tandjaoui: Univ. Oran, Algeria, June 12 till July 13, 2013 (1 month);

Joseph Yu: Abbotsford and SFU, Vancouver, Canada, from March 1 to April 19, 2013 (1 month 1/2);

8.4.1.1. Internships

Guillaume Ducoffe: ENS Cachan, from March 18, 2013 until August 31, 2013, and since October 15, 2013;

Rennan Ferreira Dantas: Univ. Federal do Ceará, Brazil, since November 2013;

Klaus Christoph Jaschan Little: Univ. Adolfo Ibañez, Chile, since December 2013;

Ioannis Lamprou: National and Kapodistrian Univ. Athens, Greece, from March 2013 until September 2013;

Christos Papageorgakis: Univ. Central Greece, from January 2013 until July 2013;

Phablo Fernando Soares Moura: Univ. São Paulo (USP), Brazil, from March 2013 until July 2013;

Claudio Soares De Carvalho Neto: Univ. Federal do Ceará, Brazil, since November 2013;

8.4.2. Visits to International Teams

J. Araújo and A.K. Maia: Visit to Simon Fraser Univ., Vancouver, Canada (January 11-February 10, 2013).

J-C. Bermond: LRI, Orsay (March 29, 2013); LIRMM, Montpellier (April 16, 2013);

D. Coudert: Visit to Univ. Adolfo Ibañez (part of EA AlDyNet), Santiago Chile (November 15-30, 2013);

F. Havet: Visit to LIRMM, Univ. Montpellier 2, (December 9-11, 2013);

A. Kodjo: Visit to Concordia Univ., Montreal, Canada, (August 1st-September 1st, 2013);

F.Z. Moataz and B. Li: Visit to Univ. Adolfo Ibañez, Santiago, Chile, (November 14-December 12, 2013);

N. Nisse: Visit to Univ. Adolfo Ibañez (part of EA AlDyNet), Santiago Chile (November 15-December 1st, 2013); Visit to Univ. Perugia, Italy (October 20-25, 2013)

DANTE Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

- 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€¨ million grant from the French government Running from 22.02.11 – 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 organisations 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, mutualising 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 organisations 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 ended in october 2013. It is a collaborative project between the GIPSA Lab (Grenoble), MOAIS (Inria Grenoble), DANTE (Inria Grenoble), the University of Osaka (the Cybermedia Center and the Department of Information Networking) and the University of Kyoto (Visualisation Laboratory).
  The aim of this collaboration was to propose 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 was the peta-scale volume of the treated data corresponding to the upper airway flow modelling.
  http://petaflow.gforge.inria.fr/
- ANR CONTINT CODDDE accepted in December 2013: It is a collaborative project between the ComplexNetwork team at LIP6/UPMC; Linkfluence and Inria Dante. The CODDDE project aims at studying critical research issues in the field of real-world complex networks study:
  - How do these networks evolve over time?
  - How does information spread on these networks?
  - How can we detect and predict anomalies in these networks?

  In order to answer these questions, an essential feature of complex networks will be exploited: the existence of a community structure among nodes of these networks. Complex networks are indeed composed of densely connected groups of that are loosely connected between themselves.

  The CODDE project will therefore propose new community detection algorithms to reflect complex networks evolution, in particular with regards to diffusion phenomena and anomaly detection.

  These algorithms and methodology will be applied and validated on a real-world online social network consisting of more than 10 000 blogs and French media collected since 2009 on a daily basis (the dataset comprises all published articles and the links between these articles).
- ANR FETUSES: The goals of this ANR project consist in the development of statistical signal processing tools dedicated to per partum fetal heat rate characterisation and acidosis detection, and are organised as follows: – construction of a large dataset of per partum fetal heart rate recordings, which is well documented and of significant clinical value; – Developments of adaptive (*e.g.* data driven) algorithms to separate data into trend (deceleration induced by contractions) and fluctuation (cardiac variability) components; – Developments of algorithms to characterise the non stationary and multifractal properties of per partum fetal heart rate ; – Acidosis detection and assessment using

the large datasets; – Algorithm implementation for performing tests in real clinical situations. ANR is a joint project between DANTE, the Physics Lab of ENS Lyon (SiSyPhe team) and the *Hôpital Femme-Mère-Enfant* of Bron (Lyon). Fetuses started in january 2012.

- ANR INFRA DISCO (DIstributed SDN COntrollers for rich and elastic network services) project: the DANTE team will explore the way SDN (Software Designed Network) can change network monitoring, control, urbanisation and abstract description of network resources for the optimisation of services. More specifically, the team will address the issues regarding the positioning of SDN controllers within the network, and the implementation of an admission control that can manage IP traffic prioritisation.

8.2. International Initiatives

8.2.1. Inria International Partners

8.2.1.1. Declared Inria International Partners

- LNCC - Laboratório Nacional de Computação Científica (several collaboration, *e.g.*, STIC AMSUD and Inria/FAPERJ)
- Academy of Science and Technology, Vietnam (collaboration via CNSR PEPS)
- Department of Mathematics/Naxys, University of Namur, Belgium (Student exchanges)
- Department of Biomedical Engineering and Computational Science, Aalto University, Finland

8.2.2. Participation In other International Programs

DANTE is part of a FAPERJ/Inria collaborative project: Complex Dynamic Networks Acronym (CoDyN). The collaboration is done with the Mechanisms and ARchitectures for TeleINformatics (MARTIN) team (http://martin.lncc.br), a R&D group at the National Laboratory for Scientific Computing (LNCC), a research unit of the Brazilian Ministry of Science and Technology. MARTIN houses staff working in Information and Communication Technologies (ICT), with a particular focus on computer networks. Currently, the main activities of the group are on Network Measurements, Mobile Computing, and Network Software Architecture and Modelling. In particular, the group promotes research and development in inter- and multidisciplinary applications based on the above-mentioned areas and their intersections (e.g. mobile health applications).

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- Artur Ziviani and Klaus Wehmuth from LNCC spent several weeks at IXXI.
- Dr. Gerardo Iñiguez from Aalto University (Finland) spent time in the DANTE team and was hosted by IXXI.

8.3.1.1. Internships

- **Arashpreet Singh Mor** master student from Indian Institute of Technology Dehli (India) did his M1 internship with DANTE from May to August 2013.
- **Thibaud Trolliet** L3 student at the department of physics of ENS Lyon did a 2 months internship with the team DANTE (june-july 2013).
- **ANH Ha Pham The** Master student at IFI (Institut de la Francophonie pour l'Informatique - Hanoi Vietnam) did his M2 internship with DANTE from May to November 2013.

8.3.2. Visits to International Teams

- Christophe Crespelle, 2 months in January-February 2013, Vietnam Institute for Advanced Study in Mathematics (VIASM), Hanoï.
- Christophe Crespelle, 1 month in June-July 2013, Institute of Mathematics, Vietnam Academy of Science and Technology, Hanoï.
- Eric Fleury visited the team of Jose Ignacio Alvarez-Hamelin at Buenos Aeres, Argentina in collaboration with Artur Ziviani.

DIANA Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- **PFT** (2011-2014) is a 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

8.2.1. ANR

- **ANR FIT** (2011-2018): FIT (Future Internet of Things) aims to develop an experimental facility, a federated and competitive infrastructure with international visibility and a broad panel of customers. It will provide this facility with a set of complementary components that enable experimentation on innovative services for academic and industrial users. The project will give French Internet stakeholders a means to experiment on mobile wireless communications at the network and application layers thereby accelerating the design of advanced networking technologies for the Future Internet. FIT is one of 52 winning projects from the first wave of the French Ministry of Higher Education and Research's "Équipements d'Excellence" (Equipex) research grant programme. The project will benefit from a 5.8 million euro grant from the French government. Other partners are UPMC, IT, Strasbourg University and CNRS. See also http://fit-equipex.fr/.
- **ANR 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 DISCO** (2013-2016): DISCO (DIstributed SDN COntrollers for rich and elastic network services) aims to explore the way how Software Defined Networking changes network monitoring, control, urbanisation and abstract description of network resources for the optimisation of services. The project works throughout experimentations and application use cases on the next generation of Software-Defined Networking solutions for large and critical distributed systems. The project will study the distribution of the current SDN control plane and the optimization of network operations that the integrated system view of cloud computing-based architectures allows.

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.

8.3.2. EIT KIC funded activities

Our project team was involved in 2013 in **three activities** funded by the EIT ICT Labs KIC:

Fitting, Future InterneT (of ThINGs) facility

The goal of this activity is to develop a testbed federation architecture that combines wireless and wired networks.

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.

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/

This Inria - UC Santa Cruz Team investigates a number of research challenges raised by message delivery in environments consisting of heterogeneous networks that may be subject to episodic connectivity.

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. So, in 2012 we 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. In particular, we are designing mechanisms to p rovide flexible, efficient, and secure capacity sharing solutions by leveraging SDN in hybrid networked environments, i.e., environments that consist of infrastructure-based as well as infrastructureless networks. We are also investigating solutions to optimize caching in infrastructure and infrastructureless networks using SDN. We have also designed a content-optimal delivery algorithm, called CODA, for distributing named data over challenged networks.

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 design a platform to make easier the evaluation of network protocols, applications and proposals for the future Internet architecture, and to make this platform available to the networking research community. The SIMULBED evaluation platform aims to conduct easily mixed simulation-experimentation evaluation of networking protocols in a scalable way, while maintaining a high degree of realism and increasing controllability and reproducibility. It is based on the PlanetLab testbed, the ns-3 network simulator and the NEPI unified programming environment developed in our team to help in simplifying the configuration, deployment and run of network scenarios on the platform. Within this collaboration, we are enhancing the support of emulation in the ns-3 network simulator through Direct Code Execution (DCE) and are extending the functionalities of NEPI to fit the needs of SIMULBED. For example, we extended the DCE and NEPI frameworks to conduct easily and in a more reaslitic way evaluation of the CCNx information-centric networking architecture through ns-3 and the PlanetLab testbed.

8.4.2. Inria International Labs

- 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

8.5.1.1. Visiting PhDs

Ilaria Cianci, Visiting PhD student (from Nov 2012 until Aug 2013)

Subject: Content Centric Networking

Institution: Politecnico di Bari, Italy

8.5.1.2. Internships

Alexandros Kouvakas (from May 2013 until Oct 2013)

Subject: An OpenFlow framework for integrated simulation and live experimentation

Institution: National and Kapodistrian University of Athens

Adel Aljalam (from Mar 2013 until Aug 2013)

Subject: Assessing Internet access quality by active measurements

Institution: Ubinet Master, University of Nice Sophia-Antipolis

Takai Eddine Kennouche (from Feb 2013 until May 2013)

Subject: Realistic Simulation of Sensor Networks - Contiki over ns-3

Institution: Institut National des Télécommunications et des TIC - Oran, Algeria.

Nicoleta Oita (from Mar 2013 until Aug 2013)

Subject: Privacy in mobile networks

Institution: Ubinet Master, University of Nice Sophia-Antipolis

Xiuhui Ye (from May 2013 until Nov 2013)

Subject: How to Network in Online Social Networks

Institution: Politecnico di Torino

8.5.2. Visits to International Teams

Alina Quereilhac, Visiting PhD student PARC in Palo Alto, USA

Period: From June to September 2013

Subject: Evaluating costs of CCNx overlays on the Internet

Thierry Turletti and Bruno Nunes Astuto, Visiting researchers to University of California at Santa Cruz

Period: One week in March 2013

Subject: Community Associated team

Bruno Nunes Astuto Visiting researchers to University of California at Santa Cruz

Period: One month in July 2013

Subject: Community Associated team

Thierry Turletti, Alina Quereilhac and Emilio Mancini, Visitors to NICT, Japan

Period: One week in October 2013

Subject: Simulbed associated team

DIONYSOS Project-Team

8. Partnerships and Cooperations

8.1. International Research Visitors

8.1.1. Inria International Chair

Participants: Bruno Tuffin, Pierre L'Ecuyer.

Title: Methods and Tools for Effective Stochastic Simulation

Period: Nov 2013 - Oct 2018

The activity deals with mathematical models that represent uncertainty in the dynamic behavior of complex systems, algorithms for efficient simulation of these systems on a computer, eventually with the aim of optimizing management decisions taken with respect to these systems, and computer software that concretely implements these methods efficiently. It applies to several types of systems that involve uncertainty, in all areas. The main part of the work is on general-purpose methodology and tools, and their mathematical analysis. Another part focuses on specific classes of applications in the areas of communications networks, reliability, finance, revenue management and network economics, and service systems such as call center or health care management. It has connections with computer science, operations research, industrial engineering, applied probability, statistics, and numerical analysis. Stochastic simulation is a key tool in practically all areas of science, engineering, and management. Its use keeps growing quickly, and new research issues pop up along the way, as the amount of available digital data on complex stochastic systems is literally exploding. Effective ways of using this large flow of data for better stochastic modeling, simulation, and decision making for those systems need to be developed, and this gives rise to large challenges.

8.2. European Initiatives

8.2.1. FP7 Projects

8.2.1.1. FP7 PROBE-IT

Participants: César Viho, Anthony Baire, Nanxing Chen.

PROBE-IT was a two years European project that aims at supporting exploitation of European research advances in IoT deployments. The work plan was split in three main areas : benchmarking, roadmap and interoperability testing. PROBE-IT comprised ten international partners from Europe, China, Brazil and Africa. Dionysos was leader of the work-package WP4 dedicated to testing roadmap and solutions to provide stakeholders with elements to validate technologies conformance and interoperability. The project ended in September 2013 See http://www.probe-it.eu

8.2.2. Collaborations with Major European Organizations

Partner 1: FTW, Vienna (Austria)

We work with FTW on network economics.

Partner2: Universidad Politécnica de Valencia

We work with UPV on network economics.

Partner 3: Vrije University (The Netherlands)

We work with Vrije University on rare event simulation.

8.3. International Initiatives

8.3.1. Inria Associate Teams

8.3.1.1. MANAP

Title: Markovian ANalysis and APplications

Inria principal investigator: Gerardo Rubino

International Partner (Institution - Laboratory - Researcher):

Technical University Federico Santa María (UTFSM), Valparaíso, Chile – Electronics Department – Prof. Reinaldo Vallejos

Starting: 2013

From the theoretical side, MANAP addresses the main problem when using Markov models today in order to analyze complex communication systems, the combinatorial explosion of the state space and its negative consequences on the cost of the associated solving procedures. We focus on the design of acceleration methods capable of reducing the computational complexity of the evaluation of metrics defined on these models. From the application viewpoint, the focus is on (i) the performance analysis of WDM communication infrastructures, taking into account the possibility of failing components, and (ii) the dependability analysis of Wireless Local Area Networks (WLANs). The activities started in 2013, where we launched a project around a new idea for solving numerically basic Markov problems: the computation of the distribution of the model in transient and in steady-state.

See also: http://people.rennes.inria.fr/Gerardo.Rubino/RESEARCH/MANAP/manap.html

8.3.1.2. 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.

8.3.2. "International activity" action from the University Rennes 1

Action funded by the University of Rennes 1 studying ads ranking (e-commerce, search engines) with their economic impact. Collaboration with Pierre L'Ecuyer (Université de Montréal).

8.3.3. Inria International Partners

Our other main international partners are:

- Peter Reichl (from FTW, Vienna, Austria), on pricing and security issues;
- Héctor Cancela and Franco Robledo (from Univ. of the Republic, Montevideo, Uruguay), on simulation issues (see 8.3.5.1);
- Tarik Taleb (from NEC Europe), on LTE issues;
- Alan Krinik, CalPoly, California, USA, on transient analysis of Markovian queues;
- Reinaldo Vallejo, UTFSM, Valparaíso, Chile, on networking and modeling problems (see 8.3.1.1 and 8.3.5.1).

8.3.4. Inria International Labs

In the context of CIRIC, we cooperate with the team of Reinaldo Vallejo, professor at the UTFSM, Valparaíso, Chile, on different topics related to networking and modeling issues. Specifically, these activities are organized around two collaborative projects, 8.3.1.1 and 8.3.5.1 , where one can find the scientific details.

8.3.5. Participation In other International Programs

8.3.5.1. Stic AmSud with UDELAR, Uruguay, and UTFSM, Chile

Program: Stic AmSud

Title: Accelerating Markov Models for analysis and design of dynamic WDM optical networks (AMMA)

Inria principal investigator: Gerardo Rubino

International Partners (Institution - Laboratory - Researcher):

University of the Republic (UDELAR), Montevideo, Uruguay – Computer Science at the Engineering Faculty – prof. Héctor Cancela

Technical University Federico Santa María (UTFSM), Valparaíso, Chile – Electronics Department – Prof. Reinaldo Vallejos

Duration: 2 years, Jan. 2013 – Dec. 2014

This project has two main scientific goals: (i) to develop methods capable of solving Markov models faster than with state-of-the-art techniques, and (ii) to apply these techniques to the design of fault-tolerant optical networks. The rationale behind (i) is that the group has ideas and some preliminary promising unpublished results that makes it expect that its approach will be effective in producing new nice solving procedures. Concerning (ii), we have already produced results in simpler cases (without taking into account failures), and we also have results on all the associated areas (dependability analysis, combinatorial optimization, etc.). These main research lines are completed with other goals all concerned with the quantitative analysis of such complex communication systems.

8.3.5.2. Math AmSud with UDELAR, Uruguay, and UV, Chile

Program: Math AmSud

Title: Stochastic Analysis, Statistics Inference, Numerical Analysiss (SIN)

Inria principal investigator: Gerardo Rubino

Main International Partners (Institution - Laboratory - Researcher):

University of the Republic (UDELAR), Montevideo, Uruguay – Computer Science at the Engineering Faculty – prof. Paola Bermolen

University of Valparaíso, Chile — Prof. Soledad Torres

Duration: 2 years, Jan. 2013 – Dec. 2014

Stochastic calculus with respect to the standard Brownian motion or more generally with respect to semi-martingales is currently one of the most important components of international research in probability theory. The applications of this theory largely exceed the original probabilistic framework and have repercussions in various fields, including differential geometry, differential partial equations, theoretical physics, modeling in finance, hydrology, telecommunications and biology. Recently, many authors have been interested in developing a stochastic calculus with respect to Gaussian processes which are not necessarily semi-martingales, as for instance the well known fractional Brownian motion. This research project is articulated around the analysis and the applications of stochastic differential equations driven by long memory processes.

SIN is a large project with many partners. Our team participates in looking at differential equations and stocastic differential equations as limits of discrete Markov processes.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

8.4.1.1. Professors

Pr. Luis Guijarro

Subject: Economics of cognitive radio networks

Institution: UP Valencia (Spain)

Duration: 1/06/2013 - 31/07/2013

Pr. Héctor Cancela

Subject: network reliability (see 8.3.5.1)

Institution: UDELAR, Montevideo, Uruguay

Duration: 10 days, Jul 2013

Pr. Reinaldo Vallejo and Marta Barría

Subject: network modeling and Markov chain analysis (see 8.3.5.1 , 8.3.1.1 , 8.3.4)

Institutions: UTFSM and UV, Valparaíso, Chile

Duration: two weeks, Sep 2013

8.4.2. Visits to International Teams

- G. Rubino visited the Design and Analysis of Communication Systems (DACS) at the University of Twente, The Netherlands, where he gave a seminar.
- C. Viho visited the Institute of Computer Science at the University of Goettingen (Germany) and the Computer Science and Engineering Department of BUPT (Beijing University of Post and Telecommunications), China, where he gave seminars.

DYOGENE Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

DYOGENE 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.

8.2. National Initiatives

8.2.1. GdR GeoSto

Members of Dyogene participate in 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.

8.2.2. ANR

8.2.2.1. ANR GAP

Graphs, Algorithms and Probability - PI: Marc Lelarge; started in Jan 2012 - 48 months. http://www.di.ens.fr/~lelarge/ANR-GAP.html

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 is to develop mathematical tools in order to contribute to a rigorous formalization of the cavity method:

- 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.

8.2.2.2. ANR MARMOTE

Markovian Modeling Tools and Environments - coordinator: Alain Jean-Marie (Inria Maestro); local coordinator (partner Inria Paris-Rocquencourt): A. Bušić; 48 months; partners: Inria Paris-Rocquencourt (EPI DYOGENE), Inria Sophia Antipolis Méditerranée (EPI MAESTRO), Inria Grenoble Rhône-Alpes (EPI MESCAL), Université Versaillese-St Quentin, Telecom SudParis, Université Paris-Est Creteil, Université Pierre et Marie Curie.

The aim of the project is to realize a modeling environment dedicated to Markov models. One part will develop the Perfect Simulation techniques, which allow to sample from the stationary distribution of the process. A second one will develop parallelization techniques for Monte Carlo simulation. A third one will develop numerical computation techniques for a wide class of Markov models. All these developments will be integrated into a programming environment allowing the specification of models and their solution strategy. Several applications will be studied in various scientific disciplines: physics, biology, economics, network engineering.

8.2.2.3. ANR MAGNUM

A. Bušić is a participant (within partner LIP6) of the national project ANR MAGNUM (Methodes Algorithmiques pour la Generation aleatoire Non Uniforme: Modeles et applications) (2010–2014), partners: LIP6, LIAFA, IGM. http://www-apr.lip6.fr/anrMagnum/.

8.3. International Initiatives

8.3.1. Inria Associate Teams

The third and last year of the Associate Team "IT-SG-WN" with the EECS department of UC Berkeley in the USA, funded from 2011 to 2014, was completed by a one month visit of Prof. Anantharam in Paris in June 2013 and a visit of F. Baccelli in Berkeley in November 2013. This Associate Team participated in the Inria@SiliconValley initiative. It led to several joint publications on Information Theory: http://www.di.ens.fr/~baccelli/IT_SG_WN_web_site.htm

8.3.2. Microsoft Research-Inria Joint Centre

DYOGENE is involved in two projetcs.

- Structured Large-Scale Machine Learning
  Project summary: Machine learning is now ubiquitous in industry, science, engineering, and personal life. While early successes were obtained by applying off-the-shelf techniques, there are two main challeges faced by machine learning in the « big data » era : structure and scale. The project proposes to explore three axes, from theoretical, algorithmic and practical perspectives: (1) large-scale convex optimization, (2) large-scale combinatorial optimization and (3) sequential decision making for structured data. The project involves two Inria sites and four MSR sites.
  As part of this project Florian Bourse (student at ENS) did an internship supervised by Marc Lelarge and Milan Vojnovic. Marc Lelarge visited MSR Cambridge and Milan Vojnovic visited Inria.
- Social information networks
  Project summary: Online Social networks provide a new way of accessing and collectively treating information. Their efficiency is critically predicated on the quality of information provided, the ability of users to assess such quality, and to connect to like-minded users to exchange useful content. To improve this efficiency, we develop mechanisms for assessing users' expertise and recommending suitable content. We further develop algorithms for identifying latent user communities and recommending potential contacts to users.
  As part of this project Rui Wu (student at UIUC) did an internship supervised by Marc Lelarge and Laurent Massoulié.

8.3.3. Participation In other International Programs

Anne Bouillard is participating in the joint lab Inria-Alcatel-Lucent and collaborated with B. Ronot [18].

Anne Bouillard is collaborating with Giovanni Stea from the University of Pisa, Italy.

Marc Lelarge is part of the IFCAM project: Application of optimal control and game theory in communication networks (PIs: Rajesh Sundaresan (Indian Institute of Science) and Eitan Altman (Inria))

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- Vijay Subramanian (Northwestern University), April 8-12, 2013.
- Venkatachalam Anantharam (UC Berkeley), June 2013.
- Moez Draief (Imperial College London), July 2013.
- Hermann Thorisson (University of Iceland), September-October 2013.
- Sean Meyn (University of Florida), November 24-30, 2013.
- Rajesh Sundaresan (Indian Institute of Science), December 1-5, 2013.

8.4.1.1. Internships

- Asma Ghorbel (EURECOM), August 2013 to January 2014; Subject: *LTE/LTE-A Network Optimization by Distributed Fast Algorithms*; co-advised with Chung Shue (Calvin) Chen (Alcatel-Lucent Bell Labs).
- Rémi Varloot (ENS), MPRI internship, March-August 2013; Subject: *Coupling From the Past with Oracle Skipping*.
- Rui Wu (UIUC), September-December 2013.
- Jiaming Xu (UIUC), September 16-20, 2013.

8.4.2. Visits to International Teams

Anne Bouillard was invited at Tokyo institute of Technology, Japan from March to September 2013.

B. Błaszczyszyn visited Probability and Stochastic Processes team at the University of Wroclaw.

FUN Project-Team

7. Partnerships and Cooperations

7.1. Regional Initiatives

7.1.1. Tracaverre

Participants: Nathalie Mitton [correspondant], Gabriele Sabatino.

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. National Initiatives

7.2.1. ANR

7.2.1.1. RESCUE

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

Title: Reseau Coordonne de substitution mobile

Type: VERSO

Duration: December 2010 - April 2004

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 provides a better service. The base network may be any access network or metropolitan network (including wired and wireless technologies). Troubles may come from an increase of unplanned traffic, a failure of an equipment, or a power outage.

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

7.2.1.2. F-Lab

Participants: Nathalie Mitton [correspondant], Tahiry Razafindralambo.

Title: Federating Computing Resources

Type: VERSO

Duration: November 2010 - March 2014

Coordinator: UPMC

Other partners: Inria DIANA, DANTE, 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 French top academic and industrial research institutions, working together to develop experimental facilities on the Future Internet. F-Lab presents an unique opportunity for the French community to play a stronger role in the design of federation systems; for the SensLAB testbed to reach an international visibility and use; and for the pioneering of testbeds based on LTE technology.

7.2.1.3. 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.

7.2.2. ADT

7.2.2.1. SenSas

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

Title: Sensor Network Applications (SensAS)

Type: ADT

Duration: November 2010 - November 2014

Coordinator: Inria DANTE

Others partners: Inria Non-A Inria DIANA 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.

7.2.2.2. SensLille

Participants: Khalil Hammami, Nathalie Mitton [correspondant], 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.

7.2.2.3. 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.

7.2.3. Equipements d'Excellence

7.2.3.1. FIT

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

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.

7.3. European Initiatives

7.3.1. FP7 Projects

7.3.1.1. VITAL

Participants: Nathalie Mitton [correspondant], Riccardo Petrolo, Valeria Loscri.

Title: Virtualized programmable InTerfAces for smart, secure and cost-effective IoT depLoyments in smart cities

Type: FP7 Smart Cities

Duration: September 2013 - August 2016

Coordinator: National University of Ireland (NUIG), Digital Enterprise Research Institute (DERI)

See also: http://vital-iot.com/

Abstract: Internet-of-Things (IoT) applications are currently based on multiple architectures, standards and platforms, which have led to a highly fragmented IoT landscape. This fragmentation is evident in the area of smart cities, which typically comprise several technological silos (i.e. IoT systems that have been developed and deployed independently). Nowadays there is a pressing need to remove these silos in order to allow cities to share data across systems and coordinate processes across domains, thereby essentially improving sustainability and quality of life. In response to this need, VITAL will realize a radical shift in the development, deployment and operation of IoT applications, through introducing an abstract virtualized digital layer that will operate across multiple IoT architectures, platforms and business contexts. Specifically, VITAL will provide platform and business context agnostic access to Internet-Connected-Objects (ICO). Moreover, it will research virtualized filtering, complex event processing (CEP) and business process management mechanisms, which will be operational over a variety of IoT architectures/ecosystems. The mechanisms will compromise the diverse characteristics of the underlying ecosystems, thereby boosting interoperability at the technical and business levels. VITAL will also provide development and governance tools, which will leverage the project's interfaces for virtualized access to ICOs. VITAL will allow solution providers to (re)use a wider range of data streams, thereby increasing the scope of potential applications. It will also enable a more connected/integrated approach to smart city applications development, which will be validated in realistic deployments in London and Istanbul. The partners will contribute and adapt a host of readily available urban infrastructures, IoT platforms and novel IoT applications, which will ease the accomplishment of the project's goals based on an optimal value for EC money.

7.3.2. Collaborations in European Programs, except FP7

Program: CoperLink

Project acronym: Palmares

Project title: Palmares

Duration: January 2012 - July 2013

Coordinator: Universita degli Studi Mediterranea, Italy

Other partners: Inria, Stellenbosch University (South Africa)

Abstract: Internet of things, VANET and substitution networks.

7.4. International Initiatives

7.4.1. Inria International Partners

7.4.1.1. Declared Inria International Partners

Currently, the FUN team has two possible International Partners awaiting for approval: Universita mediterranea di Reggio Calabria (UNIC) in Italy and Southern University in China. See next section for details.

7.4.1.2. Informal International Partners

Universita mediterranea di Reggio Calabria (UNIC), Italy

Objective of this collaboration is the design of an innovative architecture that enables autonomic and decentralized fruition of the services offered by the network of smart objects in many heterogeneous and dynamic environments, in a way that is independent of the network topology, reliable and flexible. The result is an 'ecosystem' of objects, self-organized and self-sustained, capable of making data and services available to the users wherever and whenever required, thus supporting the fruition of an 'augmented' reality thanks to a new environmental and social awareness. This collaboration gave birth to the PALMARES project (see section International programs), students and researchers exchanges (see section international visits) and joint publications, among them for 2013: [16].

Southern University, China

The purpose of this collaboration is to study the green (or energy-efficient) communication problem in vehicular ad hoc networks (VANETs) and the application of vehicular network communication in green transportation. It gave birth to joint project submission, joint conference organization and several publications, among them for 2013: [34], [36], [38], [13], [26].

PhD co-supervision with Sfax University

Since January 2013, Nathalie Mitton co-supervises Mouna Rekik as a PhD student with Pr Zied Chtourou from Université de Sfax, Tunisia. Her topic is about swarm intelligence based multi-path geographic routing for wireless sensor and actuator networks.

7.4.2. Inria International Labs

7.4.2.1. PREDNET

Participants: Nathalie Mitton [correspondant], Milan Erdelj, Julien Vandaele, Cesar Marchal, Isabelle Simplot-Ryl.

Title: Predator network

Type: LIRIMA

Duration: January 2013 - December 2016

See also: https://iww.inria.fr/prednet/en/

Abstract: PREDNET (PREDator adhoc NETwork) proposes to do research on the most suitable topology and subsequent deployment of a wireless sensor network for sparsely populated outlying rural and wilderness areas, for effective monitoring and protection of resources and ecosystems.

This collaboration gave birth to joint project submission, joint conference organization and several publications, among them for 2013: [31]

7.4.2.2. CIRIC Chile

Participant: Tahiry Razafindralambo.

Tahiry Razafindralambo is in leave at Inria Chile since August 2013. Tahiry's project within Inria Chile is linked to a project developed by NIC research Labs - Chile (Dr. Javier Bustos, Ms. Carolina Sandoval, Mr. Felipe Lema and Ms. Karina Ventura) regarding Quality of Experience, the Universidad de Chile (Pr. Nelson Baloian and Pr. Gustavo Zurita Alarcon) regarding data display, Psicomedica regarding the clinical aspect regarding the wireless sensor networks aspect. The proposed project tries to evaluate the user perception regarding a wearable monitoring system. The Wearable monitoring system will be installed on patients with mental diseases to monitor their body temperatures, heart rate, ...

GANG Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. 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.

7.1.2. 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.

7.1.3. Alcatel-Lucent Bell Labs and Inria Joint Research Lab

Participants: The-Dang Huynh, Leonardo Linguaglossa, Fabien Mathieu, Laurent Viennot.

Gang is participating to the joint laboratory between Alcatel-Lucent and Inria and contributes mainly in the ADR (joint research action) on content centric networking.

7.1.4. Laboratory of Information, Networking and Communication Sciences (LINCS)

Participants: The-Dang Huynh, Leonardo Linguaglossa, Fabien Mathieu, Laurent Viennot.

Gang is participating to the LINCS, a research centre co-founded by Inria, Institut Mines-Télécom, UPMC and Alcatel-Lucent Bell Labs, dedicated to research and innovation in the domains of future information and communication networks, systems and services. Most of the collaboration with Alcatel-Lucent is carried through this structure.

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. 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.

7.3. International Initiatives

7.3.1. 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).

7.3.2. Inria International Partners

7.3.2.1. Informal International Partners

Participants: Carole Delporte, Hugues Fauconnier.

- distributed computing and synchronization: regular visits by Sam Toueg (Toronto), Rachid Guerraoui (EPFL) and Luis Rodriguez (U. Lisboa).
- consensus agreement: Last year we have shown that $(n-1)$-set consensus can be solved obstruction-free with 2 MWMR registers and this bound is tight. We have tried to generalize this result to the $(n-k)$-set consensus with $k+1$ registers; our regular cooperation with Eli Gafni (UCLA) is still ongoing.

HIPERCOM2 Team

8. Partnerships and Cooperations

8.1. National Initiatives

8.1.1. ANR

8.1.1.1. GETRF

Participants: Paul Muhlethaler, Pascale Minet, Cédric Adjih, Emmanuel Baccelli, Philippe Jacquet.

Period: 2012 - 2014.

Partners: DGA/MI, Inria (coordinator), Alcatel-Lucent.

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 focuses 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.

8.1.2. Competitivity Clusters

8.1.2.1. SAHARA

Participants: Pascale Minet, Ridha Soua, Erwan Livolant.

Period: 2011 - 2014.

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

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 2013, we specified the protocols for layer 3. We organized demonstrations in March at Rocquencourt and in July 2013 at Suresnes to prove our concepts.

8.1.2.2. CONNEXION

Participants: Pascale Minet, Saoucene Ridene, Ines Khoufi, Erwan Livolant.

Period: 2012 - 2016.

Partners: EDF (coordinator), All4Tec, ALSTOM, AREVA, Atos WorldGrid, CEA, CNRS / CRAN, Corys TESS, 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 HIPERCOM2 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 distinguish:

- 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 virtual force based approach presents many advantages such as simplicity and fast coverage. That is why we adopt this approach. However, the distributed version is prone to node oscillations that consume energy. We proposed two distributed algorithms to reduce node oscillations: ADVFA that adapts to the effective number of operational sensor nodes and GDVFA that takes advantage of grid to avoid these oscillations and to easily detect redundant nodes that can sleep to save energy.

8.1.2.3. SMARTMESH

Participants: Cédric Adjih, Alaeddine Weslati.

This is a joint work with Emmanuel Baccelli from Inria Saclay.

Period: 2010 - 2013.

Partners: SAGEM, CEA, Telecom SudParis, Ineo Defense, IEF, Orelia, Prodomo, Reflex CES, Evitech, Accuwatt.

SMARTMESH is a System@tic project, focused on the design of intelligent wireless sensor mesh networking for video surveillance and intrusion alarm systems.

In 2013, Inria finalized the communication subsystem comprising the following elements:

- Communication hardware using Senslab nodes (WSN430), directly connected to “SMARTMESH” nodes, with 802.15.4 radio.
- Communication software based on an extended version of the Contiki-OS
- Extensions of RPL routing protocol: P2P-RPL and MLN-RPL (Multi-Level Neighborhood RPL, for filtering appropriate links).

- Adaptation of the Contiki-OS 802.15.4 MAC layer for enabling better performance.
- Development of a cross-layering transport layer, to allow the efficient transport of large burst of data (images), on top of the 6lowpan/802.15.4 layer: a "burst-mode" communication protocol.

During the year 2013, the different components of the SMARTMESH project have been integrated to develop a specific application of area surveillance, with an easily deployable system. The system comprises a number of sensors: audio sensors, PIR sensors, infrared cameras, standard camera; a number of sophisticated signal processing algorithms (audio, video, distributed fusion and tracking, energy management); the communication susbsystem itself; and a control/supervising terminal (displaying alarms, and tracks in real time).

Ten SMARTMESH prototype nodes have been created, integrating the different components. They have been tested in deployments in the military camp of Beynes (mostly from december 2012 to february 2013). The deployments had been planned with a map describing orientation and positions of the sensors of the nodes.

A demonstration of the entire SMARTMESH project was successfully conducted on 22 february, with the following application: detection of human "intruders", and of vehicles, and tracking of their motion.

8.1.2.4. ACRON

Participant: Cédric Adjih.

Period: 2011 - 2013

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.

In 2013, we finalized a protocol for diffusion in Vehicular Networks (VANETs) using network coding: the "DONC" diffusion protocol (joint work with Anthony Busson and Farhan Mirani in particular). The protocol is combining network coding with delay-based broadcast.

8.1.2.5. SWAN

Participants: Cédric Adjih, Claudio Greco.

Period: 2011 - 2014

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

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

8.1.2.6. MOBSIM

Participants: Cédric Adjih, Paul Muhlethaler, 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.

Thanks to the ADT, a module for the simulator ns-3 has been released: Ey-Wifi. It is available, along with a detailed tutorial explaining how to use it, at: http://hipercom.inria.fr/Ey-Wifi

8.2. International Initiatives

8.2.1. Participation In other International Programs

8.2.1.1. AWSN 2013

Program: Euromediterranean 3+3

Title: Auto-adaptivity in Wireless Sensor Networks

Inria principal investigator: Pascale Minet

International Partners:

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: http://hipercom.inria.fr/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 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.

In 2013, the AWSN project organized two workshops reserved to AWSN teams:

- Workshop in Rocquencourt in September 2013.
- Workshop in Catania in December 2013.

The AWSN project organized also two open workshops:

- RAWSN 2013 in Marrakech in May 2013 organized by the Moroccan team: see the program on http://www.netys.net/rawsn2013/, workshop held in conjunction with NETYS 2013.
- PEMWN 2013 workshop in Hammamet in November 2013, organized by the Tunisian and French teams, see the program on https://sites.google.com/site/pemwn2013/final-program

8.3. International Research Visitors

8.3.1. Visits of International Scientists

- **Leila Saidane**, ENSI, Tunis, Tunisia, February and September 2013,
- **Mohammed Erradi**, ENSIAS, Rabat, Morocco, September 2013,
- **Abdellatif Kobbane**, ENSIAS, Rabat, Morocco, September 2013.

MADYNES Project-Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

MADYNES is involved in Satelor, a regional research and development project funded by the AME (Agence de Mobilisation Economique) of Lorraine (October 2013 – September 2016). The consortium includes academic (Univ. of Lorraine, Inria), medical (OHS) and industrial (Diatelic-Pharmagest, ACS, Kapelse, Salendra, Neolinks) partners. It aims at developing innovative and easily deployable AAL solutions for their effective use in the tele-homecare systems. Madynes team is mainly involved in the data collection system development based on wireless sensors and IoT technology.

8.2. National Initiatives

8.2.1. ANR

8.2.1.1. ANR Quasimodo

Participants: François Despaux, Abdelkader Lahmadi, Evangelia Tsiontsiou, Ye-Qiong Song [contact].

The QUASIMODO ANR Blanc international project (http://quasimodo.loria.fr/) is a fundamental research project coordinated by Prof. Ye-Qiong SONG at LORIA - University of Lorraine in France and by Prof. Youxian SUN at SKLICT of Zhejiang University in China. The project started on March 2011 for duration of 36 months. It is funded by ANR grant (ANR 2010 INTB 0206 01) and NSFC grant (NSFC 61061130563). The main objective of the project is to specify, develop and evaluate algorithms and mechanisms to provide the self-adaptive QoS support for real-time applications using wireless sensor networks (WSN). We extended queue-MAC to iQueue-MAC to support multi-hop transmission [23]. We also conducted measurement based performance evaluation of IEEE802.15.4 beacon enabled WSN to assess the usefulness of the existing Markov models [15], [14] for evaluating the end-to-end delay distribution. A new routing algorithm called Operator calculus has been intensively studied and its execution time has been compared with SAMCRA, showing the great potential of OC to be used in WSN routing.

8.2.2. PIA LAR

Participants: Kévin Roussel, Ye-Qiong Song [contact].

LAR (Living Assistant Robot) is a national project getting together Inria (MAIA and MADYNES teams, Credit Agricole, Diatelic and Robotsoft. The aim is to develop an ambient assisted living system for elderly including both sensors and assistive robots. The task of our team is the development of a WSN based system integrating both sensors of the environment and sensors and actuators embedded on a mobile robot. The research issues include the QoS, energy and mobility management. The first step consists in identifying and developing necessary support for realizing such a system. For this purpose we investigated several OS for WSN and proposed some enhancements to ContikiMAC and RiotOS.

8.2.3. Action de Développement Technologique

8.2.3.1. ADT Métroscope

This ADT is linked to the consortium Metroscope [5], whose goal is to understand the behavior of the Internet and its uses within a mobile environment. Through this ADT, funded by Inria, an engineer (Mohammad-Irfan Khan) was hired for 2 years (2013-2015). He will participate in the design and deployment of a distributed platform. This platform will be composed of a services providing measurement tools that collect a set of data and interact with probes located at various points of the network.

[5] http://metroscope.eu/

8.2.3.2. ADT SEA

The goal of this ADT is to provide an novel security solution for Android platforms where the users will be able to evaluate the security level of their devices. The solution relies on the analysis and collection of logs and network activities of running Android applications to detect malicious activities and also the detection of vulnerable configurations of the device using an OVAL-based approach. Through, this ADT, funded by Inria, an engineer (Eric Finickel) was hired for 2 years (2013-2015). He is working on the development of Android devices embedded probes to export logs and network activities. He will also design and setup the collector and the analysis applications using a Hadoop based framework.

8.2.3.3. ADT PAL-PERCEE

The goal of this ADT (2012-2013) is to provide a multi-protocol gateway and a unified interface for easing transparent access to the heterogenous sensor data. Together with PAL partners, we specified a common data format and enriched the existing MPIGate by re-structing all using ROS middleware. The new MPIGate is operational in the smart apartment of LORIA and serves as the base for developing large scale AAL systems.

8.2.4. 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 described above, we extended MPIGate (http://mpigate.loria.fr). 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

Type: COOPERATION
Defi: The Network of the Future
Instrument: Integrated Project
Objectif: The Network of the Future
Duration: September 2010 - August 2013
Coordinator: Alcatel Lucent (France)
Partner: 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).
Inria contact: E. Fabre
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.

This FP7 European integrated project aims at consolidating the autonomic methods and techniques supporting the management of the future Internet, and at integrating these methods into a unified management framework (UMF). The objective of this framework is to address the management issues of the evolving Internet through the self-organization of the control plane and the empowerment of the management plane with cognition. Our work in the Univerself project mainly concerns the security and safety challenges posed by this unified management framework, with a special interest for the maintenance of safe configurations.

In the Year 2013, we have pursued our efforts on vulnerability management in autonomic networks and systems. In that context, we have worked on the adaptation of observation and operation methods to the specific needs of future networks and services, through the refinement of the Unified Management Framework (UMF) and its network empowerment modules (NEM). A particular focus has been given to methods for assessing past hidden vulnerable configurations [44] as well as techniques for minimizing the impact of the vulnerability assessment process on device resources [45]. We have therefore extended our vulnerability management strategy to the detection of systems compromised in the past by configuration vulnerabilities unknown at that moment, and considered a probabilistic cost-efficient assessment for dealing with resource-constrained environments by taking advantage of the statistical properties of vulnerability description sets.

We have also worked on the design of a configuration assessment service for the UMF framework. NEMs have particular requirements and specific configurations in order to work properly. The interconnections between hundreds of NEMs and the services provided by them increase the complexity of their configuration. This configuration assessment service aims at preventing configuration errors, conflicts between services and inconsistencies that can occur leading to severe operational problems as well as security issues within the framework itself. Even though operating systems where NEMs are deployed and also the NEMs themselves may have security solutions to be protected, such fact does not ensure the security of the whole framework.

8.3.1.2. FI-WARE

Type: COOPERATION

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

Instrument: Integrated Project

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

Duration: September 2011 - May 2014

Coordinator: Telefonica (Spain)

Partner: Thales, SAP, Inria

Inria contact: Olivier Festor

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 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. FI-WARE unites major European industrial actors.

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

8.3.1.3. Flamingo

Type: COOPERATION

Defi: Management of the Future Internet

Instrument: Network of Excellence

Objectif: Management of the Future Internet

Duration: November 2012 - October 2016

Coordinator: University of Twente (Netherlands)

Partner: University of Twente, Inria, University of Zurich, Jacobs University of Bremen, University des Bundeswehr Munich, Polytechnic University of Catalonia, Interdisciplinary Institute for Broadband Technology, University of Ghent, University College London

Inria contact: Olivier Festor

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

Abstract: The FP7 FLAMINGO Network of Excellence is composed of 8 partner universities, with complementary knowledge and strong ties to industry. It covers the entire spectrum of network management core functions and application domains, which are required for building, integrating, and disseminating the knowledge of the management plane for the Future Internet.

The objectives of FLAMINGO are (a) to strongly integrate the research of leading European research groups in the area of network and service management, (b) to strengthen the European and worldwide research in this area, and (c) to bridge the gap between scientific research and industrial application. To achieve these goals, FLAMINGO performs a broad range of activities, such as to develop open source software, establish joint labs, exchange researchers, jointly supervise Ph.D. students, develop educational and training material, interact with academia and industry, organize event, and strongly contribute to (IETF and IRTF) standardization [40].

Our work on network and service monitoring [42] has focused on security attacks in RPL Networks, with a study of DODAG inconsistency attacks jointly with Jacobs University of Bremen. In a RPL network, a malicious node can create artificial DODAG inconsistencies by manipulating IPv6 header options, thereby leading to increased overhead, denial of service and even black-hole attacks that are hard to detect. Our work has consisted in evaluating the impact of DODAG attacks in a RPL network, identifying the key parameters that are required to detect these attacks, developing a mitigation strategy to reduce their effects. Efforts have also been done on a NetFlow/IPFIX Probe for android-based devices, jointly with University of Twente. The major achievements of this collaboration have been the development of a NetFlow and IPFIX metering process for Android devices, the extension of nfdump/Nfsen and SURFmap with location support, and a IETF draft describing a set of information elements for IPFIX metering process location.

We have also contributed to activities on automated configuration and repair [37], with an in-depth analysis and comparison of existing management architectures. In that context, we have elaborated a survey on autonomic vulnerability assessment, recently published in IEEE Communications Survey and Tutorial [3]. This survey introduces a classification, called D3, to structure the vulnerability assessment activity into three well-defined dimensions: Discovery, Description and Detection. Background and key concepts as well as different leading methods and current techniques have been discussed along this work. We have identified potential applications over diverse contributions that may provide a strong basis for achieving this critical goal within self-governing

systems. We have also pointed out several areas such as vulnerability integration models, collaborative vulnerability management approaches and policy-based reasoning systems where the development of novel approaches and solutions are required to provide autonomic environments with the ability of assessing their own exposure.

8.3.2. Collaborations in European Programs, except FP7

Type: COOPERATION

Defi: Crowdsourcing Services for Citizen in Digital Cities

Instrument: EIT ICT Labs

Objectif: Develop new essential services for city-grade crowd-sourcing platforms and to deploy them on different platforms dedicated to different types of crowd-sourcing activities.

Duration: January 2013 - December 2013

Coordinator: Inria (France)

Partner: Imperial College of London (UK), BME (HU), KTH (SW), SAP (GE), Cap-Digital (FR), Alcatel-Luccent (FR), Inria (FR)

Inria contact: Thomas Silverston

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

Abstract: the EIT ICT Labs activity CityCrowdSource is composed of 7 partners, among which 4 partner universities and 3 partner industries. This project tackles the Crowdsourcing services and propose three milestones for such emerging services: trust service, privacy service and process model.

The objective of CityCrowdSource is to develop three new services that are essential for city-grade crowd-sourcing platforms and to deploy and evaluate them on five different existing platforms dedicated to different types of crowd-sourcing activities.

The activity supports to leverage the potential of crowd-based applications in urban contexts. Crowd-based data collection in combination with official data will lead to a vastly improved coverage and quality of digital information for urban areas.The added-value of the proposal is in : (1) the three services: trust, privacy and crowd processes modeling that are not present in any crowd-sourcing platform available today, (2) in the deployment and of these services on top of different crowd-sorucing platforms and (3) the experimentation of these paltforms in real life city scenarios.

Our work in this activity has focused on the design, deployment and experimentation of CrowdOut, a crowdsourcing service for Road Safety. This service has been designed for Android platform and has been tested and evaluated. First, a prototype has been experimented during Futur-en-Seine, the Digital World Festival in Paris (June 2013). Second, we performed experiment in the Grand Nancy Urban Area. The CrowdOut User Interface received support from the Living Lab Inria Sophia-Antipolis.

From this work we published several papers into a national conference (Ubimob) [25].

8.3.3. Collaborations with Major European Organizations

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

8.4. International Initiatives

8.4.1. Inria International Partners

8.4.1.1. Informal International Partners

- University of Twente, The Netherlands, joint work with Professor Aiko Pras on large scale network monitoring and attack detection

- Jacobs University Bremen, joint PhD. with Professor Schoenwaelder on security management in wireless sensor networks
- Federal University of Rio Grande do Sul (UFRGS), joint work with Professor Granville on autonomic management systems
- University of the Federal Armed Forces, Munich Germany, joint work with Professor Gabi Dreo on cloud and mobile cloud security management

8.5. International Research Visitors

8.5.1. Visits of International Scientists

8.5.1.1. Internships

Younes Abid

Subject: Development of a configuration service for Wireless Sensor Networks using a content centric approach
Date: from Mar 2013 to Sep 2013
Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Narjess Derouiche

Monitoring of the Anonymous I2P Network
Date: from Avril 2013 to Sep 2013
Institution: Ecole supérieure des communications de Tunis (SUP'COM) (Tunisia)

Fadwa Rebhi

Subject: Development of an automated detection tool of malicious applications in Android-based smartphones
Date: from Mar 2013 to Sep 2013
Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

Evangelia Tsiontsiou

Subject: Multi-constrained QoS routing for wireless sensor networks
Date: from March 2013 to July 2013
Institution: Université Nationale Capodistrienne d'Athènes (Greece)

Achraf Weslati

Subject: Co-Simulation applied to Networking, Driving and Pedestrian
Date: from Mar 2013 to Sep 2013
Institution: Ecole Nationale des Sciences de l'Informatique (Tunisia)

8.5.1.2. Scientific visits

Participant: Juan Caubet.

Visiting PhD student
Subject: A Distributed Authentication System for Content-Centric Networking
Date: from Aug 2013 to Nov 2013
Institution: Technical University of Catalonia (UPC) (Spain)

Visiting PhD Student Aug 2013 to Nov 2013

8.5.2. Visits to International Teams

Anthea Mayzaud visited the Jacobs University in Bremen, Germany, during August 2013, more precisely in the Computer Science department leaded by Jürgen Schönwälder. The purpose of the visit was to define the exact collaboration possible between the two research groups within the area of securing RPL networks by using risk mitigation approaches. A secondary purpose was to get familiar with the Contiki RPL implementation and the tools, such as Cooja, provided by Contiki in order to implement the chosen risk mitigation approach. A joint paper between the research group at Jacobs and Inria on the "Mitigation of RPL DAG Inconsistency Attacks by Dynamically Rate Limiting Local Repair" has been written as a result of this visit.

MAESTRO Project-Team

7. Partnerships and Cooperations

7.1. National Initiatives

7.1.1. ANR Marmote

Participants: Alain Jean-Marie, Issam Rabhi.

ANR Program: Modèles Numériques (MN) 2012

Project title: MARkovian MOdeling Tools and Environments

Duration: January 2013 - December 2016

Coordinator: Alain Jean Marie (Inria)

Partners: Inria (project-teams DYOGEN, MAESTRO and MESCAL), Univ. Versailles-Saint-Quentin (PRiSM lab.), Telecom SudParis (SAMOVAR lab.), Univ. Paris-Est Créteil (LACL), and Univ. Pierre-et-Marie-Curie (LIP6)

Abstract: ANRMARMOTE aims at realizing the prototype of a software environment dedicated to modeling with Markov chains. It brings together seven partner teams, expert in Markovian analysis, who will develop advanced solution algorithms and applications in different scientific domains: reliability, distributed systems, biology, physics and economics.

https://wiki.inria.fr/MARMOTE/Welcome

7.2. European Initiatives

7.2.1. FP7 Projects

7.2.1.1. CONGAS

Participants: Eitan Altman, Konstantin Avrachenkov, Yonathan Portilla, Alexandre Reiffers.

Project title: Dynamics and coevolution in multi level strategic interaction games

Type: COOPERATION

Challenge: Future and Emerging Technologies

Instrument: Specific Targeted Research Project

Objective: FET Proactive: Dynamics of Multi-Level Complex Systems (DyM-CS)

Duration: October 2012 - September 2015

Coordinator: Francesco De Pellegrini (CREATE-NET)

Scientific Coordinator: Eitan Altman (Inria)

Other partners: Center for Research and Telecommunication Experimentation for Network Communities (Italy), Univ. d'Avignon et des Pays de Vaucluse (France), Technische Universiteit Delft (The Netherlands), Imperial College of Science, Technology and Medicine (United Kingdom), Univ. di Pisa (Italy) and Technion - Israel Institute of Techonology (Israel)

Inria contact: Konstantin Avrachenkov

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 (c) the competition of information in social networks.

http://www.congas-project.eu/

7.2.2. Collaborations in European Programs, except FP7

Program: PHC Tournesol FL - Belgium

Project title: Stochastic modelling of dissemination and epidemic processes on complex networks

Duration: January 2013 - December 2013

Coordinator: B. Prabhu (LAAS-CNRS) is coordinator for French side and D. Fiems is coordinator for Belgian side

Other partners: CNRS, LAAS (France); Ghent University, TELIN (Belgium)

More info: The role of MAESTRO is to work on information propagation models in online social network with directed links.

7.2.3. Collaborations with Major European Organizations

European Space Operations Centre: European Space Agency, Darmstadt (Germany)

Application of a BitTorrent-like data distribution model to mission operations. In the framework of this project with ESA we cooperate with Thales-Alenia Space (France) and with Teletel S.A. (Greece).

7.3. International Initiatives

7.3.1. Inria Associate Teams

7.3.1.1. GANESH

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

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 Bombay (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 contributions to the foundations of the theory of networks, in game theory, team theory, optimization and analysis. Three areas in networking will be used to apply these: (a) economy of networks and network neutrality, (b) scheduling in wireless networks, and (c) distributed optimization issues in ad-hoc networks.

7.3.2. Inria International Partners

7.3.2.1. Informal International Partners

MAESTRO has continued collaborations with researchers from GERAD, Univ. Montreal (Canada), Flinders Univ. (Australia), National Univ. of Rosario (Argentina), Technion – Israel Institute of Technology (Israel), Univ. of Arizona (USA), Univ. of Illinois at Urbana-Champaign (USA), Univ. of Liverpool (UK), Univ. of Massachusetts at Amherst (USA), Univ. of Palermo (Italy), and Univ. of Twente (The Netherlands); cf. Sections 7.4.1.1 and 7.4.2 .

7.4. International Research Visitors

7.4.1. Visits of International Scientists

7.4.1.1. Professors / Researchers

Koen De Turck

Subject: Information Dissemination in Directed Online Social Networks

Date: from 25 Nov 2013 until 27 Nov 2013

Institution: Ghent Univ. (Belgium)

Jocelyne Elias

Subject: Network Covering

Date: from 29 Nov 2013 until 28 Dec 2013

Institution: Paris Descartes Univ. (France)

Dieter Fiems

Subject: Information Dissemination in Directed Online Social Networks

Date: from 25 Nov 2013 until 27 Nov 2013

Institution: Ghent Univ. (Belgium)

Vladimir Gaitsgory

Subject: Singular Perturbations in Markov Decision Processes

Date: from 30 Nov 2013 until 6 Dec 2013

Institution: Flinders University (Australia)

Jasper Goseling

Subject: Random Access with Physical-layer Network Coding

Date: from 13 Oct 2013 until 16 Oct 2013

Institution: Univ. of Twente (Netherlands)

Roberto Lucchetti

Subject: Application of Cooperative Games to Networks

Date: from 10 Jul 2013 until 12 Jul 2013

Institution: Politecnico di Milano (Italy)

Natalia Markovich

Subject: Modeling Clusters of Extreme Values in Random Walk Processes

Date: from 1 Jul 2013 until 15 Aug 2013

Institution: Russian Academy of Sciences (Russia)

Fabio Martignon

Subject: Network covering

Date: from 29 Nov 2013 until 28 Dec 2013

Institution: Paris Sud Univ.(France)

Vladimir Mazalov

Subject: Networking Games and Cloud Computing Market

Date: from 17 Sep 2013 until 18 Oct 2013

Institution: Petrozavodsk State Univ. (Russia)

Leon Petrosian

Subject: Game Theoretic Models in Network Formation

Date: from 2 Aug 2013 until 9 Aug 2013

Institution: St. Petersburg State Univ. (Russia)

Bruno Ribeiro

Subject: Online Myopic Network Covering

Date: from 12 Jun 2013 until 19 Jun 2013

Institution: Univ. Massachusetts, Amherst (USA)

Don Towsley

Subject: Randomness and Wireless Security

Date: from 15 Apr 2013 until 19 Apr 2013

Institution: Univ. Massachusetts, Amherst (USA)

Kavitha Voleti Veeraruna

Subject: Performance Analysis of Social Networks Using Game Theoretical Tools

Date: from 28 May 2013 until 7 Jun 2013

Institution: IIT Bombay (india)

Piotr Wiecek

Subject: Evolutionary Game Models

Date: from 16 Sep 2013 until 27 Sep 2013

Institution: Wrocław Univ. of Technology (Poland)

Sulan Wong

Subject: European Approach to Net Neutrality

Date: from 1 Dec 2013 until 15 Jan 2014

Institution: Univ. de A Coruña (Spain)

Uri Yechiali

Subject: A Retrial System with Two Input Streams and Two Orbit Queues

Date: from 21 Apr 2013 until 4 May 2013

Institution: Tel Aviv Univ. (Israel)

7.4.1.2. Ph.D. students

Giovanni Accongiagioco

Subject: Game theoretic models applied to the Internet Economy

Date: from 14 Jan 2013 until 13 Jul 2013

Institution: Pisa Univ. (Italy)

Liudmila Ostroumova

Subject: Epidemic models on directed networks

Date: from 26 May 2013 until 9 Jun 2013

Institution: Yandex and Moscow State Univ. (Russia)

Cristina Rottondi

Subject: Privacy in smart grids

Date: from 1 Nov 2013 until 30 Nov 2013

Institution: Politecnico di Milano (Italy)

Rodrigo Vaca Ramirez

Subject: Vertical handover framework towards energy efficiency

Date: from 23 Nov 2012 until 12 Mar 2013

Institution: Univ. of Edinburgh (UK)

7.4.1.3. Internships

Xinwei Bai

Subject: Optimization of spatial caches

Date: from 15 Sep 2013 until 14 Dec 2013

Institution: Univ. of Twente (Netherlands)

Grégoire Beaudoire

Subject: Complexity Analysis of the Network Coverage Problem

Date: from 10 Jun 2013 until 26 Jul 2013

Institution: ENS Lyon (France)

Kumar Chippala

Subject: Numerical comparison of various multi-armed bandit algorithms

Date: from 2 May 2013 until 23 Jul 2013

Institution: IIT Bombay (India)

Engin Eljez

Subject: Congestion games with cost that decrease in the congestion

Date: from 1 Jun 2013 until 29 Jul 2013

Institution: Politecnico di Torino (Italy)

Simon Forest

Subject: Graphes aléatoires : génération, épidémies, applications

Date: from 10 Jun 2013 until 2 Aug 2013

Institution: ENS Paris (France)

Sushma Hanawal

Subject: Creation, Simulation and Multidiscipline Evaluation of Dynamic Mobility Models in Complex Systems

Date: from 25 Aug 2012 until 25 Mar 2013

Institution: SJCE Mysore (India)

Denys Korostii

Subject: Polls in online social networks

Date: from 1 Mar 2013 until 31 Aug 2013

Institution: Univ. Nice Sophia Antipolis (France)

Vasily Medyanikov

Subject: Graph-theoretic Models for Evolution of Social Networks

Date: from 22 Jul 2013 until 11 Aug 2013

Institution: St. Petersburg State Univ. (Russia (Russian Federation))

Tanmay Vashistha Sharma

Subject: Diffusion Processes in Networks

Date: from 6 May 2013 until 12 Jul 2013

Institution: IIT Bombay (India)

Xiuhui Ye

Subject: Raise of influential individuals in Online Social Networks

Date: from 15 May 2013 until 15 Nov 2013

Institution: Politecnico di Torino (Italy)

7.4.2. Visits to International Teams

MAESTRO members have visited (the)

- GERAD, Univ. Montreal, Canada in the period 20 October – 10 November 2013 (**A. Jean-Marie**);
- Ghent Univ., Belgium in the period 21–22 November 2013 (**K. Avrachenkov**);
- Flinders Univ., Australia in the period 20 March – 20 April 2013 (**K. Avrachenkov**);
- National Univ. of Rosario, Argentina in the period 4 – 15 March 2013 (**A. Jean-Marie**);
- Petrozavodsk State Univ., Russia in the period 26 – 28 June 2013 (**K. Avrachenkov**);
- Technical Univ. of Darmstadt, Germany in the period 5–6 October 2013 (**G. Neglia**);
- Technion – Israel Institute of Technology, Tel Aviv, Israel in the period 19–28 April 2013 (**E. Altman**);
- Univ. of Arizona, USA in the period 31 March – 2 June 2013 (**M. K. Hanawal**);
- Univ. of Illinois at Urbana-Champaign, USA in the period 1 October 2013 – 31 January 2014 (**M. El Chamie**);
- Univ. of Liverpool, UK in the period 6 – 14 February 2013 (**K. Avrachenkov**);
- Univ. of Massachusetts at Amherst, USA in the periods 1 September – 30 October 2013 (**N. Choungmo Fofack**) 1–10 May 2013 and 25–30 October 2013 (**P. Nain**);
- Univ. of Twente, The Netherlands in the period 19 – 20 June 2013 (**K. Avrachenkov**);
- Yandex Research and Institute of Control Problems, Russia in the period 21 – 30 October 2013 (**K. Avrachenkov**);

RAP Project-Team

6. Partnerships and Cooperations

6.1. International Research Visitors

RAP team has received the following people:

- Louigi Addario-Berry (McGill)
- Jit Bose (Carleton)
- Vida Dujmovic (Carleton)
- Christina Goldschmidt (Oxford)
- Stefan Langerman (UL Bruxelles)
- Gabor Lugosi (Pompeu Fabra)
- Cecile Mailler (UVSQ)
- Kavita Ramanan (Brown)
- Yuting Wen (McGill)

6.2. National Research Visitors

RAP team has received the following people:

- Thomas Bonald (Telecom ParisTech, Paris)
- Fabrice Guillemin (Orange Labs)
- Esther le Rouzic (Orange Labs)

SOCRATE Project-Team

8. Partnerships and Cooperations

8.1. National Actions

8.1.1. Equipex FIT- Future Internet of Things (2011-..., 1.064 k€)

The FIT projet is a national equipex (*equipement d'excellence*), headed by the Lip6 laboratory. As a member of Inria, Socrate is in charge of the development of an Experimental Cognitive Radio platform that should be used as test-bed for SDR terminals and cognitive radio experiments. This platform will be operational in 2013 for a duration of 7 years. To give a quick view, the user will have a way to configure and program through Internet several SDR platforms (MIMO, SISO, and baseband processing nodes).

8.1.2. ANR - Cormoran - "Cooperative and Mobile Wireless Body Area Networks for Group Navigation" (2012-2015, 150 keuros)

The Cormoran project targets to figure out innovative communication functionalities and radiolocation algorithms that could benefit from inter/intra-BAN cooperation. More precisely, the idea is to enable accurate nodes/body location, as well as Quality of Service management and communications reliability (from the protocol point of view), while coping with inter-BAN coexistence, low power constraints and complying with the IEEE 802.15.6 standard. The proposed solutions will be evaluated in realistic applicative scenarios, hence necessitating the development of adapted simulation tools and real-life experiments based on hardware platforms. For this sake, Cormoran will follow an original approach, mixing theoretical work (e.g. modelling activities, algorithms and cross-layer PHY/MAC/NWK design) with more practical aspects (e.g. channel and antennas measurement campaigns, algorithms interfacing with real platforms, demonstrations).

8.1.3. ANR - Idefix - "Intelligent DEsign of Future mobile Internet for enhanced eXperience" (2013-2016, 55 keuros)

The aim of IDEFIX project is to radically revisit the way technologies are evaluated and benchmarked by proposing novel performance evaluation tools, based on the latest developments in queuing theory, that are able to tackle the complexity of traffic profiles in future mobile networks. These tools are to be carefully adapted to the different technologies discussed within 3GPP, and then used to benchmark these technologies and perform pertinent choices among them. Furthermore, IDEFIX will not adopt a passive behavior limited to performance evaluation of technologies. It will, on the contrary, propose service and network control mechanisms that enforce Quality of Service (QoS) and Quality of Experience (QoE) of users of different services. For this aim, this project puts together experts on performance evaluation tools and traffic engineering, whose world class research results are recognized in the telecommunication community. This expertise is complemented by another internationally recognized expertise on service and network control mechanisms and, for the first time in this field, by an expertise on network economy and decision-making in strategic investments. These academic and industrial experts will help two top actors in the world telecommunications industry, Alcatel Lucent and Orange, in their perpetual quest for producing the most efficient technologies and deploying networks with the best QoS.

8.1.4. ADR Green - "Green Networking" (2013-2015, 70 keuros)

This action is a part of the common lab of Inria and Alcatel Lucent Bell Labs. This action groups Urbanet and Socrate teams of Inria with the Bell Labs Vx team and adresses different aspects of Green Networking. Socrate works on the 'virtual cell concept' which deals with mobile centric cells in dense small cells networks.

8.1.5. Greentouch GTT project- "Interference Alignment" (2013-2014, 63 keuros)

The Greentouch GTT (Green transmission technology) project aims at proposiing new energy efficient transmission techniques, and focus specifically on the Energy efficiency - spectral efficiency (EE-SE) trade-off. Interference management is a critical issue and socrate aims at designing a dynamic and distributed approach allowing to cancel strong interfers by combining control theory and interference alignment principles.

8.1.6. FUI ECONHOME - "Energy efficient home networking" (2010-2014, 309 keuros)

The project aims at reducing the energy consumption of the home (multimedia) data networks, while maintaining the quality requirements for heterogeneous services and flows, and preserving, or even enhancing the overall system performance. the equipments under concern are residential gateways, set-top-boxes , PLC modules, Wifi extenders, NAS. The user equipment, such as smartphones, tablets or PCs are not concerned. The approach relies on combining both individual equipments IC and system level protocols that have to be eco-designed.

8.1.7. FUI SMACS - "SMart And Connected Sensors" (2013-2016, 267 keuros)

The SMACS projet targets the deployement of an innovating wireless sensor network dedicated to many domains sport, health and digital cities. The projet involves Socrate (Insavalor), HIKOB and wireless broadcasting company Euro Media France. The main goal is to develop a robust technology enabling real-time localization of mobile targets (like cyclists for instance), at a low energy (more generally low cost). The technology will be demonstrated at real cycling races (Tour de France 2013 and 2014). One of the goals is to include localisation information with new radio technology. Another subject of study is distributed wireless consensus algorithms for maintaining a neighborhood knowledge with a low energy budget that scales (more than 200 cycles together)

8.2. International Research Visitors

Jean-Marie Gorce is currently spending a sabbatical year at Vincent Poor's lab in Princeton university. Following the Post-Doc of Samir Perlaza, Socrate is developping a regular collaboration with Princeton on network information theory and distributed radio resource allocation algorithms.

URBANET Team

8. Partnerships and Cooperations

8.1. Regional Initiatives

- BQR INSA CROME 12/2013-12/2016
  Participants: Fabrice Valois
  The partners in this project are the CITI DynaMid team and LIRIS. The project studies the coordination of a fleet of mobile robots for the multi-view analysis of complex scenes.
- BQR INSA ARBRE 12/2011-12/2013
  Participants: Hervé Rivano, Fabrice Valois
  The partners in this project are the LIRIS (database), EVS-ITUS (social science) and CETHIL (energetic models for buildings) . The project studies wireless sensor networks deployments from different perspectives. An objective is to provide enough data to calibrate energetic models for buildings with human activity. Another is to study the behavior of people working in monitored zones, in particular with respect to the way data are accessible, represented and navigated. Last is to obtain link quality statistics from a practical deployment with real traffic.
- Labex IMU Priva'Mov 10/2013-10/2016
  Participants: Djamel Benferhat, Razvan Stanica, Hervé Rivano
  The partners in this project are DRIM LIRIS, Inria Privatics, INSA EVS, and LET ENTPE. The aim of this project is to develop and deploy a crowdsensing platform to collect mobility traces from a sample of real users equipped with android devices, while carrying research on privacy preservation issues. Our contribution consists on developing the platform and using the collected data to analyze cellular network offloading strategies.
- ARC 7 animation action "Smart Cities Days" 12/2013
  UrbaNet organized the Smart Cities Days are on the 17th and 18th of December 2013 - http://www.citi-lab.fr/seminar/journees-reseaux-et-smart-cities-17-et-18-decembre-2013/.

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.

- ANR ABCD 10/2013-04/2017.
  Participants: Diala Naboulsi, Marco Fiore, Razvan Stanica
  The partners in the ANR ABCD project are: Orange Labs, Ucopia, Inria UrbaNet, UPMC LIP6 PHARE, Telecom ParisTech. The objective of ABCD is to characterize large-scale user mobility and content consumption in urban areas via mobile data mining, so as to achieve efficient deployment and management of cloud resources via virtual machines. Our contribution in the project consists on the characterization of human mobility and service consumption at a city scale, and the design of appropriate resource allocation techniques at the cellular network level.
- ANR IDEFIX 10/2013-04/2017.
  Participants: Soukaina Cherkaoui, Hervé Rivano, Fabrice Valois
  The partners in the ANR IDEFIX project are: Orange Labs, Alcatel Lucent - Bell Labs, Telecom Paris Tech, Inria UrbaNet, Socrate and Dyogene.

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.
  UrbaNet organized the ResCom non-thematic days 18-19th of december 2013 - http://www.citi-lab.fr/seminar/journees-scientifiques-rescom/.

8.2.3. Common Laboratory Inria/Alcatel-Lucent Bell Labs

- ADR Green
  UrbaNet is part of the ADR Green of the common laboratory Inria/Alcatel-Lucent Bell Labs. This ADR provides the PhD grant of Soukaina Cherkaoui on the adaptation of wireless sensor network control protocols for optimizing the energy consumption of heterogeneous cellular LTE networks.

8.3. International Initiatives

8.3.1. Inria International Partners

8.3.1.1. Declared Inria International Partners

- **CNR - IEIIT (Italy)**. The informal cooperation with CNR - IEIIT, consisting on joint publications on mobile crowdsensing and mobile data mining, evolved this year into a strong partnership, following Dr. Marco Fiore's departure from INSA Lyon to CNR - IEIIT. Dr. Fiore remains an external collaborator of the Inria UrbaNet team, actively involved in several research projects.

8.3.1.2. Informal International Partners

- **Politecnico di Torino (Italy)**. Multiple publications co-authored with members of the Telecommunication Networks Group.
- **Universidade Federal de Minas Gerais (Brazil)**. Collaboration with Pedro Vaz de Melo and Antonio F. Loureiro on social mobility analysis.
- **Universitat Politecnica de Catalunya (Spain))**. Cooperation and joint publications on mobile malware propagation.
- **University of Waterloo (Ontario, Canada)**. Cooperation and joint publications on the optimization of wireless mesh networks.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

- **Artur Ziviani**, LNCC, Brazil, 11/2013 (one week)

8.4.1.1. Internships

Sarah Allali

Subject: Network management of Floating Car Data

Date: from Feb 2013 until Jun 2013

Institution: University Claude Bernard Lyon 1 (France)

Silvia Ancona

Subject: Offloading Floating Car Data

Date: from Oct 2013 until Feb 2014

Institution: Politecnico di Bari (Italy)

Egert-Priit Arus

Subject: Integrating Electric Vehicles with Smart Grids

Date: from Oct 2012 until Jan 2013

Institution: Tallinn University of Technology (Estonia)

Julien Delaborde

Subject: From theory to experimentation: the missing link in protocols conception in WSN

Date: from Feb 2013 until Sep 2013

Institution: University Claude Bernard Lyon 1 (France)

Ibrahima Fall

Subject: Topologies des re´seaux urbains: Proprie´te´s et Impacts

Date: from Feb 2013 until Jun 2013

Institution: University Claude Bernard Lyon 1 (France)

Mohammad Irfan Khan

Subject: Information Dissemination in Vehicular Networks

Date: from Mar 2013 until Oct 2013

Institution: INSA Lyon (France)

Yufei Li

Subject: Evaluating energy saving protocols for LTE micro-cell infrastructure

Date: from Sep 2013 until Dec 2013

Institution: INSA Lyon (France)

Sorin Serban Marc

Subject: Signal propagation for vehicular communications in a large-scale urban scenario

Date: from Feb 2013 until Jun 2013

Institution: University of Oradea (Romania)

Soukaina Merzouk

Subject: Radio Propagation in an Urban Vehicular Environment

Date: from Jul 2013 until Aug 2013

Institution: EMSI Rabat (Morocco)

Keijiro Nakagawa

Subject: Multicommodity flow in delay tolerant networks

Date: from Sep 2012 until Jan 2013

Institution: Tokyo University (Japan)

Xuan Linh Nguyen

Subject: Agrégation de données temps-réel et fiable dans les réseaux de capteurs sans fil

Date: from Feb 2013 until Sep 2013

Institution: INSA Lyon (France)

Duc Khoa Pham

Subject: Characterization of Congestion Problems in Vehicular Networks

Date: from Oct 2013 until Dec 2013

Institution: INSA Lyon (France)

Stine Sondergaard

Subject: Vehicular Mobility Simulation

Date: from Oct 2013 until Jan 2014

Institution: Technical University of Denmark (Denmark)

Hamadoun Tall

Subject: Optimizing energy consumption of RPL

Date: from Apr 2013 until Oct 2013

Institution: Institution de la Francophonie pour l'Informatique (Vietnam)

Ionut Radu Toma

Subject: Signal propagation for vehicular communications in a large-scale urban scenario

Date: from Feb 2013 until Jun 2013

Institution: University of Oradea (Romania)

8.4.2. Visits to International Teams

- **Diala Naboulsi** was a visiting scholar within the Telecommunication Networks Group at Politecnico di Torino (Italy), between Sep 2013 and Jan 2014, under the CMIRA Explora'Doc programme.
- **Hervé Rivano** was a visiting researcher at University of Waterloo (Ontario, Canada), in September 2013.