



RESEARCH CENTER

FIELD

Algorithmics, Programming, Software and Architecture

Activity Report 2016

Section Contracts and Grants with Industry

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ALGORITHMICS, COMPUTER ALGEBRA AND CRYPTOLOGY

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ARIC Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Bosch (Germany) ordered us some support for implementing complex numerical algorithms.

7.2. Bilateral Grants with Industry

- Marie Paindavoine is supported by an Orange Labs PhD Grant (from October 2013 to November 2016). She works on privacy-preserving encryption mechanisms.
- Miruna Rosca and Radu Titu are employees of BitDefender. Their research internships (from October to December 2016) are supervised by Damien Stehlé and Benoît Libert, respectively. Miruna Rosca works on the foundations of lattice-based cryptography, and Radu Titu works on functional encryption.
- Within the program Nano 2017, we collaborate with the Compilation Expertise Center of STMicroelectronics on the theme of floating-point arithmetic for embedded processors.

AROMATH Project-Team (section vide)

CARAMBA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Training and Consulting with HTCS

The training and consulting activities begun in 2012 with the HTCS company have been pursued, and the existing contract has been renewed in identical form.

CASCADE Project-Team (section vide)

DATASHAPE Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Research contract with GeometryFactory in the context of Mael Rouxel-Labbé's Ph.D. thesis on anisotropic mesh generation [12].

GRACE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

8.1.1. *Nokia (ex Alcatel-Lucent)*

Within the framework of the joint lab Inria-ALU, Grace and Alcatel-Lucent collaborate on the topic of Private Information Retrieval: that is, enabling a user to retrieve data from a remote database while revealing neither the query nor the retrieved data. (This is not the same as data confidentiality, which refers to the need for users to ensure secrecy of their data; this is classically obtained through encryption, which prevents access to data in the clear.)

A typical application would be a centralized database of medical records, which can be accessed by doctors, nurses, and so on. A desirable privacy goal would be that the central system does not know which patient is queried for when a query is made, and this goal is precisely achieved by a Private Information Retrieval protocol. Note also that in this scenario the database is not encrypted, since many users are allowed to access it.

We are exploring applications of Locally Decodable Codes to Private Information Retrieval in the multi-cloud (multi-host) setting, to ensure both secure, reliable storage, and privacy of database queries.

N. Coxon made the first implementation of these codes, who are indeed very practical. On a laptop, we can encode an ADN of a drosophila in two seconds, and a 10^9 bit data base in 30 seconds. We have a few real-life scenario in mind (DNA, geolocalisation, streaming), and we will check how realistic they are.

8.1.2. *Safran Identity and Security (ex-Morpho)*

A contract has been signed in November 2016 between Safran Identity and Security and École polytechnique, for one year post-doc position. A candidate has been found, and will arrive early 2017 (January).

The topic is the research is to use bitcoin's blockchain to issue and manipulate certification of identities, which is very close to the (trendy) topic of diplomation with blockchains.

Safran had a preliminary construction for doing that, and a preliminary version has been submitted to the [IEEE Security and Privacy on the Blockchain Workshop](#).

LFANT Project-Team (section vide)

POLSYS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Until the mid 2000's, multivariate cryptography was developing very rapidly, producing many interesting and versatile public-key schemes. However, many of them were soon successfully cryptanalysed (a lot have been done in this group). As a consequence, the confidence in multivariate cryptography cryptosystems declined. It seems that there have emerged new important reasons for renewal of the interest in a new generation of multivariate schemes. In the past two years, the algorithms for solving the Discrete Logarithm Problem over small characteristic fields underwent an extraordinary development. This clearly illustrates the risk to not consider alternatives to classical assumptions based on number theory. In parallel, two of the most important standardization bodies in the world, NIST and ETSI have recently started initiatives for developing cryptographic standards not based on number theory, with a particular focus on primitives resistant to quantum algorithms. An objective here is then to focus on the design of multivariate schemes.

The team is now involved in the industrial transfer of post-quantum cryptography. The project is supervised by SATT-LUTECH. SATT-LUTECH specializes in the processing and transfer of technologies from research laboratories of its shareholders: Inria, CNRS, University of Technology of Compiègne, National Museum of Natural History, Institute Curie, Université Panthéon-Assas, Paris Sorbonne University and National School of Industrial Creation).

The team has recently developed, in partnership with a mobile application development company (WASSA), an Android app for smartphones (Samsung G5 type) that uses multivariate cryptography. The application has been tested mid-November in a series of experiments supervised by DGA and French Ministry of Defense. The experiment gathered a total of hundred participants from various operational units. This is a first milestone in the maturation project whose goal is to create a start-up.

SECRET Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Grants with Industry

- **Thales** (02/14 → 01/17)
Funding for the supervision of Julia Chaulet's PhD.
30 kEuros.

SPECFUN Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- *Mathematical Components* (project of the MSR–INRIA Joint Centre).
Goal: Investigate the design of large-scale, modular and reusable libraries of formalized mathematics, using the Coq proof assistant. This project successfully formalized the proof of the Odd Order Theorem, resulting in a corpus of libraries related to various areas of algebra.
Leader: Georges Gonthier (MSR Cambridge). Participants: Georges Gonthier, Assia Mahboubi.
Website: <http://www.msr-inria.fr/projects/mathematical-components/>.

VEGAS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

A two years licence and cooperation agreement was signed on April 1st, 2016 between WATERLOO MAPLE INC., Ontario, Canada (represented by Laurent Bernardin, its Executive Vice President Products and Solutions) and Inria. On the Inria side, this contract involves the teams VEGAS and OURAGAN (Paris), and it is coordinated by Fabrice Rouillier (OURAGAN).

F. Rouillier and VEGAS are the developers of the ISOTOP software for the computation of topology of curves. One objective of the contract is to transfer a version of ISOTOP to WATERLOO MAPLE INC.

CAIRN Project-Team (section vide)

CAMUS Team

8. Bilateral Contracts and Grants with Industry

8.1. Caldera

Vincent Loechner and Cédric Bastoul are involved in a collaboration with the French company Caldera (<http://www.caldera.com>), specialized in software development for wide image processing. The goal of this collaboration is the development of parallel and scalable image processing pipeline for industrial printing. The project started in September 2016 and involves a contract established between the ICube laboratory and the Caldera company. This contract includes the funding of the industrial thesis (CIFRE) of Paul Godard (started in September 2016) on the topic of the collaboration, under the supervision of Vincent Loechner and Cédric Bastoul.

8.2. NANO 2017/PSAIC

The CAMUS team is taking part of the NANO 2017 national research program and its sub-project PSAIC (Performance and Size Auto-tuning thru Iterative Compilation) with the company STMicroelectronics, starting January 2015. Since the release of our automatic speculative parallelization framework Apollo, we have been working on an extension making Apollo usable as a advanced program profiling tool. We are also currently working in extending advanced loop optimization techniques to nonlinear loops using a linear virtual data layout remapping.

COMPSYS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Since the team was going to be stopped, Compsys did not try to establish any long-term contract with industry.

8.2. Bilateral Grants with Industry

Same situation.

CORSE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

- PSAIC Nano2017 is a bilateral Grant with STMicroelectronics. CORSE is involved in the development of trace analysis and hybrid compilation.
- DEMA Nano2017 is a bilateral Grant with STMicroelectronics. CORSE is involved in the development of debugging of multithreaded applications.

7.2. CIFRE contracts

- CORSE is involved in a contract with **Kalray** associated with the CIFRE PhD of Duco van Amstel who defended in Spring 2016. The subject of the collaboration is related to fine grain scheduling.
- CORSE is involved in a contract with **Aselta** for the CIFRE thesis of Nassim Halli. Nassim Halli was advised by Henri-Pierre Charles (CEA LIST, Grenoble and Jean-François Méhaut. The subject of this thesis is the code optimization of Java Applications. The thesis was defended in October 2016.
- CORSE is also involved in a contract with **STMicroelectronics** for the CIFRE thesis of Oleg Iegorov. The subject of this thesis is a Data Mining Approach to Temporal Debugging of Embedded Streaming Applications. Oleg Iegorov was advised by the SLIDE LIG team and the CORSE Inria team. The thesis was defended in April 2016.

DREAMPAL Project-Team (section vide)

PACAP Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Nano 2017 PSAIC*

Participants: Arif Ali Ana-Pparakkal, Erven Rohou, Emmanuel Riou.

Nano 2017 PSAIC is a collaborative R&D program involving Inria and STMicroelectronics. The PSAIC (Performance and Size Auto-tuning through Iterative Compilation) project concerns the automation of program optimization through the combination of several tools and techniques such as: compiler optimization, profiling, trace analysis, iterative optimization and binary analysis/rewriting. For any given application, the objective is to devise through a fully automated process a compiler profile optimized for performance and code size. For this purpose, we are developing instrumentation techniques that can be focused and specialized to a specific part of the application aimed to be monitored.

The project involves the Inria teams PACAP, AriC, CAMUS and CORSE. PACAP contributes program analyses at the binary level, as well as binary transformations. We will also study the synergy between static (compiler-level) and dynamic (run-time) analyses.

8.2. Bilateral Grants with Industry

8.2.1. *Intel research grant INTEL2014-8957*

Participants: André Seznec, Biswabandan Panda, Arthur Perais, Fernando Endo.

Intel is supporting the research of the PACAP project-team on “Mixing branch and value prediction to enable high sequential performance”.

8.2.2. *Intel research grant INTEL2016-11174*

Participants: André Seznec, Pierre Michaud, Kleovoulos Kalaitzidis.

Intel is supporting the research of the PACAP project-team on “Design tradeoffs for extreme cores”.

TASC Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *Labcom TransOp*

Participants: Charles Prud'Homme, Xavier Lorca.

Title: TransOp.

Duration: 2014-2016.

Type: **ongoing project**.

Others partners: **Eurodécision**.

The goal of the project is to handle robustness in the context of industrial timetabling problems with constraint programming using **CHOCO**. The project is managed by **Xavier Lorca**.

8.2. Bilateral Grants with Industry

8.2.1. *Gaspard Monge*

Participants: Nicolas Beldiceanu, Helmut Simonis.

Title: Gaspard Monge 3.

Duration: 2016.

Type: **ongoing project**.

Others partners: EDF.

Within the context of the Gaspard Monge call program for Optimisation and Operation Research, we work with **EDF** on the research initiative on *Optimization and Energy*. The goal of the project (continuation of last years projects) is to provide a systematic reformulation of time-series constraints in term of linear constraints that can be used in a MIP solver.

AOSTE Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Airbus CIFRE grant This contract, started on March 2014, provides full support for the PhD thesis of Cristian Maxim. The thesis concerns the statistical timing analysis while different variability factors are taken into account. The proposed methods are built on top of existing statistical approaches while proving appropriate programs for training these methods and thus learning from the history of the execution.

CONVECS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Grants with Industry

Participants: Umar Ozeer, Gwen Salaün.

Umar Ozeer is supported by a PhD grant (from November 2016 to November 2019) from Orange Labs (Grenoble) on detecting and repairing failures of data-centric applications distributed in the cloud and the Internet of Things (see § 6.5.1), under the supervision of Xavier Etchevers (Orange Labs), Gwen Salaün (CONVECS), François Gaël Ottogalli (Orange Labs), and Jean-Marc Vincent (POLARIS project-team).

HYCOMES Project-Team (section vide)

MUTANT Project-Team (section vide)

PARKAS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Technology Transfer Project, partly funded by the TETRACOM grant and by Kalray.

7.2. Bilateral Grants with Industry

Polly Labs initiative. Funded by ARM for 4 years with complementary support from Xilinx, in cooperation with ETH Zürich and Qualcomm.

POSET Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- PhD Grant CIFFRE, 2015-2018, for Jean-Michael Célérier, in partnership with **Blue Yeti** (Royan),

SPADES Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

- INRIA and Orange Labs have established this year a joint virtual research laboratory, called I/O LAB. We have been heavily involved in the creation of the laboratory and are actively involved in its operation (Jean-Bernard Stefani is one of the two co-directors of the lab). I/O LAB focuses on the network virtualization and cloudification. As part of the work of I/O LAB, we have cooperated with Orange Lab, as part of a cooperative research contract funded by Orange, on defining architectural principles and frameworks for network cloud infrastructures encompassing control and management of computing, storage and network resources.
- With Daimler (subcontracting via iUTBS): We have shown how to extend our current method for computing deadline miss models to real-time systems designed according to the Logical Execution Time paradigm.

7.2. Bilateral Grants with Industry

With Thales: Early Performance assessment for evolving and variable Cyber-Physical Systems. This CIFRE grant funds the PhD of Christophe Prévot.

TEA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Toyota Info-Technology Centre (2014-2016)

Title: Co-Modeling of Safety-Critical Multi-threaded Embedded Software for Multi-Core Embedded Platforms

Inria principal investigator: Jean-Pierre Talpin

International Partner (Institution - Laboratory - Researcher):

Toyota Info-Technology Centre, Mountain View, California

Virginia Tech Research Laboratories, Arlington

Duration: renewed yearly since 2014

Abstract: We started a new project in April 2014 funded by Toyota ITC, California, to work with Huafeng Yu (a former post-doctorate of team ESPRESSO) and with VTRL as US partner. The main topic of our project is the semantic-based model integration of automotive architectures, virtual integration, toward formal verification and automated code synthesis. This year, Toyota ITC is sponsoring our submission for the standardization of a time annex in the SAE standard AADL.

In a second work-package, we aim at elaborating a standardized solution to virtually integrate and simulate a car based on heterogeneous models of its components. This year, it will be exemplified by the elaboration of a case study in collaboration with Virginia Tech. The second phase of the project will consist of delivering an open-source, reference implementation, of the proposed AADL standard and validate it with a real-scale model of the initial case-study.

8.2. Bilateral Grants with Industry

8.2.1. Mitsubishi Electric R&D Europe (2015-2018)

Title: Analysis and verification for correct by construction orchestration in automated factories

Inria principal investigator: Jean-Pierre Talpin, Simon Lunel

International Partner: Mitsubishi Electric R&D Europe

Duration: 2015 - 2018

Abstract: The primary goal of our project is to ensure correctness-by-design in cyber-physical systems, i.e., systems that mix software and hardware in a physical environment, e.g., Mitsubishi factory automation lines. We plan to explore a multi-sorted algebraic framework for static analysis and formal verification starting from a simple use case extracted from Mitsubishi factory automation documentations. This will serve as a basis to more ambitious research where we intend to leverage recent advance in type theory, SMT solvers for nonlinear real arithmetic (dReal and δ -decidability) and contracts theory (meta-theory of Benveniste et al., Ruchkin's contracts) to provide a general framework of reasoning about heterogeneous factory components.

ANTIQUE Project-Team (section vide)

CELTIQUE Project-Team (section vide)

DEDUCTEAM Team (section vide)

GALLIUM Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *The Caml Consortium*

Participants: Xavier Leroy [[contact](#)], Damien Doligez, Didier Rémy.

The Caml Consortium is a formal structure where industrial and academic users of OCaml can support the development of the language and associated tools, express their specific needs, and contribute to the long-term stability of Caml. Membership fees are used to fund specific developments targeted towards industrial users. Members of the Consortium automatically benefit from very liberal licensing conditions on the OCaml system, allowing for instance the OCaml compiler to be embedded within proprietary applications.

The Consortium currently has 14 member companies:

- Aesthetic Integration
- Ahrefs
- Bloomberg
- CEA
- Citrix
- Dassault Aviation
- Esterel Technologies
- Facebook
- Jane Street
- Kernelyze
- LexiFi
- Microsoft
- OCamlPro
- SimCorp

For a complete description of this structure, refer to <http://caml.inria.fr/consortium/>. Xavier Leroy chairs the scientific committee of the Consortium.

8.1.2. *Scientific Advisory for OCamlPro*

Participant: Fabrice Le Fessant.

OCamlPro is a startup company founded in 2011 by Fabrice Le Fessant to promote the use of OCaml in the industry, by providing support, services and tools for OCaml to software companies. OCamlPro performs a lot of research and development, in close partnership with academic institutions such as IRILL, Inria and Univ. Paris Sud, and is involved in several collaborative projects with Gallium, such as the Bware ANR, the Vocal ANR and the Secur-OCaml FUI.

Since 2011, Fabrice Le Fessant is a scientific advisor at OCamlPro, as part of a collaboration contract for Inria, to transfer his knowledge on the internals of the OCaml runtime and the OCaml compilers.

MARELLE Project-Team (section vide)

MEXICO Project-Team (section vide)

PARSIFAL Project-Team (section vide)

PL.R2 Project-Team (section vide)

SUMO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

Joint Alstom-Inria research lab: Several researchers of SUMO are involved in the joint research lab of Alstom and Inria, in a common research team called P22. On Alstom side, this joint research team involves researchers of the ATS division (Automatic Train Supervision). The objective of this joint team is to evaluate regulation policies of urban train systems, to assess their robustness to perturbations and failures, to design more efficient regulation policies and finally to provide decision support for human regulators. The project started in march 2014. A second phase of the project started in 2016, for a duration of three years. This covers in particular the CIFRE PhD of Karim Kecir.

Joint Nokia Bell Labs - Inria research lab: Several members of the team are involved in the joint research lab of Nokia Bell Labs and Inria. This lab is co-directed by Éric Fabre (Inria) and Olivier Audouin (Bell Labs), and funds joint research teams over a period of 4 years. The 3rd phase of the lab is in preparation, and 6 new joint teams will be launched in the first quarter of 2017. Sumo is involved in the proposal *Softwarization of Everything* that aims at developing techniques for the programmability, the verification and the management of software-defined networks (SDN). This covers in particular the CIFRE PhD of Arij El Majed, to start in January 2017, on the topic of Root cause analysis in reconfigurable dynamic systems.

Joint Orange Labs - Inria research lab: Éric Fabre takes part to the joint research lab of Orange Labs and Inria. This lab funds around 5 new PhD grants every year. This covers in particular the CIFRE PhD of Sihem Cherrared on the topic of Fault management in multi-tenant programmable networks.

TOCCATA Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. *ProofInUse Joint Laboratory*

Participants: Claude Marché [contact], Jean-Christophe Filliâtre, Andrei Paskevich.

ProofInUse is a joint project between the Toccata team and the SME AdaCore. It was selected and funded by the ANR programme “Laboratoires communs”, starting from April 2014, for 3 years <http://www.spark-2014.org/proofinuse>.

The SME AdaCore is a software publisher specializing in providing software development tools for critical systems. A previous successful collaboration between Toccata and AdaCore enabled *Why3* technology to be put into the heart of the AdaCore-developed SPARK technology.

The goal is now to promote and transfer the use of deduction-based verification tools to industry users, who develop critical software using the programming language Ada. The proof tools are aimed at replacing or complementing the existing test activities, whilst reducing costs.

VERIDIS Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Modeling a Distributed File System

Participant: Stephan Merz.

Our group was contacted by Huawei R&D Silicon Valley for evaluating the suitability of using the TLA⁺ specification language for describing high-level protocols used in Cloud systems. We provided a specification of protocols used in the Ceph file system [53]. We also provided on-site training for Huawei engineers in Chengdu, China.

8.2. Logic for Business

Participant:

The group in Saarbrücken has established a master agreement with L4B (Logic for Business) on the exchange of data and the creation of bilateral research projects. L4B is involved in several consulting projects with the German car industry on product specification strategies, including software.

CARTE Team (section vide)

COMETE Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Contract with Renault

Project title: Protection techniques for location data

Duration: July 2016 - December 2016

Budget: 38K euros, financed by Renault

Coordinator: Catuscia Palamidessi, Inria Saclay, EPI Comète

Abstract: The goal of this project is to produce a survey of the state of the art methods for protecting location data, as well as a prototype showing the application of some of these methods in the context of a “connected car”.

Stage: A six month intern (Anna Pazii) was funded by this project.

DICE Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

Worldline Wordline is a leader in B2B applications development, and is in the front line to provide new technical solution in the Web 2.0 era. We have a CIFRE partnership contract on the study of flow based architectures both at the data centers and at the Web browser level.

PESTO Project-Team

8. Bilateral Contracts and Grants with Industry

8.1. Electronic Voting Systems

Participants: Véronique Cortier, Mathieu Turuani.

Since 2014, a collaboration agreement has been signed between Loria and Scytl, a Spanish company who is proposing solutions for the organization of on-line elections, including legally binding elections, in several countries. In this context, Scytl has signed a contract with the Pesto team as well as the University of Birmingham (David Galindo) to design a formal proof of both verifiability and privacy of the protocol developed by Scytl, for a deployment in Switzerland.

PRIVATICS Project-Team

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. IPsec with pre-shared key for MISTIC security

Title: IPsec with pre-shared key for MISTIC security.

Type: CIFRE.

Duration: Juillet 2014 - Juillet 2017.

Coordinator: Inria

Others partners: Privatics, Moais and Incas-ITSec.

PROSECCO Project-Team (section vide)

TAMIS Team

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

- CISCO (<http://www.cisco.com>)
- Thales (<https://www.thalesgroup.com>)
- Oberthur Technologies (<http://www.oberthur.com/>)