



IN PARTNERSHIP WITH:  
**CNRS**

**Université de Lorraine**

# Activity Report 2013

## Team **SCORE**

### Services and Cooperation

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

<b>1. Members</b>	<b>1</b>
<b>2. Overall Objectives</b>	<b>2</b>
<b>3. Research Program</b>	<b>2</b>
3.1. Introduction	2
3.2. Consistency Models for Distributed Collaborative Systems	3
3.3. Optimistic Replication	3
3.4. Business Process Management	3
3.5. Service Composition	4
<b>4. Software and Platforms</b>	<b>4</b>
4.1. Rivage	4
4.2. Replication Benchmark	4
4.3. BeGood	5
<b>5. New Results</b>	<b>5</b>
5.1. Evaluation and Design of Collaborative Editing Algorithms	5
5.2. Decentralized monitoring of orchestration execution	6
5.3. Optimization and security of business processes in SaaS contexts	6
5.4. Large Scale Coordination of Crowdsourcing Activities	6
<b>6. Partnerships and Cooperations</b>	<b>7</b>
6.1. National Initiatives	7
6.1.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010–2014)	7
6.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2014)	7
6.1.3. ANR Kolflow (2011–2014)	8
6.1.4. FSN OpenPaaS (2012–2015)	8
6.2. European Initiatives	8
6.2.1. FP7 Projects	8
6.2.2. Collaborations in European Programs, except FP7	9
6.3. International Initiatives	9
6.4. International Research Visitors	10
6.4.1.1. Internships	10
6.4.1.2. Invited researchers	10
<b>7. Dissemination</b>	<b>10</b>
7.1. Scientific Animation	10
7.2. Teaching - Supervision - Juries	11
7.2.1. Teaching	11
7.2.2. Supervision	12
7.2.3. Juries	12
<b>8. Bibliography</b>	<b>13</b>



## Team SCORE

**Keywords:** Collaborative Work, Data Management, Peer-to-peer, Process Engineering, Service Orchestration, Service Oriented Architecture

*Creation of the Team:* 2009 October 01.

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## 2. Overall Objectives

### 2.1. Overall Objectives

SCORE research domain is data centred service oriented computing and collaboration. With the raise of the Web as a platform, people consume applications as services from the web or from mobile apps. These applications are cooperative, human centred and connected to social applications. They must cope with unprecedented load and their deployment in Cloud environment requires sophisticated architectures. Their users are distributed in space (people live in different locations), in time (people participate at different time) and they cross organizational barriers. Coordination is hard and privacy and trust are key issues. New challenges appear every day. We have chosen to consider them regarding three dimensions that are primary for web and service based system stakeholders :

1. The first dimension refers to collaborative management of data, a key aspect in the development of distributed collaborative systems.
2. The second dimension is concerned with assembling and coordinating high level services, involving people, applications, and information sources on the basis of process models.
3. The third dimension concerns non functional aspects of data and service management, and more particularly the security and trust dimensions that are basics to ensure a wide acceptance of the approaches that we advocate.

We consider these dimensions at a Web scale and in contexts where there is no central authority. This raises many issues related to governance, compliance and security, trust and privacy but also to awareness and coordination. At this scale, we are also always facing the recurring problem of interoperability since we want to offer collaborators a flexibility concerning the chosen work models and technologies. We are tackling these dimensions in specific domains where they have strong interrelations:

- in software engineering where it is always difficult to find the best compromise between explicit and implicit coordination and where stands the difficulties related to collaborative software development.
- in crisis management where many organisations have to cooperate in a very ad-hoc way, share data and coordinate with a constantly changing goal, with very big issues at stake and with strong political emphasis.
- and in all domains where there is a strong need for cooperation.

## 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 require an expertise in Distributed Systems and in Computer-supported collaborative activities research area. Besides theoretical and technical aspects of distributed systems, design of distributed collaborative systems must take into account the human factor to offer solutions suitable for users and groups. The SCORE team vision is to move away from a centralized authority based collaboration towards a decentralized collaboration where users have full control over their data that they can store locally and decide with whom to share them. The SCORE team investigates the issues related to the management of distributed shared data and coordination between users and groups.

Service oriented Computing [31] is an established domain on which the ECOO and now the SCORE team has 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 CSCW. Our approach to contribute to the general vision of Service Oriented Computing and more generally to the emerging discipline of Service Science has been and is still to focus on the question of the efficient and flexible construction of reliable and secure high level services through the coordination/orchestration/composition of other services provided by distributed organizations or people.

## 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 locking, 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 type of distributed system and type of data. 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 allows improving 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 [33] 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:

- the operational transformation (OT) algorithms [29]
- the algorithms based on commutative replicated data types (CRDT) [32].

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 parametrized 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 [30] 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. Business Process Management

Business Process Management (BPM) is considered as a core discipline behind Service Management and Computing. BPM, that includes the analysis, the modelling, the execution, the monitoring and the continuous improvement of enterprise processes is for us a central domain of studies.

A lot of efforts has been devoted in the past years to establish standard business process models founded on well grounded theories (e.g. Petri Nets) that meet the needs of both business analysts but also of software engineers and software integrators. This has lead to heated debate as both points of view are very difficult to reconcile between the analyst side and the IT side. 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 point of views, leading on one side to the Bonita product and more recently on our work in crisis management where the same people are designing, executing and monitoring the process as it executes. But more generally, and at a larger scale, we have been considering the problem of process spanning the barriers of organisations. This leads us to consider the more general problem of service composition as a way to coordinate inter organisational construction of applications providing value based on the composition of lower level services [28].

### 3.5. Service Composition

More and more, we are considering processes as pieces of software whose execution traverse 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, trying to find the best compromise between the need for privacy of internal processes from organisations and the necessity to publicize large part of them, proposing to distribute the execution and the orchestration of processes among the organisations themselves, and attempting to ensure non-functional properties in this distributed setting [27].

Non functional aspects of service composition relate to all the properties and service agreements that one want to ensure and that are orthogonal to the actual business but that 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 that some properties (e.g. transactional properties) were guaranteed on process execution, either through design or through the definition of some protocols. Our work has also been extended to the problems of security, privacy and service level agreement among partners. These questions are still central in our work. Then, one major problem of current approaches is to monitor the execution of the compositions, integrating the distributed dimension. This problem can be tackled using event-based algorithms and techniques. Using our previous results an event oriented composition framework DISC, we have obtained new results dedicated to the runtime verification of violations in service choreographies.

## 4. Software and Platforms

### 4.1. Rivage

**Participants:** Claudia-Lavinia Ignat, Stéphane Martin [contact].

Rivage (Real-time Vector grAphic Group Editor) 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. The code is available at <https://github.com/stephanemartin/rivage>.

### 4.2. Replication Benchmark

**Participants:** Pascal Urso [contact], Mehdi Ahmed-Nacer, Stéphane Martin, Gérald Oster.



The Replication Benchmark 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). The source code of this evaluation framework is available at <https://github.com/score-team/replication-benchmark>.

### 4.3. BeGood

**Participant:** G r me Canals.

BeGood is a generic system for managing non-regression tests on knowledge-bases. BeGood 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 BeGood. BeGood has been developed following a REST architecture and is independent of any application domain. BeGood is a part of the Kolflow infrastructure and is available at <https://github.com/kolflow>.

## 5. New Results

### 5.1. Evaluation and Design of Collaborative Editing Algorithms

**Participants:** Mehdi Ahmed-Nacer, Luc Andr , Claudia-Lavinia Ignat, St phane Martin, G rald Oster, Pascal Urso.

Since the Web 2.0 era, the Internet is a huge content editing place in which users contribute to the content they browse. Users do not just edit the content but they collaborate on this content. Such shared content can be edited by thousands of people. However, current consistency maintenance algorithms seem not to be adapted to massive collaborative updating involving large amount of contributors and a high velocity of changes. This year we continued our work on the evaluation of existing collaborative editing approaches and on the design of new algorithms that overcome limitations of state of the art ones. Moreover, we started to work on experimental user studies for understanding the real-time requirements for collaborative editing and grounding a theory for the effect of real-time constraints in collaborative work [26].

We also run experiments to compare the merge automatically obtained by collaborative editing algorithms – CRDTs, OTs and the world-wide used diff3 – to the merge validated by the user. We obtain automatically such results exploiting the massively available distributed version control systems histories of open-source software. We use these results to improve an existing collaborative editing algorithm and obtain result statistically better than the existing ones (including diff3 used in major DVCS systems) [9].

In existing collaborative editing algorithms shared data is usually fragmented into fixed granularity atomic elements that can only be added or removed. Coarse-grained data leads to the possibility of conflicting updates while fine-grained data requires more metadata. In [11] we offer a solution for handling an adaptable granularity for shared data that overcomes the limitations of fixed-grained data approaches. Our solution relies on a novel commutative replicated data type (CRDT) for sequences of text that assigns unique identifiers to substrings of variable length contrary to existing CRDTs that assign unique identifiers to fixed size elements of the text (i.e. characters or lines). This offers the possibility to define coarse grained elements when they are created and refine them when needed. This greatly reduces the memory consumption since a smaller memory overhead is needed to store metadata (identifiers). Moreover, we show using simulations that overall performances of our algorithms are superior to existing ones.

We proposed a new concurrency control algorithm, based on conflict-free data types. It is built on the ideas previously developed for synchronous collaboration, extending them to support asynchronous collaboration. Our solution also includes the necessary information for providing comprehensive awareness information to users. The evaluation of our algorithm shows that comparing our solution with traditional solutions in collaborative editing, the conflict resolution strategy proposed in this paper leads to results closer to the ones expected by users [10].

## 5.2. Decentralized monitoring of orchestration execution

**Participants:** Mohamed Aymen Baouab, Olivier Perrin, Claude Godart.

Cross-organizational service-based processes are increasingly adopted by different companies when they cannot achieve goals on their own. The dynamic nature of these processes poses various challenges to their successful execution. In order to guarantee that all involved partners are informed about errors that may happen in the collaboration, it is necessary to monitor the execution process by continuously observing and checking message exchanges during runtime. This allows a global process tracking and evaluation of process metrics. Complex event processing can address this concern by analysing and evaluating message exchange events, to the aim of checking if the actual behaviour of the interacting entities effectively adheres to the modelled business constraints. In our recent work (Aymen Baouab thesis [1]), we presented an approach for decentralized monitoring of cross-organizational choreographies. We have defined a hierarchical propagation model for exchanging external notifications between the collaborating parties. We also proposed a runtime event-based approach to deal with the problem of monitoring conformance of interaction sequences. Our approach allows for an automatic and optimized generation of rules. After parsing the choreography graph into a hierarchy of canonical blocks, tagging each event by its block ascendancy, an optimized set of monitoring queries is generated. We evaluate the concepts based on a scenario showing how much the number of queries can be significantly reduced [12].

## 5.3. Optimization and security of business processes in SaaS contexts

**Participants:** Claude Godart, Elio Goettelmann, Samir Youcef.

Globalization and the increase of competitive pressures created the need for agility in business processes, including the ability to outsource, offshore, or otherwise distribute its once-centralized business processes or parts thereof. While hampered thus far by limited infrastructure capabilities, the increase in bandwidth and connectivity and decrease in communication cost have removed these limits. This is even more true with the advent of cloud, particularly in its "Service as a software" dimension. To adapt to such a context, there is a growing need for the ability to fragment one's business processes in an agile manner, and be able to distribute and wire these fragments so that their combined execution recreates the function of the original process. Our work focuses on solving some of the core challenges resulting from the need to dynamically restructure enterprise interactions. Restructuring such interactions corresponds to the fragmentation of intra and inter enterprise business process models. It describes how to identify, create, and execute process fragments without losing the operational semantics of the original process models. In addition, this fragmentation is complicated by the constraints of quality of service, in particular the execution time and the cost, and of security, especially privacy. During the year, we consider this problem at two levels: the design of privacy-aware process models, and the process scheduling optimization. We developed a methodology to integrate privacy concerns in the design of a business process before distribution in the cloud. Based on a risk analysis, the result of the design is a set of process (re-)modelling actions, a set of constraints on process fragments assignments to clouds, and a set of constraints for cloud selection based on cloud properties [19]. We developed bi-criteria strategies for business processes scheduling in cloud environments with execution time and cost constraints, augmented with fairness metrics, and taking into account the availability of human resources, a critical point in business processes [14], [15], [3].

## 5.4. Large Scale Coordination of Crowdsourcing Activities

**Participants:** François Charoy, Karim Benouaret, Raman Valliyur-Ramalingam, Alexandre Roux d Anzi.

As a follow-up of our work on coordination of large scale processes that we have investigated in the domain of crisis management [4], [5], we have studied a new application domain for BPM, crowdsourcing. In order to make cities smarter, it would be interesting to design a platform where citizens are given an opportunity to be effectively connected to the governing bodies in their location and to contribute to the general well being. We have developed CrowdSC, a crowdsourcing framework designed for smarter cities. We have shown that it is possible to combine data collection, data selection and data assessment crowdsourcing activities in a crowdsourcing process to achieve sophisticated goals in a predefined context. Depending on the executing strategy of this process, different kinds of outcomes can be produced. We have conducted an experimental study that evaluates these process outcomes depending on different execution strategies [2], [13].

## 6. Partnerships and Cooperations

### 6.1. National Initiatives

#### 6.1.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010–2014)

**Participants:** Pascal Urso [contact], Mehdi Ahmed-Nacer, Claudia-Lavinia Ignat, Gérald Oster.

Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), CITI institute (Universidade Nova de Lisboa, Portugal), GDD team (University of Nantes) and SCORE team.

Website: <http://concordant.lip6.fr/>

Massive computing systems and their applications suffer from a fundamental tension between scalability and data consistency. Avoiding the synchronisation bottleneck requires highly skilled programmers, makes applications complex and brittle, and is error-prone.

The ConcoRDanT project (oct. 2010 – apr. 2014) investigates a promising new approach that is simple, scales, and provably ensures eventual consistency. A Commutative Replicated Data Type (CRDT) is a data type where all concurrent operations commute. If all replicas execute all operations, they converge; no complex concurrency control is required. We have shown in the past that CRDTs can replace existing techniques in a number of tasks where distributed users can update concurrently, such as co-operative editing, wikis, and version control. However CRDTs are not a universal solution and raise their own issues (e.g., growth of meta-data).

The ConcoRDanT project engages in a systematic and principled study of CRDTs, to discover their power and limitations, both theoretical and practical. Its outcome will be a body of knowledge about CRDTs and a library of CRDT designs, and applications using them. We are hopeful that significant distributed applications can be designed using CRDTs, a radical simplification of software, elegantly reconciling scalability and consistency.

#### 6.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2014)

**Participants:** Gérald Oster [coordinator], Luc André, Claudia-Lavinia Ignat, Stéphane Martin, Pascal Urso, Hien Thi Thu Truong.

Partners: SCORE team (coordinator), ASAP project-team (University of Rennes 1 / Inria Rennes - Bretagne Atlantique), CASSIS project-team (Inria Nancy - Grand Est / Nancy University), REGAL project-team (Inria Paris - Rocquencourt / LIP6) and GDD team (University of Nantes / LINA)

Website: <http://streams.loria.fr/>

The STREAMS project (nov. 2010 – oct. 2013) proposes to design peer-to-peer solutions that offer underlying services required by real-time social web applications and that reduce the disadvantages of centralised architectures. These solutions are meant to replace a central authority-based collaboration with a distributed collaboration that offers support for decentralisation of services.

The STREAMS project aims to advance the state of the art on peer-to-peer networks for social and real-time applications. Scalability is generally considered as an inherent characteristic of peer-to-peer systems. It is traditionally achieved using replication techniques. Unfortunately, the current state of the art in peer-to-peer networks does not address replication of continuously updated content due to real-time user changes. Moreover, there exists a tension between sharing data with friends in a social network deployed in an open peer-to-peer network and ensuring privacy. One of the most challenging issue in social applications is how to balance collaboration with access control to shared objects. Interaction is aimed at making shared objects available to all who need them, whereas access control seeks to ensure this availability only to users with proper authorisation. STREAMS project aims at providing theoretical solutions to these challenges as well as practical experimentations.

### 6.1.3. ANR Kolflow (2011–2014)

**Participant:** G r me Canals.

Partners: GDD team (University of Nantes / LINA), Loria (Orpailleur and SCORE Teams), Silex Team (LIRIS, University of Lyon), Edelweiss (Inria Project).

Website: <http://kolflow.univ-nantes.fr/mediawiki/index.php>

Kolflow aims at building a social semantic space where humans collaborate with smart agents in order to produce knowledge understandable by humans and machines. Humans are able to understand the actions of smart agents. Smart agents are able to understand actions of humans. Kolflow targets the co-evolution of content and knowledge as the result of interactions of humans and machines. Our work in the Kolflow project focus on implementing knowledge base testing strategies [23].

### 6.1.4. FSN OpenPaaS (2012–2015)

**Participants:** Olivier Perrin, Ahmed Bouchami.

Partners: Samovar team (Telecom SudParis), SCORE team (Universit  de Lorraine, Loria), ARMINES (Ecole des Mines d'Albi), Brake France, Linagora.

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

The OpenPaaS project aims at developing a PaaS (Platform as a Service) technology dedicated to enterprise collaborative applications deployed on hybrid clouds (private/public). OpenPaaS is a platform that allows to design and deploy applications based on proven technologies provided by partners such as collaborative messaging systems, integration and workflow technologies that will be extended in order to address Cloud Computing requirements. Available as an open-source Enterprise Social Network, the OpenPaaS project innovates both at the collaborative level and by its capacity to leverage heterogeneous cloud technologies at the IaaS level (Infrastructure as a Service). This project is funded under the French FSN umbrella (Fond National pour la soci t  Num rique).

## 6.2. European Initiatives

### 6.2.1. FP7 Projects

#### 6.2.1.1. SyncFree FP7-ICT 609551 (2013–2016)

**Participants:** Pascal Urso [contact], Jordi Martori.

Partners: REGAL project-team (Inria Paris - Rocquencourt / LIP6, coordinator), SCORE team, Trifork A/S (Denmark), Universidade Nova de Lisboa (Portugal), Technische Universit t Kaiserslautern (Germany), Basho Technologies (United Kingdom), Rovio Entertainment (Finland), Universit  Catholique de Louvain (Belgium), Ko  Universitesi (Turkey)

Website: <https://syncfree.lip6.fr/>

SyncFree FP7-ICT project brings together academic researchers and industrial practitioners to explore new approaches to data consistency at a massive scale. On-line services including social networks and multi-player games handle huge quantities of frequently changing shared data. Maintaining its consistency is simple in a centralised cloud, but no longer possible due to increased scalability requirements. Instead, data must be replicated across several distributed data centers, requiring new principled approaches.

In this context, SCORE team is interested in designing new and useful replicated data types and in evaluating their performance and behaviour using the massive corpus of real-usage data provided by industrial partners.

### **6.2.2. Collaborations in European Programs, except FP7**

Program: EIT ICT Labs

Project acronym: CityCrowdSource

Project title:

Duration: 12 months 2013 - 2013

Coordinator: Thomas Silverston

Other partners: BMU (Hungary), Imperial College London (UK), SAP (Germany), Cap Digital (France)

Abstract: This activity aims at leveraging the potential of crowd-based applications in urban contexts. Crowd-based data collection in combination with official data will lead to a vastly improved coverage and quality of digital information for urban areas. The added-value of the proposal is in : (1) the three services: trust, privacy and crowd processes modelling that are not present in any crowd-sourcing platform available today, (2) the deployment and of these services on top of different crowd-sourcing platforms and (3) the experimentation of these platforms in real life city scenarios. To this end, the activity combines Test bed, Open Source and Living labs catalysts.

## **6.3. International Initiatives**

### **6.3.1. Inria Associate Teams**

#### **6.3.1.1. USCOAST**

Title: User Studies on Trustworthy Collaborative Systems

Inria principal investigator: Claudia-Lavinia Ignat

International Partner:

Wright State University (United States of America) - Department of Psychology - Valerie SHALIN

Duration: 2013 - 2015

See also: <http://uscoast.loria.fr/>

USCoast has, as main objective, the validation of trustworthy collaborative systems using experimental user studies. This type of validation requires the expertise of both computer scientists that designed the systems and social scientists for conceptualizing and measuring human behaviour in collaborative work. The project focuses on the real-time requirements and trust policies in collaborative editing, resulting in a theory for the effect of real-time constraints in collaborative editing and awareness management for the coordination of work in the presence of conflict and disruption. The project includes also validation of proposed light security mechanisms for decentralised collaboration, based on posted measures of voluntary compliance with data sharing restrictions. We will develop new methods for the cost-effective evaluation of collaborative work to compensate for otherwise unrealistic sample sizes and costly engineering, using game theory to inspire task analogues and simulated users along with human users.

## 6.4. International Research Visitors

### 6.4.1. Visits of International Scientists

#### 6.4.1.1. Internships

**Meagan Aldridge**

Subject: Experimental user studies of real-time collaborative systems

Date: from June 2013 until October 2013

Institution: Wright State University, Department of Psychology, United States of America

#### 6.4.1.2. Invited researchers

**Participant:** Valerie Shalin.

Subject: Experimental user studies of real-time collaborative editing and trust-based collaboration

Date: from May 2013 until June 2013 and from October 2013 until May 2014 (sabbatical)

Institution: Wright State University, Department of Psychology, United States of America

**Participant:** Weihai Yu.

Subject: Collaborative editing algorithms

Date: from September 2013 until July 2014 (sabbatical)

Institution: University of Tromsø, Department of Computer Science, Norway

## 7. Dissemination

### 7.1. Scientific Animation

- Claude Godart is member of the editorial board of IEEE transaction on Service Computing, International Journal of Services Computing and International Journal of E-adoption journals, and member of the review board of the International Journal of Next Generation Computing. He has been PC co-chair of EIDWT 2013 (4th International Conference on Emerging Intelligent Data and Web Technologies). In 2013, he has been program committee member of BPM (Business Process Management), BPMDS (Business Process Modelling, Development and Support), CBI (IEEE Conference on Business Informatics), IEEE Conference on Big Data, EDOC (The enterprise computing conference), IEEE CLOUD Computing, ICWS (IEEE International Conference on Web Services), RCIS (Research challenges in Information Systems), SCC (IEEE International Conference on Services Computing) conferences.
- Claudia-Lavinia Ignat is member of the editorial board of Journal of CSCW (Computer Supported Cooperative Work). She has been or is PC member of CSCW (International Conference on Computer Supported Cooperative Work and Social Computing) 2015, SIGMOD Demo 2014, CDVE (International Conference on Cooperative Design, Visualization and Engineering) 2013 and 2014, ICEBE (International Conference on Business Engineering) 2013 and the workshop IWCES (International Workshop on Collaborative Editing Systems) in 2013 and 2014. She reviewed papers for IEEE Transactions on Parallel and Distributed Systems and Transactions on Internet Technology.
- Olivier Perrin has been or is Program Committee member of ICSOC 2013, BPM PALS 2013 workshop (3rd International Workshop on Process-Aware Logistics Systems), QASBA 2013 workshop (Quality Assurance for Service-based applications) 2013, BIS 2013 (International Conference on Business Information Systems), SITIS conference 2013 and 2014. He reviewed in 2013 papers for IEEE Transactions on Services Computing, International Journal of Cooperative Information Systems, Automated Software Engineering, IEEE Transactions on the Web journals.

- Gérald Oster was a PC member of CoopIS 2013 (International Conference on Cooperative Information Systems).
- François Charoy has been PC member of ICEBE (International Conference on Business Engineering) 2013, CTS 2013 (International Symposium on Collaborative Technologies and Systems), DG.O (International Conference on Digital Government Research) 2013, and of several workshops. He is member of the editorial board of the Service Oriented Computing and Applications Journal (Springer). He was co-chair of the Third Collaborative Technology for Coordinating Crisis Management Track at WETICE 2013.
- Claudia-Lavinia Ignat is member of the Inria Nancy-Grand Est COMIPERS researchers committee. She is in charge of European affairs for Inria Nancy Grand-Est. She is the Delegate of International Relations for Inria Nancy-Grand Est. She is member of the Inria Nancy - Grand Est committee for health, safety and working conditions. She was a member of the jury for the recruitment of permanent Inria junior researchers at Inria Nancy-Grand Est.
- Olivier Perrin is member of the council of École Doctorale IAEM (Informatique, Automatique, Électronique et Mécanique), and co-head of the Commission de la mention Informatique.
- Gérald Oster is member of the Administration Council of TELECOM Nancy.
- Nacer Boudjlida addressed an invited conference at the 3rd International Symposium ISKO-Maghreb'2013: Concepts and Tools for Knowledge Management. Marrakech, Morocco, November 2013.
- Nacer Boudjlida is a member of the council of the Fédération Charles Hermite (Université de Lorraine) and a member of the council of the Faculté Sciences et Technologies (Université de Lorraine).
- Nacer Boudjlida has been a PC member in many scientific events, including COOPIS, COOPIS/EI2N, CAISE/EMMSAD, IEEE-CBI, BPM/AICCSA, ISKO Maghreb symposium, IFAC, etc.

## 7.2. Teaching - Supervision - Juries

### 7.2.1. Teaching

Permanent members of the SCORE team are leading teachers in their respective institutions. They are responsible of lecture in disciplines like software engineering, database systems, object oriented programming and design, distributed systems, service computing and even more advanced topics at all levels and in all kind of departments in the University. Most of the PhD Students have also teaching duties in the same institutions. As a whole, the SCORE team accounts for more than 2500 hours of teaching.

- G r me Canals is the head of the Computer science department of the Nancy University Institute of Technology (IUT Nancy Charlemagne) since sept. 2010, and is responsible for the professional licence degree "Web application programming" since sept. 2001.
- Jacques Lonchamp is responsible for the professional licence degree "Free and Open Source Software".
- Claude Godart is responsible for the Computer Science department of the engineering school ESSTIN. He was study director of the master degree "Distributed Services, Security and Networks" until September 2013. Claude Godart is member of the board of directors and the recruitment committee 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.
- Olivier Perrin was responsible of the Certificat Informatique et Internet (C2I) course for DEG collegium of University of Lorraine.

- François Charoy is responsible of the Software Engineering specialisation at the TELECOM Nancy Engineering School of University of Lorraine.
- Gérald Oster is responsible of the 3rd year internship program at the TELECOM Nancy Engineering School of University of Lorraine.
- Pascal Urso is responsible for the "Security, Services, Systems and Network" track of the master degree in computer science at University of Lorraine from September 2013.

### 7.2.2. Supervision

PhD: Aymen Baouab, Gouvernance et supervision décentralisée des chorégraphies inter-organisationnelles, Université de Lorraine, 5/2013, Claude Godart, Olivier Perrin

PhD: Yongxin Liao, Title: Semantic annotations for systems interoperability in a PLM environment, University of Lorraine, 5/2013, Advisors: Nacer Boudjlida (LORIA) and Hervé Panetto (CRAN).

PhD in progress: Luc André, Réplication et Maintien de la Cohérence en Temps Réel dans les Réseaux Pair-à-pair, started in 9/2011, François Charoy et Gérald Oster

PhD in progress: Mehdi Ahmed Nacer, Title: Evaluation of CRDT for optimistic replication, started in 9/2011, François Charoy et Pascal Urso

PhD in progress: Elio Goettelman, Exécution en confiance de processus dans le cloud, started in 9/2011, Claude Godart

PhD in progress: Ahmed Bouchami, Sécurité des données collaboratives d'une plateforme PaaS, started in 11/2012, Olivier Perrin

PhD in progress: Adrien Devresse, Study of effective sharing and analysis of very large metadata repositories: application to the High Energy Physics computing community, started on 11/2011, Olivier Perrin

PhD in progress: Badrina Gasmi, Title: Distributed Competence Management, Béjaïa University, Algeria, started in January 2011, Advisors: Nacer Boudjlida and Hassina Talantikite (Béjaïa University).

PhD in progress: Faïza Bouchaib, Title: Toward a Generic Model for Competence Management, Béjaïa University, Algeria, started in January 2011, Advisors: Nacer Boudjlida and Hassina Talantikite.

PhD in progress: Jordi Martori i Adrian, Data constraints for large-scale collaboration, started in 10/2013, François Charoy et Pascal Urso

### 7.2.3. Juries

SCORE members were members of the following PhD defense committees:

- Mohammed Oussame Kherbouche, PhD, Université du Littoral Côte d'Opale, December 2013 (François Charoy)
- Oussema Dabbebi; PhD, Université Henri Poincaré Nancy 1, June 2013 (Claude Godart)
- Chedlia Chakroun, PhD, ENSMA Poitiers, October 2013 (Claude Godart)
- Francis Ouedraogo, PhD, INSA Lyon, November 2013 (Claude Godart)
- Hanane Abdeljelil, PhD, Université Claude Bernard Lyon1, November 2013 (Claude Godart)
- Hanaa Mayzad, PhD, Université du Littoral Côte d'Opale, January 2013 (Claude Godart)
- Mohamed Hilia, PhD, Université Paris Est, December 2013 (Claude Godart)
- Fahad Muhammad, PhD, University Lumière, Lyon 2, April 2013 (N. Boudjlida, reviewer and member)
- Karim Doumi, PhD, University Med V-Souissi, Rabat, Morocco, September 2013 (N. Boudjlida, reviewer and member)
- Yonxin Liao, PhD, Université de Lorraine, November 2013 (N. Boudjlida)
- Maryam Eslamichalandar, PhD, CNAM Paris, December 2013 (Olivier Perrin)
- M. Komlan Akpédjé KEDJI, PhD, Université de Toulouse, July 2013 (Khalid Benali)



SCORE members were members of the following Habilitation defense committees:

- Mme Julie Dugdale, HDR, Université Joseph Fourier Grenoble 1, December 2013 (François Charoy)
- Youakim Badr, HDR, INSA Lyon, December 2013 (Claude Godart)

## 8. Bibliography

### Publications of the year

#### Doctoral Dissertations and Habilitation Theses

- [1] A. BAOUAB. , *Gouvernance et supervision décentralisée des chorégraphies inter-organisationnelles*, Université de Lorraine, June 2013, <http://hal.inria.fr/tel-00843420>

#### Articles in International Peer-Reviewed Journals

- [2] K. BENOURET, R. VALLIYUR-RAMALINGAM, F. CHAROY. *CrowdSC: Building Smart Cities with Large-Scale Citizen Participation*, in "IEEE Internet Computing", November 2013, vol. 17, n<sup>o</sup> 6, pp. 57-64 [DOI : 10.1109/MIC.2013.88], <http://hal.inria.fr/hal-00919513>
- [3] K. BESSAI, S. YOUCEF, S. NURCAN, C. GODART, A. OULAMARA. *Scheduling strategies for business process applications in Cloud environment*, in "International Journal of Grid and High Performance Computing", January 2014, <http://hal.inria.fr/hal-00920341>
- [4] J. FRANKE, F. CHAROY, P. EL KHOURY. *Framework for Coordination of Activities in Dynamic Situations*, in "Enterprise Information Systems", February 2013, vol. 7, n<sup>o</sup> 1, pp. 33-60 [DOI : 10.1080/17517575.2012.690891], <http://hal.inria.fr/hal-00726746>
- [5] J. FRANKE, F. CHAROY. *Coordination of Distributed Collaborative Activities for Disaster Management*, in "International Journal of Collaborative Enterprise", October 2013, vol. 3, n<sup>o</sup> 2/3, pp. 110 - 129 [DOI : 10.1504/IJCENT.2013.053291], <http://hal.inria.fr/hal-00870713>
- [6] S. HADDAD, L. MOKDAD, S. YOUCEF. *Bounding models families for performance evaluation in composite Web services*, in "Journal of Computational Science", March 2013, vol. 4, n<sup>o</sup> 4, pp. 232-241 [DOI : 10.1016/J.JOCS.2011.11.003], <http://hal.inria.fr/hal-00920332>

#### Invited Conferences

- [7] N. BOUDJLIDA. *Complementarity in Competence Management*, in "International Symposium ISKO-Maghreb", Marrakech, Morocco, November 2013, <http://hal.inria.fr/hal-00926532>

#### International Conferences with Proceedings

- [8] A. AGUSTINA, N. GU, C.-L. IGNAT, M. MACFADDEN, H. SHEN, D. SUN, C. SUN. *The Thirteenth International Workshop on Collaborative Editing Systems*, in "Conference on Computer supported cooperative work", San Antonio, United States, February 2013, <http://hal.inria.fr/hal-00924922>
- [9] M. AHMED-NACER, P. URSO, F. CHAROY. *Improving Textual Merge Result*, in "9th IEEE International Conference on Collaborative Computing: Networking, Applications and Worksharing", Austin, Texas, United States, IEEE, October 2013, <http://hal.inria.fr/hal-00873506>

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- [10] M. AHMED-NACER, P. URSO, B. VALTER, N. PREGUIÇA. *Concurrency Control and Awareness Support for Multi-synchronous Collaborative Editing*, in "9th IEEE International. Conference on Collaborative Computing: Networking, Applications and Worksharing", Austin, Texas, United States, IEEE, October 2013, <http://hal.inria.fr/hal-00873496>
- [11] L. ANDRÉ, S. MARTIN, G. OSTER, C.-L. IGNAT. *Supporting Adaptable Granularity of Changes for Massive-scale Collaborative Editing*, in "CollaborateCom - 9th IEEE International Conference on Collaborative Computing: Networking, Applications and Worksharing - 2013", Austin, United States, October 2013, <http://hal.inria.fr/hal-00903813>
- [12] A. BAOUAB, O. PERRIN, C. GODART. *Supervision Décentralisée des Chorégraphies de Services*, in "31ème Congrès INFormatique des ORganisations et Systèmes d'Information et de Décision (INFORSID 2013)", Sorbonne, Paris, France, May 2013, <http://hal.inria.fr/hal-00828498>
- [13] K. BENOURET, R. VALLIYUR-RAMALINGAM, F. CHAROY. *Answering Complex Location-Based Queries with Crowdsourcing*, in "9th IEEE International Conference on Collaborative Computing: Networking, Applications and Worksharing", Austin, United States, October 2013, <http://hal.inria.fr/hal-00877357>
- [14] K. BESSAI, S. YOUCEF, C. GODART, S. NURCAN, A. OULAMARA. *Business Process scheduling strategies in Cloud environments with fairness metrics*, in "SCC - IEEE International Conference on Services Computing - 2013", Santa Clara, United States, IEEE, June 2013, pp. 519 - 526 [DOI : 10.1109/SCC.2013.94], <http://hal.inria.fr/hal-00920349>
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- [17] B. GASMI BOUMEZOUED, H. NACER, N. BOUDJLIDA. *Competence Discovery and Composition*, in "International Symposium ISKO-Maghreb", Marrakech, Morocco, November 2013, <http://hal.inria.fr/hal-00926522>
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- [19] E. GOETTELMMANN, N. MAYER, C. GODART. *A general approach for a trusted deployment of a business process in clouds.*, in "Medes (Fifth International Conference on Management of Emergent Digital EcoSystems)", Luxembourg, Luxembourg, ACM, 2013, pp. 92-99 [DOI : 10.1145/2536146.2536164], <http://hal.inria.fr/hal-00922189>
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- [21] M. PASLARIU, N. BOUDJLIDA. *A wireless library for the Nintendo dual screen (DS) game console*, in "2013 International Conference on Sport and Computer Science", Hong Kong, China, December 2013, <http://hal.inria.fr/hal-00926556>

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- [22] M. GAUTIER, B. WROBEL-DAUTCOURT. *Visualisation dynamique de programmes, artEoz : l'outil qui manquait*, in "Sciences et technologies de l'information et de la communication (STIC) en milieu éducatif", Clermont-Ferrand, France, B. DROT-DELANGE, G.-L. BARON, E. BRUILLARD (editors), 2013, <http://hal.inria.fr/edutice-00875615>

### **Conferences without Proceedings**

- [23] G. CANALS, A. CORDIER, E. DESMONTILS, L. INFANTE-BLANCO, E. NAUER. *Collaborative Knowledge Acquisition under Control of a Non-Regression Test System*, in "Workshop on Semantic Web Collaborative Spaces", Montpellier, France, May 2013, 14 p. , <http://hal.inria.fr/hal-00880347>

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- [24] N. GUERMOUCHE, C. GODART. *Composition of Web Services : from Qualitative to Quantitative Timed Properties*, in "Web Services Foundations", A. BOUGUETTAYA, Q. Z. SHENG, F. DANIEL (editors), Springer, January 2014, pp. 399-422 [DOI : 10.1007/978-1-4614-7518-7\_16], <http://hal.inria.fr/hal-00921395>

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- [26] C.-L. IGNAT, G. OSTER, M. NEWMAN, V. SHALIN, F. CHAROY. , *Measurement of Remote Response Delay in Multi-Synchronous Collaborative Editing*, Inria, December 2013, n<sup>o</sup> RR-8419, 20 p. , <http://hal.inria.fr/hal-00917317>

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