RESEARCH CENTER

FIELD
Networks, Systems and Services, Distributed Computing

Activity Report 2015

Section Contracts and Grants with Industry

Edition: 2016-03-21

ASAP Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Technicolor

Participants: Fabien André, Anne-Marie Kermarrec.

We have a contract with Technicolor for collaboration on large-scale infrastructure for recommendation systems . In this context, Anne-Marie Kermarrec has been the PhD advisor of Fabien André since Nov 2013. Fabien André will work on efficient algorithms for heterogeneous data on large-scale platforms.

7.2. Web Alter-Egos Google Focused Award

Participants: George Giakkoupis, Anne-Marie Kermarrec, Nupur Mittal, Javier Olivares.

Duration: Sep. 2013 - Sep. 2015; Coordinator: Inria and EPFL.

This project addresses the problem of extracting the alter-egos of a Web user, namely profiles of like-minded users who share similar interests, across various Internet applications, in real time and in the presence of high dynamics. Beyond their intrinsic social interest, the profiles of alter-egos of a user are crucial to identify a personalized slice of the Internet that can be leveraged to personalize the Web navigation of that user. The expected outcome of the project is a generic architecture of a Web-Alter-Ego service that can run on various devices and use, as well as be used for, various Web applications.

ATLANMODELS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

Orange Labs (Cesson-Sévigné) is founding a PhD Thesis (CIFRE) on the topic of trust modeling on Web-RTC communications.

CIDRE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **CS contract (2014-2016): "SecEF"**

  The SecEF contract consists in analyzing current used standards for information security events [39]. Such events following a standardized structure are needed to allow communications between the various security tools, in order to consolidate and correlate information, and for communications between different security response teams, to share information relative to incidents. Examples of such events are IDMEF (Intrusion Detection Message Exchange Format, RFC 4765) or IODEF (Incident Object Description Exchange Format, RFC 5070). Unfortunately, these two standards are insufficiently deployed on a market still dominated by proprietary formats. The objective of the SecEF (Security Exchange Format) project is thus to propose evolutions of these formats, based on the initial feedback from current users. During the first years of the project, we focused our work on alert formats. We conduced a comparative study of different alert formats and propose quantitative metrics to asses format expressiveness. We also proposed some evolutions for the IDMEF format and started the development of a generic library dedicated to IDMEF. This library could be used in different programming languages to generate and parse IDMEF messages. It will also support different encodings and transport protocols.
- **HP contract (2013-2016): "Embedded Systems Security"**

  We have initiated a research program in collaboration with HP Inc Labs in the domain of embedded systems security. We aim at researching and prototyping low-level intrusion detection mechanisms in embedded system software. This involves mechanisms in continuation of previous work realized by our team as well as investigating new techniques more directly tied to specific device architectures. In 2015, the project has been extended. We initiated a knew research work involving a Master student. The main objective of this extension is to monitor low-level software (firmware, OS kernels, hypervisors) thanks to a dedicated external co-processor. HP Inc Labs will fund a PhD on that subject. Details about this research program cannot be provided as they are covered by a non-disclosure agreement.

8.2. Bilateral Grants with Industry

- **DGA-MI: "BGP-like Inter Domain routing protocol for tactical mobile ad hoc networks: feasibility, performances and quality of service."**

  Florian Grandhomme is doing his PhD thesis in the context of a cooperation with DGA-MI. The goal of this thesis is to propose new secure and efficient algorithms and protocols to provide inter-domain routing in the context of tactical mobile ad hoc network. The protocol proposed will have to handle context modification due to the mobility of MANET, that is to say split of a MANET, merge of two or more MANET, and also handle hetereogeneity of technology and infrastructure. The solution will be independant from the underlying intra-domain routing protocol and from the infrastructure: wired or wireles, fixed or mobile.
- **DGA-MI: "Visualization for security events monitoring"**

  Damien Crémilleux was hired this year as a Ph.D. student on a DGA-MI funding to work on visualization for security events monitoring. The purpose of this thesis it to define relevant representations to allow front-line security operators to monitors systems from a security perspective. A first proposal was made that led to a tool, VEGAS, that allows to monitor large quantities of alerts in real time and to dispatch these alerts in a relevant way to security analysts. VEGAS was presented during the poster session in VizSec 2015 [58] that took place in Chicago, Illinois on the 26th of October 2015.

- **Orange Labs: "Data persistence and consistency in ISP infrastructures"**

  Pierre Obame is doing his PhD thesis in the context of a CIFRE contract with Orange Labs at Rennes. Pierre Obame has proposed a distributed storage system called Mistore, dedicated to users who access Internet via a Digital Subscriber Line (DSL) technology. This system aims at guaranteeing data availability, persistence, and low access latency by leveraging millions of home gateways and the hundreds of Points of Presence (POP) of an Internet Service Provider (ISP) infrastructure. Pierre Obame has also proposed a mathematical framework for defining both strong and weak consistency criteria within the same formalism. These criteria are offered by Mistore to its clients when they manipulate their data. Pierre Obame, whose PhD thesis is planned to terminate in 2016, is in the process of writing his PhD manuscript so as to defend it in 2016.

- **Orange Labs: "Privacy-preserving location-based services"**

  Solenn Brunet has started her PhD thesis since 2014 within the context of a CIFRE contract with Orange Labs Caen. Her PhD subject concerns the development of privacy-preserving location-based services that are able to personalize the service provided to the user according to his current position while preserving his location privacy. In particular, Solenn will adapt existing cryptographic primitives (private information retrieval, secure multiparty computation, secure set intersection, ...) or design novel ones to use them as building blocks for the construction of these privacy-preserving location-based services. A first paper on the development of a privacy-preserving e-toll service based on the partially blind signature has just been accepted for publication.

- **DGA-MI: "Security events visualization"**

  Christopher Humphries defended his Ph.D. thesis on the 8th of December 2015. This Ph.D. was funded by DGA-MI. The objective of this thesis was to propose new visualization mechanisms dedicated to the analysis of security events, for instance for forensic purposes. Two tools, ELVIS and CORGI, were produced. This research led to two publications in VizSec, which is the most famous venue on the topic of visualization for security.

- **DGA-MI: "Alerts correlation taking the context into account"**

  The PhD of Erwan Godefroy is done in the context of a cooperation with DGA-MI. This PhD started in November 2012 and is expected to finish in 2016. The current work consists in the automatic generation of alert correlation rules in the context of deployed distributed systems. The correlation rules aim at being used by our GnG correlation system.

COAST Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Grants with Industry

6.1.1. CIFRE Grant with Bonitasoft

Participants: François Charoy, Samir Youcef, Guillaume Rosinosky.

Bonitasoft is a leading software company in the domain of open source Business Process Management Systems. The objective of this grant is to help Bonitasoft to support effective elastic BPM operation in the Cloud by leveraging both the business knowledge, the process models and the execution history of process instances and correlate them with cloud resource consumption. Guillaume Rosinosky has been recruited as a PhD Student to work on this project. We will define models that will be validated based on a detailled analysis of existing use cases that we have started to collect from Bonitasoft and its clients.

CTRL-A Team

8. Bilateral Contracts and Grants with Industry

8.1. CIFRE PhD grant Orange

This Cifre PhD started in the beginning of 2012, and was defended in may 2015, on the topic of "Discrete Control in the Internet of things and Smart Environments through a Shared Infrastructure" [8]. Hassane Alla and Eric Rutten advised the PhD student for 10%.

One result of this cooperation is that a patent deposited at the INPI on "Configuration automatique du controle discret d'entites physiques dans un systeme de supervision et de controle", by Gilles Privat et Mengxuan Zhao (Orange labs), Hassane Alla (Gipsa-lab), Eric Rutten (Inria).

8.2. Bilateral Grants with Industry

Our cooperation with CEA LETI/LIST DACLE at Grenoble Minatec is bilateral, involving the CEA PhD grant of Adja Sylla, to work with F. Pacull and M. Louvel on high-level programming on top of a rule-based middleware.

MIMOVE Team (section vide)

MYRIADS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Thales Research and Technology

Participants: Baptiste Goupille–lescar, Christine Morin, Nikolaos Parlavantzas.

Our collaboration with Thales Research and Technology focuses on the development of distributed Cyber-Physical Systems, such as those developed by Thales to monitor and react to changing physical environments. These systems need to be highly adaptable in order to cope with the dynamism and diversity of their operating environments. Notably, they require distributed, parallel architectures that support dynamic sets of applications, not known in advance, while providing strong QoS guarantees. The objective of this collaboration is to explore adaptive resource management mechanisms for such systems that can adapt to changes in the requirements and in the availability of resources. From November 2015 to December 2015, we performed a state of the art study on resource management in virtualized computing infrastructures to cope with cyber-physical system constraints.

REGAL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Joint industrial PhD with Orange Labs and Renault

- Orange Lab, 30,000 euros for 1 PhD Students (CIFRE), Ralucca Diaconu
- Renault, 60,000 over 3 years (2013 - 2016) for a CIFRE. In the context of a Cifre cooperation with Renault, we are supervising with Whipser the PhD of Antoine Blin on the topic of scheduling processes on a multicore machine for the automotive industry. The goal is to allow real-time and multimedia applications to cohabit on a single processor. The challenge here is to control resource consumption of non real-time processes so as to preserve the real-time behavior of critical ones. As part of this cooperation, we will use the Bossa DSL framework for implementing process schedulers that we have previously developed.

7.1.2. Joint industrial PhD: CRDTs for Large-Scale Storage Systems, with Scality SA

This year, we continued the joint CIFRE (industrial PhD) research of Tao Thanh Vinh, with the French start-up company Scality, as described above (under "Large-Scale File Systems").

The objective of this research is to design new algorithms for file and block storage systems, considering both the issues of scaling the file naming tree to a very large size, and the issue of conflicting updates to files or to the name tree, in the case of high latency or disconnected work. Preliminary results were published at Systor 2015 [58].

7.1.3. EMR CREDIT, with Thales.

Franck Petit and Swan Dubois participate to the creation of the EMR (Equipe Mixte de Recherche) *CREDIT*, (Compréhension, Représentation et Exploitation Des Interactions Temporelles) between LIP6/UPMC and Thales.

Nowadays, networks are the field of temporal interactions that occur in many settings networks, including security issues. The amount and the speed of such interactions increases everyday. Until recently, the dynamics of these objects was little studied due to the lack of appropriate tools and methods. However, it becomes crucial to understand the dynamics of these interactions. Typically, how can we detect failures or attacks in network traffic, fraud in financial transactions, bugs or attacks traces of software execution. More generally, we seek to identify patterns in the dynamics of interactions. Recently, several different approaches have been proposed to study such interactions. For instance, by merging all interactions taking place over a period (e.g. one day) in a graph that are studied thereafter (evolving graphs). Another approach was to built meta-objects by duplicating entities at each unit of time of their activity, and by connecting them together.

The goal of the EMR is to join both teams of LIP6 and Thales on these issues. More specifically, we hope to make significant progress on security issues such as anomaly detection. This requires the use of a formalism sufficiently expressive to formulate complex temporal properties. Recently, a vast collection of concepts, formalisms, and models has been unified in a framework called Time-Varying Graphs. We want to pursuit that way. In the short run, the challenges facing us are: (1) refine the model to capture some interaction patterns, (2) design of algorithms to separate sequences of interactions, (3) Identify classes of entities playing a particular role in the dynamics, such as bridges between communities, or sources and sinks.

7.1.4. Joint industrial PhDs: data sharing in mobile networks and automatic resizing of shared I/O caches, with Magency

Magency organizes large events during which participants can use mobile devices to access related data and interact together.

The thesis of Lyes Hamidouche concerns efficient data sharing among a large number of mobile devices. Magency brings traces captured during real events (data accesses and user mobility). We are jointly working on the design of algorithms allowing a large number of mobile devices to efficiently access remote data.

Magency also runs servers. A server is used before an event in order to be prepared and tested, and then, during the event to serve the numerous mobile devices accesses. Many servers are run on a single physical machine using containers. Using this configuration, the memory is partitioned, leading to poor performances for applications that need a large amount of memory for caching purpose. In the context of Damien Carver's PhD thesis, we are designing kernel-level mechanisms that automatically give more memory to the most active containers, leveraging the expertise acquired during Maxime Lorrillere's PhD thesis.

SCALE Team (section vide)

SPIRALS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. ip-label

Participants: Christophe Ribeiro, Romain Rouvoy [correspondant].

A software exploitation license of the APISENSE® crowd-sensing platform has been sold to the ip-label company. They use this platform as a solution to monitor the quality of the GSM signal in the wild. The objective is to provide developers and stakeholders with a feedback on the quality of experience of GSM connection depending on their location.

8.2. Orange Labs

Participants: Laurence Duchien [correspondant], Amal Tahri.

This collaboration aims at bridging the gap between home networks and cloud environments for the design, the provisionning and the administration of distributed services. The purpose is to define solutions, essentially software design tools and runtime infrastructures, for the seamless migration of distributed applications and services between home networks and cloud environments. The envisioned approach is based on the research activities that we are conducting in the domain of software product lines.

This collaboration is conducted in the context of the ongoing PhD thesis of Amal Tahri.

8.3. Scalair

Participants: Yahya Al-Dhuraibi, Philippe Merle [correspondant].

This collaboration aims at proposing a framework to deal with elasticity in cloud computing environments. This framework must cover all kind of resources, IaaS, PaaS, SaaS, must provide a solution for interoperability between different clouds and virtualization technologies, and must enable the specification and composition of reactive and predictive strategies.

This collaboration is conducted in the context of the ongoing PhD thesis of Yahya Al-Dhuraibi.

WHISPER Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Julia Lawall participates in the OSADL project SIL2LinuxMP (http://www.osadl.org/SIL2LinuxMP.sil2-linux-project.0.html). This project aims at the certification of the base components of an embedded GNU/Linux RTOS running on a single-core or multi-core industrial COTS computer board.

Together with Julien Sopena from REGAL, we are collaborating with Renault, in the context of the PhD of Antoine Blin (CIFRE), on hierarchical scheduling in multicore platforms for real-time embedded systems. This work is a dissemination of our previous research on the Bossa domain-specific language [6].

ALPINES Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Contract with Total, February 2015 - February 2018, that funds the PhD of Hussam Al Daas on enlarged Krylov subspace methods for oil reservoir and seismic imaging applications. Supervisor, L. Grigori.

AVALON Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Animerique

One of the goals of the CapRézo company is to provide an original tool to make 2D/3D animation films. This tool is an innovative and distributed numerical platform. This platform is built on software developed by Avalon like DIET. Technologies developed in collaboration between CapRézo and Inria are based on Cloud federation environment. The collaboration, started in 2014, is scheduled for the next 5 years.

8.2. Bilateral Grants with Industry

8.2.1. NewGeneration-SR

We have a collaboration with the company NewGeneration-SR. The aim of this company is to reduce the energy impact through solutions on each layer of the energy consumption (from the data- center design and the production to usage). NewGeneration-SR improve the life cycle (design, production, recycling) in order to reduce the environmental impact of it. NewGeneration-SR was member of the Nu@ge consortium: one of five national Cloud Computing projects with “emprunts d’avenir” funding. With a CIFRE PhD student (Daniel Balouek), we are developing models to reduce the energy consumption for the benefit of data-center

8.2.2. IFPEN

We have collaboration with IFPEN. IFPEN develops numerical code to solve PDE with specific adaption of the preconditioning step to fit the requirement of their problems. With a PhD student (Adrien Roussel) we are studying parallel implementation of multi-level decomposition domain on many-core architecture and GPGPU.

HIEPACS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Airbus Defence and Space research and development contract:

- Design of a parallel version of the FLUSEPA software (Jean-Marie Couteyen (PhD); Pierre Brenner, Jean Roman).

CEA DPTA research and development contract:

- The objective was to evaluate if our ScalFMM library could be used to compute electrostatic interactions in molecular dynamics code (Stamp) of the CEA.

CEA-CESTA research and development contract:

- Performance analysis of the recent improvements in PaStiX sparse direct solver for matrices coming from different applications developped at CEA-CESTA.

CEA Cadarache (ITER) research and development contract:

- Peta and exaflop algorithms for turbulence simulations of fusion plasmas (Fabien Rozar (PhD); Guillaume Latu, Jean Roman).

EDF R & D - SINETICS research and development contract:

- Design of a massively parallel version of the SN method for neutronic simulations (Moustafa Salli (PhD); Mathieu Faverge, Pierre Ramet, Jean Roman).

TOTAL research and development contracts:

- Parallel hybrid solver for massivelly heterogeneoux manycore platforms (Stojce Nakov (PhD); Emmanuel Agullo, Luc Giraud, Abdou Guermouche, Jean Roman).

8.2. Bilateral Grants with Industry

Airbus Group Innovations research and development contract:

- Design and implementation of temporal FMM calculation (B. Bramas (PhD); Olivier Coulaud, Guillaume Sylvand).
- Design and implementation of FMM and block Krylov solver for BEM applications. The HIBOX project is led by the SME IMACS and funded by the DGA Rapid programme (C. Piacibello (Engineer), Olivier Coulaud, Luc Giraud).

KERDATA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Microsoft: Z-CloudFlow (2013–2016). In the framework of the Joint Inria-Microsoft Research Center, this project is a follow-up to the A-Brain project. The goal of this new project is to propose a framework for the efficient processing of scientific workflows in clouds. This approach will leverage the cloud infrastructure capabilities for handling and processing large data volumes. In order to support data-intensive workflows, the cloud-based solution will: adapt the workflows to the cloud environment and exploit its capabilities; optimize data transfers to provide reasonable times; manage data and tasks so that they can be efficiently placed and accessed during execution. The validation will be performed using real-life applications, first on the Grid5000 platform, then on the Azure cloud environment, access being granted by Microsoft through a *Azure for Research Award* received by G. Antoniu. The project also provides funding for the PhD thesis of Luis Pineda, started in 2014. The project is being conducted in collaboration with the Zenith team from Montpellier, led by Patrick Valduriez.

MESCAL Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry: Alcatel Lucent-Bell

A common laboratory between Inria and the Alcatel Lucent-Bell Labs was created in early 2008 and consists on three research groups (ADR). MESCAL leads the ADR on self-optimizing networks (SELFNET). The researchers involved in this project are Bruno Gaujal and Panayotis Mertikopoulos.

7.2. Bilateral Contracts with Industry: Stimergy

Stimergy is a startup that aims at developing a distributed data center built by connecting mini data centers embedded in digital boilers installed in multi-unit residential buildings. Each boiler contains several servers and the dissipated power can thus be used to cover a large part of the annual energy requirements for preparing domestic hot water for a building. Such infrastructure drastically reduces the energy required to operate data centers, while reducing total cost of infrastructure and ownership. Mescal (Olivier Richard, and Michael Mercier, full-time Inria engineer) provides the necessary expertise for the realization and implementation of software infrastructure allowing the coordination of operating such mini data center.

MOAIS Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

6.1.1. CEA

Thanks to past collaboration with CEA, XKaapi was used for multi-core version of EPX. We have a contract with CEA [2014-2015] to manage transition from XKaapi to OpenMP as well as specific loop scheduling among hierarchical NUMA architecture.

ROMA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Mumps Consortium (2014-2019)

In the context of the MUMPS consortium (http://mumps-consortium.org):

- We have signed three new membership agreements, with ESI-Group, Siemens SISW (Belgium) and TOTAL in 2015, on top of the on-going agreements signed in 2014 with Altair, EDF, LSTC, Michelin.
- We have organized point-to-point meetings with several members.
- We have provided technical support and scientific advice to members.
- We have provided non-public releases in advance to members, with a specific licence.
- We have organized the first consortium committee meeting, at EDF (Clamart).
- Two engineers have been funded by the membership fees, for software engineering and software development, comparison with other solvers, business development and management of the consortium.

8.1.2. Contract with EMGS (Norway)

Following a strong interest from EMGS (Norway) in the latest evolutions of MUMPS (see Section 6.1) we worked on the third and final phase of a contract related to low-rank compression for electromagnetics applications in geophysics; the contract was managed by INP Toulouse.

8.2. Technological Transfer: XtremLogic Start-Up

The XTREMLOGIC start-up (former Zettice project) was initiated 4 years ago by Alexandru Plesco and Christophe Alias. The goal of XTREMLOGIC is to build on the state-of-the-art research results from the polyhedral community to provide the HPC market with efficient and communication-optimal circuit blocks (IP) for FPGA. The compiler technology transferred to XTREMLOGIC is the result of a tight collaboration between Christophe Alias and Alexandru Plesco.

XTREMLOGIC won several awards and grants: Rhône Développement Initiative 2015 (loan), “concours émergence OSEO 2013” at Banque Publique d’Investissement (grant), “most promising start-up award” at SAME 2013 (award), “lean Startup award” at Startup Weekend Lyon 2012 (award), “excel&rate award 2012” from Crealys incubation center (award).

STORM Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

CodePlay A Contract has been established between CodePlay and Team Storm to experiment with the ComputeCpp compiler for the SYCL language and OpenCL based framework on hybrid, accelerated architectures.

8.2. Bilateral Grants with Industry

TOTAL SA Total is granting the CIFRE PhD thesis of Corentin Rossignon on Sparse GMRES on heterogeneous platforms in oil extraction simulation from april 2012 to march 2015.

CEA CEA is granting the CIFRE PhD thesis of Emmanuelle Saillard (2012-2015) on Static/Dynamic Analysis for the validation and optimization of parallel applications, Grégory Vaumourin (2013-2016) on Hybrid Memory Hierarchy and Dynamic data optimization for embedded parallel architectures, Emmanuel Cieren (2012-2015) on Molecular Dynamics on Exascale Supercomputers, and Jean-Charles Papin (2013-2016) on Potential-based Dynamic Scheduling techniques and Partitioning tools for domain decomposition simulations.

CEA - REGION AQUITAINE CEA together with the Aquitaine Region Council is funding the PhD thesis of Marc Sergent (2013-2016) on Scalability for Task-based Runtimes.

RAPID HiBOX This contract between IMACS an EADS France aims to develop a state of the art library for fast iterative, direct and hybrid methods, efficient on new heterogeneous parallel and hybrid architectures, that can be used on Boundary Element Methods. Applications targeted are acoustics, elastodynamics and electromagnetism. The contrat grants 2 year engineer for the parallelization of the library based on StarPU.

TADAAM Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with CEA

CEA is granting the PhD thesis of Hugo Taboada on specialized thread management in the context of multi programming models, and the PhD thesis of Rémi Barat on multi-criteria graph partitioning.

7.2. Bilateral Grants with Bull/Atos

Bull/ATOS is granting the CIFRE PhD thesis on Nicolas Denoyelle on advanced memory hierarchies and new topologies.

7.3. Bilateral Grants with Onera

Onera is granting the PhD thesis of Raphaël Blanchard on the parallelization and data distribution of discontinuous Galerkin methods for complex flow simulations.

7.4. Bilateral Grants with EDF

EDF is granting the CIFRE PhD thesis of Benjamin Lorendeau on new programming models and optimization of Code Saturn.

ASCOLA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Cooperation with SIGMA group

Participants: Thomas Ledoux [correspondent], Simon Dupont.

In 2012, we have started a cooperation with Sigma Group (http://www.sigma.fr), a software editor and consulting enterprise. The cooperation consists in a joint (a so-called Cifre) PhD on eco-elasticity of software for the Cloud and the sponsorship of several engineering students at the MSc-level.

As a direct consequence of the increasing popularity of Cloud computing solutions, data centers are rapidly growing in number and size and have to urgently face with energy consumption issues. The aim of Simon Dupont's PhD, started in November 2012, is to explore the *software elasticity* capability in Software-as-a-Service (SaaS) development to promote the management of SaaS applications that are more flexible, more reactive to environment changes and therefore self-adaptive for a wider range of contexts. As a result, SaaS applications become more elastic and by transitivity more susceptible to energy constraints and optimization issues.

In 2015, we have presented an autonomic approach to manage cloud elasticity that obey cross-layer constraints [23].

DIVERSE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. April

This work is performed in collaboration with APRIL Technologies. This company develops all the IT solutions for APRIL group [0] and their clients in the insurance business. They have a very large information system that they specialize for all the divisions of the group. A critical need for them is to ensure that changes in their applications (new features, bug repair, etc.) do not degrade functional correctness and performance.

Software testing techniques and tools have greatly improved over the last decade and it is now possible for software developers to write test cases that are automatically executed. Consequently, each time the program evolves, it is rebuild and re-tested automatically, which supports the detection of errors early in the process and prevents the propagation of the bug into the production code. However, the test cases are manually written and are thus usually weak when it comes at finding bugs that are deep in the code or in nested loops for example. The main challenge of this work is automatically generate new test cases that increase the effectiveness of regression testing.

In this project we aim at automatically generating new test cases from the ones that have been manually produced by the developers, in order to add value in the continuous integration process and improve the quality of software that goes in production. The process of automatically producing new test cases from existing ones is called *test amplification*. We can experiment our recent results about test transformations on APRIL Technologies's set of test cases very early in the project.

This project supports one postdoc in the DiverSE team and is funded by Inria's transfer and industrial partnership department.

8.2. Bilateral Grants with Industry

8.2.1. Partnership with Thales

Dates: 2011-2014

This partnership with Thales Research and Technology explores variability management both in modeling and metamodeling (*i.e.*, design and implementation of software languages). At the model level, this collaboration is a direct follow-up of the MOVIDA and the MUTATION projects, in which we explore the challenges related to software product line and multi-view engineering for the different development phases of systems of systems construction. At the metamodeling level, we investigate how the notions of variability modeling and management can serve the rigorous definition of families of modeling languages, which address the different interpretations of UML needed to model the different viewpoints in the systems engineering.

The project enrolls 4 faculty members and 2 PhD students from the Triskell team. This year, we keep working on the CVL usage in the Thales context.

[0] http://groupe.april.fr/groupe

FOCUS Project-Team (section vide)

INDES Project-Team (section vide)

PHOENIX Project-Team (section vide)

RMOD Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. SafePython FUI

Participants: Damien Cassou [Correspondant], Jean-Baptiste Arnaud, Stéphane Ducasse.

Contracting parties: CEA, Evitech, Inria, Logilab, Opida, Thales, Wallix.

Beyond embedded computing, there is not so much research and development on the verification of software safety. Recently, some tools have been created for languages such as JAVA, SQL, VB or PHP. Nevertheless, nothing exists for Python even though this language is growing fast. SafePython's goal is to provide code analysis tools applicable to Python programs. This project will define a subset of Python that the developers will have to use to have their programs analyzed.

8.2. Sponsoring LAM

Participants: Stéphane Ducasse [Correspondant], Marcus Denker.

Contracting parties: Inria, LAM Research, Inc.

LAM Research Inc.(http://lamrc.com) is a leading supplier of wafer fabrication equipment and services to the global semiconductor industry. LAM has started to sponsor RMOD in 2014. RMOD used the sponsored funds to pay student internships in 2015.

8.3. Worldline CIFRE

Participants: Anne Etien [Correspondant], Nicolas Anquetil, Stéphane Ducasse, Vincent Blondeau.

In the context of a CIFRE PhD we are working on large industrial project characterization. The PhD started in October 2014.

8.4. Pharo Consortium

The Pharo Consortium was founded in 2012 and is growing constantly. As of end 2015, it has 19 company members, 13 academic partners and 3 sponsoring companies. Inria supports the consortium with one full time engineer starting in 2011. More at http://consortium.pharo.org.

TACOMA Team (section vide)

COATI Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Amadeus

Participants: Marco Biazzini, David Coudert, Stéphane Pérennes, Michel Syska.

Duration: May 2014 - April 2015

Inria teams: COATI, SCALE

Abstract: This collaboration aims at assessing the benefits that digital technologies can bring in complex travel distribution applications. Indeed, these applications require both high performance algorithms and distributed programming methods to search for the best solutions among billions of combinations, in a very short time thanks to the simultaneous use of several hundreds (if not thousands) of computers. These benefits will be demonstrated in an application to build 'off the shelf' optimized packages, fully customized to best meet the complex demands of the traveler.

8.2. Bilateral Grants with Industry

8.2.1. Contract CIFRE with KONTRON

Participants: Michel Syska, Mohamed Amine Bergach.

We have contracted with KONTRON (worldwide company which designs and manufactures embedded systems) a "Convention de recherche encadrant une bourse CIFRE" on the topic *Graphic Processing Units for Signal Processing*, which work is a joint supervision with AOSTE project.

Duration: November 2011 - April 2015

8.2.2. ADR Network Science, joint laboratory Inria / Alcatel-Lucent Bell-labs France

Participants: David Coudert, Nicolas Nisse.

COATI is part of the joint laboratory Inria / Alcatel-Lucent Bell-labs France within the ADR Network Science and works on the fast computation of topological properties (hyperbolicity, covering, etc.).

Duration: January 2013 - December 2015

8.2.3. Allocation Carnot Inria / Instant System

Participants: David Coudert, Idriss Hassine.

The Instant System startup company develop a platform in the area of Intelligent transportation systems (ITS). The partnership with COATI aims at designing algorithms for itinerary planning in multimodal transportation networks. The main objective is to combine public transport system and dynamic car-pooling.

Duration: December 2015 - November 2016 (12 man-month)

DANTE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. HiKoB

Participant: Éric Fleury.

A bilateral contract has been signed between the DANTE Inria team and HiKoB to formalise their collaboration in the context of the 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 euros 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.

8.1.2. GranDATA

Participants: Márton Karsai [correspondant], Éric Fleury.

Founded in 2012, Grandata is a Palo Alto-based company that leverages advanced research in Human Dynamics (the application of "big data" to social relationships and human behavior) to identify market trends and predict customer actions. Leading telecom and financial services firms are using Grandata's Social Universe product to transform "big data" into impressive business results.

The DANTE team and Grandata started to collaborate in 2014 on the analysis of large datasets provided by the company. The aim of the collaboration is to gain better understanding about the dynamical patterns of human interactions, mobility, and the socio-economic structure of the society. As a part of this collaboration Carlos Sarraute (Grandata - R&D Director) visited the Dante team on November and Yannick Leo (DANTE - PhD student) visited Grandata office in Buenos Aires in 2014 December.

8.1.3. STACC, Skype/Microsoft Labs

Participant: Márton Karsai [correspondant].

The Software Technology and Applications Competence Centre (STACC) is a research and development centre conducting high-priority applied research in the field of data mining and software and services engineering. Together with Skype/Microsoft Labs, STACC maintains a long lasting research collaboration with Márton Karsai (DANTE) on the modeling the adoption dynamics of online services.

8.2. Inria Alcatel-Lucent Bell Labs joint laboratory

Participants: Isabelle Guérin Lassous, Paulo Gonçalves Andrade, Thomas Begin, Éric Fleury [correspondant].

The main scientific objectives of the collaboration within the framework Inria Alcatel-Lucent Bell Labs joint laboratory is focused on network science:

- to design efficient tools for measuring specific properties of large scale complex networks and their dynamics;
- to propose accurate graph and dynamics models (*e.g.*, generators of random graph fulfilling measured properties);
- to use this knowledge with an algorithmic perspectives, for instance, for improving the QoS of routing schemes, the speed of information spreading, the selection of a target audience for advertisements, etc.

8.3. Bilateral Grants with Industry

8.3.1. Orange R&D

Participant: Isabelle Guérin Lassous.

A contract has been signed between Inria and France Télécom for the PhD supervision of Laurent Reynaud. The PhD thesis subject concerns mobility strategies for fault resilience and energy conservation in wireless networks.

DIANA Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Programmable data plane network functions

In the context of the common Inria - Alcatel Lucent Bell-Labs laboratory on Communication networks of the future, we participate to the Content Centric Networking ADR (Action de Recherche). In the context of this ADR, a post-doctoral position is working on the Most network applications and network functions today are implemented using specialized hardware middleboxes. The dedicated specialized hardware makes packet processing rates match that of the line rates that has been difficult to achieve on general purpose hardware. Recently the advancement in general purpose processors has made it possible to use general purpose CPU's for packet processing at line rates. If general purpose CPU's can replace dedicated hardware, this will drastically reduces the cost as the network functions can be moved from dedicated hardware to software. Currently, Virtualization has been promoted to realize network functions on general purpose computing devices and this currently popular in both academia and industry. There are a number of problems with using virtualization to realize network functions, the most important being the latency introduced by the software stacks. In this work, we will be looking at alternative approaches to implementing network functions on general purpose hardware. One of the main outcomes will be an approach that performs much better than the existing solutions. One of the goals of the work will be to find appropriate use cases for which the proposed architecture is a clear advantage with respect to other NFV solutions. Alcatel Lucent has joined Nokia in 2015. See http://company.nokia.com/en.

7.2. Privacy leaks monitoring and control

We are collaborating with the startup Novathings to deploy early stage privacy leaks monitoring and control solutions. We have proposed in Meddle a VPN based infrastructure performing SSL-bumping in order to capture all the mobile data traffic and to inspect even the SSL flows. The biggest advantage is that, as most mobile platforms support VPNs, we don't need any installation or root access on the devices to perform traffic redirection and inspection. We have a Carnot funding for a one year engineer position that started in April 2015 to implement a new solution on a home appliance sold by Novathings to improve transparency and control for personal devices.

We implemented a first prototype on a raspberry Pi device and started an integration following the Novathings graphical chart. See http://www.novathings.com/#/?lang=en.

DIONYSOS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contract with Industry: ALSTOM-Inria Common Lab

Participants: Bruno Tuffin, Gerardo Rubino.

Bruno Tuffin is the co-director of ALSTOM-Inria common Lab.

The group currently manages a project with ALSTOM on system availability simulation taking into account logistic constraints. Current ALSTOM Transport and Power contracts, especially service-level agreements, impose stringent system availability objectives. Non-adherence to the required performance levels often leads to penalties, and it is therefore critical to assess corresponding risk already at a tender stage. The challenge is to achieve accurate results in a reasonable amount of time. Monte Carlo simulation provides estimates of the quantities it is desired to predict (e.g., availability). Since we deal with rare events, variance reduction techniques, specifically Importance Sampling (IS) here, is used. The goal of the project is to establish the feasibility of IS for solving problems relevant to ALSTOM and to develop the corresponding mathematical tools.

7.2. Bilateral Contract with Industry: Participation in a CRE with Orange

Participant: Bruno Tuffin.

We are participating to a CRE (managed by Telecom Bretagne) with Orange on the strategies of Content Delivery Networks (CDNs) and their impact on the overall Internet economy and regulation. In this study, we focus on the CDN as an economic actor. The goals are 1) to analyze CDNs' caching strategies from an economic point of view, 2) to study the strategies of an integrated CDN actor, and 3) to study the impact of CDNs in the net neutrality debate.

7.3. Cifre contract on Device-Assisted Distributed Machine-Learning on Many Cores

Participants: Corentin Hardy, Bruno Sericola.

This is a Cifre contract including a PhD thesis supervision, done with Technicolor. The starting point of this thesis would be to consider the possibility to deploy machine-learning algorithms over many cores, but out of the datacenter: on the devices (home-gateways) deployed by Technicolor in users' homes. In this device-assisted view, an initial processing step in the device may significantly reduce the burden on the datacenter back-end. Problems are numerous (power consumption, CPU power, network bandwidth and latency), but costs for the operator can be lowered and scale may bring some new level in data processing.

7.4. Cifre contract on Small Cell Networks

Participants: Adlen Ksentini, César Viho.

This is a Cifre contract (2013-2016) including PhD thesis supervision, done with Orange Labs, on cooperation and self-* small cell networks. The aim is to define architectures and protocols for deploying small cell networks in AMEA (Africa, Middle East and Asia) countries.

7.5. Cifre contract on SDN for 5G mobile networks

Participant: Adlen Ksentini.

This is a Cifre contract (2015-2018) including PhD thesis supervision, done with TDF, on cooperation the use SDN for the 5 generation of mobile network. The objective of the thesis is to study and devise appropriate solutions to introduce SDN with the current LTE architecture toward 5G.

7.6. DGA Grant

Participant: Adlen Ksentini.

This DGA grant, with Cidre Inria team, is for the PhD supervision of Florient Grandhomme.

7.7. DVD2C

Participants: Adlen Ksentini, Pantelis Frangoudis.

We are working in the 3-year (September 2014 – September 2017) FUI Project DVD2C, which aims to virtualize CDN through the Cloud and Network Function Virtualization concept. DVD2C is leaded by Orange labs., and the partners are two SMEs (Viotech and Resonate) and two academics (our team and Télécom Paris Sud).

7.8. Cifre contract on a dynamic adaptive service-driven SDN architecture

Participants: Jean-Michel Sanner, Yassine Hadjadj-Aoul, Gerardo Rubino.

This is a Cifre contract (2013-2016) including the supervision and work of the PhD thesis of Jean-Michel Sanner, done with Orange Labs, on defining a dynamic adaptive service-driven network architectures based on the SDN concept.

7.9. Cifre contract on defining an open, a flexible and a unified network architecture

Participants: Yue Li, Yassine Hadjadj-Aoul, Gerardo Rubino.

This is a Cifre contract (2013-2016) including the supervision and work of the PhD thesis of, done with Orange Labs, on designing an open, flexible and unified network architecture.

7.10. Camion

Participants: Yassine Hadjadj-Aoul, César Viho, Raymond Marie, Thiago Wanderley Matos de Abreu.

We are working in the 2-year (October 2014 to October 2016) Eurostars European Project Camion, which aims at offering cost-efficient, QoE-optimized content delivery, allowing for faster content access, as well as offline operation, while improving wireless network capacity and coverage. Camion is leaded by JCP-Connect, and the partners are a SME (FON) and our team.

DYOGENE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. CRE with Orange

One year CRE contract titled “Détermination de la distribution des conditions radio validée avec les données terrain pour les outils de dimensionnement” (Determining the distribution of the radio channel conditions validated by the real data for network dimensioning tools) between Inria and Orange Labs have been signed in 2015. It is a part of the long-term collaboration between TREC/DYOGENE and Orange Labs, represented by M. K. Karray, for the development of analytic tools for the QoS evaluation and dimensioning of operator cellular networks. Arpan Chattopadhyay was hired by Inria as a post-doctoral fellow thanks to this contract.

8.2. MSR-Inria Joint Lab

- Social Information Networks and Privacy
  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.
- Machine Learning and Big Data
  Multi-Armed Bandit (MAB) problems constitute a generic benchmark model for learning to make sequential decisions under uncertainty. They capture the trade-off between exploring decisions to learn the statistical properties of the corresponding rewards, and exploiting decisions that have generated the highest rewards so far. In this project, we aim at investigating bandit problems with a large set of available decisions, with structured rewards. The project addresses bandit problems with known and unknown structure, and targets specific applications in online advertising, recommendation and ranking systems.

EVA Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. CNES

Participants: Ines Khoufi, Pascale Minet, Erwan Livolant.

Partners: CNES, Inria.
Following the SAHARA project that ended in 2015, CNES decided to fund a study about the use of wireless sensor networks in space environment. This new project started in November 2015 and will end in November 2016.

8.2. Bilateral Grants with Industry

8.2.1. Gridbee CIFRE

Participants: Thomas Watteyne, Jonathan Muñoz.

- Title: km-scale Industrial Networking
- Type: CIFRE agreement
- Period: Nov 2015 - Oct 2018
- Coordinator: **Thomas Watteyne**
- Goal: CIFRE agreement with Gridbee (http://www.gridbeecom.com/) to apply 6TiSCH-style scheduling on top of long-range IEEE802.15.4g radios. Implementation of those solutions on OpenWSN.

8.2.2. SAGEM

Participants: Paul Muhlethaler, Gerard Le Lann.

This work aims at improving the reliability of some SAGEM communications systems. A few “altruist” algorithms using the inherent broadcast capabilities of wireless transmission have been analyzed.

FUN Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Traxens partnershipTraxens partnership
  Participants: Natale Guzzo, Nathalie Mitton [correspondant].

  This collaboration aims to set up a full protocol stack for TRAXENS's guideline. This collaboration is a CIFRE contract. In the framework of this collaboration, a full protocol stack has been developed for the purpose of container monitoring. 3 national and 2 international patents have been submitted so far. 2 are under preparation.

GANG Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Collaboration with Bell Labs

Gang has a strong collaboration with Bell Labs (Alcatel-Lucent / Nokia). We notably collaborate with Fabien Mathieu and Diego Perino who are former members of GANG that have joined Alcatel-Lucent. A Cifre grant allowed to fund the PhD thesis of The-Dang Huynh to study ranking techniques and their application to social networks. An ADR (joint research action) is dedicated to content centric networks and forwarding information verification. The PhD thesis of Leonardo Linguaglossa is funded by this contract. We also collaborate with Ludovic Noirie on voting systems.

This collaboration is developed inside the Alcatel-Lucent and Inria joint research lab.

INFINE Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

1. Participation to Microsoft Research – Inria Joint Centre, which funds two PhD students (Lennart Gulikers and Remi Varloot) and funded postdoc Kuang Xu over 2015.
2. During 2015, Cisco Systems (through direct contract) and Google (through GSoC) have funded further development of RIOT.

7.2. GranData

Participants: Aline Carneiro Viana, Eduardo Mucelli.

Since June 2014, we have a collaboration with GranData (http://grandata.com/), Buenos Aires, Argentina on traffic vs mobility modeling of smartphone users. GranData is a small company that integrates first-party and telco partner data to understand key market trends, to predict customer behavior, and to deliver business results. Its products integrates and analyzes diverse data traces (e.g., telco, social media, or mobile data) to generate behavioral insights and deliver targeted mobile marketing. Part of the thesis of Eduardo Mucelli analysis data traffic using telco traces provided by GranDatas. While this collaboration allow us collaborating with machine learning experts, GranData has the opportunity to get our expertise in mobility analysis.

MADYNES Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Xilopix (Epinal, France):
  - Pay-per-use contract for the use of Grid'5000
  - Support contract for their use of Grid'5000 (define experimental requirements and plans)

8.2. Bilateral Grants with Industry

- CIFRE, Thales TRT (Paris, France):
  - CIFRE PhD (Florian Greff, managed by Ye-Qiong Song and Laurent Ciarletta)
  - Dynamic reconfiguration and graceful degradation of distributed real-time applications over mesh networks
- CIFRE, Orange Labs (Issy-Les-Moulineaux, France)
  - CIFRE PhD (Maxime Compastie, managed by Olivier Festor and Remi Badonnel)
  - Software-Defined Security for Distributed Cloud Infrastructures
- CIFRE, Xilopix (Epinal, France):
  - CIFRE PhD (Abdulqawi Saif, managed by Ye-Qiong Song and Lucas Nussbaum)
  - Open Science for the scalability of a new generation search technology

MAESTRO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

MAESTRO members are involved in the

- Inria Alcatel-Lucent Bell Labs joint laboratory: the joint laboratory consists of six ADRs (Action de Recherche/Research Action) in its second phase (starting October 2012). MAESTRO members participate in two ADRs (see §8.1.1 and §8.1.2).
- Inria ALSTOM joint laboratory: the joint laboratory consists of four projects. MAESTRO members participate in project P11 (see §8.1.3).

8.1.1. ADR "Self-Organized Networks in Wireless" (July 2008 – June 2016)

Participant: Eitan Altman.

- Contractor: Alcatel-Lucent Bell Labs (http://www.alcatel-lucent.com/bell-labs)
- Collaborators: Laurent Roullet (coordinator), Véronique Capdevielle.

Coordinator for Inria: Bruno Gaujal (team MESCAL).

During the investigations carried out within this ADR, in collaboration with Alcatel-Lucent Bell Labs and WIRELESS ENB teams (System Engineering and Modem), three technical solutions to the LTE Mobility State Estimation problem have been proposed. In particular,

- Three patents have been submitted and filed (two in 2013, and one in 2014);
- A white paper written by the joint team (Inria/Bell-Labs and Wireless SE) summarizing the theoretical baseline of the methods, their performances, as well as the implementation issues, is documented.

These solutions have been set up between Inria and Alcatel-Lucent Bell Labs iteratively after numerous meetings, in order to cope with the product requirements.

8.1.2. ADR "Network Science" (June 2013 – August 2016)

Participants: Konstantin Avrachenkov [coordinator], Jithin Kazhuthuveettil Sreedharan, Philippe Nain, Giovanni Neglia.

- Contractor: Alcatel-Lucent Bell Labs (http://www.alcatel-lucent.com/bell-labs)
- Collaborators: Philippe Jacquet (coordinator), Alonso Silva.

"Network Science" aims at understanding the structural properties and the dynamics of various kind of large scale, possibly dynamic, networks in telecommunication (e.g., the Internet, the web graph, peer-to-peer networks), social science (e.g., community of interest, advertisement, recommendation systems), bibliometrics (e.g., citations, co-authors), biology (e.g., spread of an epidemic, protein-protein interactions), and physics. The complex networks encountered in these areas share common properties such as power law degree distribution, small average distances, community structure, etc. Many general questions/applications (e.g., community detection, epidemic spreading, search, anomaly detection) are common in various disciplines and are being analyzed in this ADR "Network Science". In particular, in the framework of this ADR we are interested in efficient network sampling (see §7.1.2).

8.1.3. Project P11 "Data Communication Network Performance" (December 2013 – May 2016)

Participants: Sara Alouf [coordinator], Konstantin Avrachenkov, Abdulhalim Dandoush, Philippe Nain, Giovanni Neglia, Alina Tuholukova.

- Contractor: ALSTOM Transport (http://www.alstom.com/transport/)
- Collaborators: Pierre Cotelle, Pascal Derouet (coordinator from November 2015), Pierre Dersin, Sébastien Simoens (coordinator until October 2015).

The objective of this study is to build a simulation platform (see §6.2) and develop an evaluation methodology for predicting Quality of Service and availability of the various applications supported by the data communication system of train networks.

8.2. Bilateral Grants with Industry

8.2.1. "Multi-Objective Optimization for LTE-Advanced Networks" (December 2012 – November 2015)

Participant: Eitan Altman.

- Contractor: Orange Labs (http://www.orange.com/en/innovation)
- Collaborators: Zwi Altman, Abdoulaye Tall.

The objective of this Cifre thesis is threefold: (1) to develop solutions based on stochastic approximations and optimal control for the optimization and setting of LTE-Advanced Networks; (2) to develop queuing models to capture the dynamics of the traffic and the physical layer mechanisms (e.g. relay, MIMO, scheduling); and (3) to apply the developed methods to engineering problems such the interference management, load balancing, optimization of coverage and capacity, and mobility management.

MUSE Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- "Improving the quality of recommendation using semi-structured user feedback" CIFRE contract with Technicolor for thesis of Sara el Aouad from May 2014 to April 2017.
- "Crowdsourced Home Network Diagnosis" CIFRE contract with Technicolor for thesis of Diego da Hora from February 2014 to January 2017.
- "Exploiting Network Content-awareness to provide novel added value services" contract under the Inria-Alcatel Lucent Bell Labs common Lab (ADR ICN) to fund the doctoral thesis of Giuseppe Scavo from November 2013 to October 2016.

7.2. Bilateral Grants with Industry

- "Collaborative Home Network Troubleshooting", Comcast grant, from December 2015.

RAP Project-Team

5. Bilateral Contracts and Grants with Industry

5.1. Bilateral Contracts with Industry

- Contrat de recherche externalisé avec ORANGE SA "Scheduling Global OS". Duration three years 2014-2016.
- *Christine Fricker* is the leader of PGMO project "Systèmes de véhicules en libre-service: Modélisation, Analyse et Optimisation" with G-Scop (CNRS lab, Grenoble) and Ifsttar. From 1 to 3 years. From 1/10/2013 to 30/9/2016.
- PhD grant CJS (Contrat Jeune Scientifique) Frontières du vivant of INRA for Renaud Dessalles.
- PhD grant from Fondation Sciences Mathématiques de Paris for Wen Sun.
- PhD grant from Brazilian Government for Guilherme Thompson.

SOCRATE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Socrate has strong collaboration with Orange Labs (point to point collaboration) and Alcatel Lucent through the Inria-ALU common lab and the GreenTouch initiative.

Socrate also works with Sigfox a important french young company deploying the first cellular network operator dedicated to M2M and IoT. A bilateral cooperation with sigfox supported the PhD of Minh Tien Do and continues with the PhD of Yuqi Mo. Socrate has also regular collaboration with HIKOB a start-up originated from the Citi laboratory providing sensor networks.

Socrate also collaborates with Euromedia group on advanced wireless techniques for sports events broadcasting systems.

7.1.1. Contractual Study - SigFox - "Standardization support" (2015-2016, 50 keuros)

SigFox is a French start-up deploying and exploiting a network for Internet of Things data collection. Their network is currently being deployed worldwide, and gaining more and more interest from customers. The network is based on a patented transmission protocol (Ultra Narrow Band and Random frequency multiple access), which is now entering standardisation process. The goal of this work is to support this standardization, by providing a deep analysis of the network performances.

7.1.2. CIFRE - SigFox - "Analysis and optimization of a bidirectional network based on UNB" (2015-2018, 50 keuros)

The goal of this thesis is to characterize and improve the network performance. To do so, the following tasks are envisioned:

1. retransmissions strategies to reach a targeted QoS;
2. feedback exploitation (acknowledgment);
3. coherent detection of signals provided by all the base stations (spatial diversity exploitation); and
4. nodes position estimation, and use of this knowledge in the access protocol.

URBANET Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- We have contracted bilateral cooperation with Rtone, an SME focusing on the connected objects area. This collaboration is associated with the CIFRE PhD grant for Alexis Duque, on the subject of Visible Light Communication.
- We have contracted bilateral cooperation with some industrial partners on the subject of smart casing. However, these contracts are under non disclosure agreements and cannot be mentioned here.
- We have contracted bilateral cooperation with industrial and academic partners in the context of the PSPC Fed4PMR project (2015-2018). In this context, we will be working on the design of new professional mobile radio solutions, compatible with 4G and 5G standards.

8.2. Bilateral Grants with Industry

- 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 channel access capacity evaluation in 5G networks.