Activity Report 2019

Project-Team COAST

Web Scale Trustworthy Collaborative Service Systems

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Project-Team COAST

Creation of the Team: 2014 July 01, updated into Project-Team: 2015 July 01

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1. Team, Visitors, External Collaborators

Research Scientist
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Claude Godart [Univ de Lorraine, Professor]
Gérald Oster [Univ de Lorraine, Associate Professor]
Olivier Perrin [Univ de Lorraine, Professor, HDR]
Samir Youcef [Univ de Lorraine, Associate Professor]

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Amina Ahmed Nacer [Univ de Lorraine, Chercheur, until Jul 2019]

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Visiting Scientist

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2. Overall Objectives

2.1. Overall Objectives

The advent of the Cloud, smart mobile devices and service-based architecture has opened a field of possibilities as wide as the invention of the Web 25 years ago. Software companies now deliver applications and services using the Web as a platform. From text to video editing, from data analytic to process management, they distribute business applications to users within their web browser or on some mobile appliance [1]. These services are deployed on sophisticated infrastructures that can cope with very demanding loads. The Software as a Service approach (SaaS) highlights their cooperative nature, by enabling the storage of data in cloud infrastructures that can be easily shared among users. Thus, clients consume applications through service API (web services), available on delivery platforms, called stores or markets. This approach of software distribution outstrips the traditional software distribution channels, in both scale and opportunity. Scale has different dimensions: the number of users (communities rather than groups), the size of data produced and managed (billions of documents), the number of services and of organizations (tens of thousands). Opportunity refers to the infinite number of combinations between these services and the many ways to consume and use them. This fast-paced evolution challenges research because the creation of applications from the composition of services must incorporate new content and context based constraints. From a socio-technical perspective, the behaviour of users is evolving constantly as they get acculturated to new services and ways to cooperate. Mere enhancement of current existing solutions to cope with these challenges is insufficient. We conduct a dedicated research effort to tackle the problems arising from the evolution of contemporary technologies and of those we can anticipate. For this purpose, we explore three directions: large scale collaborative data management, data centred service composition and above all, a foundation for the construction of trustworthy collaborative systems. **Large scale collaborative data management** concerns mostly the problem of allowing people to collaborate on shared data, synchronously or not, on a central server or on a peer to peer network. This research has a long history referring back to a paper by Ellis [14]. Users acculturation to online collaboration triggers new challenges. these refer to the number of participants to a collaboration (a crowd), to sharing among

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[1] See http://blog.programmableweb.com/2011/09/16/open-api-growth-a-visualization/

different organizations and to the nature of documents that are shared and produced. The problem is to design new algorithms and to evaluate them under different usage conditions and constraints and for different kinds of data. **Data centred service composition** deals with the challenge of creating applications by composing services from different providers. Service composition has been studied for some time now but the technical evolution and the growing availability of public API oblige us to reconsider the problem [13]. Our goal here is, taking into account this evolution, like the advent of the Cloud, the availability at a large scale of public API based on the REST [2] architectural style, to design models, methods and tools to help developers to compose these services in a safe and effective way. Based on the work that we do in the two first topics, our main research direction aims at providing support to build **trustworthy collaborative applications.** We base it on the knowledge that we can gather from the underlying algorithms, the composition of services and the quality of services that we can deduce and monitor. The complexity of the context in which applications are executed does not allow to provide proven guarantees. Our goal is to base our work on a contractual and monitored approach to provide users with confidence in the service they use. Surprisingly, people rely today on services with very little knowledge about the amount of confidence they can put in these services. They are based on composition of other unknown services. Thus, it becomes very difficult to understand the consequences of the failure of a component of the composition. We follow a path that portrays a ruptured continuum, to underscore both the endurance of the common questions along with the challenge of accommodating a new scale. We regard collaborative systems as a combination of supportive services, encompassing safe data management and data sharing. Trustworthy data centred services are an essential support for collaboration at the scale of communities and organizations. We will combine our results and expertise to achieve a new leap forward toward the design of methods and techniques to enable the construction of usable large scale collaborative systems.

3. Research Program

3.1. Introduction

Our scientific foundations are grounded on distributed collaborative systems supported by sophisticated data sharing mechanisms and on service oriented computing with an emphasis on orchestration and on non-functional properties. Distributed collaborative systems enable distributed group work supported by computer technologies. Designing such systems requires an expertise in Distributed Systems and in Computer-supported collaborative Work research area. Besides theoretical and technical aspects of distributed systems, the design of distributed collaborative systems must take into account the human factor to offer solutions suitable for users and groups. The Coast team vision is to move away from a centralized authority based collaboration toward a decentralized collaboration. Users will have full control over their data. They can store them locally and decide with whom to share them. The Coast team investigates the issues related to the management of distributed shared data and coordination between users and groups. Service oriented Computing [16] is an established domain on which the ECOO, Score and now the Coast teams have been contributing for a long time. It refers to the general discipline that studies the development of computer applications on the web. A service is an independent software program with a specific functional context and capabilities published as a service contract (or more traditionally an API). A service composition aggregates a set of services and coordinates their interactions. The scale, the autonomy of services, the heterogeneity and some design principles underlying Service Oriented Computing open new research questions that are at the basis of our research. They span the disciplines of **distributed computing**, **software engineering** and **computer supported collaborative work** (CSCW). Our approach to contribute to the general vision of Service Oriented Computing is to focus on the issue of the efficient and flexible construction of reliable and secure high-level services. We aim to achieve it through the coordination/orchestration/composition of other services provided by distributed organizations or people.

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[2]representational state transfer

3.2. Consistency Models for Distributed Collaborative Systems

Collaborative systems are distributed systems that allow users to share data. One important issue is to manage consistency of shared data according to concurrent access. Traditional consistency criteria such as serializability, linearizability are not adequate for collaborative systems. Causality, Convergence and Intention preservation (CCI) [21] are more suitable for developing middleware for collaborative applications. We develop algorithms for ensuring CCI properties on collaborative distributed systems. Constraints on the algorithms are different according to the kind of distributed system and to the data structure. The distributed system can be centralized, decentralized or peer-to-peer. The type of data can include strings, growable arrays, ordered trees, semantic graphs and multimedia data.

3.3. Optimistic Replication

Replication of data among different nodes of a network promotes reliability, fault tolerance, and availability. When data are mutable, consistency among the different replicas must be ensured. Pessimistic replication is based on the principle of single-copy consistency while optimistic replication allows the replicas to diverge during a short time period. The consistency model for optimistic replication [19] is called eventual consistency, meaning that replicas are guaranteed to converge to the same value when the system is idle. Our research focuses on the two most promising families of optimistic replication algorithms for ensuring CCI:

- operational transformation (OT) algorithms [14]
- algorithms based on commutative replicated data types (CRDT) [18].

Operational transformation algorithms are based on the application of a transformation function when a remote modification is integrated into the local document. Integration algorithms are generic, being parametrised by operational transformation functions which depend on replicated document types. The advantage of these algorithms is their genericity. These algorithms can be applied to any data type and they can merge heterogeneous data in a uniform manner. Commutative replicated data types is a new class of algorithms initiated by WooT [15], the first algorithm designed WithOut Operational Transformations. They ensure consistency of highly dynamic content on peer-to-peer networks. Unlike traditional optimistic replication algorithms, they can ensure consistency without concurrency control. CRDT algorithms rely on natively commutative operations defined on abstract data types such as lists or ordered trees. Thus, they do not require a merge algorithm or an integration procedure.

3.4. Process Orchestration and Management

Process Orchestration and Management is considered as a core discipline behind Service Management and Computing. It includes the analysis, the modelling, the execution, the monitoring and the continuous improvement of enterprise processes and is for us a central domain of studies. Many efforts have been devoted establishing standard business process models founded on well-grounded theories (e.g. Petri Nets) that meet the needs of business analysts, software engineers and software integrator. This led to heated debate in the Business Process Management (BPM) community as the two points of view are very difficult to reconcile. On one side, business people in general require models that are easy to use and understand and that can be quickly adapted to exceptional situations. On the other side, IT people need models with an operational semantic in order to be able transform them into executable artifacts. Part of our work has been an attempt to reconcile these points of view. This resulted in the development of the Bonita BPM system. It resulted also more recently on our work in crisis management where the same people are designing, executing and monitoring the process as it executes. More generally, and at a larger scale, we have been considering the problem of processes spanning the barriers of organizations. This leads to the more general problem of service composition as a way to coordinate inter organizational construction of applications. These applications provide value, based on the composition of lower level services [12].

3.5. Service Composition

Recently, we started a study on service composition for software architects where services are coming from different providers with different plans (capacity, degree of resilience...). The objective is to support the architects to select the most accurate services (wrt. to their requirements, both functional and non-functional) and plans for building their software. We also compute the properties that we enforce for the composition of these services.

4. Application Domains

4.1. Crisis Management

Crisis management research investigates all the dimensions regarding the management of unexpected catastrophic events like floods, earthquake or terrorist attacks. All the phases of a crisis, from preparedness to recovery require collaboration between people from many organizations. This provides opportunities to study inter-organizational collaboration at a large scale and to propose and evaluate mechanisms that ensure secure and safe collaboration. The work of Béatrice Linot provides us with a deep understanding of the factors that encourage collaboration and help to maintain trustworthy collaboration between stakeholders. This work is continued by Clélie Amiot who studies the effects of human chat-bot collaboration in this kind of setting.

4.2. Collaborative Editing

Collaborative editing is a common application of optimistic replication in distributed settings. The goal of collaborative editors, irrespective of the kind of document, is to allow a group of users to update a document concurrently while ensuring that they eventually get all the same copy at the end. Our algorithm allows to implement collaborative editor in a peer to peer way. It avoids the need for a central server ensuring a higher level of privacy among collaborators. In this context, it requires to consider the problem of authentication and authorization of participants[4] and of trust between them[7].

5. Highlights of the Year

5.1. Highlights of the Year

In collaboration with Valerie Shalin (Department of Psychology, Wright State University), we proposed a novel validation methodology for automatic trust assessment of users based on their collaboration behavior. Our validation methodology relies on experimental game theory, namely trust game. In the large scale collaboration context of our team research, results of our experimental design [7] suggest that trust score could enhance or even replace traditional identity mechanisms.

6. New Software and Platforms

6.1. MUTE

Multi-User Text Editor

KEYWORD: Collaborative systems

SCIENTIFIC DESCRIPTION: MUTE is a peer 2 peer collaborative editing platform that is used to evaluate replication algorithms in editing situations regarding their performances and to understand how it affects user experience.

FUNCTIONAL DESCRIPTION: Existing collaborative systems generally rely on a service provider that stores and has control over user data which is a threat for privacy. MUTE (Multi-User Text Editor) is a web-based real-time collaborative editor that overcomes this limitation by using a peer-to-peer architecture relying on WebRTC. Several users may edit in real-time a shared document and their modifications are immediately sent to the other users without transiting through a central server. Our editor offers support for working offline while still being able to reconnect at a later time, which gives it a unique feature. Data synchronisation is achieved by using the LogootSplit algorithm developed by team Coast.

NEWS OF THE YEAR: In 2019 we implemented a new algorithm, dotted logoot-split. We integrated a group key management algorithm to evaluate a secure version of the algorithm in dynamic situation. We also incorporated probes to evaluate collaboration situation.

- Participants: Claudia Ignat, François Charoy, Gérald Oster, Luc André, Matthieu Nicolas and Victorien Elvinger
- Contact: Gérald Oster
- URL: https://github.com/coast-team/mute

7. New Results

7.1. Trustworthy Collaboration

Participants: Claudia-Lavinia Ignat, Hoang Long Nguyen, Olivier Perrin.

In order to test user acceptance of a collaboration model based on automatic trust assessment, we designed an experiment relying on the trust game. In the trust game money exchange is entirely attributable to the existence of trust between users. Our experimental design [7] tested variations of the trust game: with and without showing the partner identity and with and without explicit computation of partner trust values based on the computational trust model we previously proposed. We organized a user study with 30 participants that confirmed that the availability of this trust metric improves user cooperation and that it predicts participants future behavior. We showed that trust score availability has the same effect as an identity to improve cooperation. Our study suggests that trust score could function as an enhancement or even replacement of traditional identity systems and has the advantage of scalability.

In the scope of Hoang Long Nguyen's PhD thesis, we proposed the architecture of ÔBlock, an open ecosystem for quick development of transparent applications based on consortium blockchain.

7.2. Undo in Collaborative Editing

Participants: Victorien Elvinger, Claudia-Lavinia Ignat.

In collaborative editors a selective undo allows a user to undo an earlier operation, regardless of when, where and by which user the operation was generated. In most existing collaborative editors such as GoogleDrive, selective undo is not integrated and users can only undo their own operations but not the ones generated by the other users. There is currently no generally applicable undo support as stated in the manifesto on CRDTs [17]. We presented a generic support of selective undo for CRDTs by proposing an abstraction that captures the semantics of concurrent undo and redo operations through equivalence classes. The abstraction is a natural extension of undo and redo in sequential applications and is straightforward to implement in practice [9].

7.3. Mitigating the Cost of Identifiers in Sequence CRDT

Participants: Matthieu Nicolas, Gérald Oster, Olivier Perrin.

To achieve high availability, large-scale distributed systems have to replicate data and to minimise coordination between nodes. The literature and industry increasingly adopt Conflict-free Replicated Data Types (CRDTs) to design such systems. CRDTs are data types which behave as traditional ones, e.g. the Set or the Sequence. However, compared to traditional data types, they are designed to support natively concurrent modifications. To this end, they embed in their specification a conflict-resolution mechanism.

To resolve conflicts in a deterministic manner, CRDTs usually attach identifiers to elements stored in the data structure. Identifiers have to comply with several constraints such as uniqueness or being densely ordered according to the kind of CRDT. These constraints may prevent the identifiers' size from being bounded. As the number of the updates increases, the size of identifiers grows. This leads to performance issues, since the efficiency of the replicated data structure decreases over time.

To address this issue, we propose a new CRDT for Sequence which embeds a renaming mechanism. It enables nodes to reassign shorter identifiers to elements in an uncoordinated manner. Obtained experiment results demonstrate that this mechanism decreases the overhead of the replicated data structure and eventually limits it.

To validate the proposed renaming mechanism, we performed an experimental evaluation to measure its performances on several aspects: (i) the size of the data structure ; (ii) the integration time of the rename operation ; (iii) the integration time of insert and remove operations. In cases (i) and (iii), we use LogootSplit as the baseline data structure to compare results. The results we obtained are very encouraging, as the integration time is far shorter with the renaming mechanism, even with the time spent to apply the rename operation.

7.4. Social Networks as Collaboration Support

Participants: Quentin Laporte Chabasse, Gérald Oster, François Charoy.

Safe peer to peer collaborative services requires a trusted peer to peer network in order to be effective. We started to investigate how to leverage social networks underlying inter organizational collaboration to support such collaboration. To reach this goal, we need to analyze collaborative graphs. They are a relevant sources of information to understand behavioural tendencies of groups of individuals. Exponential Random Graph Models (ERGMs) are commonly used to analyze such social processes including dependencies between members of the group. Our approach considers a modified version of ERGMs, modeling the problem as an edge labelling one. The main difficulty is inference since the normalizing constant involved in classical Markov Chain Monte Carlo approaches is not available in an analytic closed form.

The main contribution is to use the recent ABC Shadow algorithm [20]. This algorithm is built to sample from posterior distributions while avoiding the previously mentioned drawback. The proposed method is illustrated on real data sets provided by the HAL [3] platform and provides new insights on self-organized collaborations among researchers[11]

7.5. Secure Collaborative Editing

Participants: Mohammed Riyadh Abdmeziem, François Charoy.

Collaborative edition allows a group of entities to simultaneously edit and share the content of a document in real time. To provide the required keying materials, group key management protocols are usually considered in order to secure and encrypt the exchanged data. Indeed, existing fully distributed protocols induce significant overhead. Instead, centralized solutions are preferred for their high efficiency. Nevertheless, these centralized solutions present two main issues. The first issue is related to the broken end-to-end property, considering the central entity has access to the established credentials. The second issue is related to the single point of failure problem. In fact, if the central entity fails, the key establishment process fails too. To address these challenges, we proposed a simple, and yet efficient approach which enhances central-based protocols with both fault tolerance and end-to-end properties. To do so, we considered the group key as composed of two sub-keys. The first sub-key is only known to the members of the group, excluding the central entity, while the second sub-key is distributed and updated by the central entity following membership changes[3], [4]. Our initial assessment shows that the overall complexity of rekeying operations is not negatively impacted. In addition, our approach is backward compatible with existing solutions in the literature.

7.6. Trust and Data Sharing in Crisis Management

Participants: François Charoy, Béatrice Linot.

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[3]https://hal.inria.fr/

Sharing information between responders is important during crisis management response. Tools and platforms are eagerly developed for that purpose. They are supposed to support people and help them to build a shared situation awareness. However as the scale of crisis increases and as more and more organizations are involved, people get reluctant to use them to share their data. They prefer to rely on one to one communication tools like phones or text. This is why we are studying how these collaborative platforms impact the work of responders positively or negatively. We want to know why most of the time they don't want to use them for their original purpose. We studied reports on past incidents and conducted extensive analysis of the use of existing systems (e.g. the French platform CRISORSEC) through interviews, observation and data analysis. Early results show that participant have problems sharing written information for different kind of reason including its persistence, the time taken to produce the message and the lack of knowledge regarding who may access this information. This informs us on the requirement for future collaborative platforms.

7.7. Identification and Selection of Services from Cloud Providers

Participants: Anis Ahmed Nacer, François Charoy, Olivier Perrin.

We continued our work on providing a framework to compare plans for services from cloud providers in order to help architects to select the best composition given the required criteria (both both functional and non-functional requirements) for an application. This year, we have made progress in two directions: the first is how to identify the key elements to be considered when architects want to compare the different plans, and the second one is a methodology to compute the best composition, given partial information provided in service description (based on the WOWA method).

In order to gather the key elements of the comparison that met the architects' requirements and the relationship between these key elements of the comparison, we reviewed the service providers' plans and previous works on benchmarks. Finally, to ensure that the list of key elements of the comparison and their relationship was complete for the service selection process, we conducted an empirical study with the architects.

Regarding the second part, we use the WOWA (Weighted Ordered Weighted Averaging) operator to solve this decision problem. This operator provides an aggregation function that uses both the simultaneous advantage of the OWA method to allow compensation between high and low values and the weighted average method to consider the importance of the suppliers who provide the information. WOWA uses two sets of weights: one corresponds to source significance, and the other corresponds to value significance.

Our evaluations are encouraging, and we are now ready to submit our proposals to conferences.

7.8. Risk Management for the Deployment of a Business Process in a Multi-Cloud Context

Participants: Amina Ahmed Nacer, Claude Godart, Guillaume Rosinosky, Samir Youcef.

The lack of trust in cloud organizations is often seen as braking forces to SaaS developments. This work proposes an approach which supports a trust model and a business process model in order to allow the orchestration of trusted business process components in the cloud.

The contribution is threefold and consists in a method, a model and a framework. The method categorizes techniques to transform an existing business process into a risk-aware process model that takes into account security risks related to cloud environments. These techniques are partially described in the form of constraints to automatically support process transformation. The model formalizes the relations and the responsibilities between the different actors of the cloud. This allows users to identify the different pieces of information required to assess and quantify security risks in cloud environments.

The framework is a comprehensive approach that decomposes a business process into fragments that can automatically be deployed on multiple clouds. The framework also integrates a selection algorithm that combines the security information of cloud offers and of the process with other quality of service criteria to generate an optimized configuration. It is implemented in a tool to assess cloud providers and decompose processes.

Rooted in past years' work, the paper [5] synthesizes our trust-aware deployment method.

7.9. Priority based events management in IoT-BPM architecture

Participants: Khalid Benali, Abir Ismaili-Alaoui.

BPM allows organizations to evolve their performance and achieve their goals, as it helps them to have a clear vision of their business. Several research works have been done in this area and aimed at improving business processes, by focusing on the optimization of business processes issues at build-time and at run-time, from different perspectives: control-flow perspective, data and event data perspective, and scheduling and event management perspective. Business process instances scheduling and event management are considered as a crucial step in the journey of business process improvement. However, this step becomes more challenging especially when the events are triggered by IoT devices. The main objective of our research consists on scheduling business process instances based on the priority of events that trigger these instances, taking into consideration historical data gathered from previous business process instances. We proposed a clustering approach based on the K-Means algorithm that we apply on a set of event sources, as to classify these sources on different clusters using a score calculated for each event source. This score is based on the frequency and the critically of previous events. The main objective of this approach was to create clusters of priorities. These clusters are used to estimate the criticality level of incoming events, and then the priority level of incoming process instances. However, there is always a degree of uncertainty regarding the criticality/priority level of events generated from sources that belong to the same cluster. This issue can be addressed by using fuzzy logic. In fact, the integration of a Fuzzy Inference System (FIS) in our IoT-BPM architecture, helps us to handle uncertainties regarding the criticality level of events, especially when these events are generated by sources that may have the same characteristics [8].

8. Bilateral Contracts and Grants with Industry

8.1. Bilateral Contracts with Industry

8.1.1. Open Group

Participants: Claudia-Lavinia Ignat, François Charoy [contact], Gérald Oster, Olivier Perrin, Anis Ahmed Nacer.

Company: Open Group

Dates: 2017-2020

The objective of the project is to propose and validate a model of service composition for middleware services for software as a service architecture. The composition must take into account middleware service quality attributes and service plan in order to optimise the operational cost while ensuring a level of quality of service.

9. Partnerships and Cooperations

9.1. Regional Initiatives

9.1.1. Region Grand Est TV Paint (2017–2019)

Participants: Claudia-Lavinia Ignat [contact], Gérald Oster, Cédric Enclos.

Partners: TVPaint Development, Inria

Website: https://www.tvpaint.com/

This is a project in collaboration with TVPaint Development financed by Region Grand Est. It is a follow-up of a project in collaboration with TVPaint Development financed by Region Lorraine from 2016 to 2017.

The goal is to contribute to the creation of a collaborative system dedicated to manage the production of animated movies. This system has to manipulate a large amount of data in a safe and secure manner. Based on the previously proposed architecture and prototype, this project intends to design and implement a commercial product. In the framework of this project, we bring our expertise in data management, business process management, distributed systems and collaborative systems.

9.2. National Initiatives

9.2.1. *OpenPaas NG (2015–2019)*
Participants: Claudia-Lavinia Ignat, François Charoy [contact], Gérald Oster, Olivier Perrin, Jean-Philippe Eisenbarth, Matthieu Nicolas, Mohammed Riyadh Abdmeziem, Victorien Elvinger, Quentin Laporte Chabasse, Hoai-Le Nguyen, Hoang Long Nguyen.

Partners: Linagora, XWiki, Nexedi, Université de Lorraine, LIX.

Website: http://www.open-paas.org/

This project is funded by BpiFrance and involves French industrial leaders in open-source software development (Linagora, Nexedi, XWiki) and academic partners in collaborative work (Coast team) and recommender systems (DaScim team, LIX). The goal of the project is to develop next generation of cloud enabled virtual desktop based on an Enterprise Social Network to provide advanced collaborative and recommendation services. Coast is responsible for the work package dedicated to the design of the peer-to-peer collaborative middleware. In this context, we bring our expertise on data replication for collaborative data in peer-to-peer environments and on trust and access control and identity management in distributed collaborative information systems.

9.3. International Research Visitors

9.3.1. *Visits of International Scientists*

Weihai Yu, The Arctic University of Norway, did his sabbatical year in the period September 1, 2018 - August 31, 2019 in the Coast team. He worked on the formalisation of undo with CRDTs.

9.3.2. *Research Stays Abroad*

François Charoy was invited by Heiko Ludwig to spend 3 month (March-May 2019) at IBM Almaden Research Center in San Jose,CA. He worked on P2P Federated Learning. A replication protocol has been designed that is under evaluation thanks to a shared internship. It also led to an ANR submission on the topic with a french company.

François Charoy was invited by Akhil Kumar to spend 6 weeks at Penn State University to collaborate to on a long transaction protocol implementation on a permissioned blockchain. This work is based on previous work done in the Coast project-team. It is also ongoing and has led to the submission of a project to a proposal submission with a local startup.

10. Dissemination

10.1. Promoting Scientific Activities

10.1.1. *Scientific Events: Selection*

10.1.1.1. Member of the Conference Program Committees

- Khalid Benali was a PC member of WorldCIST (World Conference on Information Systems and Technologies) 2019, MEDES (11th International Conference on Management of Digital EcoSystems) 2019, ICCCI (11th International Conference on Computational Collective Intelligence) 2019, CEISEE (15th China-Europe International Symposium on Software Engineering Education) 2019, I3E (IFIP Conference on e-Business, e-Services and e-Society) 2019, INFORSID (INFormatique des ORganisations et Systèmes d'Information et de Décision) 2019, ISKO-Maghreb (8th. Edition of the International Symposium on: « Digital Sciences: impacts and challenges on Knowledge Organization. ») 2019, and SysCoBIoTS (4th International Conference on Systems of Collaboration, Big Data, Internet of Things and Security), 2019.
- Claudia-Lavinia Ignat was a PC member of ECSCW (European Conference on Computer-Supported Cooperative Work: The International venue on Practice-centred computing and the Design of cooperation technologies) 2019, CDVE (International Conference on Cooperative Design, Visualization and Engineering) 2019 and 2020, CollabTech (International Conference on Collaboration Technologies and Social Computing) 2019
- Olivier Perrin was a PC member of the conference program committee of ICSOC (International Conference on Services Oriented Computing) 2019, CoopIS (27h International Conference on Cooperative Information Systems) 2019, and IEEE ATC-19 (16th IEEE International Conference on Advanced and Trusted Computing).
- François Charoy was a PC Member of ICEBE (International Conference on Business Engineering) 2019, ICSOC 2019, IEEE International Conference on Business Information Systems, ISCRAM 2019, and of several workshops.
- Claude Godart is a member of the editorial board of IEEE transaction on Service Computing. In 2019, he was a PC member of BPMDS (Business Process Modeling, Development and Support), EDOC (The enterprise computing conference), ICSOC (International Conference on Services Computing), ICWS (IEEE International Conference on Web Services), SCC (IEEE International Conference on Services Computing)and WISE (Web Information Systems Engineering) conferences.

10.1.2. Journal

10.1.2.1. Member of the Editorial Boards

- Claudia-Lavinia Ignat is an Associate editor for the Journal of Computer Supported Cooperative Work (JCSCW) since 2011 and is Member of Editorial Board for the journal track of ECSCW conference since 2019
- François Charoy is a member of the editorial board of Service Oriented Computing and Applications (Springer)

10.1.2.2. Reviewer - Reviewing Activities

- Claudia-Lavinia Ignat reviewed papers for International Journal of Cooperative Information Systems
- Olivier Perrin reviewed papers for Elsevier Information Systems and Spring SoSyM (Software and Systems Modeling) journals.
- Francois Charoy reviewed papers for IEEE IoT, VLDB Journal and Interacting with Computers

10.1.3. Invited Talks

- In November 2019 Claudia-Lavinia Ignat was invited to give a talk at Inria Paris on "Large-scale trustworthy distributed collaborative systems"

10.1.4. Leadership within the Scientific Community

- François Charoy is steering committee member of European Society for Socially Embedded Technologies (EUSSET).
- Claudia-Lavinia Ignat was steering committee member of EUSSET until August 2019

10.1.5. Scientific Expertise

François Charoy was a member of the HCERES committee for the evaluation of the Laboratoire d'Informatique de Grenoble, Université de Grenoble Alpes

10.1.6. Research Administration

- Claudia-Lavinia Ignat is member of the Inria Evaluation Commission. She is a member of the Inria Nancy-Grand Est COMIPERS committee. She was a member of COST-GTRI commission. She is a member of the organisation committee of the Security Seminar at LORIA. Until March 2019 she was in charge of the European affairs and Delegate for International Relations for Inria Nancy-Grand Est. Until August 2019 she was member of Inria CAP Chercheurs commission. In 2019, she was a member of the CRCN recruitment jury at Inria Nancy-Grand Est and at Inria Saclay Ile de France. In 2019, she was a member of the national CRCN Inria recruitment jury and of the CRCN Inria admission jury.
- Gérald Oster is an elected member at AM2I scientist council of University of Lorraine
- Francois Charoy is an elected member of the CNU 27. He is a member of the board as assessor.

10.2. Teaching - Supervision - Juries

10.2.1. Teaching

Permanent members of the Coast project-team are leading teachers in their respective institutions. They are responsible of lectures in disciplines like software engineering, database systems, object oriented programming and design, distributed systems, service computing and more advanced topics at all levels and in different of departments in the University. Most PhD Students have also teaching duties in the same institutions. Claudia-Lavinia Ignat teaches the lecture and the exercises on data replication and consistency at master level (M2 SIRAV) at University of Lorraine. As a whole, the Coast team accounts for more than 2500 hours of teaching. Members of the Coast team are also deeply involved in the pedagogical and administrative life of their departments.

- Olivier Perrin is responsible for the MIAGE of Nancy at the IDMC of University of Lorraine.
- Claude Godart is responsible for the Computer Science Department of the Polytech Nancy engineering school .
- Khalid Benali is responsible for the professional master degree speciality "Distributed Information Systems" of MIAGE and of its international branch in Morocco.
- François Charoy is responsible for the Software Engineering specialisation at the TELECOM Nancy Engineering School of University of Lorraine.
- Gérald Oster is responsible for the 3rd (last) year of study at the TELECOM Nancy Engineering School of University of Lorraine.

10.2.2. Supervision

- PhD : Guillaume Rosinoski, Elasticity of business processes execution, January 2019, François Charoy and Samir Youssef [2]
- PhD : Amina Ahmed Nacer, Contributions au déploiement sécurisé de processus métiers dans le cloud, Université de Lorraine et Université A. Mira (Bejaïa, Algérie), February 2019, Claude Godart, Samir Youcef and Abdelkamel Tari. [1]
- PhD : Hoang Long Nguyen, Blockchain based transparency system, December 2019, Claudia-Lavinia Ignat and Olivier Perrin
- PhD in progress: Hoai Le Nguyen, Study of group performance and behaviour in collaborative editing, started in September 2015, Claudia-Lavinia Ignat and François Charoy
- PhD in progress: Victorien Elvinger, Secured Replication for Peer-to-Peer Collaborative Infrastructures, started in October 2015, François Charoy and Gérald Oster
- PhD in progress: Abir Ismaïli-Alaoui, started in September 2016, Khalid Benali and Karim Baïna (Université Mohammed V, Rabat, Morocco)

- PhD in progress: Quentin Laporte-Chabasse, Federation of Organisations over Peer to Peer Collaborative Network, started in October 2016, François Charoy and Gérald Oster
- PhD in progress: Béatrice Linot, Trust in cooperative systems, started in November 2016, Jérome Dinet and François Charoy
- PhD in progress: Anis Ahmed Nacer, Safe Service Composition, started in March 2017, Olivier Perrin and François Charoy
- PhD in progress: Matthieu Nicolas, Optimisation of Replication Algorithms, started in October 2017, Olivier Perrin and Gérald Oster
- PhD in progress: Jean Philippe Eisenbarth, Securing the future blockchain-based security services, started in May 2019, Olivier Perrin and Thibault Cholez.
- PhD in progress: Clélie Amiot, Trust and Human/Chatbot collaboration, started in October 2019, Jérome Dinet and François Charoy

10.2.3. Juries

Coast members were members of the following PhD defence committees:
- Sina Namaki Arraghi, PhD,IMT Mines d'Albi-Carmaux, November 2019 (François Charoy, rapporteur)
- Nicolas Schnepf, PhD, Université de Lorraine, September 2019 (François Charoy, président)
- Suhrid Satyal, PhD, University of New South Wales, June 2019 (François Charoy, rapporteur)

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[2] G. ROSINOSKY. *Elasticity of business processes execution*, Université de Lorraine, January 2019, https://hal.univ-lorraine.fr/tel-02096324

Articles in International Peer-Reviewed Journals

[3] M. R. ABDMEZIEM. *Securing IoT-based collaborative applications using a new compressed and distributed MIKEY mode*, in "International Journal of Information and Computer Security", March 2019, vol. x,No.x, https://hal.archives-ouvertes.fr/hal-02378897

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[5] A. AHMED NACER, C. GODART, G. ROSINOSKY, A. TARI, S. YOUCEF. *Business process outsourcing to the cloud: Balancing costs with security risks*, in "Computers in Industry", January 2019, vol. 104, pp. 59-74 [*DOI : * 10.1016/J.COMPIND.2018.10.003], https://hal.archives-ouvertes.fr/hal-01888396

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Conferences without Proceedings

[10] B. LINOT, F. CHAROY, J. DINET, V. SHALIN. *Une perspective computationnelle sur un défi (probable) CRISORSEC*, in "1ère biennale de la sécurité civile: « L'acceptabilité des risques : approches pluridisciplinaires »", Aix-en-Provence, France, Ecole nationale supérieure des officiers de sapeurs-pompiers, 2019, https://hal.univ-lorraine.fr/hal-02280588

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