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**Team SCORE**

Services and Cooperation

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RESEARCH CENTER  
**Nancy - Grand Est**

THEME  
**Distributed Systems and Services**



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

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## 2. Overall Objectives

### 2.1. Overall Objectives

SCORE research domain is cooperative, distributed, and Process-Aware Web Information Systems. The advent of the web 2.0 and its emphasis on services pushed new IS applications such as electronic commerce, collaborative editing, e-learning, e-engineering to become widespread. A common characteristic of these applications is that they are cooperative, human-centered, creative by nature but also driven by sophisticated underlying infrastructure. Such applications are also distributed in space (people work in different locations), in time (people work at different time) and they cross organizational barriers, making difficult their coordination and crucial the issues of privacy and trust. In this domain, the evolution of the Internet and of the Web seems to open new challenges and questions every day. In our case, we have chosen to consider two dimensions of the issues faced by users and developers of web and service based systems :

1. The first dimension refers to management of collaborative 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. This is part of the service oriented computing research field.

We are considering these two dimensions at a Web scale where there is no central authority that governs the system. This raises many challenges 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 as we want to offer collaborators a flexibility concerning the chosen work models and technologies. We are tackling these two 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 writing.
- 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;

### 2.2. Highlights

- Hien Thi Thu Truong, Claudia Lavinia Ignat, Mohamed Rafik Bouguelia from the SCORE team and Pascal Molli, Professor at the University of Nantes, received the Best Paper Award at the CollaborateCom 2011 conference.
- Olivier Perrin has been promoted to the rank Professor at the University of Nancy 2.
- François Charoy has spent six month as visiting academic at SAP Research Australia as well as at the NICTA (National ICT Australia Ltd).
- Three PhD have been successfully defended in the SCORE team in 2011[1], [3], [2].

BEST PAPER AWARD :

[18] **7th International Conference on Collaborative Computing: Networking, Applications and Work-sharing (CollaborateCom 2011)**. H. T. T. TRUONG, C.-L. IGNAT, M.-R. BOUGUELIA, P. MOLLI.

## 3. Scientific Foundations

### 3.1. Introduction

Our scientific foundations are grounded on two different dimensions, distributed collaborative systems supported by sophisticated data sharing mechanisms and service oriented computing with an emphasis on orchestration and on non functional properties.

Distributed collaborative systems enable distributed group work using computer technologies. Designing such systems require an expertise in the domain of Distributed Systems (DS) and in the Computer-supported collaborative work (CSCW) 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. 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 can decide with whom to share them. In this type of collaboration SCORE team investigated the issues of management of distributed shared data and coordination between users and groups.

Service oriented Computing [33] is an established domain in which the ECOO and now the SCORE team has been working on for a long time. It refers to the general discipline that studies the development of computer applications at the scale of the web. In this context, a service is an independent software program with a specific functional context and capabilities published as a service contract (or more traditionally an API). Service composition is the aggregation of a set of services whose interactions are coordinated. The scale, the autonomy of services, the heterogeneity and some well defined design principles underlying SoC opens new research questions that are at the basis of the SCORE problematic and that spans 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) [36] 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 [35] 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 [31]
- the algorithms based on commutative replicated data types (CRDT) [34]

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 parameterized 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 [32]. 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 modeling, 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 established standards business process models founded on well grounded theories (e.g. Petri Nets) that meet the needs of both business analyst 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 artifacts. 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 application providing value based on the composition of lower level services [28].

### **3.5. Service Composition**

More and more, we are considering processes as piece 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 transactional 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.

## **4. Application Domains**

### **4.1. E-government**

E-government is now a well established domain that provides its own requirements in the field of service and information management. From our perspective, mostly processes, e-government applications have very strong requirements regarding security, privacy and interoperability between different organizations, belonging potentially to different countries. One of the prominent contributions we have made in this domain is related to our collaboration with SAP on the relationship between processes, security policies and the problem of delegation that we considered as a important for organizational flexibility. This work resonante also with its current continuation in crisis management.



Crisis management is a special case of e-government application as it involves mostly governmental agencies in coordination with other organizations like the Red Cross or other NGO. Moreover, it brings with it a lot of requirements that are very interesting for us in the domain of coordination: a crisis process shall be very flexible, adaptable and distributed. It is mostly human driven and can be critical. In this domain, we are collaborating with SAP to define a new model of coordination that should support people involved in crisis resolution.

## 4.2. E-learning, Collaborative Knowledge Building

Collaborative knowledge building process is a distributed social process [29]. During this process, Knowledge is built by a constellation of communities, each community being a node in the knowledge building network. Each node in the network is autonomous and has its own knowledge that can be exchanged and negotiate with other communities. A peer-to-peer architecture is more compatible with social architecture of knowledge building processes [30]. In addition, knowledge is basically created by individuals involved in social process [26]. Therefore, it is fundamental to support personal knowledge building in a collaborative knowledge building environment.

We develop distributed semantic wikis for collaborative knowledge building. These environments support the distributed social process of knowledge building and support personal knowledge building.

## 4.3. Groupware Systems and CASE Tools

Software engineering can be seen as distributed collaborative systems. Software Forges are social software. They transform stranger into collaborators, sometimes into developers. Forges are online services that allow instantiating, composing and managing collaborative services. Traditionally, provided collaborative services are version control systems, issue trackers, forums, mailing lists or wikis. We are applying our research results on coordination and data sharing into this context.

# 5. Software

## 5.1. QualiPSo Factory: Next Generation Forge

**Participants:** Gérald Oster [contact], Jérôme Blanchard, Christophe Bouthier.

The QualiPSo Factory <sup>1</sup> is a next generation forge based on Service Oriented Architecture developed within the QualiPSo european project <sup>2</sup>. Forges transform foreigners into collaborators, sometimes into developers. Forges are online services that allow instantiation, composition and management of collaborative services. Traditionally, provided collaborative services are version control systems, issue trackers, forums, mailing lists or wikis. In the framework of the european QualiPSo project, we are designing and implementing the next generation of forges. The QualiPSo factory framework aims to ease collaboration between forge users and integration of new collaborative services by developers. Our proposal relies on a software oriented architecture (SOA) and thereby allows composition of services. The current architecture provides core services such as security, notification, indexation, composition and naming which are externalized to other collaborative services. The Factory has been delivered as an outcome of the Qualipso project. Its future needs to be clarified.

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<sup>1</sup><http://qualipso.gforge.inria.fr/>

<sup>2</sup><http://www.qualipso.org>

## 6. New Results

### 6.1. Business Process Management - Service Oriented Computing

Processes have received a lot of attention in the last decade and proposed workflow solutions for office automation. The topic is subject today to a lot of interests carried by the expansion of business on the Web. However it is required need to satisfy new application requirements and execution contexts. We are interested in different aspects of process engineering: the management of change in business process; modeling and implementing Quality of Services properties (time, security, constraints...); composing existing process fragments of different nature and models; decentralizing a global process for a distributed execution with organizational constraints; process governance. Most of these aspects are considered within the frame of Web services and/or peer to peer architectures, and we are also interested in proposing new models of process for new applications domains.

#### 6.1.1. *Optimized decentralization and synchronization of cross-organizational business processes*

**Participants:** Claude Godart, Walid Fdhila.

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. An organization that aims for such fragmentation of its business processes needs to be able to separate the process into different parts. Therefore, 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. Additionally, this needs to be done in a networked environment, which is where Service Oriented Architecture plays a vital role.

Our work is focused 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. It also proposes methods to optimize the fragmentation process in terms of QoS properties and communication overhead [21], [10]. Moreover, it presents a framework to model web service choreographies in Event Calculus formal language.

Walid Fdhila has successfully defended his thesis on October, 7th [1].

#### 6.1.2. *A Declarative Approach to Web Services Computing*

**Participants:** Olivier Perrin, Ehtesham Zahoor, Claude Godart.

Web services composition and monitoring are still highly active and widely studied research directions. Little work however has been done in integrating these two dimensions using an unified framework and formalism. Classical approaches introduce an additional layer for handling the composition monitoring and thus do not provide the important execution time violations feedback to the composition process. This year, we proposed the DISC framework which aims to provide a highly declarative event-oriented model to accommodate various aspects such as composition design and exceptions, data relationships and constraints, business calculations and decisions, compliance regulations, security or temporal requirements. Then, the same model is used for combining the control of the composition definition, its execution and the composition monitoring. We proposed a service oriented architecture with a flexible logic, including complex event patterns and choreographies, business oriented rules, and dynamic control of compositions. Advantages of this unified framework are the higher level of abstraction to design, execute, and reason upon a composition, the flexibility of the approach, and the ability to easily include non-functional requirements such as temporal or security issues and we implement the DISC framework using the Discrete Event Calculus reasoner. Ehtesham Zahoor defended his thesis in November [3], and had presented the DISC framework at ICWS 2011 [20].

We also continued the previous work initiated within the Associate Team INRIA VanaWeb about the provisioning of Web services composition using constraints solvers. The approach consists in instantiating this abstract representation of a composite Web service by selecting the most appropriate concrete Web services. This instantiation is based on constraint programming techniques which allow matching Web services according to a given request. The proposal performs this instantiation in a distributed manner, i.e., the solvers for each service type are solving some constraints at one level, and they are forwarding the rest of the request (modified by the local solution) to the next services. When a service cannot provision part of the composition, a distributed backtrack mechanism enables to change previous solutions (i.e., provisions). A major interest of this approach is to preserve privacy: solutions are not sent to the whole composition, services know only the services to which they are connected, and parts of the request that are already solved are removed from the next requests.

### **6.1.3. Alignment between Business Process and Service Architecture**

**Participants:** François Charoy, Karim Dahman, Claude Godart.

In the continuation of work done previously on change management during process execution, we are conducting work on the governance of change at the business level and on its implications at the architecture and infrastructure level of an information system. Last year was devoted to the definition of the transformation rules that allowed to go from a business model to an IT model, i.e. a transformation between model based on different paradigms. During this year, a great deal of effort has been done in order to extend our work on Business to IT alignment management. Our goal is still to maintain this alignment at the lowest possible cost when the business process are changing [9]. Further than that we are trying to describe and validated an engineering method to help designer to maintain this alignment [8].

### **6.1.4. Distributed Processes with Security Constraints**

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

Distributed processes governance is a very important challenge. In the past, we proposed various approaches for dealing with distribution, particularly for computing a set of sub-processes that can be distributed and that are equivalent to a given process. However, we did not deal with non-functional requirements as the focus was only on control and data flows. In this work, we try to deal not only with functional requirements, but also with non-functional requirements, in particular the security aspects. With Aymen Baouab, we already proposed an event-based approach that is able to verify that choreographies are valid with respect to given constraints (security constraints for instance) [7].

### **6.1.5. A Crisis Management Process Model**

**Participants:** François Charoy, Joern Franke.

As said before, crisis management has been a very fruitful domain to investigate new approaches in the domain of high value, human driven activity coordination in a multi organisational setting. Our work benefits from a large amount of use cases and detailed accounts of previous dramatic events to analyze requirements and confront our proposals. 2011 has been devoted to terminate the evaluation and the validation of the model that we have defined during the previous years. It has also been devoted to complete the work done in the previous years on the inter organisational dimension of the coordination management [11]. The entire contribution on crisis management, i.e. the model, the system and the evaluation are described in Joern Franke PhD document [2]

In order to try to leverage this work in a more information system oriented way, we have started some collaboration to confront our view on coordination with existing reference model for humanitarian operations[12]. We are currently looking for alternative financing vehicle in order to continue this work.

This work was conducted as a cooperation with SAP Research Sophia Antipolis and partially funded by a CIFRE Grant.

## 6.2. Distributed Collaborative Systems

Starting with Web2.0 era, the web became easily writable and changeable, and nowadays, it is getting more real-time. Rather than requiring that users or their software check a source periodically for updates, real-time web is a paradigm based on the principle of pushing information to users as soon as it is available. We are faced with an explosion of real-time social software (Twitter, Facebook, etc.). Even if many social software are currently available, most of them rely on collaborative systems with a centralized architecture or authority and consequently suffer of intrinsic problems of centralization: lack of fault tolerance, poor scalability, costly infrastructure, problems of privacy.

Distributed collaborative systems (DCS) ease and coordinate collaboration among multiple users who jointly fulfill common tasks over computer networks without the need of a central architecture or authority .

We continued our work on migrating DCS to pure peer-to-peer architectures. This year we focussed on the real-time aspect of the collaboration. We evaluated replication mechanisms suitable for real-time collaboration over peer-to-peer architectures.

Moreover, peer-to-peer collaborative systems need revisiting traditional security models that prevent users from accessing to data and granted rights are checked before access is allowed. These access control mechanisms are too strict and they do not scale well in a peer-to-peer architecture. We make the assumption that an effective collaboration should rely on a flexible optimistic security model based on trust. This year we proposed a new collaboration model based on contracts where we rely on an optimistic security model. Rather than adopting an a priori strict enforcement of security rules, in this optimistic solution, access is given first to data without control but with restrictions that are verified a posteriori.

### 6.2.1. Evaluation of algorithms for Peer-to-Peer Real-time collaboration

**Participants:** Mehdi Ahmed-Nacer, Claudia Ignat, Gérald Oster, Hyun-Gul Roh, Pascal Urso.

Nowadays, real-time collaborative editing systems such as Etherpad or Google Docs became very popular. The operational transformation (OT) approach is a traditional optimistic replication mechanism that was used for real-time collaboration. Recently, Commutative Replicated Data Types (CRDTs) were introduced as a new class of replication mechanisms whose concurrent operations are designed to be natively commutative. CRDTs, such as WOOT, Logoot, Treedoc, and RGAs, are expected to be substitutes of replication mechanisms in collaborative editing systems.

We investigated the suitability of CRDTs for realtime collaborative editing [6]. To reflect the tendency of decentralized collaboration, which can resist censorship, tolerate failures, and let users have control over documents, we collect editing logs from real-time peer-to-peer collaborations. We provided a theoretical evaluation as well as an experimental one by replaying the editing logs on various CRDTs and OT algorithms implemented in the same environment. We found out that CRDT algorithms initially designed for peer-to-peer asynchronous collaboration are suitable for real-time collaboration. Moreover, they outperform some representative operational transformation approaches that were well established for real-time collaboration in terms of generation time, remote integration time and space complexity

### 6.2.2. Contract-based collaboration

**Participants:** Claudia Ignat, Hien Thi Thu Truong.

In the push-pull-clone collaborative editing model widely used in distributed version control systems users replicate shared data, modify it and redistribute modified versions of this data without the need of a central authority. However, in this model no usage restriction mechanism is proposed to control what users can do with the data after it has been released to them. We extended the push-pull-clone model with contracts that express usage restrictions and that are checked a posteriori by users when they receive the modified data [18], [25]. We proposed a merging algorithm that deals not only with modifications on data but also with contracts. A log-auditing protocol [19] was used to detect users who do not respect contracts after they received data and to adjust user trust levels. The associated trust values can be computed by using any existing decentralised trust model. Our proposed contract-based model has been implemented and evaluated by using PeerSim simulator.

## 6.3. Interoperability and Enterprise Modeling

**Participants:** Nacer Boudjlida [contact], Khalid Benali.

In the continuation of our previous work on semantic-based and model-based solutions for interoperability, we applied and experienced a variety of semantic annotation types (structural, terminological and behavioral) in the frame of dynamic web services discovery and for competence management systems. In addition, we explored semantic graphs as a formal framework for competence description and management. Further, in order to ease semantic interoperability of heterogeneous competence management systems, we are defining a generic representation model that could serve as a shared ontology for these types of systems.

## 7. Contracts and Grants with Industry

### 7.1. CIFRE Grant with SAP Research

**Participants:** François Charoy, Joern Franke.

Since several years, we are strengthening our relationships with SAP Research in the areas of process management and security. This collaboration has been formalized in 2008 by the funding of Joern Franke under a CIFRE contract to work on a PhD thesis on process models for crisis management (or crisis process managements systems). The PhD has been defended in october 2011.

## 8. Partnerships and Cooperations

### 8.1. National Initiatives

#### 8.1.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010–2013)

**Participants:** Pascal Urso [contact], Mehdi Ahmed-Nacer, Claudia 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 – sep. 2013) will investigate a promising new approach that is simple, scales indefinitely, 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.

### 8.1.2. ANR STREAMS ANR-10-SEGI-010 (2010–2013)

**Participants:** Gérald Oster [coordinator], Luc André, Claudia Ignat, 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 eliminate 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 technics. 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 issues 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.

### 8.1.3. Wiki 3.0 (2009–2012)

**Participants:** Claudia Ignat [contact], Luc André, Gérald Oster, G r me Canals, Bogdan Flueraș.

Partners: XWiki SAS, SCORE team and Mandriva.

Website: <http://wiki30.xwikisas.com/>

The Wiki 3.0 project (dec. 2009 - juin 2012) is sponsored by the call for projects “Innovative Web” launched by the French Ministry of Economy. The objective of this project is the development of an open-source platform based on XWiki (<http://www.xwiki.org>) that addresses the three major evolution axes of collaborative Web: real-time collaboration, social interaction integrated into the production (chat, micro-blogging, etc) and on demand scalability (cloud computing). This platform should be competitive with major editors of collaborative Web developed by Google such as Google Wave, IBM and Microsoft.

### 8.1.4. Coclico (2009–2011)

**Participants:** G r me Canals, Christophe Bouthier.

Partners: INRIA, Bull, Orange Labs, Xerox, TELECOM & Management Sud Paris, CELI France, Bearstech, Gnurandal, Object Direct.

Website: <http://www.projet-coclico.org/>

The Coclico project (oct. 2009 – nov. 2011) aims to boost software forges communities by structuring a free and open source ecosystem for which a critical mass of actors exists in France. This reinforcement of communities is a key aspect to leverage issues related to collaborative and distributed software development that business companies are confronted.

In the framework of this project, SCORE Team has been designing and prototyping a demonstrator of the first semantic-based software forge.



### 8.1.5. 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.

### 8.1.6. Crisis Management Decision Making Support (2010–2011)

**Participant:** Fran ois Charoy [contact].

This project is a collaboration between LORIA, the Technological University of Troyes and EDF R&D and is sponsored by the GIS 3SGS. It aims to start a pluridisciplinary investigation on facilitating crisis management decision-making.

## 8.2. International Initiatives

### 8.2.1. INRIA International Partners

Fran ois Charoy has been invited by NICTA (National ICT Australia Ltd) in the team of Anna Liu during his stay in Australia to contribute to a project involving BPM and the Cloud. This work is ongoing.

### 8.2.2. Visits of International Scientists

Victor Grishchenko, post-doc, TU Delft visited our group for two days in February 2011.

Ilaria Liccardi, postdoc in In-situ INRIA team in Paris who finished her Phd thesis at University Southampton visited our group for one day in September 2011.

### 8.2.3. Participation In International Programs

#### 8.2.3.1. GIS Interop Grande R gion

**Participants:** Nacer Boudjlida [responsible], Khalid Benali, Fran ois Charoy, Olivier Perrin.

Following the INTEROP Network of Excellence, the INTEROP V-Lab (International Virtual Laboratory on interoperability, <http://www.interop-vlab.eu/> ) has been officially created in Brussels on March 2007 as an international non-profit making association. In this context, Nancy played also a leading role in the definition of the V-Lab and in the settlement of the so-called INTEROP Grande Region pole, a partner of the INTEROP V-Lab <http://www.interop-grande-region.eu/>. On behalf of UHP Nancy 1, Nacer Boudjlida is the legal representative of this pole in the V-Lab and he is also the head of its management board. The Grande Region pole encompasses University of Namur, University of Paris I La Sorbonne, University Henri Poincar  Nancy 1 and University of Nancy 2 as the founding partners. It is defined as a Scientific (International) Interest Group (Groupement d'Int r t Scientifique or GIS). Its attachment to the INTEROP V-Lab has been achieved in May 2009. In 2010, three institutions joined the INTEROP Grande Region pole: INSA Lyon, University Lyon III and INSA Strasbourg.

#### 8.2.3.2. Associate Team INRIA VanaWeb

SCORE is involved in the Associate Team INRIA VanaWeb (with UTFSM Valpara so, Chili) which is interested in autonomous constraint solving concepts and their application to composition problems for Web services. The coordinators of this project are Carlos Castro (UTFSM Valpara so, Chili) and Christophe Ringeissen (CASSIS).

### 8.2.3.3. Co-advisory of PhD Thesis

- PhD Thesis of Yongxin Liao (UHP Nancy 1, LORIA and CRAN): started November 2010
- PhD Thesis of Badrina Gasmi with Béjaïa University, Algeria: starts January 2011 (Nacer Boudjlida)
- PhD Thesis of Faïza Bouchaib with Béjaïa University, Algeria: starts January 2011 (Nacer Boudjlida)

## 9. Dissemination

### 9.1. Animation of the scientific community

- Khalid Benali has been PC member of I-ESA 2011, INFORSID 2011 and of several workshops.
- Nacer Boudjlida is a member of the *prime board* of the program committee of CAISE (Computer Assisted Information Systems) 2011, I-ESA'2010 and I-ESA'2012 (International Conference on Interoperability of Enterprise Systems and Applications). He also acts for several years as a PC member for many international conferences and workshops (CAiSE, COOP'IS, EMMSAD, SIIE, WWS, etc.). He acted as a co-organizer and a co-scientific editor of the workshops and the doctoral symposium of I-ESA'2010. He was also a reviewer for the Enterprise Information Systems Journal and for a special volume of Springer LNBIP (Lecture Notes in Business Information Processing series).
- G r me Canals is the co-chair of the "Mobilit  et Ubiquit " french national working group (GDR I3).
- Fran ois Charoy has been PC member of ICEBE (International Conference on Business Engineering) 2011, 4th European Conference ServiceWave (Industry Track), CTS 2011 (International Symposium on Collaborative Technologies and Systems), DG.O (International Conference on Digital Government Research) 2011, CEC 2011 (IEEE Conference on Commerce and Electronic Computing), ACIS (Australasian Conference in Information Systems) 2011, WISE 2011 (International Conference on Web Information System Engineering) 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 Collaborative Technology for Coordinating Crisis Management Track at WETICE 2011
- Claude Godart has been PC chair of the IEEE International Conference on Commerce and Enterprise Computing 2011 conference, PHD symposium chair of the BPM 2011 conference, demo chair if the Wise 2011 conference. He is member of the editorial board of "Advance in enterprise systems" and "International Journal of E-adoption" journals, and member of the review board of the International Journal of Next Generation Computing. He has been or is program committee member of BPM (Business Process Management) 2011, BPMDS (Business Process Modelling, Development and Support) 2011, Collaborative Computing (CollaborateComm)2011, EDOC(The enterprise computing conference) 2011, CEC (IEEE Conference on Commerce and Enterprise Computing) 2011, IEEE CLOUD Computing 2011, ICWS (IEEE International Conference on Web Services)2011, SCC (IEEE International Conference on Services Computing)2011, WISE (Web Information Engineering) 2011, ECOWS (European Conference on Web Services) 2011.
- Claudia-Lavinia Ignat has been or is PC member of CDVE (International Conference on Cooperative Design, Visualization and Engineering) 2011 and 2012, ICEBE (International Conference on Business Engineering) 2011, AINA (International Conference on Advanced Information Networking and Applications) 2012, COLLA (International Conference on Advanced Collaborative Networks, Systems and Applications) 2011 and the workshops SocialComNet (International Workshop on Social Computing, Network, and Services) 2011 and 2012 and IWCES (International Workshop on Collaborative Editing Systems) in 2011 and 2012. She is member of the editorial board of Journal of CSCW (Computer Supported Cooperative Work).



- Jacques Lonchamp has been or is PC member of CSEDU (International Conference on Computer Supported Education) 2011, ICALT (International Conference on Advanced Learning Technologies) 2011, . He reviewed papers for "Journal of Computer-Supported Collaborative Learning", "Computers & Education", "Interacting With Computers", "Internet and Enterprise Management", "International Journal of Distance Education Technologies".
- Gérald Oster was a PC member of CoopIS 2011 (International Conference on Cooperative Information Systems). He reviewed papers for "Computer Supported Cooperative Work" and "Entreprise Information Systems" journals.
- Olivier Perrin has been Program Committee member of PALS (Process-Aware Logistics Systems) workshop of BPM 2011, Qasba (Quality Assurance for Service-based applications) workshop of ECOWS 2011, GRCIS workshop 2011). He reviewed in 2011 papers for IEEE Transactions on Services Computing and Software and Systems Modeling journals. He also gave a tutorial at BPM 2011 enterprise day.
- François Charoy is member of the Administration Council of University Henri Poincaré Nancy 1 and of ESIAL.
- Pascal Urso is member of the Scientific Council of University Henri Poincaré Nancy 1.
- Claudia-Lavinia Ignat is member of the INRIA Nancy-Grand Est COMIPERS researchers committee. She is member of the INRIA Nancy-Grand Est center committee. She was interim leader of the SCORE team in the period February-August 2011 during the leave of François Charoy at NICTA.
- Gérald Oster is member of the Administration Council of ESIAL.
- Gérôme Canals is member of the Administration Council of Nancy University Institute of Technology (IUT Nancy Charlemagne).
- Boudjlida Nacer is a member of the Council ("Conseil") of the Scientific and Technology Faculty (FST) of the University Henri Poincaré Nancy 1 as he is a member of the council of the scientific sector MIAE (Mathematics, Informatics, Atomic, Electronic) of that FST.

SCORE members were member of the following PhD defense committees:

- Joern Franke, PhD, Université Henri Poincaré Nancy 1, October 2011 (François Charoy)
- Virginie Legrand Contes, PhD, Université de Nice, Décembre 2011 (François Charoy)
- Adeel Ahmad, PhD, Université du littoral côte d'Opale, December (Claude Godart)
- Issam Bouslimi, PhD, Université de Toulouse 1, June 2011 (Claude Godart)
- Thibault Cholez, PhD, Université Henri Poincaré Nancy 1, June 2011 (Claude Godart)
- Walid Fdhila, PhD, Université Henri Poincaré Nancy 1, October 2011 (Claude Godart)
- Mohamed-Anis Mekki, PhD, Université Henri Poincaré Nancy 1, December 2011 (Claude Godart)
- Ehtesham Zahoor, PhD, Université Nancy 2, November 2011 (Claude Godart, Olivier Perrin)
- Chantal Cherifi-Bonner, PhD, Université de Corse Pascal Paoli, December 2011 (Nacer Boudjlida)
- Mumtaz Ahmad, PhD, Université Henri Poincaré Nancy 1, November 2011 (Nacer Boudjlida)

SCORE members were members of the following Habilitation defense committee:

## 9.2. Teaching

SCORE members have important responsibilities and are leading teachers in several cursus in Nancy University (University Henri Poincaré Nancy 1, University Nancy 2 and INPL), at different levels, including Masters (ESIAL, ESSTIN, research and professional masters). Some members have also a lecturing activity with international partners (Algeria, Morocco, Lebanon) at the Master's degree level. It would be too long to detail all the lectures for which Score members are responsible. In 2010/2011, members of the Score team have delivered more than 2000 hours of lectures to which can be added other activities like internship and project supervising.

- Nacer Boudjlida is the head of the Computer Science department of the Faculty of Sciences and technologies, UHP Nancy 1.
- Gérôme Canals is the head of the Computer science department of the Nancy University Institute of Technology (IUT Nancy Charlemagne), and is responsible for the professional licence degree "Web application programming" since sept. 2011.
- Jacques Lonchamp is responsible for the professional licence degree "Free and Open Source Software".
- Claude Godart is responsible for the Computer Science department of ESSTIN. He is study director of the research and professional master degree "Distributed Services, Security and Networks".
- 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 for the professional licence degree "Web application programming" until august 2011, and is now responsible of the Certificat Informatique et Internet (C2I) for University Nancy 2.
- François Charoy is responsible of the Software Engineering specialisation at the ESIAL Engineering School of University Henri Poincaré Nancy 1.
- Gérald Oster is responsible of the 3rd year internship program at the ESIAL Engineering School of University Henri Poincaré Nancy 1.

PhD & HdR :

PhD : Joern Franke, Coordination des activités réparties dans des situations dynamiques : le cas de la gestion de crise inter-organisationnel, Université Henri Poincaré Nancy 1, October 2011 (François Charoy)

PhD: Ehtesham Zahoor, Gouvernance de service: aspects sécurité et données, Université de Nancy 2, November 2011 (Olivier Perrin)

PhD: Walid Fdhila, Décentralisation Optimisée et Synchronisation des Procédés Métiers Inter-Organisationnels, Université Henri Poincaré Nancy 1, October 2011 (Claude Godart)

PhD: Aymen Baouab, Distribution de processus interentreprises basée sur une architecture orientée services en respectant les politiques de sécurité, Université Henri Poincaré Nancy 1 (Olivier Perrin)

Phd: Luc André, Réplication optimiste, Université Henri Poincaré Nancy 1 (François Charoy, Gérald Oster)

Phd: Medhi Ahmed Nacer, CRDT et nouveaux types de donnés, Université Henri Poincaré Nancy 1 (François Charoy, Pascal Urso)

## 10. Bibliography

### Publications of the year

#### Doctoral Dissertations and Habilitation Theses

- [1] W. FDHILA. *Décentralisation Optimisée et Synchronisation des Procédés Métiers Inter-Organisationnels*, Université Henri Poincaré - Nancy I, October 2011, <http://hal.inria.fr/tel-00643827/en>.

- [2] J. FRANKE. *Coordination des activités réparties dans des situations dynamiques : le cas de la gestion de crise inter-organisationnel*, Université Henri Poincaré - Nancy I, October 2011, <http://hal.inria.fr/tel-00642820/en>.
- [3] E. ZAHOOR. *Gouvernance de service : aspects sécurité et données*, Université Nancy II, November 2011, <http://hal.inria.fr/tel-00643552/en>.

### Articles in International Peer-Reviewed Journal

- [4] S. BHIRI, W. GAALLOUL, C. GODART, O. PERRIN, M. ZAREMBA, W. DERGUECH. *Ensuring customised transactional reliability of composite services*, in "Journal of Database Management", April 2011, vol. 22, n<sup>o</sup> 2, p. 64-92 [DOI : 10.4018/JDM.2011040103], <http://hal.inria.fr/hal-00603143/en>.
- [5] N. GUERMOUCHE, C. GODART. *Characterizing Compatibility of Timed Choreography*, in "International Journal of Web Services Research", 2011, vol. 8, n<sup>o</sup> 2, p. 1-28, <http://hal.inria.fr/hal-00646961/en>.

### International Conferences with Proceedings

- [6] M. AHMED-NACER, C.-L. IGNAT, G. OSTER, H.-G. ROH, P. URSO. *Evaluating CRDTs for Real-time Document Editing*, in "11th ACM Symposium on Document Engineering", Mountain View, California, United States, September 2011, p. 103–112 [DOI : 10.1145/2034691.2034717], <http://hal.inria.fr/inria-00629503/en>.
- [7] A. BAOUAB, O. PERRIN, C. GODART. *An Event-Driven Approach for Runtime Verification of Inter-Organizational Choreographies*, in "The 8th International Conference on Services Computing (IEEE SCC 2011)", Washington, United States, H.-A. JACOBSEN, Y. WANG, P. HUNG (editors), IEEE, July 2011, p. 640 - 647 [DOI : 10.1109/SCC.2011.55], <http://hal.inria.fr/inria-00596454/en>.
- [8] K. DAHMAN, F. CHAROY, C. GODART. *From Business Process to Component Architecture: Engineering Business to IT Alignment*, in "The Scientific Workshop on Service-oriented Enterprise Architecture for Enterprise Engineering", Helsinki, Finland, August 2011, <http://hal.inria.fr/inria-00597070/en>.
- [9] K. DAHMAN, F. CHAROY, C. GODART. *Towards Consistency Management for a Business-Driven Development of SOA*, in "The 15th IEEE International Enterprise Distributed Object Computing Conference (EDOC'11)", Helsinki, Finland, August 2011, <http://hal.inria.fr/inria-00597067/en>.
- [10] W. FDHILA, A. BAOUAB, K. DAHMAN, C. GODART, O. PERRIN, F. CHAROY. *Change Propagation in Decentralized Composite Web Services*, in "CollaborateCom", Orlando, United States, October 2011, <http://hal.inria.fr/hal-00647004/en>.
- [11] J. FRANKE, F. CHAROY, C. ULMER. *Handling Conflicts in Autonomous Coordination of Distributed Collaborative Activities*, in "20th IEEE International Conference on Collaboration Technologies and Infrastructures", Paris, France, S. REDDY, S. TATA (editors), IEEE CPS, June 2011 [DOI : 10.1109/WETICE.2011.73], <http://hal.inria.fr/inria-00605243/en>.
- [12] J. FRANKE, A. WIDERA, F. CHAROY, B. HELLINGRATH, C. ULMER. *Reference Process Models and Systems for Inter-Organizational Ad-Hoc Coordination - Supply Chain Management in Humanitarian Operations*, in "8th International Conference on Information Systems for Crisis Response and Management (IS-CRAM'2011)", Lisbon, Portugal, May 2011, <http://hal.inria.fr/inria-00593290/en>.

- [13] K. GAALOUL, E. PROPER, F. CHAROY. *Delegation Protocols in Human-Centric Workflows*, in "2011 IEEE 13th Conference on Commerce and Enterprise Computing (CEC)", Luxembourg, France, October 2011, p. 219 - 224 [DOI : 10.1109/CEC.2011.38], <http://hal.inria.fr/hal-00643449/en>.
- [14] K. GAALOUL, E. PROPER, F. CHAROY. *Injecting Task Delegation Constraints into a Role-based Access Control Model*, in "The first Workshop on Alignment of Business Process and Security Modelling (ABPSM'11)", Riga, Latvia, September 2011, p. 219 - 224, <http://hal.inria.fr/hal-00646869/en>.
- [15] Y. LIAO, M. LEZOUCHE, H. PANETTO, N. BOUDJLIDA. *Semantic Annotation Model Definition for Systems Interoperability*, in "OTM 2011 Workshops 2011 - 6th International Workshop on Enterprise Integration, Interoperability and Networking (EI2N)", Hersonissos, Crete, Greece, Lecture Notes in Computer Science, Springer-Verlag, October 2011, vol. 7046, p. 61-70, ISBN 978-3-642-25125-2 [DOI : 10.1007/978-3-642-25126-9\_14], <http://hal.inria.fr/hal-00627909/en>.
- [16] Y. LIAO, M. LEZOUCHE, H. PANETTO, N. BOUDJLIDA. *Why, Where and How to use Semantic Annotation for Systems Interoperability*, in "1st UNITE Doctoral Symposium", Bucarest, Romania, June 2011, p. 71-78, ISSN 2247-6040, <http://hal.inria.fr/hal-00597903/en>.
- [17] J. LONCHAMP. *Deixis in synchronous CSCL systems. A collection of socio-technical patterns.*, in "3rd International Conference on Computer Supported Education - CSEDU 2011", Noordwijkerhout, Netherlands, INSTICC, 2011, <http://hal.inria.fr/inria-00616920/en>.
- [18] *Best Paper*  
H. T. T. TRUONG, C.-L. IGNAT, M.-R. BOUGUELIA, P. MOLLI. *A Contract-extended Push-Pull-Clone Model*, in "7th International Conference on Collaborative Computing: Networking, Applications and Work-sharing (CollaborateCom 2011)", Orlando, Florida, United States, October 2011, <http://hal.inria.fr/inria-00636183/en>.
- [19] H. T. T. TRUONG, C.-L. IGNAT. *Log Auditing for Trust Assessment in Peer-to-Peer Collaboration*, in "The 10th International Symposium on Parallel and Distributed Computing (ISPDC 2011)", Cluj-Napoca, Romania, July 2011, <http://hal.inria.fr/inria-00636177/en>.
- [20] E. ZAHOOR, O. PERRIN, C. GODART. *An event-based reasoning approach to Web services monitoring*, in "The 9th IEEE International Conference on Web Services (ICWS 2011)", Washington DC, United States, July 2011, <http://hal.inria.fr/inria-00596461/en>.

### National Conferences with Proceeding

- [21] W. FDHILA, C. GODART, M. DUMAS. *Décentralisation Optimisée de Services Web Composés*, in "INFOR-SID", LILLE, France, May 2011, <http://hal.inria.fr/inria-00597009/en>.

### Research Reports

- [22] K. DAHMAN. *Bridging the Gap between the Business Processes and the Service Oriented Architecture*, LORIA, July 2011, <http://hal.inria.fr/inria-00608230/en>.

[23] M. LEZOCHE. *Explicating semantics in Enterprise Information Systems Models*, Université Henri Poincaré, November 2011, 140 pages Report for the Post-Doctorate diploma of the Université Henri Poincaré Supervisors: Hervé Panetto and Alexis Aubry, <http://hal.inria.fr/hal-00639095/en>.

[24] M. QUINSON, G. OSTER. *The Java Learning Machine: A Learning Management System Dedicated To Computer Science Education*, INRIA, February 2011, n<sup>o</sup> RR-7537, <http://hal.inria.fr/inria-00565344/en>.

### Other Publications

[25] H. T. T. TRUONG, M.-R. BOUGUELIA, C.-L. IGNAT, P. MOLLI. *Collaborative Editing with Contract over Friend-to-Friend Networks*, June 2011, Atelier Protection de la Vie Privée / Géolocalisation et Vie Privée (APVP2011), <http://hal.inria.fr/inria-00636184/en>.

### References in notes

[26] G. STAHL (editor). *Group cognition: Computer support for building collaborative knowledge*, Cambridge, MA: MIT Press, 2006.

[27] 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/>.

[28] 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, p. 37–55, Article dans revue scientifique avec comité de lecture. internationale., <http://hal.inria.fr/inria-00099953/en/>.

[29] M. BONIFACIO, P. BOUQUET, P. TRAVERSO. *Enabling Distributed Knowledge Management: Managerial and Technological Implications*, in "Novatica and Informatik/Informatique", 2002, vol. III, n<sup>o</sup> 1.

[30] M. BONIFACIO, R. CUEL, G. MAMELI, M. NORI. *A Peer-to-Peer Architecture for Distributed Knowledge Management*, in "In Proceedings of 3rd International Symposium on Multi-Agent Systems, Large Complex Systems, and E-Businesses", 2002.

[31] 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, p. 399–407, <http://doi.acm.org/10.1145/67544.66963>.

[32] G. OSTER, P. URSO, P. MOLLI, A. IMINE. *Data Consistency for P2P Collaborative Editing*, in "ACM Conference on Computer-Supported Cooperative Work - CSCW 2006 Proceedings of the 2006 20th anniversary conference on Computer supported cooperative work", Banff, Alberta, Canada, ACM Press, 11 2006, p. 259 - 268, C.: Computer Systems Organization/C.2: COMPUTER-COMMUNICATION NETWORKS/C.2.4: Distributed Systems/C.2.4.1: Distributed applications, H.: Information Systems/H.5: INFORMATION INTERFACES AND PRESENTATION (e.g., HCI)/H.5.3: Group and Organization Interfaces/H.5.3.2: Computer-supported cooperative work, <http://hal.inria.fr/inria-00108523/en/>.

[33] M. P. PAPAZOGLU, P. TRAVERSO, S. DUSTDAR, F. LEYMAN. *Service-Oriented Computing: State of the Art and Research Challenges*, in "Computer", 2007, vol. 40, p. 38-45.

- [34] 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, p. 395-403 [DOI : 10.1109/ICDCS.2009.20], <http://hal.inria.fr/inria-00445975/en/>.
- [35] Y. SAITO, M. SHAPIRO. *Optimistic Replication*, in "Computing Surveys", March 2005, vol. 37, n<sup>o</sup> 1, p. 42–81, <http://doi.acm.org/10.1145/1057977.1057980>.
- [36] 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<sup>o</sup> 1, p. 63–108, <http://doi.acm.org/10.1145/274444.274447>.