IN PARTNERSHIP WITH:
CNRS

Université de Lorraine

Activity Report 2018

Project-Team Coast

Web Scale Trustworthy Collaborative Service Systems

IN COLLABORATION WITH: Laboratoire lorrain de recherche en informatique et ses applications (LORIA)

RESEARCH CENTER
Nancy - Grand Est

THEME
Distributed Systems and middleware

Table of contents

Project-Team Coast

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

Keywords:

Computer Science and Digital Science:

A1.3. - Distributed Systems
A1.3.4. - Peer to peer
A1.3.5. - Cloud
A2.5.1. - Software Architecture & Design
A2.6.2. - Middleware
A3.1.3. - Distributed data
A3.1.5. - Control access, privacy
A5.1.1. - Engineering of interactive systems
A5.1.2. - Evaluation of interactive systems
A7.1. - Algorithms

Other Research Topics and Application Domains:

B6.1.1. - Software engineering
B6.3.1. - Web
B6.5. - Information systems
B8.4. - Security and personal assistance
B8.4.1. - Crisis management
B9.1.1. - E-learning, MOOC
B9.6.1. - Psychology
B9.8. - Reproducibility
B9.10. - Privacy

1. Team, Visitors, External Collaborators

Research Scientist

Claudia-Lavinia Ignat [Inria, Researcher]

Faculty Members

Khalid Benali [Univ de Lorraine, Associate Professor, HDR]
Gérôme Canals [Univ de Lorraine, Associate Professor]
François Charoy [Team Leader,Univ de Lorraine, Professor, HDR]
Claude Godart [Univ de Lorraine, Professor, HDR]
Gérald Oster [Univ de Lorraine, Associate Professor]
Olivier Perrin [Univ de Lorraine, Professor, HDR]
Samir Youcef [Univ de Lorraine, Associate Professor]

Post-Doctoral Fellows

Mohammed Riyadh Abdmeziem [Univ de Lorraine, ATER]
Siavash Atarodi [Univ de Lorraine, from Mar 2018]
Chahrazed Labba [Univ de Lorraine, from Mar 2018]

PhD Students

Anis Ahmed Nacer [Inria]

Victorien Elvinger [Univ de Lorraine]
Abir Ismaili-Alaoui [Univ de Lorraine]
Quentin Laporte Chabasse [Univ de Lorraine]
Beatrice Linot [Univ de Lorraine]
Hoai Le Nguyen [Univ de Lorraine]
Hoang Long Nguyen [Univ de Lorraine]
Matthieu Nicolas [Univ de Lorraine]
Guillaume Rosinosky [Univ de Lorraine]
Béatrice Linot [Univ de Lorraine]
Amina Ahmed Nacer [Univ de Lorraine]

Technical staff

Jean-Philippe Eisenbarth [Univ de Lorraine]
Cédric Enclos [Inria, from Apr 2018]
Phillippe Kalitine [Univ de Lorraine, until Oct 2018]

Administrative Assistants

Sophie Drouot [Inria]
Annick Jacquot [CNRS, from Jul 2018]
Sylvie Musilli [Univ de Lorraine]

Visiting Scientists

Valerie Shalin [Wright State University, Ohio, USA, Oct 2018]
Weihai Yu [Artic University, Norway, from Sep 2018]

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 analytics 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 organisations (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 likely 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 of Ellis [23]. New challenges arise regarding needs related to the user's acculturation to collaboration. It includes the number of participants to a collaboration

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

(a crowd), sharing among different organisations and the nature of documents that are shared and produced. The problem here 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 [22]. 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 organisations. 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 centralised authority based collaboration toward a decentralised 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 [29] 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 organisations or people.

[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) [34] 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 centralised, decentralised 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 [32] 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 [23]
- algorithms based on commutative replicated data types (CRDT) [30].

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 [28], a 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 to establish standard business process models founded on well-grounded theories (e.g. Petri Nets) that meet the needs of business analysts, software engineers and software integrators. This has led to heated debate in the BPM community as the two points of view are very difficult to reconcile. On one side, the 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 artefacts. Part of our work has been an attempt to reconcile these points of view. It resulted in the development of the Bonita Business process management 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 organisations. It leads to the more general problem of service composition as a way to coordinate inter organisational construction of applications. These applications provide value, based on the composition of lower level services [20].

3.5. Service Composition

We are considering processes as pieces of software whose execution traverses the boundaries of organisations. This is especially true with service oriented computing where processes compose services produced by many organisations. We tackle this problem from very different perspectives. We try to find the best compromise between the need for privacy of internal processes from organisations and the necessity to publicise large part of them. To do that, we propose to distribute the execution and the orchestration of processes among the organisations themselves, and attempting to ensure non-functional properties in this distributed setting [19]. Non-functional aspects of service composition relate to all the properties and service agreements that one wants to ensure. They are orthogonal to the actual business but they are important when a service is selected and integrated in a composition. This includes transactional context, security, privacy, and quality of service in general. Defining and orchestrating services on a large scale while providing the stakeholders with some strong guarantees on their execution is a first-class problem for us. For a long time, we have proposed models and solutions to ensure some properties (e.g. transactional properties) during process execution, either by design or by the definition of some protocols. We also extended our work to the problems of security, privacy and service level agreement among partners. 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. Highlights of the Year

4.1. Highlights of the Year

In 2018 we organised in Nancy the 16th European Conference on Computer-Supported Cooperative Work: The International venue on Practice-centred computing and the Design of cooperation technologies (ECSCW 2018).

5. New Software and Platforms

5.1. BeGoood

FUNCTIONAL DESCRIPTION: BeGoood is a generic system for managing non-regression tests on knowledge bases. BeGoood allows to define test plans in order to monitor the evolution of knowledge-bases. Any system answering queries by providing results in the form of set of strings can be tested with BeGoood. BeGoood has been developed following a REST architecture and is independent of any application domain. BeGoood is a part of the Kolflow infrastructure.

- Participant: Gérôme Canals
- Contact: Gérôme Canals
- URL: https://github.com/kolflow/begoood

5.2. MUTE

Multi-User Text Editor

FUNCTIONAL DESCRIPTION: MUTE (Multi-User Text Editor) is a web-based text editing tool that allows to edit documents collaboratively in real-time. It implements our recent work on collaborative editing algorithms and more specifically the LogootSplit+ approach. Compared to existing web-based collaborative text editing tool this editor does not require a powerful central server since the server is not performing any computation and acts as a simple broadcast server. Our editor offers support for working offline while still being able to reconnect at a later time.

- Participants: Claudia-Lavinia Ignat, François Charoy, Gérald Oster and Luc André
- Contact: Gérald Oster
- URL: https://github.com/coast-team/mute-demo/

5.3. Replication Benchmarker

FUNCTIONAL DESCRIPTION: The Replication Benchmarker is a performance evaluation framework for optimistic replication mechanisms used in collaborative applications. It contains a library of implementation of several CRDT (Commutative Replicated Data Type) and OT (Operational Transformation) algorithms for different data types: text, set, trees. The framework is able to evaluate the performance of comparable algorithms on different corpus of events traces. These events traces can be produced randomly according to different parameters, can be extracted from real real-time editing session that have been recorded, or can be automatically extracted from distributed version control repositories such as the one produced with Git. Performances of the algorithms are measured in term of execution time, memory footprint and merge result quality (compared to manual merge history stored in git repositories).

- Participants: Gérald Oster, Mehdi Ahmed-Nacer and Pascal Urso
- Contact: Pascal Urso
- URL: https://github.com/score-team/replication-benchmarker/

5.4. Rivage

Real-tIme Vector grAphic Group Editor
FUNCTIONAL DESCRIPTION: Rivage is a real-time collaborative graphical editor. Several users can edit at the same time and in real-time a graphical document, user changes being immediately seen by the other users. The editor relies on a peer-to-peer architecture where users can join and leave the group at any time. Each user has a copy of the shared document and user changes on the document copies are merged in real-time by using a CRDT (Commutative Replicated Data Type) algorithm.

- Participant: Claudia-Lavinia Ignat
- Contact: Claudia-Lavinia Ignat
- URL: https://github.com/stephanemartin/rivage/

6. New Results

6.1. Design and Analysis of Collaborative Editing Approaches

Participants: Matthieu Nicolas, Victorien Elvinger, Hoai Le Nguyen, Quentin Laporte Chabasse, Claudia-Lavinia Ignat [contact], Gérald Oster, François Charoy, Olivier Perrin.

Since the Web 2.0 era, the Internet is a huge content editing place on which users collaborate. Thousand of people can edit this shared document. However, current consistency maintenance algorithms are not adapted to massive collaborative updating involving large number of contributors and a high velocity of changes. This year we studied collaborative editing user behaviour and started to work on an optimised solution for sequence CRDTs. Version control systems such as Git became very widespread in the open-source community. In these collaborative systems, conflict resolution that arise during synchronisation of parallel changes might become a burden for the user. We analysed concurrency and conflicts in Git repository of four projects: Rails, IkiWiki, Samba and Linux Kernel. We analysed the collaboration process of these projects at specific periods revealing how change integration and conflict rates vary during the project development life-cycle. Our study suggests that developers should use more intensively awareness mechanisms close to release dates where changes integration rate is higher. We also discussed the mechanism adopted by Git to consider concurrent changes made on two adjacent lines as conflicting. Based on the high rate of false positives of this mechanism, our study suggests that Git should reconsider signalling adjacent line conflicts inside the source code files [4]. Sequence Conflict-free Replicated Data Types (CRDTs) allow one to replicate and edit, without any kind of coordination, sequences in distributed systems. To ensure convergence, existing works from the literature add metadata to each element but they do not bind its footprint, which impedes their adoption. Several approaches were proposed to address this issue but they do not fit a fully distributed setting. We started to work on the design and validation of a fully distributed renaming mechanism, setting a bound to the metadata's footprint [14]. Addressing this issue opens new perspectives of adoption of these CRDTs in distributed applications.

6.2. Trustworthy Collaboration

Participants: Claudia-Lavinia Ignat, Victorien Elvinger, François Charoy, Olivier Perrin, Gérald Oster, Hoang Long Nguyen.

Trust between users is an important factor for the success of a collaboration. Users might want to collaborate only with those users they trust. We are interested in assessing users trust according to their behaviour during collaboration in a large scale environment. We studied the trust assessment problem and designed a computational trust model for collaborative systems [1]. We also studied how to predict the trust relation between users that did not interact in the past. Given a network in which the links represent the trust/distrust relations between users, we aimed to predict future relations. We proposed a link-sign prediction algorithm [6] that does not require full graph information, is suitable for dynamic networks and takes into account the creation time of the links in the network. Our solution combines state-of-the-art techniques in natural language processing (Doc2Vec [25]) and deep learning (Recurrent Neural Networks [31] with Long-Short Term Memory [24]) with the random walk graph sampling [26]. Our algorithm outperforms state-of-the-art approaches on real world signed directed social network datasets. In distributed collaborative systems, participants maintain a replicated copy of shared documents. They edit their own copy and then share their modifications without any coordination. Copies follow successions of divergence and convergence. Convergence is a liveness property of collaborative systems. Some malicious participants may find an advantage to make the collaboration fail. To that end, they can preclude convergence of the copies. To protect convergence of copies, participants can exploit an authenticated log of modifications. New participants have to retrieve the entire log in order to contribute. Unfortunately, the cost of joining a collaboration increases with the size of this log. Causal Stability allows to prune authenticated logs in a static collaborative group without any malicious participants. We tailored Causal Stability to dynamic groups in the presence of malicious participants. We also proposed a mechanism to verify the consistency of a pruned log and a mechanism to authenticate a snapshot from a pruned log [7]. Public key server is a simple yet effective way of key management in secure end-to-end communication. To ensure the trustworthiness of a public key server, CONIKS [27] employs a tamper-evident data structure on the server and a gossiping protocol among clients in order to detect compromised servers. However, due to lack of incentive and vulnerability to malicious clients, a gossiping protocol is hard to implement in practice. Meanwhile, alternative solutions such as EthIKS [21] are too costly. We proposed Trusternity [13], [12], an auditing scheme relying on Ethereum blockchain that is easy to implement, inexpensive to operate and resilient to malicious clients. We also conducted an empirical

study of system behaviour in face of attacks and proposed a lightweight anomaly detection algorithm to protect clients against such attacks.

6.3. Trust and data sharing in crisis management

Participants: François Charoy, Béatrice Linot, Valerie Shalin.

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 organisations 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 [17], [10] and conducted extensive analysis of the use of existing systems (e.g. the French platform CRISORSEC) through interviews, observation and data analysis. [11]

6.4. Cloud Provisioning for Elastic BPM

Participants: François Charoy, Samir Youcef, Guillaume Rosinosky.

Cloud computing providers do not help consumers to use optimally the available resources. Several approaches have been proposed [33] that take benefit from the elasticity of the Cloud, starting and stopping virtual machines on demand. They suffer from several shortcomings. Often they consider only one objective, the reduction of the cost, or a level of quality of service. We proposed to optimise two conflicting objectives, the number of migrations of tenants that is helpful to reach the optimal cost and the cost incurred considering a set of resources. Our approach allows to take into account the multi-tenancy property and the Cloud computing elasticity, and is efficient as shown by an extensive experimentation based on real data from Bonita BPM customers. In the continuation of our previous work we proposed and validated a more efficient algorithm for elastic execution of processes in the cloud [16]. To ensure a realistic validation, we collaborated with colleagues from the University of Lugano to set up a benchmarking platform in order to evaluate the impact of migration in a multi-tenant setting. This allowed us to execute reproducible experiments and to validate our hypothesis regarding the effect of migration and the parameters that affect them [15]. This platform is now an asset that can be used for all kinds of live migration experiments of software architectures.

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

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

The lack of trust in cloud organisations 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 categorises 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 formalises the relations and the responsibilities between the different actors of the cloud. This allows to identify the different 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 optimised configuration. It is implemented in a tool to assess cloud providers and decompose processes. Rooted in past years work, we are contributing this year at the methodological and framework levels in two directions:

- At the methodological level, while our risk computing model rested previously only on data provided by cloud providers (provider-side risk model), we are developing a risk model integrating client-side knowledge (client-side risk model).
- Additionally are developing a simulation tool for supporting designer decision with the ability to balance risk with cost when selecting the best cloud configuration [2].

6.6. Scheduling and Resource Allocation in Business Processes

Participants: Khalid Benali, Abir Ismaili-Alaoui.

Business Process Management (BPM) is concerned with continuously enhancing business processes by adapting a systematic approach that enables companies to increase the performance of their existing business processes and achieve their business goals. Business processes are generally considered as blind, stateless and reactive. This means that in each business process execution we do not take into consideration either the results from last process instances nor the context (for most cases). The rise of new technologies such as big and fast data, cloud computing, Internet of Things (IoT), etc, implies new business process scheduling problems. They are linked to limited resources (human and/or machine) or the need to use resources in an optimal and exible way. In order to avoid either under-provisioning (when there is an underestimation for the needed resources, business processes may not be executed) or over-provisioning (the resources planned in advance to cover peak times demands were not used in non-peak time) and also to take into consideration the priority level of each business process instances.

7. Bilateral Contracts and Grants with Industry

7.1. Bilateral Contracts with Industry

7.1.1. Contrat Open Group 2017-2020

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

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.

8. Partnerships and Cooperations

8.1. Regional Initiatives

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

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

Partners: TVPaint Development, Inria Coast project-team

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.

8.2. National Initiatives

8.2.1. OpenPaas NG (2015–2019)

Participants: Claudia-Lavinia Ignat, François Charoy [contact], Gérald Oster, Olivier Perrin, Jean-Philippe Eisenbarth, Phillippe Kalitine, Matthieu Nicolas, Mohammed Riyadh Abdmeziem, Victorien Elvinger, Quentin Laporte Chabasse, Hoai Le Nguyen, Hoang Long Nguyen.

Partners: Linagora, XWiki SAS, Nexedi, Coast project-team (Université de Lorraine, LORIA), DaScim team (LIX).

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

This project is financed 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 team is responsible of 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.

8.3. International Initiatives

8.3.1. Inria Associate Teams Not Involved in an Inria International Labs

8.3.1.1. USCoast2

Title: User Studies on Trustworthy Collaborative Systems

International Partner (Institution - Laboratory - Researcher):

Wright State University (United States) - Department of Psychology, Knoesis - Valerie Shalin

Start year: 2016

See also: http://usCoast.loria.fr

The proposed project addresses the perception of trust by users, the appropriateness of a trust-based security approach and the role of trust metrics in the management of distributed work. The main challenge of this project is how to measure trust based on user behaviour and to verify by means of experimental studies with users that the trust-based mechanism is acceptable by users. We plan to apply this trust-based mechanism for two types of applications. The first one is collaborative editing where user trust will be computed based on the quality of user contributions for a document or project. The second type of application is in the management of work over a large group of people in order to conduct efficient, high-yield, high-density real time crowdsourcing activities. Partners of USCoast2 project have complementary expertise. Coast provides expertise in collaborative methods, systems and related technologies. Coast will propose algorithms that track and manipulate trust metrics.Knoesis provides expertise on the analysis of human work-related behaviour, including methods of data collection and data analysis, as well as a theoretical foundation for the evaluation of human performance. Knoesis will analyse trust from a psychological phenomenon point of view.

8.3.2. Inria International Partners

8.3.2.1. Informal International Partners

As part of our work on elastic business processes execution, we started a collaboration with Professor Cesare Pautasso from the University of Lugano. We developed a benchmarking framework for business process execution in the cloud, including hot migration of process engine in a multi-tenant setting. This collaboration resulted in a framework that allows repeatable evaluation of process execution.

8.4. International Research Visitors

8.4.1. Visits of International Scientists

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

8.4.2. Visits to International Teams

8.4.2.1. Research Stays Abroad

- François Charoy visited Knoesis team at Wright State University, OH from the 15th of June to the 23rd of July (USCoast2). He worked with Valerie Shalin on trust in sharing data during crisis amng different organisations.
- François Charoy visited the SOC Team of Boualem Benatallah at UNSW, Sydney, Australia from the 26 of August to the 14th of September. He collaborated with Boualem Benatallah on a new project on Composition of cognitive services at a large scale.

9. Dissemination

9.1. Promoting Scientific Activities

9.1.1. Scientific Events Organisation

9.1.1.1. General Chair, Scientific Chair

Claudia-Lavinia Ignat and François Charoy were general co-chairs of ECSCW 2018.

9.1.1.2. Member of the Organizing Committees

Claudia-Lavinia Ignat, François Charoy and Gérald Oster were members of the ECSCW organising committee (European Conference on Computer-Supported Cooperative Work: The International venue on Practice-centred computing and the Design of cooperation technologies) 2018.

9.1.2. Scientific Events Selection

9.1.2.1. Chair of Conference Program Committees

Claudia-Lavinia Ignat was co-chair of the Program Committee of ECSCW 2018. Gérald Oster was co-chair of the Demo an Poster Program Committee of ECSCW 2018.

9.1.2.2. Member of the conference program committees

- Claude Godart was PC member of the conference program committee of BPMDS (Business Process Modelling, Development and Support) 2018, EDOC (The enterprise computing conference), ICSOC (International Conference on Services Oriented Computing) 2018, ICWS (IEEE International Conference on Web Services) 2018, SCC (IEEE International Conference on Services Computing) 2018, WISE (Web Information Systems Engineering) 2018.
- Claudia-Lavinia Ignat was PC member of ECSCW (European Conference on Computer-Supported Cooperative Work: The International venue on Practice-centred computing and the Design of cooperation technologies) 2018, CDVE (International Conference on Cooperative Design, Visualisation and Engineering) 2018, CRIWG (International Conference on Collaboration and Technology) 2018
- François Charoy was PC Member of ICEBE (International Conference on Business Engineering) 2018, CTS 2018 (International Symposium on Collaborative Technologies and Systems), DG.O (International Conference on Digital Government Research) 2018, ICSOC 2018, IEEE International Conference on Business Information Systems, ISCRAM 2018, ECSCW 2018 and of several workshops.

- Gérald Oster was a PC member of CoopIS (International Conference on Cooperative Information Systems) 2018, CSCW (21st ACM Conference on Computer-Supported Cooperative Work and Social Computing) 2018 and ECSCW 2018.
- Khalid Benali was PC member of I-ESA'2018 (Interoperability of Enterprise Software and Applications), WorldCIST'18 (World Conference on Information Systems and Technologies), I3E 2018 (IFIP Conference on e-Business, e-Services and e-Society), ISKO-Maghreb'2018 (7th International Symposium ISKO-Maghreb'2018), MEDES 2018 (10th International Conference on Management of Digital EcoSystems).

9.1.3. Journal

9.1.3.1. Member of the editorial boards

- Claude Godart is a member of the editorial board of IEEE Transactions on Service Computing, International Journal of Services Computing, and member of the review board of the International Journal of Next Generation Computing.
- Claudia-Lavinia Ignat is member of the editorial board of Journal of CSCW (Computer Supported Cooperative Work).
- François Charoy is member of the editorial board of Service Oriented Computing and Applications Journal (Springer).

9.1.3.2. Reviewer - Reviewing activities

- Olivier Perrin reviewed papers for IEEE Transactions on Services Computing journal, IEEE Transactions on Parallel and Distributed Systems and Journal of Systems and Software.
- Claudia-Lavinia Ignat reviewed papers for CSCW 2018.
- Gérald Oster reviewed papers for Computer Supported Cooperative Work Journal, ECSCW 2018, CSCW 2018, CoopIS 2018.

9.1.4. Invited Talks

Claudia-Lavinia Ignat was invited to give the opening keynote "From groupware to large-scale trustworthy distributed collaborative systems" at CRIWG 2018.

9.1.5. Scientific Expertise

François Charoy was member of the HCERES committee for the SAMOVAR Lab, IMT Sud Paris

9.1.6. Research Administration

François Charoy and Claudia-Lavinia Ignat are steering committee members of European Society for Socially Embedded Technologies (EUSSET).

9.2. Teaching - Supervision - Juries

9.2.1. 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 of the PhD Students have also teaching duties in the same institutions. 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.

- Claude Godart is responsible for the Computer Science Department of the engineering school ESSTIN.
- 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 of the Software Engineering specialisation at the TELECOM Nancy Engineering School of University of Lorraine.

9.2.2. Supervision

- PhD (defended): Quang Vinh Dang, Trust-based large scale collaboration, started in 10/2014, Claudia-Lavinia Ignat and François Charoy
- PhD (in progress): Hoai Le Nguyen, Study of group performance and behaviour in collaborative editing, started in 9/2015, Claudia-Lavinia Ignat and François Charoy
- PhD (in progress): Hoang Long Nguyen, A Trust Based Authorisation Model and Framework for the Cloud, started in 11/2015, Claudia-Lavinia Ignat and Olivier Perrin
- PhD (in progress): Victorien Elvinger, Secured Replication for Peer-to-Peer Collaborative Infrastructures, started in 10/2015, François Charoy and Gérald Oster
- PhD (in progress): Guillaume Rosinoski, Elastic BPM and the Cloud, started in 10/2014, François Charoy and Samir Youssef
- PhD (in progress): Quentin Laporte-Chabasse, Federation of Organisations over Peer to Peer Collaborative Network, started in 10/2016, François Charoy and Gérald Oster
- PhD (in progress): Béatrice Linot, Trust in cooperative systems, Jérome Dinet et François Charoy, started 11/2016
- PhD (in progress): Anis Ahmed Nacer, Safe Service Composition, Olivier Perrin and François Charoy, started 3/2017
- PhD (in progress): Matthieu Nicolas, Optimisation of Replication Algorithms, Olivier Perrin and Gérald Oster, started 10/2017

9.2.3. Juries

- Claudia-Lavinia Ignat was member of CRCN recruitment jury at Inria Nancy-Grand Est

Coast members were members of the following PhD and HdR defence committees:

- Noura Faci, HdR, Université de Lyon, Décembre 2018 (François Charoy, president)
- Wafa Triaa, PhD, Université Grenoble Alpes, Septembre 2018 (François Charoy, rapporteur)
- Guillaume Garzone, PhD, Université de Toulouse, Novembre 2018 (François Charoy, rapporteur)
- Audrey Fertier, PhD,IMT Mines d'Albi-Carmaux, Novembre 2018 (François Charoy, rapporteur)
- Yacine Abboud, PhD, Université de Lorraine, Novembre 2018 (François Charoy, examinateur)
- Teuku Aulia Geumpana, PhD, University of New South Wales, December 2018 (François Charoy, rapporteur)

9.3. Popularization

9.3.1. Internal or external Inria responsibilities

- Claudia-Lavinia Ignat is in charge of European affairs for Inria Nancy Grand-Est. She is the Delegate of International Relations for Inria Nancy-Grand Est and member of COST-GTRI commission. She is a member of the Inria Nancy-Grand Est COMIPERS committee. She is a member of Inria CAP Chercheurs commission. She is responsible with the activity kindergarten at AGOS Inria Nancy-Grand Est. She is a member of the organisation committee of the Security Seminar at LORIA.
- Gerald Oster is a member of the council of the scientific pole AM2I (Automatique, Mathématiques, Informatique et leurs Interactions) of University of Lorraine

10. Bibliography

Publications of the year

Doctoral Dissertations and Habilitation Theses

[1] Q.-V. DANG. *Trust assessment in large-scale collaborative systems*, Université de Lorraine, January 2018, https://hal.archives-ouvertes.fr/tel-01634377

Articles in International Peer-Reviewed Journals

[2] A. AHMED NACER, E. GOETTELMANN, S. YOUCEF, A. TARI, C. GODART. *A Design-Time Semi-Automatic Approach for Obfuscating a Business Process Model in a Trusted Multi-Cloud Deployment: A Design-Time Approach for BP Obfuscation*, in "International Journal of Web Services Research", October 2018, vol. 15, n° 4 [*DOI :* 10.4018/IJWSR.20181001], https://hal.archives-ouvertes.fr/hal-01888396

[3] S. ATARODI, A. BERARDI, A.-M. TONIOLO. *The technology acceptance model since 1986: 30 years of development*, in "Psychologie du travail et des organisations", September 2018, https://hal.archives-ouvertes.fr/hal-01943567

[4] H. LE NGUYEN, C.-L. IGNAT. *An Analysis of Merge Conflicts and Resolutions in Git-based Open Source Projects*, in "Computer Supported Cooperative Work", June 2018, vol. 27, n° 3-6, pp. 741-765 [*DOI :* 10.1007/s10606-018-9323-3], https://hal.archives-ouvertes.fr/hal-01917249

Invited Conferences

[5] C.-L. IGNAT. *Keynote: From groupware to large-scale trustworthy distributed collaborative systems*, in "CRIWG 2018 - 24th International Conference on Collaboration and Technology", Costa de Caparica, Portugal, September 2018, https://hal.archives-ouvertes.fr/hal-01875534

International Conferences with Proceedings

[6] Q.-V. DANG, C.-L. IGNAT. *Link-Sign Prediction in Dynamic Signed Directed Networks*, in "CIC 2018 - 4th IEEE International Conference on Collaboration and Internet Computing", Philadelphia, United States, October 2018, https://hal.inria.fr/hal-01881035

[7] V. ELVINGER, G. OSTER, F. CHAROY. *Prunable Authenticated Log and Authenticable Snapshot in Distributed Collaborative Systems*, in "CIC 2018 - 4th IEEE International Conference on Collaboration and Internet Computing", Philadelphia, United States, 2018 IEEE 4th International Conference on Collaboration and Internet Computing (CIC), October 2018, https://hal.univ-lorraine.fr/hal-01932528

[8] A. ISMAILI-ALAOUI, K. BAÏNA, K. BENALI, J. BAÏNA. *Towards Smart Incident Management Under Human Resource Constraints for an IoT-BPM Hybrid Architecture*, in "ICWS 2018 - 25th International Conference on Web Services", Seattle, United States, H. JIN, Q. WANG, L.-J. ZHANG (editors), Lecture Notes in Computer Science, Springer International Publishing, June 2018, vol. 10966, pp. 457-471 [*DOI :* 10.1007/978-3-319-94289-6_29], https://hal.inria.fr/hal-01843095

[9] A. ISMAILI-ALAOUI, K. BENALI, K. BAÏNA, J. BAÏNA. *Business Process Instances Scheduling with Human Resources Based on Event Priority Determination*, in "BDCA 2018 - Third International Conference on Big Data, Cloud and Applications", Kenitra, Morocco, Y. TABII, M. LAZAAR, M. A. ACHHAB, N. ENNEYA (editors), springer, April 2018, vol. 872, pp. 118-130 [*DOI :* 10.1007/978-3-319-96292-4_10], https://hal.inria.fr/hal-01889906

[10] B. LINOT, J. DINET, F. CHAROY, V. SHALIN. *Information gain in sociotechnical systems*, in "ISCRAM 2018 - 15th International Conference on Information Systems for Crisis Response and Management", Rochester, United States, May 2018, https://hal.inria.fr/hal-01823245

[11] B. LINOT. *Trust in Computer-Supported crisis management information sharing*, in "ECSCW'2018 - 16th European Conference on Computer-Supported Cooperative Work: The International venue on

Practice-centred computing and the Design of cooperation technologies", Nancy, France, June 2018 [*DOI :* 10.18420/ECSCW2018_DC07], https://halshs.archives-ouvertes.fr/halshs-01896410

[12] H.-L. NGUYEN, J.-P. EISENBARTH, C.-L. IGNAT, O. PERRIN. *Blockchain-Based Auditing of Transparent Log Servers*, in "32th IFIP Annual Conference on Data and Applications Security and Privacy (DBSec)", Bergamo, Italy, F. KERSCHBAUM, S. PARABOSCHI (editors), Data and Applications Security and Privacy XXXII, Springer International Publishing, July 2018, vol. LNCS-10980, pp. 21-37, Part 1: Administration, https://hal.archives-ouvertes.fr/hal-01917636

[13] H.-L. NGUYEN, C.-L. IGNAT, O. PERRIN. *Trusternity: Auditing Transparent Log Server with Blockchain*, in "Companion of the The Web Conference 2018", Lyon, France, April 2018 [*DOI :* 10.1145/3184558.3186938], https://hal.inria.fr/hal-01883589

[14] M. NICOLAS. *Efficient renaming in CRDTs*, in "Middleware 2018 - 19th ACM/IFIP International Middleware Conference", Rennes, France, December 2018, https://hal.inria.fr/hal-01932552

[15] G. ROSINOSKY, C. LABBA, V. FERME, S. YOUCEF, F. CHAROY, C. PAUTASSO. *Evaluating Multi-Tenant Live Migrations Effects on Performance*, in "CoopIS 2018 - 26th International Conference on Cooperative Information Systems", Valetta, Malta, Confederated International Conferences: CoopIS, C&TC, and ODBASE 2018, Valletta, Malta, October 22-26, 2018, Proceedings, Part I, Springer, October 2018, n° 11229, 16 p. , https://hal.archives-ouvertes.fr/hal-01870812

[16] G. ROSINOSKY, S. YOUCEF, F. CHAROY. *A Genetic Algorithm for Cost-Aware Business Processes Execution in the Cloud*, in "ICSOC 2018 - The 16th International Conference on Service-Oriented Computing", Hangzhou, China, Lecture Notes in Computer Science, Springer, November 2018, n° 11236, 14 p. , https://hal.archives-ouvertes.fr/hal-01870828

Conferences without Proceedings

[17] B. LINOT, J. DINET, F. CHAROY, V. SHALIN. *Temporal Dispersion In Distributed Work*, in "IEA 2018 - 20th Congress of International Ergonomics Association", Florence, Italy, August 2018, https://halshs.archives-ouvertes.fr/halshs-01896434

Books or Proceedings Editing

[18] C.-L. IGNAT, P. BJØRN, P. DEWAN (editors). *Special Issue: ECSCW 2018: The 16th European Conference on Computer-Supported Cooperative Work, The International Venue on Practice-centred Computing and the Design of Cooperation Technologies*, Springer Verlag, Nancy, France, December 2018, vol. 27, n° 3-6, pp. 291-1020, https://hal.archives-ouvertes.fr/hal-01917238

References in notes

[19] S. BHIRI, W. GAALOUL, C. GODART. *Mining and Improving Composite Web Services Recovery Mechanisms*, in "International Journal of Web Services Research", 03 2008, vol. 3, http://hal.inria.fr/inria-00438424/en/

[20] S. BHIRI, O. PERRIN, W. GAALOUL, C. GODART. *An Object-Oriented Metamodel For Inter-Enterprises Cooperative Processes Based on Web Services*, in "Journal of Integrated Design and Process Science", 2004, vol. 8, pp. 37–55, http://hal.inria.fr/inria-00099953/en/

[21] J. BONNEAU. *EthIKS: Using Ethereum to audit a CONIKS key transparency log*, in "International Conference on Financial Cryptography and Data Security", Springer, 2016, pp. 95–105

[22] F. CASATI. *Promises and Failures of Research in Dynamic Service Composition*, in "Seminal Contributions to Information Systems Engineering", J. BUBENKO, J. KROGSTIE, O. PASTOR, B. PERNICI, C. ROLLAND, A. SØLVBERG (editors), Springer Berlin Heidelberg, 2013, pp. 235-239, http://dx.doi.org/10.1007/978-3-642-36926-1_18

[23] C. A. ELLIS, S. J. GIBBS. *Concurrency Control in Groupware Systems*, in "Proceedings of the ACM SIGMOD Conference on the Management of Data - SIGMOD 89", Portland, Oregon, USA, May 1989, pp. 399–407, http://doi.acm.org/10.1145/67544.66963

[24] S. HOCHREITER, J. SCHMIDHUBER. *Long Short-Term Memory*, in "Neural Comput.", November 1997, vol. 9, n^{O} 8, pp. 1735–1780, http://dx.doi.org/10.1162/neco.1997.9.8.1735

[25] Q. V. LE, T. MIKOLOV. *Distributed Representations of Sentences and Documents*, in "ICML", JMLR Workshop and Conference Proceedings, JMLR.org, 2014, vol. 32, pp. 1188–1196

[26] C. D. MANNING, P. RAGHAVAN, H. SCHÜTZE. *Introduction to Information Retrieval*, Cambridge University Press, New York, NY, USA, 2008

[27] M. S. MELARA, A. BLANKSTEIN, J. BONNEAU, E. W. FELTEN, M. J. FREEDMAN. *CONIKS: Bringing key transparency to end users*, in "24th USENIX Security Symposium (USENIX Security 15)", 2015, pp. 383–398

[28] G. OSTER, P. URSO, P. MOLLI, A. IMINE. *Data Consistency for P2P Collaborative Editing*, in "ACM Conference on Computer-Supported Cooperative Work - CSCW 2006", Banff, Alberta, Canada, ACM Press, 11 2006, pp. 259 - 268, http://hal.inria.fr/inria-00108523/en/

[29] M. P. PAPAZOGLOU, P. TRAVERSO, S. DUSTDAR, F. LEYMANN. *Service-Oriented Computing: State of the Art and Research Challenges*, in "Computer", 2007, vol. 40, pp. 38-45

[30] N. PREGUIÇA, J. M. MARQUÈS, M. SHAPIRO, M. LETIA. *A commutative replicated data type for cooperative editing*, in "29th IEEE International Conference on Distributed Computing Systems (ICDCS 2009)", Montreal, Québec Canada, IEEE Computer Society, 2009, pp. 395-403 [*DOI :* 10.1109/ICDCS.2009.20], http://hal.inria.fr/inria-00445975/en/

[31] D. E. RUMELHART, G. E. HINTON, R. J. WILLIAMS. *Neurocomputing: Foundations of Research*, J. A. ANDERSON, E. ROSENFELD (editors), MIT Press, Cambridge, MA, USA, 1988, chap. Learning Representations by Back-propagating Errors, pp. 696–699, http://dl.acm.org/citation.cfm?id=65669.104451

[32] Y. SAITO, M. SHAPIRO. *Optimistic Replication*, in "Computing Surveys", March 2005, vol. 37, n^{O} 1, pp. 42–81, http://doi.acm.org/10.1145/1057977.1057980

[33] S. SCHULTE, C. JANIESCH, S. VENUGOPAL, I. WEBER, P. HOENISCH. *Elastic Business Process Management: State of the art and open challenges for BPM in the cloud*, in "Future Generation Computer Systems", 2015, vol. 46, pp. 36 - 50 [*DOI :* 10.1016/J.FUTURE.2014.09.005], http://www.sciencedirect.com/science/article/pii/S0167739X1400168X

[34] C. SUN, X. JIA, Y. ZHANG, Y. YANG, D. CHEN. *Achieving Convergence, Causality Preservation, and Intention Preservation in Real-Time Cooperative Editing Systems*, in "ACM Transactions on Computer-Human Interaction", March 1998, vol. 5, n^{o} 1, pp. 63–108, http://doi.acm.org/10.1145/274444.274447