



IN PARTNERSHIP WITH:  
**CNRS**

**Ecole normale supérieure de  
Paris**

Activity Report 2018

## **Project-Team CASCADE**

Construction and Analysis of Systems for  
Confidentiality and Authenticity of Data and  
Entities

IN COLLABORATION WITH: Département d'Informatique de l'Ecole Normale Supérieure

RESEARCH CENTER  
**Paris**

THEME  
**Algorithmics, Computer Algebra and  
Cryptology**



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# Project-Team CASCADE

*Creation of the Project-Team: 2008 July 01*

## Keywords:

### Computer Science and Digital Science:

A4. - Security and privacy  
A4.3. - Cryptography  
A4.3.1. - Public key cryptography  
A4.3.3. - Cryptographic protocols  
A4.8. - Privacy-enhancing technologies  
A7. - Theory of computation  
A8.5. - Number theory

### Other Research Topics and Application Domains:

B6.4. - Internet of things  
B9.5.1. - Computer science  
B9.10. - Privacy

## 1. Team, Visitors, External Collaborators

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### Administrative Assistant

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## 2. Overall Objectives

### 2.1. Presentation

Cryptographic algorithms are the equivalent of locks, seals, security stamps and identification documents over the Internet. They are essential to protect our online bank transactions, credit cards, medical and personal information, and to support e-commerce and e-government. They come in different flavors. Encryption algorithms are necessary to protect sensitive information such as medical data, financial information and Personal Identification Numbers (PINs) from prying eyes. Digital signature algorithms (in combination with hash functions) and MAC algorithms replace hand-written signatures in electronic transactions. Identification protocols allow to securely verify the identity of a remote party. As a whole, cryptology is a research area with a high strategic impact in industry, for individuals, and for society as a whole. The research activity of project-team CASCADE addresses the following topics, which cover most of the areas that are currently active in the international cryptographic community, with a focus on public-key algorithms:

1. Implementation of cryptographic algorithms, and applied cryptography;
2. Algorithm and protocol design, and provable security;
3. Theoretical and practical attacks.

### 2.2. Design of Provably Secure Primitives and Protocols

Since the beginning of public-key cryptography, with the seminal Diffie-Hellman paper, many suitable algorithmic problems for cryptography have been proposed and many cryptographic schemes have been designed, together with more or less heuristic proofs of their security relative to the intractability of the underlying problems. However, many of those schemes have thereafter been broken. The simple fact that a cryptographic algorithm withstood cryptanalytic attacks for several years has often been considered as a kind of validation procedure, but schemes may take a long time before being broken. An example is the Chor-Rivest cryptosystem, based on the knapsack problem, which took more than 10 years to be totally broken by Serge Vaudenay, whereas before this attack it was believed to be strongly secure. As a consequence, the lack of attacks at some time should never be considered as a full security validation of the proposal.

A completely different paradigm is provided by the concept of “provable” security. A significant line of research has tried to provide proofs in the framework of computational complexity theory (a.k.a. “reductionist” security proofs): the proofs provide reductions from a well-studied problem (factoring, RSA or the discrete logarithm) to an attack against a cryptographic protocol.

At the beginning, researchers just tried to define the security notions required by actual cryptographic schemes, and then to design protocols which could achieve these notions. The techniques were directly derived from complexity theory, providing polynomial reductions. However, their aim was essentially theoretical. They were indeed trying to minimize the required assumptions on the primitives (one-way functions or permutations, possibly trapdoor, etc), without considering practicality. Therefore, they just needed to design a scheme with polynomial-time algorithms, and to exhibit polynomial reductions from the basic mathematical assumption on the hardness of the underlying problem to an attack of the security notion, in an asymptotic way. However, such a result has no practical impact on actual security. Indeed, even with a polynomial reduction, one may be able to break the cryptographic protocol within a few hours, whereas the reduction just leads to an algorithm against the underlying problem which requires many years. Therefore, those reductions only prove the security when very huge (and thus maybe unpractical) parameters are in use, under the assumption that no polynomial-time algorithm exists to solve the underlying problem. For many years, more efficient reductions have been expected, under the denomination of either “exact security” or “concrete security”, which provide more practical security results, with concrete efficiency properties.

Unfortunately, in many cases, even just provable security is at the cost of an important loss in terms of efficiency for the cryptographic protocol. Thus, some models have been proposed, trying to deal with the security of efficient schemes: some concrete objects are identified with ideal (or black-box) ones. For example, it is by now usual to identify hash functions with ideal random functions, in the so-called “random-oracle model”. Similarly, block ciphers are identified with families of truly random permutations in the “ideal cipher model”. Another kind of idealization has also been introduced in cryptography, the black-box group, where the group operation, in any algebraic group, is defined by a black-box: a new element necessarily comes from the addition (or the subtraction) of two already known elements. It is by now called the “generic group model”, extended to the bilinear and multi-linear setting. Some works even require several ideal models together to provide some new validations.

But still, such idealization cannot be instantiated in practice, and so one prefers provable security without such idealized assumptions, under new and possibly stronger computational assumptions. As a consequence, a cryptographer has to deal with the following four important steps, which are **all** main goals of ours:

**computational assumptions**, which are the foundation of the security. We thus need to have a strong evidence that the computational problems are reasonably hard to solve.

**security model**, which makes precise the security notions one wants to achieve, as well as the means the adversary may be given. We contribute to this point, in several ways:

- by providing security models for many primitives and protocols;
- by enhancing some classical security models;
- by considering new means for the adversary, such as side-channel information.

**design** of new schemes/protocols, or more efficient ones, with additional features, etc.

**security proof**, which consists in exhibiting a reduction.

## 3. Research Program

### 3.1. Quantum-Safe Cryptography

The security of almost all public-key cryptographic protocols in use today relies on the presumed hardness of problems from number theory such as factoring and computing discrete logarithms. This is problematic because these problems have very similar underlying structure, and its unforeseen exploit can render all currently used public-key cryptography insecure. This structure was in fact exploited by Shor to construct efficient quantum algorithms that break all hardness assumptions from number theory that are currently in use. And so naturally, an important area of research is to build provably secure protocols based on mathematical problems that are unrelated to factoring and discrete log. One of the most promising directions in this line of research is using lattice problems as a source of computational hardness, which also offer features that other alternative public-key cryptosystems (such as MQ-based, code-based or hash-based schemes) cannot provide.

### 3.2. Advanced Encryption

Fully Homomorphic Encryption (FHE) has become a very active research area since 2009, when IBM announced the discovery of a FHE scheme by Craig Gentry. FHE allows to perform any computation on encrypted data, yielding the result encrypted under the same key. This enables outsourcing computation in the Cloud, on encrypted data, so the Cloud provider does not learn any information. However, FHE does not allow to share the result.

Functional encryption is another recent tool that allows an authority to deliver functional decryption keys, for any function  $f$  of his choice, so that when applied to the encryption of a message  $m$ , the functional decryption key yields  $f(m)$ . Since  $m$  can be a large vector,  $f$  can be an aggregation or statistical function: on encrypted data, one can get the result  $f(m)$  in clear.

While this functionality has initially been defined in theory, our team has been very active in designing concrete instantiations for practical purposes.

### 3.3. Security amidst Concurrency on the Internet

Cryptographic protocols that are secure when executed in isolation can become completely insecure when multiple such instances are executed concurrently (as is unavoidable on the Internet) or when used as a part of a larger protocol. For instance, a man-in-the-middle attacker participating in two simultaneous executions of a cryptographic protocol might use messages from one of the executions in order to compromise the security of the second – Lowe’s attack on the Needham-Schroeder authentication protocol and Bleichenbacher’s attack on SSL work this way. Our research addresses security amidst concurrent executions in secure computation and key exchange protocols.

Secure computation allows several mutually distrustful parties to collaboratively compute a public function of their inputs, while providing the same security guarantees as if a trusted party had performed the computation. Potential applications for secure computation include anonymous voting, privacy-preserving auctions and data-mining. Our recent contributions on this topic include

1. new protocols for secure computation in a model where each party interacts only once, with a single centralized server; this model captures communication patterns that arise in many practical settings, such as that of Internet users on a website, and
2. efficient constructions of universally composable commitments and oblivious transfer protocols, which are the main building blocks for general secure computation.

In key exchange protocols, we are actively involved in designing new password-authenticated key exchange protocols, as well as the analysis of the widely-used SSL/TLS protocols.

### 3.4. Electronic Currencies and the Blockchain

Electronic cash (e-cash) was first proposed in the 1980s but has never been deployed on a large scale. Other means of digital payments are instead largely replacing physical cash, but they do not respect the citizens’ right to privacy, which includes their right of anonymous payments of moderate sums. Recently, so-called decentralized currencies, such as Bitcoin, have become a third type of payments in addition to physical cash, and card and other (non-anonymous) electronic payments. The continuous growth of popularity and usage of this new kind of currencies, also called “cryptocurrencies”, have triggered a renewed interest in cryptographic e-cash.

On the one hand, our group investigates “centralized” e-cash, in keeping with the current economic model that has money be issued by (central) banks (while cryptocurrencies use money distribution as an incentive for participation in the system, on which its stability hinges). Of particular interest among centralized e-cash schemes is transferable e-cash, which allows users to transfer coins between each other without interacting with a third party (or the blockchain). Existing efficient e-cash schemes are not transferable, as they require coins to be deposited at the bank after having been used in a payment. Our goal is to propose efficient transferable e-cash schemes.

Another direction concerns (decentralized) cryptocurrencies, whose adoption has grown tremendously over the last few years. While in Bitcoin all transactions are publicly posted on the so-called “blockchain”, other cryptocurrencies such as *Zcash* respect user privacy, whose security guarantees we have analyzed. Apart from privacy, two pressing challenges for cryptocurrencies, and blockchains in general, are sustainability and scalability. Regarding the former, we are addressing the electricity waste caused by the concept of “proof of work” used by all major cryptocurrencies by proposing alternatives; for the latter, we are working on proposals that avoid the need for all data having to be stored on the blockchain forever.

Blockchains have meanwhile found many other applications apart from electronic money. Together with Microsoft Research, our group investigates decentralized means of authentication that uses cryptography to guarantee privacy.



## 4. Application Domains

### 4.1. Privacy for the Cloud

Many companies have already started the migration to the Cloud and many individuals share their personal informations on social networks. While some of the data are public information, many of them are personal and even quite sensitive. Unfortunately, the current access mode is purely right-based: the provider first authenticates the client, and grants him access, or not, according to his rights in the access-control list. Therefore, the provider itself not only has total access to the data, but also knows which data are accessed, by whom, and how: privacy, which includes secrecy of data (confidentiality), identities (anonymity), and requests (obliviousness), should be enforced. Moreover, while high availability can easily be controlled, and thus any defect can immediately be detected, failures in privacy protection can remain hidden for a long time. The industry of the Cloud introduces a new implicit trust requirement: nobody has any idea at all of where and how his data are stored and manipulated, but everybody should blindly trust the providers. The providers will definitely do their best, but this is not enough. Privacy-compliant procedures cannot be left to the responsibility of the provider: however strong the trustfulness of the provider may be, any system or human vulnerability can be exploited against privacy. This presents too huge a threat to tolerate. *The distribution of the data and the secrecy of the actions must be given back to the users. It requires promoting privacy as a global security notion.*

In order to protect the data, one needs to encrypt it. Unfortunately, traditional encryption systems are inadequate for most applications involving big, complex data. Recall that in traditional public key encryption, a party encrypts data to a single known user, which lacks the expressiveness needed for more advanced data sharing. In enterprise settings, a party will want to share data with groups of users based on their credentials. Similarly, individuals want to selectively grant access to their personal data on social networks as well as documents and spreadsheets on Google Docs. Moreover, the access policy may even refer to users who do not exist in the system at the time the data is encrypted. Solving this problem requires an entirely new way of encrypting data.

A first natural approach would be **fully homomorphic encryption** (FHE, see above), but a second one is also **functional encryption**, that is an emerging paradigm for public-key encryption: it enables more fine-grained access control to encrypted data, for instance, the ability to specify a decryption policy in the ciphertext so that only individuals who satisfy the policy can decrypt, or the ability to associate keywords to a secret key so that it can only decrypt documents containing the keyword. Our work on functional encryption centers around two goals:

1. to obtain more efficient pairings-based functional encryption;
2. and to realize new functionalities and more expressive functional encryption schemes.

Another approach is **secure multi-party computation protocols**, where interactivity might provide privacy in a more efficient way. Recent implicit interactive proofs of knowledge can be a starting point. But stronger properties are first expected for improving privacy. They can also be integrated into new ad-hoc broadcast systems, in order to distribute the management among several parties, and eventually remove any trust requirements.

Strong privacy for the Cloud would have a huge societal impact since it would revolutionize the trust model: users would be able to make safe use of outsourced storage, namely for personal, financial and medical data, without having to worry about failures or attacks of the server.

## 5. Highlights of the Year

### 5.1. Highlights of the Year

#### 5.1.1. Awards

- Melissa Rossi received a 2018 Google's WomenTechmakers Scholarship.

## 6. New Results

### 6.1. Results

All the results of the team have been published in journals or conferences (see the list of publications). They are all related to the research program (see before) and the research projects (see after):

- Advanced primitives for privacy in the cloud
- Efficient functional encryption
- Several predicate-encryption schemes
- New primitives for efficient anonymous authentication
- Analyses of currently deployed zero-knowledge SNARKs

## 7. Partnerships and Cooperations

### 7.1. National Initiatives with Industry

#### 7.1.1. *CryptoComp*

Program: FUI

Duration: October 2014 – November 2018

Coordinator: CryptoExperts

Partners: CEA, CNRS, Kalray, Inria, Dictao, Université de Limoges, VIACCESS, Bertin technologies, GEMALTO

Local coordinator: David Pointcheval

We aim at studying delegation of computations to the cloud, in a secure way.

#### 7.1.2. *ANBLIC*

Title: Analysis in Blind Clouds

Program: FUI

Duration: January 2018 – December 2020

Coordinator: Wallix

Partners: UPEC, CEA, Ingenico, Atos, SOGETI, CoeSSI

Local coordinator: David Pointcheval

The main goal is to industrialize for the first time several privacy enhancing technologies that are on the edge of theory and practice.

Fully Homomorphic Encryption let cloud providers compute arbitrary functions on their client's encrypted data, ensuring at the same time full privacy and functionality. Functional Encryption is a refinement of classical encryption, which allows data owners to delegate fine-grained access to their data. Thus it is possible to enable the computation of aggregated statistics over your personal data, while cryptographically ensuring its confidentiality.

However both these technologies still suffer from prohibitive inefficiencies for business applications. ANBLIC's academic partners will create new cryptographic schemes and performance models, tailored for industrial use cases, and create the first real-life scenario of encrypted queries on encrypted data and on open data.

### 7.1.3. RISQ

Program: GDN

Duration: February 2017 – September 2020

Coordinator: Secure-IC

Partners: ANSSI, AIRBUS, C-S, CEA LIST, CryptoExperts, Inria/ENS/CASCADE, GEMALTO, Inria POLSYS, Inria AriC, IRISA, Orange Labs, THALES, UVSQ, PCQC

Local coordinator: Michel Abdalla

The main goal of RISQ is to help the French Industry and Academia become a significant international player in the transition to post-quantum cryptography.

## 7.2. National Collaborations with Academics

### 7.2.1. EnBiD

Title: Encryption for Big Data

Program: ANR JCJC

Duration: October 2014 – September 2019

PI: Hoeteck Wee

Partners: Université Paris 2, Université Limoges

The main objective of this project is to study techniques for efficient and expressive functional encryption schemes. Functional encryption is a novel paradigm for public-key encryption that enables both fine-grained access control and selective computation on encrypted data, as is necessary to protect big, complex data in the cloud.

### 7.2.2. EfTrEC

Title: Efficient Transferable E-Cash

Program: ANR JCJC

Duration: October 2016 – September 2020

PI: Georg Fuchsbauer

Partners: Université Paris 2

This project deals with e-cash systems which let users transfer electronic coins between them offline. The main objectives of this project are:

- establish a clean formal model for the primitive;
- construct schemes which are practically efficient;
- develop schemes that are resistant to attacks on quantum computers.

### 7.2.3. ALAMBIC

Title: AppLicAtions of MalleaBility in Cryptography

Program: ANR PRC

Duration: October 2016 – September 2020

PI: Damien Vergnaud

Partners: ENS Lyon, Université Limoges

The main objectives of the proposal are the following:

- Define theoretical models for “malleable” cryptographic primitives that capture strong practical attacks (in particular, in the settings of secure computation outsourcing, server-aided cryptography, cloud computing and cryptographic proof systems);

- Analyze the security and efficiency of primitives and constructions that rely on malleability;
- Conceive novel cryptographic primitives and constructions (for secure computation outsourcing, server-aided cryptography, multi-party computation, homomorphic encryption and their applications);
- Implement these new constructions in order to validate their efficiency and effective security.

## 7.3. European Initiatives

### 7.3.1. *CryptoAction*

Title: Cryptography for Secure Digital Interaction

Program: H2020 ICT COST

Duration: April 2014 – April 2018

Local coordinator: Michel Abdalla

The aim of this COST CryptoAction is to stimulate interaction between the different national efforts in order to develop new cryptographic solutions and to evaluate the security of deployed algorithms with applications to the secure digital interactions between citizens, companies and governments.

### 7.3.2. *CryptoCloud*

Title: Cryptography for the Cloud

Program: FP7 ERC Advanced Grant

Duration: June 2014 – May 2020

PI: David Pointcheval

The goal of the CryptoCloud project is to develop new interactive tools to provide privacy in the Cloud.

### 7.3.3. *SAFEcrypto*

Title: Secure Architectures of Future Emerging Cryptography

Program: H2020

Duration: January 2015 – January 2019

Coordinator: The Queen's University of Belfast

Partners: Inria/ENS (France), Emc Information Systems International (Ireland), Hw Communications (United Kingdom), The Queen's University of Belfast (United Kingdom), Ruhr-Universitaet Bochum (Germany), Thales Uk (United Kingdom), Universita della Svizzera italiana (Switzerland), IBM Research Zurich (Switzerland)

Local coordinator: Michel Abdalla

SAFEcrypto will provide a new generation of practical, robust and physically secure post quantum cryptographic solutions that ensure long-term security for future ICT systems, services and applications. Novel public-key cryptographic schemes (digital signatures, authentication, public-key encryption, identity-based encryption) will be developed using lattice problems as the source of computational hardness. The project will involve algorithmic and design optimisations, and implementations of the lattice-based cryptographic schemes addressing the cost, energy consumption, performance and physical robustness needs of resource-constrained applications, such as mobile, battery-operated devices, and of real-time applications such as network security, satellite communications and cloud. Currently a significant threat to cryptographic applications is that the devices on which they are implemented leak information, which can be used to mount attacks to recover secret

information. In SAFEcrypto the first analysis and development of physical-attack resistant methodologies for lattice-based cryptographic implementations will be undertaken. Effective models for the management, storage and distribution of the keys utilised in the proposed schemes (key sizes may be in the order of kilobytes or megabytes) will also be provided. This project will deliver proof-of-concept demonstrators of the novel lattice-based public-key cryptographic schemes for three practical real-world case studies with real-time performance and low power consumption requirements. In comparison to current state-of-the-art implementations of conventional public-key cryptosystems (RSA and Elliptic Curve Cryptography (ECC)), SAFEcrypto's objective is to achieve a range of lattice-based architectures that provide comparable area costs, a 10-fold speed-up in throughput for real-time application scenarios, and a 5-fold reduction in energy consumption for low-power and embedded and mobile applications.

### 7.3.4. ECRYPT-NET

Title: Advanced Cryptographic Technologies for the Internet of Things and the Cloud

Program: H2020 ITN

Duration: March 2015 – February 2019

Coordinator: KU Leuven (Belgium)

Partners: KU Leuven (Belgium), Inria/ENS (France), Ruhr-Universität Bochum (Germany), Royal Holloway, University of London (UK), University of Bristol (UK), CryptoExperts (France), NXP Semiconductors (Belgium), Technische Universiteit Eindhoven (the Netherlands)

Local coordinator: Michel Abdalla

ECRYPT-NET is a research network of six universities and two companies, as well as 7 associated companies, that intends to develop advanced cryptographic techniques for the Internet of Things and the Cloud and to create efficient and secure implementations of those techniques on a broad range of platforms.

### 7.3.5. aSCEND

Title: Secure Computation on Encrypted Data

Program: H2020 ERC Starting Grant

Duration: June 2015 – May 2020

PI: Hoeteck Wee

The goals of the aSCEND project are (i) to design pairing- and lattice-based functional encryption that are more efficient and ultimately viable in practice; and (ii) to obtain a richer understanding of expressive functional encryption schemes and to push the boundaries from encrypting data to encrypting software.

### 7.3.6. FENTEC

Title: Functional Encryption Technologies

Program: H2020

Duration: January 2018 – December 2020

Coordinator: ATOS Spain SA

Scientific coordinator: Michel Abdalla

Partners: Inria/ENS (France), Flensburg University (Germany), KU Leuven (Belgium), University of Helsinki (Finland), Nagra (Switzerland), XLAB (Switzerland), University of Edinburgh (United Kingdom), WALLIX (France)

Local coordinator: Michel Abdalla

Functional encryption (FE) has recently been introduced as a new paradigm of encryption systems to overcome all-or-nothing limitations of classical encryption. In an FE system the decryptor deciphers a function over the message plaintext: such functional decryptability makes it feasible to process encrypted data (e.g. on the Internet) and obtain a partial view of the message plaintext. This extra flexibility over classical encryption is a powerful enabler for many emerging security technologies (i.e. controlled access, searching and computing on encrypted data, program obfuscation...). FEN-TEC's mission is to make the functional encryption paradigm ready for wide-range applications, integrating it in ICT technologies as naturally as classical encryption. The primary objective is the efficient and application-oriented development of functional encryption systems. FEN-TEC's team of cryptographers, software and hardware experts and information technology industry partners will document functional encryption needs of specific applications and subsequently design, develop, implement and demonstrate applied use of functional cryptography. Ultimately, a functional encryption library for both SW and HW-oriented application will be documented and made public so that it may be used by European ICT entities. With it, the FEN-TEC team will build emerging security technologies that increase the trustworthiness of the European ICT services and products. Concretely, the FEN-TEC team will showcase the expressiveness and versatility of the functional encryption paradigm in 3 use cases:

- Privacy-preserving digital currency, enforcing flexible auditing models
- Anonymous data analytics enabling computation of statistics over encrypted data, protecting European Fundamental Rights of Data Protection and Privacy
- Key and content distribution with improved performance & efficiency as foundational technology for establishing secure communication among a vast number of IOT devices.

## 7.4. International Initiatives with Industry

### 7.4.1. *CryptBloC*

Title: Cryptography for the Blockchain

Partners: MSR Redmond (USA), MSR Cambridge (UK), Inria

Duration: October 2017 – October 2021

PI: Georg Fuchsbauer

The goal of this Microsoft-Inria joint project on privacy and decentralization is to use cryptography to improve privacy on the blockchain and decentralized systems more generally. We will investigate means of privacy-preserving authentication, such as electronic currencies, and other applications of blockchain and distributed transparency mechanisms.

## 7.5. International Research Visitors

- Yuval Ishai (Technion)
- Dan Boneh (Stanford)
- Katsuyuki Takashima (Mitsubishi and Kyushu University)
- Tal Malkin (Columbia)
- Adam O'Neill (Georgetown University)
- Julian Loss (Ruhr Universität Bochum)

# 8. Dissemination

## 8.1. Promoting Scientific Activities

### 8.1.1. *Scientific Events Organisation*

#### 8.1.1.1. *Events and Activities*

- punctual seminars are organized: <https://crypto.di.ens.fr/web2py/index/seminars>
- quarterly Paris Crypto Days (<https://pariscryptoday.github.io>) supported by CryptoCloud and aSCEND
- BibTeX database of papers related to Cryptography, open and widely used by the community (<https://cryptobib.di.ens.fr>)
- LATCA Bertinoro workshop (<http://crypto-events.di.ens.fr/LATCA/>)

#### 8.1.1.2. Steering Committees of International Conferences

- steering committee of CANS: David Pointcheval
- steering committee of PKC: David Pointcheval
- steering committee of LATINCRYPT: Michel Abdalla (chair)
- steering committee of PAIRING: Michel Abdalla

#### 8.1.1.3. Board of International Organisations

- Board of the *International Association for Cryptologic Research* (IACR): Michel Abdalla (2013 – 2018)

### 8.1.2. Scientific Events Selection

#### 8.1.2.1. Program Committee Member

- CT-RSA '18 – 16-20 April (San Francisco, California, USA): David Pointcheval
- Eurocrypt '18 – 29 April-3 May (Tel Aviv, Israel): Georg Fuchsbauer and David Pointcheval
- Crypto '18 – 19-23 August (Santa Barbara, USA): Georg Fuchsbauer and Hoeteck Wee
- SCN '18 – 5-7 September (Amalfi, Italy): Georg Fuchsbauer and Romain Gay
- TCC '18 – 11-14 November (Goa, India): Hoeteck Wee

### 8.1.3. Editorial Boards of Journals

Editor-in-Chief

- of the *International Journal of Applied Cryptography (IJACT)* – Inderscience Publishers: David Pointcheval

Associate Editor

- of *IET Information Security*: Michel Abdalla
- of *ETRI Journal*: Michel Abdalla
- of *Applicable Algebra in Engineering, Communication and Computing*: David Pointcheval

## 8.2. Teaching - Supervision - Juries

### 8.2.1. Teaching

- Master: Michel Abdalla, David Pointcheval, Cryptography, M2, MPRI
- Master: David Pointcheval, Cryptography, M2, ESIEA
- Bachelor: Georg Fuchsbauer, David Pointcheval, Jacques Stern, Hoeteck Wee, Introduction to Cryptology, L3/M1, ENS
- Bachelor: Georg Fuchsbauer, Cryptology, 3rd year, ESGI

### 8.2.2. Defenses

- PhD: Raphaël Bost, Algorithmes de recherche sur bases de données chiffrées, Univ. Rennes I, January 8th, 2018 (Supervisors: Pierre-Alain Fouque & David Pointcheval)
- PhD: Rafael Del Pino, Efficient Lattice-Based ZeroKnowledge Proofs And Applications, ENS, June 1st, 2018 (Supervisors: Vadim Lyubashevsky & David Pointcheval)

- PhD: Pierre-Alain Dupont, Advanced password-authenticated key exchanges, ENS, August 29th, 2018 (Supervisor: David Pointcheval)
- PhD: Dahmun Goudarzi, Implémentations Sécurisées de Chiffrement par Bloc contre les Attaques Physiques, ENS, September 21st, 2018 (Supervisor: Damien Vergnaud)
- PhD: Michele Minelli, Fully Homomorphic Encryption for Machine Learning, ENS, October 26th, 2018 (Supervisors: Michel Abdalla & Hoeteck Wee)
- PhD: Quentin Santos, Cryptography for Pragmatic Distributed Trust and the Role of Blockchain, ENS, December 20th, 2018 (Supervisor: David Pointcheval)

### 8.2.3. Supervision

- PhD in progress: Aurélien Dupin, Multi-Party Computations, from 2015, David Pointcheval (with Christophe Bidan, at Rennes)
- PhD in progress: Romain Gay, Functional Encryption, from 2015, Michel Abdalla & Hoeteck Wee
- PhD in progress: Louiza Khati, Disk Encryption Modes, from 2015, Damien Vergnaud
- PhD in progress: Anca Nitulescu, Verifiable Outsourced Computations, from 2015, Michel Abdalla & David Pointcheval
- PhD in progress: Razvan Rosie, Practical Functional Encryption Schemes For the Cloud, from 2015, Michel Abdalla & Hoeteck Wee
- PhD in progress: Jérémy Chotard, Attribute-Based Encryption, from 2016, David Pointcheval (with Duong Hieu Phan, at Limoges)
- PhD in progress: Michele Orrù, Functional Encryption, from 2016, Hoeteck Wee & Georg Fuchs-bauer
- PhD in progress: Balthazar Bauer, Transferable e-Cash, from 2017, Georg Fuchsbauer
- PhD in progress: Chloé Hébant, Big Data and Privacy, from 2017, David Pointcheval (with Duong Hieu Phan, at Limoges)
- PhD in progress: Mélissa Rossi, Post-Quantum Cryptography, from 2017, Michel Abdalla (with Henri Gilbert at ANSSI and Thomas Prest at Thales)
- PhD in progress: Antoine Plouviez, Privacy and Decentralization, from 2018, Georg Fuchsbauer
- PhD in progress: Quoc Huy Vu, Quantum Cryptography, from 2018, Céline Chevalier

### 8.2.4. Committees

- PhD Raphaël Bost. *Algorithmes de recherche sur bases de données chiffrées* – Université Rennes I – France – January 8th, 2018: David Pointcheval (Co-supervisor)
- PhD Xavier Bultel. *Mécanismes de délégation pour les primitives de cryptographie à clé publique* – Université Clermont Auvergne – France – May 17th, 2018: David Pointcheval (President)
- PhD Luca Nizzardo. *Cryptographic Techniques for the Security of Cloud and Blockchain Systems* – IMDEA / UPM – Spain – May 24th, 2018: Georg Fuchsbauer (Reviewer)
- PhD Rafael Del Pino. *La cryptographie à base de réseaux* – Ecole Normale Supérieure – France – June 1st, 2018: David Pointcheval (Co-supervisor)
- PhD Pierre-Alain Dupont. *Advanced password-authenticated key exchanges* – Ecole Normale Supérieure – France – August 29th, 2018: David Pointcheval (Supervisor)
- PhD Dahmun Goudarzi. *Implémentations Sécurisées de Chiffrement par Bloc contre les Attaques Physiques* – Ecole Normale Supérieure – France – September 21st, 2018: David Pointcheval (President)
- PhD Cédric Van Rompay. *Protocoles Multi-Utilisateurs de Recherche sur Bases de Données Chiffrées* – Eurecom, Sophia Antipolis, Télécom ParisTech – France – October 4th, 2018: David Pointcheval (President)



- PhD Damien Ligier. *Functional encryption applied to privacy-preserving classification: practical use, performances and security* – CEA, Saclay, IMT Atlantique – France – October 15th, 2018: David Pointcheval (President)
- PhD Fabrice Mouhartem. *Cryptographie protégeant la vie privée à base de couplages et de réseaux* – ENS Lyon – France – October 18th, 2018: David Pointcheval (Reviewer)
- PhD Michele Minelli. *Fully Homomorphic Encryption for Machine Learning* – Ecole Normale Supérieure – France – October 26th, 2018: Michel Abdalla and Hoeteck Wee (Co-supervisors)
- PhD Nadim Kobeissi. *Formal Verification for Real-World Cryptographic Protocols and Implementations* – Inria Paris – France – December 10th, 2018: David Pointcheval (President)
- PhD Quentin Santos. *Cryptography for Pragmatic Distributed Trust and the Role of Blockchain* – Ecole Normale Supérieure – France – December 20th, 2018: David Pointcheval (Supervisor)

## 9. Bibliography

### Major publications by the team in recent years

- [1] M. ABDALLA, D. CATALANO, D. FIORE. *Verifiable Random Functions: Relations to Identity-Based Key Encapsulation and New Constructions*, in "Journal of Cryptology", 2014, vol. 27, n<sup>o</sup> 3, pp. 544-593
- [2] M. ABE, G. FUCHSBAUER, J. GROTH, K. HARALAMBIEV, M. OHKUBO. *Structure-Preserving Signatures and Commitments to Group Elements*, in "Journal of Cryptology", 2016, vol. 29, n<sup>o</sup> 2, pp. 363-421
- [3] F. BENHAMOUDA, O. BLAZY, C. CHEVALIER, D. POINTCHEVAL, D. VERGNAUD. *New Techniques for SPHF's and Efficient One-Round PAKE Protocols*, in "Advances in Cryptology – Proceedings of CRYPTO '13 (1)", R. CANETTI, J. A. GARAY (editors), Lecture Notes in Computer Science, Springer, 2013, vol. 8042, pp. 449-475
- [4] P. CHAIDOS, V. CORTIER, G. FUCHSBAUER, D. GALINDO. *BeleniosRF: A Non-interactive Receipt-Free Electronic Voting Scheme*, in "Proceedings of the 23rd ACM Conference on Computer and Communications Security (CCS '16)", E. R. WEIPPL, S. KATZENBEISSER, C. KRUEGEL, A. C. MYERS, S. HALEVI (editors), ACM Press, 2016, pp. 1614-1625
- [5] I. DINUR, O. DUNKELMAN, N. KELLER, A. SHAMIR. *New Attacks on Feistel Structures with Improved Memory Complexities*, in "Advances in Cryptology – Proceedings of CRYPTO '15 (1)", R. GENNARO, M. ROBSHAW (editors), Lecture Notes in Computer Science, Springer, 2015, vol. 9215, pp. 433-454
- [6] Y. DODIS, D. POINTCHEVAL, S. RUHAULT, D. VERGNAUD, D. WICHS. *Security Analysis of Pseudo-Random Number Generators with Input: /dev/random is not Robust*, in "Proceedings of the 20th ACM Conference on Computer and Communications Security (CCS '13)", Berlin, Germany, V. D. GLIGOR, M. YUNG (editors), ACM Press, 2013, pp. 647-658
- [7] R. GAY, D. HOFHEINZ, E. KILTZ, H. WEE. *Tightly CCA-Secure Encryption Without Pairings*, in "Advances in Cryptology – Proceedings of Eurocrypt '16 (2)", M. FISCHLIN, J.-S. CORON (editors), Lecture Notes in Computer Science, Springer, 2016, vol. 9665, pp. 1-27
- [8] S. GORBUNOV, V. VAIKUNTANATHAN, H. WEE. *Predicate Encryption for Circuits from LWE*, in "Advances in Cryptology – Proceedings of CRYPTO '15 (2)", R. GENNARO, M. ROBSHAW (editors), Lecture Notes in Computer Science, Springer, 2015, vol. 9216, pp. 503-523

- [9] V. LYUBASHEVSKY, C. PEIKERT, O. REGEV. *On Ideal Lattices and Learning with Errors over Rings*, in "Journal of the ACM", 2013, vol. 60, n<sup>o</sup> 6, pp. 43:1–43:35
- [10] W. QUACH, H. WEE, D. WICHS. *Laconic Function Evaluation and Applications*, in "59th Annual IEEE Symposium on Foundations of Computer Science (FOCS 2018)", M. THORUP (editor), IEEE, 2018

## Publications of the year

### Doctoral Dissertations and Habilitation Theses

- [11] P.-A. DUPONT. *Advanced password-authenticated key exchanges*, PSL Research University, August 2018, <https://hal.inria.fr/tel-01868828>
- [12] D. GOUDARZI. *Secure Implementation of Block Ciphers against Physical Attacks*, ENS Paris - Ecole Normale Supérieure de Paris, September 2018, <https://hal.inria.fr/tel-01896103>
- [13] M. MINELLI. *Fully Homomorphic Encryption for Machine Learning*, PSL University, October 2018, <https://hal.archives-ouvertes.fr/tel-01918263>
- [14] Q. SANTOS. *Cryptography for Pragmatic Distributed Trust and the Role of Blockchain*, PSL Research University ; École Normale Supérieure, December 2018, <https://hal.archives-ouvertes.fr/tel-01966109>

### Articles in International Peer-Reviewed Journals

- [15] M. ABDALLA, M. BELLARE, G. NEVEN. *Robust Encryption*, in "Journal of Cryptology", April 2018, vol. 31, n<sup>o</sup> 2, pp. 307-350 [DOI : 10.1007/s00145-017-9258-8], <https://hal.archives-ouvertes.fr/hal-01538113>
- [16] M. ABDALLA, F. BENHAMOUDA, A. PASSELÈGUE, K. PATERSON. *Related-Key Security for Pseudorandom Functions Beyond the Linear Barrier*, in "Journal of Cryptology", October 2018, vol. 31, n<sup>o</sup> 4, pp. 917-964 [DOI : 10.1007/s00145-017-9274-8], <https://hal.inria.fr/hal-01723012>
- [17] M. ABDALLA, F. BENHAMOUDA, D. POINTCHEVAL. *On the Tightness of Forward-Secure Signature Reductions*, in "Journal of Cryptology", February 2018, pp. 1-67 [DOI : 10.1007/s00145-018-9283-2], <https://hal.inria.fr/hal-01722996>
- [18] S. CANARD, D. H. PHAN, D. POINTCHEVAL, V. C. TRINH. *A new technique for compacting ciphertext in multi-channel broadcast encryption and attribute-based encryption*, in "Theoretical Computer Science", May 2018, vol. 723, pp. 51 - 72 [DOI : 10.1016/J.TCS.2018.02.036], <https://hal.inria.fr/hal-01903749>
- [19] G. FUCHSBAUER, C. HANSER, D. SLAMANIG. *Structure-Preserving Signatures on Equivalence Classes and Constant-Size Anonymous Credentials*, in "Journal of Cryptology", 2018 [DOI : 10.1007/s00145-018-9281-4], <https://hal.inria.fr/hal-01870052>

### International Conferences with Proceedings

- [20] M. ABDALLA, D. CATALANO, D. FIORE, R. GAY, B. URSU. *Multi-Input Functional Encryption for Inner Products: Function-Hiding Realizations and Constructions without Pairings*, in "Advances in Cryptology – CRYPTO 2018", Santa Barbara, United States, H. SHACHAM, A. BOLDYREVA (editors), Lecture Notes in Computer Science, August 2018, vol. 10991 [DOI : 10.1007/978-3-319-96884-1\_20], <https://hal.archives-ouvertes.fr/hal-01900273>

- [21] M. BARBOSA, P. FARSHIM. *Indifferentiable Authenticated Encryption*, in "Advances in Cryptology – CRYPTO 2018", Santa Barbara, United States, H. SHACHAM, A. BOLDYREVA (editors), LNCS - Lecture Notes in Computer Science, Springer, August 2018, vol. 10991 [DOI : 10.1007/978-3-319-96884-1\_7], <https://hal.inria.fr/hal-01904141>
- [22] G. BARTHE, S. BELAÏD, T. ESPITAU, P.-A. FOUQUE, B. GRÉGOIRE, M. ROSSI, M. TIBOUCHI. *Masking the GLP Lattice-Based Signature Scheme at Any Order*, in "Eurocrypt 2018 - 37th Annual International Conference on the Theory and Applications of Cryptographic Techniques", Tel Aviv, Israel, J. B. NIELSE, V. RIJME (editors), Lecture Notes in Computer Science, Springer, April 2018, vol. 10821, pp. 354-384 [DOI : 10.1007/978-3-319-78375-8\_12], <https://hal.inria.fr/hal-01900708>
- [23] B. BAUER, P. FARSHIM, S. MAZAHERI. *Combiners for Backdoored Random Oracles*, in "Advances in Cryptology – CRYPTO 2018", Santa Barbara, United States, H. SHACHAM, A. BOLDYREVA (editors), LNCS - Lecture Notes in Computer Science, Springer, August 2018, vol. 10992 [DOI : 10.1007/978-3-319-96881-0\_10], <https://hal.inria.fr/hal-01866724>
- [24] B. BAUER, L. ISENMANN. *Discrete Morse theory for the collapsibility of supremum sections*, in "ICGT: International Colloquium on Graph Theory and combinatorics", Lyon, France, July 2018, <https://arxiv.org/abs/1803.09577> , <https://hal.archives-ouvertes.fr/hal-01867246>
- [25] S. CANARD, D. POINTCHEVAL, Q. SANTOS, J. TRAORÉ. *Practical Strategy-Resistant Privacy-Preserving Elections*, in "ESORICS 2018", Barcelona, Spain, Computer Security. ESORICS 2018, Springer, September 2018, vol. Lecture Notes in Computer Science, n<sup>o</sup> 11099 [DOI : 10.1007/978-3-319-98989-1\_17], <https://hal.inria.fr/hal-01903777>
- [26] S. CANARD, D. POINTCHEVAL, Q. SANTOS, J. TRAORÉ. *Privacy-Preserving Plaintext-Equality of Low-Entropy Inputs*, in "ACNS 2018 - 16th International Conference on Applied Cryptography and Network Security", Leuven, Belgium, A. PRENEEL, F. VERCAUTERE (editors), Applied Cryptography and Network Security. ACNS 2018, Springer, July 2018, vol. Lecture Notes in Computer Science, n<sup>o</sup> 10892 [DOI : 10.1007/978-3-319-93387-0\_14], <https://hal.inria.fr/hal-01903746>
- [27] J. CHEN, J. GONG, L. KOWALCZYK, H. WEE. *Unbounded ABE via Bilinear Entropy Expansion, Revisited*, in "EUROCRYPT 2018 - Annual International Conference on the Theory and Applications of Cryptographic Techniques", Tel Aviv, Israel, J. B. NIELSE, V. RIJME (editors), LNCS - Lecture Notes in Computer Science, Springer, April 2018, vol. 10820, pp. 503-534 [DOI : 10.1007/978-3-319-78381-9\_19], <https://hal.inria.fr/hal-01899901>
- [28] J. CHEN, J. GONG, H. WEE. *Improved Inner-product Encryption with Adaptive Security and Full Attribute-hiding*, in "ASIACRYPT 2018 - 24th Annual International Conference on the Theory and Application of Cryptology and Information Security", Brisbane, Australia, December 2018, <https://hal.inria.fr/hal-01900153>
- [29] Y. CHEN, V. VAIKUNTANATHAN, B. WATERS, H. WEE, D. WICHS. *Traitor-Tracing from LWE Made Simple and Attribute-Based*, in "TCC 2018 - Theory of Cryptography Conference", Goa, India, November 2018, <https://hal.inria.fr/hal-01900152>
- [30] Y. CHEN, V. VAIKUNTANATHAN, H. WEE. *GGH15 Beyond Permutation Branching Programs: Proofs, Attacks, and Candidates*, in "CRYPTO 2018 - 38th Annual International Cryptology Conference", Santa Barbara, United States, H. SHACHAM, A. BOLDYREVA (editors), LNCS - Lecture Notes in Computer Science, Springer, August 2018, vol. 10991, <https://hal.inria.fr/hal-01899903>

- [31] J. CHOTARD, E. DUFOUR SANS, R. GAY, D. POINTCHEVAL, D. H. PHAN. *Decentralized Multi-Client Functional Encryption for Inner Product*, in "ASIACRYPT '18 - 24th Annual International Conference on the Theory and Application of Cryptology and Information Security", Brisbane, Australia, Advances in Cryptology - ASIACRYPT '18, Springer, December 2018, vol. Lecture Notes in Computer Science, n<sup>o</sup> 11273 [DOI : 10.1007/978-3-030-03329-3\_24], <https://hal.archives-ouvertes.fr/hal-01668020>
- [32] G. COUTEAU, A. DUPIN, P. MÉAUX, M. ROSSI, Y. ROTELLA. *On the Concrete Security of Goldreich's Pseudorandom Generator*, in "ASIACRYPT 2018 - 24th Annual International Conference on the Theory and Application of Cryptology and Information Security", Brisbane, Australia, LNCS - Lecture Notes in Computer Science, Springer, December 2018, vol. 11273, pp. 96-124 [DOI : 10.1007/978-3-030-03329-3\_4], <https://hal.inria.fr/hal-01944772>
- [33] A. DUPIN, D. POINTCHEVAL, C. BIDAN. *On the Leakage of Corrupted Garbled Circuits*, in "ProvSec 2018 - 12th International Conference on Provable Security", Jeju, South Korea, J. BAEK, W. SUSILO, J. KIM (editors), Provable Security. ProvSec 2018, Springer, October 2018, vol. Lecture Notes in Computer Science, n<sup>o</sup> 11192 [DOI : 10.1007/978-3-030-01446-9\_1], <https://hal.inria.fr/hal-01903806>
- [34] P.-A. DUPONT, J. HESSE, D. POINTCHEVAL, L. REYZIN, S. YAKOUBOV. *Fuzzy Password-Authenticated Key Exchange*, in "EUROCRYPT 2018 - 37th Annual International Conference on the Theory and Applications of Cryptographic", Tel Aviv, Israel, J. B. NIELSE, V. RIJME (editors), Advances in Cryptology – EUROCRYPT 2018, Springer, April 2018, vol. Lecture Notes in Computer Science, n<sup>o</sup> 10822 [DOI : 10.1007/978-3-319-78372-7\_13], <https://hal.inria.fr/hal-01903733>
- [35] P. FARSHIM, J. HESSE, D. HOFHEINZ, E. LARRAIA. *Graded Encoding Schemes from Obfuscation*, in "PKC 2018 - 21st IACR International Conference on Practice and Theory of Public-Key Cryptography", Rio De Janeiro, Brazil, M. ABDALLA, R. DAHAB (editors), LNCS - Lecture Notes in Computer Science, Springer, March 2018, vol. 10769 [DOI : 10.1007/978-3-319-76581-5\_13], <https://hal.inria.fr/hal-01904151>
- [36] G. FUCHSBAUER. *Subversion-Zero-Knowledge SNARKs*, in "PKC 2018 - 21st IACR International Conference on Practice and Theory of Public-Key Cryptography", Rio de Janeiro, Brazil, M. ABDALLA, R. DAHAB (editors), LNCS - Lecture Notes in Computer Science, Springer, March 2018, vol. 10769, pp. 315-347 [DOI : 10.1007/978-3-319-76578-5\_11], <https://hal.inria.fr/hal-01869978>
- [37] G. FUCHSBAUER, R. GAY. *Weakly Secure Equivalence-Class Signatures from Standard Assumptions*, in "PKC 2018 - 21st IACR International Conference on Practice and Theory of Public-Key Cryptography", Rio de Janeiro, Brazil, M. ABDALLA, R. DAHAB (editors), Springer, March 2018, pp. 153-183 [DOI : 10.1007/978-3-319-76581-5\_6], <https://hal.inria.fr/hal-01869971>
- [38] G. FUCHSBAUER, E. KILTZ, J. LOSS. *The Algebraic Group Model and its Applications*, in "CRYPTO 2018 - 38th Annual International Cryptology Conference", Santa Barbara, United States, H. SHACHAM, A. BOLDYREVA (editors), LNCS - Lecture Notes in Computer Science, Springer, August 2018, vol. 10992, pp. 33-62 [DOI : 10.1007/978-3-319-96881-0\_2], <https://hal.inria.fr/hal-01870015>
- [39] G. FUCHSBAUER, M. ORRÙ. *Non-interactive Zaps of Knowledge*, in "ACNS 2018 - 16th International Conference on Applied Cryptography and Network Security", Leuven, Belgium, A. PRENEEL, F. VERCAUTERE (editors), Springer, July 2018, vol. LNCS - Lecture notes in computer science, n<sup>o</sup> 10892, pp. 44-62 [DOI : 10.1007/978-3-319-93387-0\_3], <https://hal.inria.fr/hal-01870005>

- [40] R. GAY, D. HOFHEINZ, L. KOHL, J. PAN. *More Efficient (Almost) Tightly Secure Structure-Preserving Signatures*, in "EUROCRYPT 2018 - 37th Annual International Conference on the Theory and Applications of Cryptographic Techniques", Tel Aviv, Israel, J. B. NIELSE, V. RIJME (editors), Springer, April 2018 [DOI : 10.1007/978-3-319-78375-8\_8], <https://hal.archives-ouvertes.fr/hal-01900268>
- [41] R. GAY, L. KOWALCZYK, H. WEE. *Tight Adaptively Secure Broadcast Encryption with Short Ciphertexts and Keys*, in "SCN 2018: Security and Cryptography for Networks", Amalfi, Italy, September 2018, <https://hal.inria.fr/hal-01900275>
- [42] R. GENNARO, M. MINELLI, A. NITULESCU, M. ORRÙ. *Lattice-Based zk-SNARKs from Square Span Programs*, in "ACM CCS 2018", Toronto, Canada, October 2018, <https://hal.archives-ouvertes.fr/hal-01743360>
- [43] P. GRUBBS, M.-S. LACHARITÉ, B. MINAUD, K. G. PATERSON. *Learning to Reconstruct: Statistical Learning Theory and Encrypted Database Attacks*, in "IEEE Symposium on Security and Privacy (S&P) 2019", San Francisco, United States, May 2019, <https://hal.inria.fr/hal-01974962>
- [44] L. KHATI, D. VERGNAUD. *Analysis and Improvement of an Authentication Scheme in Incremental Cryptography*, in "Selected Areas in Cryptography - SAC 2018", Calgary, Canada, C. CID, M. J. JACOBSON JR. (editors), Lecture Notes in Computer Science, Springer, August 2018, vol. 11349, pp. 50-70 [DOI : 10.1007/978-3-030-10970-7\_3], <https://hal.inria.fr/hal-01893905>
- [45] T. LIU, V. VAIKUNTANATHAN, H. WEE. *Towards Breaking the Exponential Barrier for General Secret Sharing*, in "EUROCRYPT 2018 - 37th Annual International Conference on the Theory and Applications of Cryptographic Techniques", Tel Aviv, Israel, J. B. NIELSE, V. RIJME (editors), LNCS - Lecture Notes in Computer Science, Springer, April 2018, vol. 10820, <https://hal.inria.fr/hal-01899902>
- [46] S. PARK, A. KWON, G. FUCHSBAUER, P. GAŽI, J. ALWEN, K. PIETRZAK. *SpaceMint: A Cryptocurrency Based on Proofs of Space*, in "Financial Cryptography and Data Security 2018", Curaçao, Curaçao, February 2018, <https://hal.inria.fr/hal-01869990>
- [47] D. POINTCHEVAL, O. SANDERS. *Reassessing Security of Randomizable Signatures*, in "CT-RSA 2018 - The Cryptographers' Track at the RSA Conference 2018", San Francisco, United States, Topics in Cryptology – CT-RSA 2018, Springer, April 2018, vol. Lecture Notes in Computer Science, n<sup>o</sup> 10808 [DOI : 10.1007/978-3-319-76953-0\_17], <https://hal.inria.fr/hal-01903717>
- [48] W. QUACH, H. WEE, D. WICHS. *Laconic Function Evaluation and Applications*, in "FOCS 2018 - 59th Annual IEEE Symposium on Foundations of Computer Science", Paris, France, October 2018, <https://hal.inria.fr/hal-01899904>