



RESEARCH CENTER

FIELD

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

Activity Report 2017

Section Contracts and Grants with Industry

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ASAP Project-Team (section vide)

COAST Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

6.1.1. Industrial funding Groupe Open (2016–2019)

Groupe Open is a leading french company specialised in digital services and operations. The goal of the project is to propose an industrial composition model for APIs that takes into account the new constraints imposed by this new way to distribute and operate software. It will be based on a formal API contract along with trust and reputation attributes in order to allow consumers to anticipate risks regarding the quality and the safety of services. A PhD student is under recruitment for this project. Coast funding : 237,000 €

6.2. Bilateral Grants with Industry

6.2.1. 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 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 detailed analysis of existing use cases that we have started to collect from Bonitasoft and its clients.

CTRL-A Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Our cooperation with CEA (an EPIC, industrial and commercial public institution) concerns the LETI/LIST DACLE laboratory at Grenoble Minatoc; it is bilateral, currently 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 (See Sections 6.1.3 and 6.2.2.1).

7.2. Bilateral Grants with Industry

7.2.1. Orange

We have a cooperation with Orange labs, around a CIFRE PhD grant, on the topic of autonomic device management (see Section 6.2.2.2). This activity is part of the Inria/Orange joint laboratory.

7.2.2. Nokia / Bell labs

We are starting a research action with Nokia / Bell labs, around a PhD, co-advised with project-team Dyonisos at Inria Rennes, on the topic of the integration of FPGA-based accelerators in network nodes, and their reconfiguration management in coordination with higher level Software Defined Networks management. This activity is part of the Inria/ Nokia / Bell labs joint laboratory.

MIMOVE Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

“Monitoring and diagnosis of Internet QoE”, Google Faculty Award to R. Teixeira (Inria) and D. Choffnes (Northeastern University), 2017.

MYRIADS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Technicolor (2016-2017)*

Participant: Guillaume Pierre.

Our collaboration with Technicolor has focused on the design of a scalable and elastic virtual customer premises equipment based on Network Function Virtualization, Software-Defined Networking and Cloud technologies. In 2017 we completed the system design and started implementing the system. The collaboration completed successfully in June 2017. However, the vCPE project within which this collaboration took place was unfortunately interrupted by Technicolor before we could write a paper about this work.

8.2. Bilateral Grants with Industry

8.2.1. *Thales Research and Technology (2016-2018)*

Participants: Baptiste Goupille-Lescar, Christine Morin, Nikos 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. This contract funds Baptiste Goupille-Lescar's PhD grant.

8.2.2. *Nokia (2015-2018)*

Participant: Christine Morin.

Together with CIDRE Inria project-team we are involved in a collaboration with Nokia on security policy adaptation driven by risk evaluation in modern communication infrastructures. To address the need for efficient security supervision mechanisms, approaches such as attack graphs generation, coupled to a risk-based assessment have been used to provide an insight into a system's threat exposure. In comparison to static infrastructures, clouds exhibit a dynamic nature and are exposed to new attack scenarios due to virtualization. The goal of this collaboration is thus to revisit existing methods in the context of clouds. This contract funds Pernelle Mensah's PhD grant. Pernelle is a member of CIDRE project-team.

REGAL Project-Team

6. Bilateral Contracts and Grants with Industry

6.1. Bilateral Contracts with Industry

Regal has two CIFRE contracts with Scality SA:

- Vinh Tao is advised by Marc Shapiro and Vianney Rancurel. He works on highly available geo-replicated file systems, building on CRDT technology. He defended his thesis in December 2017.
- Dimitrios Vasilas is advised by Marc Shapiro and Brad King. He works on secondary indexing in large-scale storage systems under weak consistency.

Regal has two CIFRE contracts with Magency SA:

- Damien Carver is advised by Julien Sopena and Sébatien Monnet. He works on designing kernel-level mechanisms that automatically give more memory to the most active containers.
- Lyes Hamidouche is advised by Pierre Sens and Sébatien Monnet. He works on efficient data dissemination among a large number of mobile devices.

Regal has one contract with Orange within the I/O Lab joint laboratory:

- Guillaume Fraysse is advised by Jonathan Lejeune, Julien Sopena, and Pierre Sens. He works on distributed resources allocation in virtual network environments.

SPIRALS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. ip-label

Participant: 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. Scalair

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

This collaboration (2015–18) aims at proposing a framework to deal with elasticity in cloud computing environments. This framework must cover all kinds 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.

8.3. Davidson

Participants: Romain Rouvoy [correspondant], Lionel Seinturier.

This collaboration (2017–20) aims at proposing new solutions for optimizing the energy footprint of ICT software infrastructures. We want to be able to measure and assess the energy footprint of ICT systems while preserving various quality of service parameters, such as performance and security. We aim at proposing a testbed for assessing the energy footprint of various programming languages. This testbed will also incorporate frameworks for web and mobile programming. Finally, we want to be able to issue recommendations to developers in order to assist them in improving the energy footprint of their programs. This collaboration will take advantage of the POWERAPI software library.

The PhD of Mohammed Chakib Belgaid will start in January 2018 in the context of this collaboration.

8.4. Orange Labs

Participants: Philippe Merle [correspondant], Lionel Seinturier.

This collaboration (2017–18) aims at defining a computational model for software infrastructures layered on top of virtualized and interconnected cloud resources. This computational model will provide application programming and management facilities to distributed applications and services. This computational model will define a pivot model that will enable the interoperability of various existing and future standards for cloud systems such as OCCI and TOSCA. This pivot model will be defined with the Alloy specification language [62]. This collaboration takes advantage of the expertise that we are developing since several years on reconfigurable component-based software systems [73], on cloud systems [67], and on the Alloy specification language [66].

This collaboration with Orange Labs is a joint project with Jean-Bernard Stefani from the **Spades** Inria project-team.

WHISPER Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Orange Labs, 2016-2018, 120 000 euros. The purpose of this contract is to apply the techniques developed in the context of the PhD of Antoine Blin to the domain of Software Defined Networks where network functions are run using virtual machines on commodity multicore machines.
- Thales Research, 2016-2018, 45 000 euros. The purpose of this contract is to enable the usage of multicore architectures in avionics systems. More precisely, our goal is to develop optimizations for a software TDMA hypervisor developed by Thales that provides full time-isolation of tasks. The PhD of Cédric Courtaud is supported by a CIFRE fellowship with Thales Research.
- OSADL, 2016-2017, development of the Prequel patch query language, 20 000 euros. OSADL is an organization headquartered in Germany that promotes and supports the use of open source software in the automation and machine industry. The project is in the context of the OSADL project SIL2LinuxMP bringing together various companies in automotive and embedded systems with the goal of developing methodologies for certifying the basic components of a GNU/Linux-based RTOS.

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 thesis of Hussam Al Daas on enlarged Krylov subspace methods for oil reservoir and seismic imaging applications. Supervisor L. Grigori.
- Contract with IFPen, February 2016 - February 2019, that funds the Phd thesis of Zakariae Jorti on adaptive preconditioners using a posteriori error estimators. Supervisor L. Grigori.
- Contract with IFPen, October 2016 - October 2019, that funds the Phd thesis of Julien Coulet on the virtual element method (VEM). Supervisor F. Nataf and V. Girault.

AVALON Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. IFPEN

We have a collaboration with IFPEN (<http://ifpenergiesnouvelles.com/>). IFPEN develops numerical codes 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 the parallel implementation of multi-level decomposition domains on many-core architecture and GPGPU.

DATAMOVE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- **BULL-ATOS SE (2016-2019)**. Two PhD grants (Michael Mercier and Adrien Faure). Job and resource management algorithms.
- **CEA DAM (2016-2018)**. PhD grant support contract (PhD of Estelle Dirand, funded by CEA). In situ analysis for Molecular Simulations.

HIEPACS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

Airbus Group Innovations research and development contract:

- Design and implementation of linear algebra kernel for FEM-BEM coupling (A. Falco (PhD); Emmanuel Agullo, Luc Giraud, 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

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Huawei: HIRP Low-Latency Storage for Stream Data (2016–2017)

Participants: Alexandru Costan, Ovidiu-Cristian Marcu, Gabriel Antoniu.

The goal of this project is to explore the plausible paths towards a dedicated storage solution for low-latency stream storage. Such a solution should provide on the one hand traditional storage functionality and on the other hand stream-like performance (i.e., low-latency I/O access to items and ranges of items).

We have investigated the main requirements and challenges, evaluated the different design choices (e.g., a standalone component vs. an extension of an existing Big Data solution like HDFS) and proposed a new converged architecture for smart storage.

7.1.2. Total: In situ Visualization with Damaris (2017-2018).

Participants: Hadi Salimi, Matthieu Dorier, Gabriel Antoniu, Luc Bougé.

The goal of this expertise contract is to 1) disseminate the usage of Damaris for engineers at Total; 2) to realize a feasibility study for the usage of Damaris for in situ analysis of data for Total's HPC simulations.

POLARIS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- ULTRON, bilateral contract with Huawei over 18 months, supporting two postdoctoral researchers, Amélie Heliou and Luigi Vigneri.
- Inria/Orange Labs Laboratory. Polaris is involved in this partnership with Orange Labs by supervising two PhD students members of this common laboratory: Bruno Donnassolo (supervised by Arnaud Legrand, Panayotis Mertikopoulos, and Ilhem Fajjari) and Umar OzeerX (supervised by Jean-Marc Vincent and Gwenn Salaün).
- Cifre contract with Schneider Electric. The PhD thesis of Benoit Vinot (supervised by Nicolas Gast and Florent Cadoux (G2Elab)) is supported by this collaboration.
- A common laboratory between Inria and the Alcatel Lucent-Bell Labs was created in early 2008 and consists on three research groups (ADR). POLARIS leads the ADR on self-optimizing networks (SELFNET). The researchers involved in this project are Bruno Gaujal and Panayotis Mertikopoulos.

ROMA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. MUMPS Consortium

In 2017, in the context of the MUMPS consortium (<http://mumps-consortium.org>), we worked in close collaboration with Toulouse INP to:

- sign or renew membership contracts with EDF, Altair, Michelin, LSTC, FFT-MSc, and with the Lawrence Berkeley National Laboratory, on top of the ongoing contracts with ESI-Group, Safran, Siemens and Total,
- organize point-to-point meetings with several members,
- provide technical support and scientific advice to members,
- provide experimental releases to members in advance,
- organize the third consortium committee meeting, at Altair (Grenoble).

Three engineers have been funded by the membership fees in 2017, for software engineering and software development, performance study and tuning, business development and management of the consortium. Half a year of a PhD student was funded by the membership fees (see Section 9.1). On top of their membership, an additional contract was signed with Michelin to provide a new functionality and study how to best exploit MUMPS recent features in their computing environment.

8.2. The XtremLogic Start-Up

XTREMLOGIC is a spin-off of Inria founded 6 years ago by Alexandru Plesco and Christophe Alias.

XTREMLOGIC leverages the results obtained in both HPC and polyhedral compilation communities to synthesize energy-efficient circuits for FPGA. The circuits commercialized by XTREMLOGIC target markets including HPC, data centers and artificial intelligence. 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 Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- HiBOX project, with Airbus and IMACS (2013-2017).

TADaaM Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

8.1.1. Intel

INTEL granted \$30k and provided information about future many-core platforms and memory architectures to ease the design and development of the HWLOC software with early support for next generation hardware.

8.1.2. CEA

CEA is funding 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.

8.1.3. Bull/Atos

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

8.1.4. EDF

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

ASCOLA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Participants: Adrien Lebre [Contact point], Ronan-Alexandre Cherrueau, Alexandre Van Kempen.

During 2017, we agreed with Orange Labs (Lannion) to conduct a dedicated study on the evaluation of AMQP message bus alternatives within the OpenStack ecosystem. This bilateral contract (“Contrat de Recherche Externalisé”) officially started in Sept 2017 for one year. With the allocated budget (100K), we hired a new research engineer, Alexandre Van Kempen. Alexandre Van Kempen works with Ronan-Alexandre Cherrueau (Temporary Research Engineer, hired in the context of the MERCURY InriHub) and Matthieu Simonin (Permanent Research Engineer from the Rennes Bretagne Atlantique Center) on conducting this analysis. In addition to extending the EnOS framework previously presented, they are performing several experiments with the support of the OpenStack open-source community (in particular RedHat). The goal of the study is to identify major drawbacks of the default RabbitMQ solution with respect to the Fog/Edge requirements and evaluate whether some alternatives are available in the open-source ecosystem.

DIVERSE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. GLOSE

- Partners: Inria/CNRS/Safran
- Dates: 2017-2021
- Abstract: The GLOSE project develops new techniques for heterogeneous modeling and simulation in the context of systems engineering. It aims to provide formal and operational tools and methods to formalize the behavioral semantics of the various modeling languages used at system-level. These semantics will be used to extract behavioral language interfaces supporting the definition of coordination patterns. These patterns, in turn, can systematically be used to drive the coordination of any model conforming to these languages. The project is structured according to the following tasks: concurrent xDSML engineering, coordination of discrete models, and coordination of discrete/continuous models. The project is funded in the context of the network DESIR, and supported by the GEMOC initiative.

8.1.2. One Shot Software (OSS)

- Partners: Inria/Orange
- Dates: 2017-2019
- Abstract: The OSS project investigates an extreme version of moving target defense where a slightly different version of the application is deployed each time it is used (e.g., for crypto functions or payment services). We investigate the analysis, synthesis and transformation techniques to support diversification at 5 points of a software construction pipeline, which, once combined yield up to billions of variants. We also evaluate the support of diversification as a first class property in DevOps.

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. Bilateral Contracts with Industry

8.1.1. *BlockChain*

Participants: Henrique Rocha, Marcus Denker, Stéphane Ducasse
From 2016, ongoing.

We started a new collaboration with a local startup (UTOCAT) about tools and languages in the context of Blockchain systems. The collaboration started with a 2 month exploration phase involving an engineer at Inria Tech. A postdoc started in 2017.

8.1.2. *Pharo Consortium*

Participants: Esteban Lorenzano, Clément Béra, Marcus Denker, Stéphane Ducasse
From 2012, ongoing.

The Pharo Consortium was founded in 2012 and is growing constantly. By the end 2017, it has 27 company members, 14 academic partners. Inria supports the consortium with one full time engineer starting in 2011. In 2018, the Pharo Consortium will join InriaSoft.

More at <http://consortium.pharo.org>.

8.2. Bilateral Grants with Industry

8.2.1. *Worldline CIFRE*

Participants: Vincent Blondeau, Anne Etien, Nicolas Anquetil
From 2014 to 2017.

We are working on improving the testing behavior of the developers.

The PhD started in October 2014 and finished in 2017: Vincent Blondeau, *Test Selection Practices in a Large IT Company*, CIFRE WorldLine, November 8th, University Lille 1 (France),

8.2.2. *Thales CIFRE*

Participants: Brice Govin, Anne Etien, Nicolas Anquetil, Stéphane Ducasse
From 2015, ongoing.

We are working on large industrial project rearchitcturization. PhD in progress: Brice Govin, *Support to implement a rejuvenated software architecture in legacy software*. CIFRE Thale started Jan 2015.

8.2.3. *Remodularization of Architecture*

Participants: Anne Etien, Nicolas Anquetil, Stéphane Ducasse
From 2017, ongoing.

We started a new collaboration with the software editor Berger Levrault about software architecture remodularization. The collaboration started with an end study project exploring the architecture used in the company in order to later migrate from GWT to Angular JS since GWT will not be backward supported anymore in the next versions. An internship and a PhD CIFRE thesis will successively start in 2018.

TACOMA Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Project: SIMHet

Partner: YoGoKo

Starting: Nov 2015; Ending : October 2018

Contact: JM Bonnin

Abstract: The SIMHet project is performed in partnership with YoGoKo, a start-up that develops innovative communication solutions for cooperative intelligent transport systems. The SIMHet project aims to develop a decision making mechanism that would be integrated in the ISO/ETSI ITS communication architecture. It will allow mobile devices or mobile routers to choose the best network interface for each embedded application/flow. For example, in a vehicular environment this mechanism could manage global (Internet) and local connections for each on board device/application, in order to ensure that applications and services are always best connected. Aware that "best" concept is context-dependent, such a decision making mechanism should take into account requirements from different actors (e.g., applications, user, network administrators) and contextual information. One of the difficulties is to take advantage of the knowledge the system could have about near future connectivity. In the vehicular context such information about the movement and the availability of network resources is available. If taking into account the future makes the decision making more complex, this could allow a better usage of network resources when they are available. Once current solutions in the market are based on very simple decisions (use WiFi if available and 3G elsewhere), this smart mechanism will give competitive advantage for YoGoKo over its competitors.

AGORA 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 industrial and academic partners in the context of the PSPC Fed4PMR project (2015-2018). In this context, we are working on the design of new professional mobile radio solutions, compatible with 4G and 5G standards. This collaboration funds the PhD thesis of Jad Oueis and a part of the PhD thesis of Abderrahman Ben Khalifa.

8.2. Bilateral Grants with Industry

- Common Laboratory Inria/Nokia Bell Labs - ADR Network Information Theory.
Agora is part of the ADR Network Information Theory of the common laboratory Inria/Nokia Bell Labs.
- Spie - INSA Lyon IoT Chaire.
Agora is involved in the SPIE INSA Lyon IoT Chaire, launched in November 2016. The IoT Chaire partially funds the PhD thesis of Abderrahman Ben Khalifa. The PhD thesis work of Alexis Duque and Amjed Belkhiri are also contributing in this structure.
- Volvo - INSA Lyon Chaire.
Agora is involved in the Volvo Chaire at INSA Lyon, on the area of autonomous electrical distribution vehicle in urban environments. Razvan Stanica is a member in the steering committee of this structure.

COATI Project-Team (section vide)

DANTE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *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 behaviour) 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.

8.2. Bilateral Grants with Industry

8.2.1. *Orange R&D*

Participant: Isabelle Guerin 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. Bilateral Contracts with Industry

We have signed a bilateral contract for one year with Safran in order to build a network simulator specialised for aeronautical networks.

We are involved in an ADR "Rethinking the Network: Virtualizing Network Functions, from Middleboxes to Applications" with Nokia Bell Labs. The idea is to work on Unified control plane for fast NFV deployment.

7.2. Bilateral Grants with Industry

The ANSWER project is led by the QWANT search engine and the Inria Sophia Antipolis Méditerranée research center. This proposal is the winner of the "Grand Challenges du Numérique" (BPI) and aims to develop the new version of the search engine <http://www.qwant.com> with radical innovations in terms of search criteria, indexed content and privacy of users. In the context of this project, we got with Nataliia Bielova from the INDES project-team a funding for a 3 years Ph.D. student to work on Web tracking technologies and privacy protection.

DIONYSOS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. 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 (PhD of Corentin Hardy), done with Technicolor. The starting point of this thesis is 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.

8.2. Cifre contract on Throughput Prediction in Mobile Networks

Participants: Yann Busnel

This is a Cifre contract (2015-2018) including a PhD thesis supervision (PhD of Alassane Samba), done with Orange, on cooperation in statistical approaches for the prediction of throughput without history. Throughput has a strong impact on user experience in cellular networks. The ability to predict the throughput of a connection, before it starts, brings new possibilities, particularly to Internet service providers. They could adapt contents to the quality of service really reachable by users, in order to enhance their experience.

8.3. Cifre contract on Mobile SDN architecture

Participants: Yassine Hadjadj-Aoul, César Viho

This is a Cifre contract (2015-2018) including a PhD thesis supervision (PhD of Imad Alawe), done with TDF, on the proposition of a scalable SDN-based mobile network architectures for the future 5G network.

8.4. Cifre contract on Personalization for Cognitive Autonomic Networks in 5G

Participants: César Viho

This is a Cifre contract (2017-2019) including a PhD thesis supervision (PhD of Illyne Saffar), done with Nokia, on the proposition to use machine learning and data analytics to transform user and network data into actionable knowledge which in turn can be automatically exploited by Autonomic Networking approaches for cognitive self management of the 5G network.

8.5. 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 the corresponding risks 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.

8.6. Bilateral Contract with Industry: ADR Nokia Bell Labs

Participants: Yassine Hadjadj-Aoul, Gerardo Rubino

Gerardo Rubino is the coordinator of the reasearch action, named “Analytics and machine learning”, with Nokia Bell Labs.

The objective is to carry out common research on an integrated framework for 5G, programmable networks, IoT and clouds that aims at statically and dynamically managing and optimizing the 5G infrastructure using, in particular, machine learning techniques.

DYOGENE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. CRE with Orange

One year contract titled “Scheduling effect on the distribution of QoS over cells in 4G wireless cellular networks” between Inria and Orange Labs have been realized in 2017. It is a part of the long-term collaboration between TREC/DYOGENE, represented by B. Blaszczyszyn and Orange Labs, represented by M. K. Karray, for the development of analytic tools for the QoS evaluation and dimensioning of operator cellular networks. The developed solutions are implemented in Orange dimensioning toolbox *CapRadio* 6.2.1 . Antoine Brochard was hired by Inria as a research engineer thanks to this contract.

8.1.2. CRE with Huawei

18-month contract titled “Mathematical Modeling of 5G Ultra Dense Wireless Networks” between Inria represented by B. Blaszczyszyn (PI) and F. Baccelli, and Huawei. It aims at investigating obstacle-based shadowing fields in the spatial models of cellular networks and efficient scheduling policies. Paul Keeler was hired by Inria as a research engineer thanks to this contract.

8.1.3. Contract with the Ministry of Defense

The contract supports a PhD student Alexandre Hollocou hired in 2015, co-advised by M. Lelarge.

8.1.4. CIFRE with Nokia

Contract with Nokia started in 2015 for the co-advising by B. Blaszczyszyn of a PhD student of Nokia, Dalia-Georgiana Herculea.

8.1.5. CIFRE with Orange

Contract with Orange started in 2017 for the co-advising by B. Blaszczyszyn of a PhD student of Orange, Quentin Le Gall.

8.2. Bilateral Grants with Industry

8.2.1. Google Tides

Ana Busic and Sean Meyn received jointly in 2015 a Google Faculty Research Award for their research on Distributed Control for Renewable Integration in Smart Communities. The corresponding grant allowed us to cover some part of the scholarship of the PhD student **Sebastien Samain**. in 2017.

EVA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. CNES contract

Participants: Pascale Minet, Ines Khoufi.

Inria and CNES co-funded a study of one year in the framework of the CNES Launchers Research and Technology program. This study deals with the improvement and performance evaluation of a solution of wireless sensor networks in a spatial environment, based on the IEEE 802.15.4e standard of TSCH (Time Slotted Channel Hopping).

In space launch vehicles, a NASA study shows that the mass per channel of 0.45 kg for a wiring approach can be reduced to 0.09 kg for a wireless approach.⁸ A question arises: which wireless technology is able to meet the requirements of space launch vehicles in terms of latency, throughput and robustness. The IEEE 802.15.4e amendment has been designed to meet such requirements. More specifically, the Time Slotted Channel Hopping (TSCH) mode of the IEEE 802.15.4e standard that has been designed for industrial automation, process control and equipment monitoring, appears very promising for space launch vehicles. More precisely, the study for CNES deals with:

- Avoiding collisions on shared slots: see the PEMWN 2017 conference.
- Building an IEEE 802.15.4e TSCH network: see the EUCASS 2017 publication.
- Increasing the reliability of an IEEE 802.15.4e TSCH network: see the NCA 2017 publication.
- Scheduling transmissions in an IEEE 802.15.4e TSCH network: see the VTC-Fall 2017 publication.

FUN Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- Evolution

Participants: Gabriele Sabatino, Nathalie Mitton [correspondant].

This collaboration aims to set up a full RFID system on the basis of AspireRFID middleware and pre-existing RFID modules issued from FUN research in the Evolution company facility and to integrate them with their IS.

GANG Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Collaboration with Nokia Bell Labs

Gang has a strong collaboration with Bell Labs (Nokia). We notably collaborate with Fabien Mathieu who is a former member of GANG and Nidhi Hegde. An ADR (joint research action) is dedicated to content centric networks and forwarding information verification. The PhD thesis of Leonardo Linguaglossa was funded by this contract.

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

INFINE Project-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).
2. Fujitsu has funded further development of RIOT and sponsored the RIOT Summit 2017.
3. Cisco Systems Silicon Valley has sponsored the RIOT Summit 2017.
4. In the framework of the joint research lab between Nokia Bell Labs and Inria, we participate in the ADR (action de recherche) Network Information Theory.

7.2. GranData

- Participants: Aline Carneiro Viana, Guangshuo Chen, Adriano Di Luzio

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 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, supervised by Ye-Qiong Song and Laurent Ciarletta)
 - Dynamic reconfiguration and graceful degradation of distributed real-time applications over mesh networks
- CIFRE, Thales (Palaiseau, France):
 - CIFRE PhD (Pierre-Olivier Brissaud, supervised by Isabelle Chrisment and Jérôme François)
 - Anomaly detection in encrypted network traffic
- CIFRE, Orange Labs (Issy-Les-Moulineaux, France):
 - CIFRE PhD (Maxime Compastie, supervised by Olivier Festor and Rémi Badonnel)
 - Software-Defined Security for Distributed Cloud Infrastructures
- CIFRE, Orange Labs (Issy-Les-Moulineaux, France):
 - CIFRE PhD (Paul Chaignon, supervised by Olivier Festor and Jérôme François)
 - Monitoring of Software-Defined Networks
- CIFRE, Xilopix (Epinal, France):
 - CIFRE PhD (Abdulqawi Saif, supervised by Ye-Qiong Song and Lucas Nussbaum)
 - Open Science for the scalability of a new generation search technology
- CIFRE, Cynapsys Technologies (Paris, France):
 - CIFRE PhD (Haftay Gebreslasie Abreha, supervised by Michael Rusinowitch, Adel Bouhoula and Abdelkader Lahmadi)
 - Compressed and Verifiable Filtering Rules in Software-defined Networking

NEO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

NEO members are involved in the

- Inria-Nokia Bell Labs joint laboratory: the joint laboratory consists of six ADRs (Action de Recherche/Research Action) in its second phase (starting October 2012). NEO members participate in one ADR (see §8.1.1);
- Inria-Orange Labs joint laboratory;
- Inria-ALSTOM joint laboratory: the joint laboratory consists of four projects. NEO members participated in project P11.

8.1.1. ADR “Network Science” (June 2013 – March 2017)

Participants: Konstantin Avrachenkov [coordinator], Giovanni Neglia.

- Contractor: Nokia Bell Labs (<http://www.bell-labs.com>)
- 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 were interested in efficient network sampling. Related publication: [20]

8.2. Bilateral Grants with Industry

8.2.1. Huawei CIFRE on the topic “Scalable Online Algorithms for SDN controllers” (June 2016 – May 2019)

Participants: Zaid Allybokus, Konstantin Avrachenkov.

- Contractor: Huawei Technologies (<http://www.huawei.com/en/about-huawei/research-development>)
- Collaborators: Jérémie Leguay and Lorenzo Maggi

Software-Defined Networking (SDN) technologies have radically transformed network architectures. They provide programmable data planes that can be configured from a remote controller platform.

The objective of this CIFRE thesis is to provide fundamental answers on how powerful SDN controller platforms could solve large online flow problems to optimize networks in real-time and in a distributed or semi-distributed fashion. We use methods from both optimization and dynamic programming.

RAP2 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 2014-2017.
- 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.
- CELTIC+ Contract "SENDATE".

SOCRATE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

7.1.1. Research Contract with Orange Labs (2015-2017)

The goal of this project “PERformances Théoriques des réseaux cellulaires pour la 5G” No. F05151 (50KEuro) is to develop a theoretical approach allowing to study the energy efficiency spectral efficiency tradeoff for 5G networks, by revisiting information theory for dense networks and short packets transmissions.

7.1.2. Research Contract with Bosch (2016-2017)

This contract between Bosch and two project-teams (AriC and Socrate) focusses on the evolution of high-performance embedded controllers.

7.1.3. Research Contract with Sigfox (2015-2017)

A collaboration with Sigfox to work on extension of SigFox network to multi-base station case: cifre grant.

7.1.4. Research Contract with Atlantic

Socrate has a collaborative contract with Atlantic, around wireless communications in HVAC systems.