INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Team SCORE

Services and Cooperation

Nancy - Grand Est

Theme : Distributed Systems and Services

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SCORE is a team of LORIA (UMR 7503), a joint venture between CNRS, INRIA, Université Henri Poincaré Nancy 1, Université Nancy 2 and Institut National Polytechnique de Lorraine. The SCORE team has been created on October 1st, 2009 as a follow-up of the ECOO project-team.

1. Team

Research Scientist

Claudia Ignat [Junior Researcher (CR), INRIA]

Faculty Members

François Charoy [Team leader from September, 1st 2010, Associate Professor, Université Henri Poincaré Nancy 1, ESIAL, HdR]
Pascal Molli [Team leader until August, 31st 2010, Associate Professor, Université Henri Poincaré Nancy 1 until 31 August 2010, HdR]
Khalid Benali [Associate Professor, Université Nancy 2, HdR]
Nacer Boudjlida [Professor, Université Henri Poincaré Nancy 1, HdR]
Gérôme Canals [Associate Professor, Université Nancy 2]
Claude Godart [Professor, Université Henri Poincaré Nancy 1, ESSTIN, HdR]
Jacques Lonchamp [Professor, Université Nancy 2, HdR]
Gérald Oster [Associate Professor, Université Henri Poincaré Nancy 1, ESIAL]
Olivier Perrin [Associate Professor, Université Nancy 2, HdR]
Hala Skaf-Molli [Associate Professor, Université Henri Poincaré Nancy 1 until September 2010]
Pascal Urso [Associate Professor, Université Henri Poincaré Nancy 1]

Technical Staff

Abdelhilah Boudhan [Technical staff, since January 2010]
Jérôme Blanchard [Technical staff, FP6 IP QualiPSo, since February 2007]
Christophe Bouthier [Technical staff, Coclico, since July 2009]
Bogdan Flueras [Technical staff, Wiki 3.0, since February 2010]
Jean-Philippe Muller [Technical staff, from October 2008 untill September 2010]

PhD Students

Aymen Baouab [MESR grant since October 2009]
Karim Dahman [MESR grant since October 2008]
Sergiu Dumitriu [CIFRE grant with XWiki SAS since December 2007]
Walid Fdhila [MESR Grant since October 2007]
Khaled Gaaloul [SAP Research Grant since February 2006, ATER Université Henri Poincaré Nancy 1 since September 2009, ESIAL]
Joern Franke [CIFRE Grant with SAP Research since October 2008]
Nawal Guermouche [INRIA-Region Lorraine grant since October 2006, ATER Université Henri Poincaré Nancy 1 since September 2009, ESSTIN until August 2010]
Khaled Aslan Almoubayed [Syrian grant since October 2009 until August 2010]
Charbel Rahhal [ATER, Université Henri Poincaré Nancy 1 since September 2009, ESIAL]
Hien Thi Thu Truong [INRIA CORDI grant since October 2009]
Stéphane Weiss [CNRS-Region Lorraine grant since October 2006, ATER Université Henri Poincaré Nancy 1 since September 2009, ESSTIN]
Ehtesham Zahoor [French government grant since October 2008]

Post-Doctoral Fellow

Mario Lezoche [from CNR Roma, Italy, since November 2010, ATER, Nancy University, ESIAL, until September 2011]

Administrative Assistants

Isabelle Blanchard [Secretary (SAR), INRIA]
Delphine Hubert [Secretary, LORIA]

2. Overall Objectives

2.1. Overall Objectives

SCORE is interested in cooperative, distributed, and process-aware Web Information Systems. An Information System (IS) uses information technology to capture, transmit, store, retrieve, manipulate, and display information, thereby supporting one or more work 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 opens 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 the 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 includes integrating business processes with Web technologies and increasing the flexibility of existing process models to support creative and cooperative applications. 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 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

- The LOGOOT+ algorithm is an optimistic replication mechanism with an undo mechanism. Its scalability has been evaluated on thousand of pages' complete history extracted from Wikipedia and it overperform all the other approaches for collaborative editing [9].
- Pascal Molli, team leader until August 31st has been promoted to Professor at the University of Nantes.
- Three project proposals submitted by SCORE team members have been selected for funding by the ANR.
- One Habilitation and four PhD have been successfully defended in the SCORE team in 2010[3], [2], [1], [5], [4].

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 [54] is an emerging 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) [57] 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 [56] 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 [52]
- the algorithms based on commutative replicated data types (CRDT) [55]

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 [53]. 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 reconciliate 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 [48].

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 [47].

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 [33], [25].

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.

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 [49]. 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 [50]. In addition, knowledge is basically created by individuals involved in social process [45]. 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.

Libresource and QualiPSo Factory are forges developed within the Team. Bonita has been integrated with NovaForge [1], the forge from Bull.

5. Software

5.1. WikiTaaable

Participants: Hala Skaf-Molli [contact], Pascal Molli.

WIKITAAABLE [2] is a distributed collaborative knowledge building systems for cooking recipes. It integrates a case-based reasoning engine. It was designed to participate to CCC *Computer Cooking Contest*[3]. It is the vice-champion of the CCC. WIKITAAABLE uses SEMANTIC MEDIAWIKI as a central module to manage all data and knowledge used in the system. Making use of a semantic wiki has two major advantages: it enables humans and machines to rely on the same tool for representing and reasoning on shared knowledge and it provides users with user-friendly interfaces for browsing and editing knowledge.

[1] http://www.novaforge.org/
[2] http://taaable.fr/
[3] http://www.wi2.uni-trier.de/ccc09/index.php

5.2. QualiPSo Factory: Next Generation Forge

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

The QualiPSo Factory [4] is a next generation forge based on Service Oriented Architecture developed within the QualiPSo european project [5]. 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.

5.3. DSMW: Distributed Semantic MediaWiki

Participants: Pascal Molli [contact], Hala Skaf-Molli, Gérôme Canals.

DSMW is an extension to Semantic Media Wiki (SMW), the semantic version of MediaWiki, the wikipedia engine. DSMW allows to create a network of trusted distributed SMW servers that interact by publishing local changes and integrating remote changes. DSMW users can create communication channels between servers and use a publish-subscribe approach to manage the change propagation. DSMW synchronizes concurrent updates of shared semantic pages to ensure their consistency.

The first version of DSMW was released in October 2009. The latest version was released in August 2010 and includes now the propagation of file attachments and an enhanced user interface. This version was recently imported in the MediaWiki source repository by the MediaWiki community. DSMW is available at http://www.dsmw.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. Dynamic Authorisation Policies for Event-based Task Delegation

Participants: François Charoy, Khaled Gaaloul, Claude Godart.

[4] http://qualipso.gforge.inria.fr/
[5] http://www.qualipso.org

Task delegation presents one of the business process security leitmotifs. It defines a mechanism that bridges the gap between both workflow and access control systems. In this work, we investigate the potential of delegation events to ensure a secure task delegation within a workflow. Securing delegation involves the definition of authorisation policies which are compliant with the global policy of the workflow. Therefore, these delegation events will imply appropriate authorisations on the delegatee side for further actions as well as contain specific constraints for those actions. To that end, we introduce a delegation model that forms the basis of what can be analysed during the delegation process in terms of monitoring and security. We define an approach to support dynamic delegation of authority within an access control framework. The novelty consists of reasoning on authorisation based on task delegation events, and specifying them in terms of delegation policies. When one of these events changes, our access policy decision may change implying dynamic delegation of authority. We propose a technique that automates delegation policies using event calculus to control the delegation execution and increase the compliance of all delegation changes in the authorisation policy [25]. This work also lead to the thesis of Khaled Gaaloul as the result of a collaboration with SAP Research Karlsruhe[1]

6.1.2. Composition of Services with Time Constraints

Participants: Claude Godart, Nawal Guermouche, Olivier Perrin.

We propose a framework for analyzing the choreography compatibility of a set of services supporting asynchronous communications and taking into account data flow and constraints over data involved when exchanging messages. Especially, we consider timed properties that specify delays to exchange messages. By studying the possible impacts of timed properties on a choreography, we remarked that when theWeb services are interacting together, implicit timed dependencies can be inferred and give rise to implicit timed conflicts. As most related works study choreographies of synchronous messages, we propose new formal primitives and a model checking process to discover deadlocks in the context of asynchronous data exchanges. This work is implemented as an extension of the UPAAL environment.

Finally, the last problem we dealt with is the construction of a composition which attempts to satisfy the client need, even when a composition of services without any intervention is possible.In this objective, the approach that we propose is based on the generation of a mediator to try, whenever possible, to resolve the incompatibilities that may arise during a collaboration. Several mechanisms and algorithms have been developed to implement such a mediator [27].

All these aspects are deepened in Nawal Guermouche's PhD thesis [2].

6.1.3. Decentralization of Process Control Flow Execution

Participants: Claude Godart, Walid Fdhila.

Composite services are usually specified by orchestration models that capture control and data-flow relations among activities. Concrete services are then assigned to each activity based on various criteria. In mainstream service orchestration platforms, the orchestration model is executed by a centralized orchestrator through which all interactions are channeled. This architecture is not optimal in several ways: from an organizational point of view and especially with regards to privacy and confidentiality problems, and from a system point of view in terms of communication overhead with in addition the usual problems of a single point of failure. In previous work, mainly concerned with the organizational dimension, we proposed a method for executing service orchestrations in a decentralized manner while fulfilling collocation and separation constraints. This year, we concentrated on a method for optimizing the selection of services assigned to activities in a service orchestration in terms of QoS properties and communication overhead [19]. The method takes into account the communication cost between pairs of services, the number of data that these services need to exchange in the orchestration, and the collocation and separation constraints imposed by the service providers. This system aspect is integrated with the organizational aspect previously studied.

6.1.4. 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. This work has been presented in [33] and we are in the process of implement the DISC framework using the Discrete Event Calculus reasoner. We extended the DISC approach to take into account security aspects in [32].

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 [42].

6.1.5. Alignement 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. Following the work of Karim Dahman's Master thesis [51], we are working on the analysis of the impact of a business change, generated by process execution monitoring to the whole transformation chain, from the business level (e.g. process models) to the IT level (e.g. architecture). A first step in this direction has been to define the methodology and the technics to transform BPM processes (as BPMN model) in a Component based architecture (as a SCA model) that maintain as much as possible of the process design decision [17]. The next step will be to evaluate the impact of changes on one of the model to the other.

6.1.6. 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 service oriented architecture that can support the orchestration of various security services [46].

6.1.7. ACrisis Management Process Model

Participants: François Charoy, Joern Franke.

As said before, crisis management is a very promising domain to investigate new approaches in the domain of high value, human driven activity coordination in a multi organisational setting. Our work can benefit from a large amount of use cases and detailed accounts of previous dramatic events to analyze requirements and confront our proposals. We have already invalidated the use of BPM system to support such coordination and we have started to develop a model that should be ready for first experimentation during the coming year. This model is founded on a distributed network of activities with advanced governance rules at the activity level[20], [24], [21], [22], [34], [23]. This model has been implemented on top of Google Wave for future evaluations with end users.

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

6.2. Distributed Collaborative Systems

Distributed collaborative systems (DCS) ease and coordinate collaboration among multiple users who jointly fulfil common tasks over computer networks. The rise of Web 2.0 and especially wiki systems showed that a simple distributed collaborative system can transform communities of strangers into a community of collaborators. This is the main lesson taught by Wikipedia. Even if many DCS are currently available, most of them rely on a centralized architecture and consequently suffer of intrinsic problems of centralized architectures: lack of fault tolerance, poor scalability, costly infrastructure, problems of privacy.

Our main work focused on migrating DCS to pure peer-to-peer architecture. It requires developing new algorithms to enable massive collaboration and collaborative editing of complex data. Moreover, peer-to-peer collaborative systems need revisiting traditional access control mechanisms to balance users desire of flexibly sharing their data with keeping it private against some undesirable use.

This year, we made several contributions: we developed an algorithm that scales in terms of number of sites and number of edits, we proposed a novel architecture for deploying wikis over structured peer-to-peer networks, we extended algorithms to manage complex data types such as XML documents and semantic wikis. We also proposed a trust management mechanism for preventing data misuse in peer-to-peer collaboration.

6.2.1. Scalable Optimistic Replication Algorithms for Collaborative Editing

Participants: Pascal Molli, Pascal Urso, Stéphane Weiss.

Collaborative editing systems are becoming massive. They support a huge number of users to obtain quickly a huge amount of data. For instance, Wikipedia is edited by 7.5 million of users and got 10 million of articles in only 6 years.

Distributed systems rely on replication to ensure scalability and fault tolerance. The frameworks able to support the actual Web applications need very large scale replication mechanisms. When data are mutable, the consistency between replicas must be achieved. Since algorithms based on strong consistency have a poor scalability, many of these frameworks support only eventual consistency [58].

In the context of collaborative editing, the replication mechanism also requires to preserve causality and respect user's intention. These criteria form the CCI consistency model [57] (Causality, eventual Consistency, and Intention).

This year, we have designed an optimistic replication approach for linear structures with an undo mechanism. This approach is a CRDT (Commutative Replicated Data Type) that respects the CCI criteria and its scalability has been evaluated and compared to other approaches on thousand of pages' complete history extracted from Wikipedia[9]. We proposed a first complete formalization of the CCI criteria including undo operations[5]. Also, we designed a CRDT for XML collaborative editing with undo[29].

6.2.2. Distributed Collaborative Systems over Peer-to-Peer Structured Networks

Participants: Pascal Molli, Gérald Oster, Sergiu Dumitriu.

The ever growing need for digital information raises the need for content distribution architectures providing high storage capacity, data availability and good performance. While many simple solutions for scalable distribution of quasi-static content exist, there are still no approaches that can ensure both scalability and consistency for the case of highly dynamic content, such as the data managed inside wikis. Last years, we studied and proposed solution based on unstructured peer-to-peer networks. If these results were promising, the chosen architecture implies that the whole content (whole wiki data) is replicated on every peer-to-peer node. Often, this assumption is not acceptable. Therefore, this year, we proposed a peer-to-peer solution for distributing and managing dynamic content over a peer-to-peer structured network. The proposed solution [7] combines two widely studied technologies: Distributed HashTables (DHT) and optimistic replication. In our "universal wiki" engine architecture (UniWiki), on top of a reliable, inexpensive and consistent DHT-based storage, any number of front-ends can be added, ensuring both read and write scalability, as well as suitability for large-scale scenarios.

6.2.3. *Collaborative Knowledge Building over Trusted Semantic Wikis Networks*

Participants: Hala Skaf-Molli, Gérôme Canals, Pascal Molli.

Semantic wikis are new generation of wikis. They combine the advantage of Web 2.0 and Semantic Web. Existing semantic wikis are based on centralized architecture. This architecture is in contradiction with the distributed social process of knowledge building [49]. *The objective of this research is to build peer-to-peer semantic wikis for collaborative knowledge building.*

In previous work(SWOOKI [6]), we studied the design of a distributed semantic wiki based on an unstructured network of servers. In SWOOKI, all wiki pages are replicated to all servers with the objective of providing better performance and fault tolerance. The new approach we develop is based on the idea that users should have the control on the replication algorithm. The collaboration in DSMW is based on the *publish/subscribe* model. The publication, the propagation and the integration of modifications are under the control of the user [31]. This new approach serves two main objectives: enhance the privacy degree granted to users and offer a basis for supporting distributed collaborative processes. A better level of privacy is obtained thanks to the fact that users can decide which modifications they make public. They also can choose with which distant server they interact, and they can decide which remote changes should be integrated to their own copy. The system also offers an interesting basis for supporting distributed collaborative processes. By building a network of interconnected servers that correspond to the desired flow of semantic wiki pages, and assigning each server a particular step or activity, it is possible to represent a distributed process as a specific network of wiki servers. This is interesting for representing distributed co-authoring processes for semantic wiki documents [30].

DSMW uses the LOGOOT [59] algorithm to synchronize the semantic wikis pages. LOGOOT is an optimized version of WOOT, it ensures the convergence and intention preservation if the causality is ensured. The system is implemented an extension of SEMANTIC MEDIAWIKI. The first version of DSMW was released in October 2009 at http://www.dsmw.org. The latest version (1.0) was released in August 2010, and was recently included in the MediaWiki code repository.

6.2.4. *Trust Management in Peer-to-Peer Networks*

Participants: Claudia Ignat, Hien Thi Thu Truong.

This year we started to investigate privacy aspects in a peer-to-peer collaboration where users have control over their data and they share their data only with users that they trust. We proposed a trust management mechanism [43] where we log modifications done by users as well as the obligations related to usage policy of shared data and we detect mismatching between user actions and the received obligations. Trust values are adjusted according to users behavior.

6.3. Interoperability and Enterprise Modeling

Participants: Nacer Boudjlida [contact], Khalid Benali.

[6] http://wooki.sf.net/

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) [15] 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 [26]. Further, in order to ease semantic interoperability [12] of heterogeneous competence management systems, we are defining a generic representation model [18] that could serve as a shared ontology for these types of systems.

Information Systems are nowadays collaborative information systems and our aim is to strengthen the distributed and collaborative aspects in information systems (IS). Companies rely on their IS and the underlying models and technology platforms used for their implementation have a heavy impact on the company and its various businesses. [39] focuses on alignment of company business and its IS.

Actually, the term "business'" must be understood as performed by companies that may be virtual, distributed, or cooperating. In this context, the IS must be open, scalable, mobile and interoperable while keeping its usability. In this context, [40] focuses on the ability of models / formalisms, to produce enterprise systems and information systems that are formally validated , flexible, adaptable, scalable and interoperable.

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).

7.2. CIFRE Grant with XWiki SAS

Participants: Pascal Molli, Gérald Oster, Sergiu Dumitriu.

Following the fruitful work of the ANR XWiki Concerto, we are continuing the collaboration with XWiki SAS company. The PhD thesis funded by this CIFRE contract investigates peer-to-peer software architecture enabling distributed collaboration over a peer-to-peer wiki. The proposed architecture is based on a structured peer-to-peer architecture. It allows running large-scale wiki usage scenarios on top of a reliable and inexpensive distributed network of peers.

8. Other Grants and Activities

8.1. Regional Initiatives

8.1.1. CyWiki Project

Participants: Hala Skaf-Molli, Pascal Molli, Gérôme Canals.

Partners: The partners of the project are Orpailleur (coordinator), SCORE and KIWI teams (LORIA-INRIA Nancy-Grand Est), ATILF and LISEC (Université de Nancy 2), NUTICE (Nancy Université).

CyWiki is a multi-disciplinary project funded by the EPST, Universités Lorraines.

The objective of the project is to build a software infrastructure for the collaborative and assisted transformation of textual content into formal and structured knowledge. The transformation process is a decentralized process in which both human agents and automatic agents (text-mining agents, classification agents) collaborate to build knowledge units (in the form of ontology elements). This knowledge can then be used to query and make reasoning about the content. The experimental and application domain of the project is education. The project will focus on the transformation of textual pedagogical resources into domain ontologies and annotations and metadata about the content of these resources.

8.2. National Initiatives

8.2.1. ANR ConcoRDanT ANR-10-BLAN-0208 (2010-2013)

Participants: Pascal Urso [contact], 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.

8.2.2. ANR STREAMS ANR-10-SEGI-014 (2010-2013)

Participants: Gérald Oster [coordinator], 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)
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.

8.2.3. Wiki 3.0 (2009-2011)

Participants: Claudia Ignat [contact], Gérald Oster, Gérôme Canals, Bogdan Flueras.

Partners: XWiki SAS, SCORE team and Mandriva.

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

The Wiki 3.0 project (dec. 2009 - nov. 2011) 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.

8.2.4. Coclico (2009-2011)

Participants: Gérôme Canals, Christophe Bouthier, Pascal Molli.

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 is designing and prototyping the first semantic-based software forge.

8.2.5. ADT Galaxy (2009-2010)

Participants: François Charoy [contact], Olivier Perrin, Abdelhilah Boudhan.

Partners: Contributors to this ADT are mainly research project-teams, including ADAM, SCORE, OASIS, ASCOLA, TUVALU, SARDES and TRISKELL, and the galaxy ADT is led and managed by the TUVALU team.

Website: http://galaxy.gforge.inria.fr/

The galaxy ADT (Technology Development Action) contributes to make INRIA a value-added player in the SOA arena, by designing and developing an Open Framework for Agile and Dynamic Software Architecture. This ADT works for INRIA and INRIA's research project-teams direct benefit, and aims at pre-assembling technological bricks from various teams, projects and preparing them to be transferred through the open source software channel. The goal of the galaxy ADT is to provide an IT agile platform, built on dynamic software architecture principles, and fitting for flexibility, dynamical reconfiguration, adaptability, continuity and autonomic computing. Fractal, SCA-Tinfi and GCM-ProActive are the major technologies which will be the technological drivers of this ADT. The different usage scenarios as well as the different tools which will be developed at infrastructure, application and business levels will demonstrate that this platform is able to support the design, modelling, deployment and execution of business processes. In the same time, the ADT targets the definition of a new common language to manipulate dynamically adaptive distributed SOA-based systems, encompassing application and middleware layers. This common language takes different forms, inherited from works done by several project-teams with their distinct skills, and illustrates a new kind of collaboration between teams, coupling research and development works.

8.2.6. Crisis Management Decision Making Support (2010-2011)

Participant: François Charoy [contact].

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

8.3. European Initiatives

8.3.1. Project IP QualiPSo IST-FP6-IP-034763 (2006-2010)

Participants: Pascal Molli, Jérôme Blanchard, Christophe Bouthier, Gérald Oster.

Partners: Atos Origin, Bull, Engineering Ingegneria Informatica, Siemens, Telefonica I+D, Thales, European Dynamics, Mandriva, the Department for innovation and technologies of the Italian Presidency of the Council of ministers, Centro Ricerche Matematica Pura e Applicata, Fraunhofer Institute for Open Communication Systems, INRIA, Poznan Supercomputing and Networking Center, State University of Sao Paulo, South China University of Technology / Guangzhou Middleware Research Center, University of Bozen, University of Insubria, University Rey Juan Carlos.

Website: http://www.qualipso.org/

The goal of the QualiPSo integrated project is to define and implement technologies, procedures and policies to leverage the Open Source Software development current practices to sound and well recognized and established industrial operations.

SCORE is involved in activity 7 whose goal is to specify and develop the QualiPSo factory, a collaborative platform. In particular, SCORE leads the 7.1 work package and has proposed and developed a novel service oriented architecture for the factory.

8.4. International Initiatives

8.4.1. GIS Interop Grande Région

Participants: Nacer Boudjlida [responsible], Khalid Benali, François Charoy, Olivier Perrin, Hala Skaf-Molli.

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 Poincaré Nancy 1 and University of Nancy 2 as the founding partners. It is defined as a Scientific (International) Interest Group (Groupement d'Intérêt 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.

8.4.2. Associate Team INRIA VanaWeb

SCORE is involved in the Associate Team INRIA VanaWeb (with UTFSM Valparaìso, 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 Valparaìso, Chili) and Christophe Ringeissen (CASSIS).

8.4.3. Peer-to-Peer Semantic Wikis for Distributed Knowledge Building, MINCyT Project

Participants: Hala Skaf-Molli, Pascal Molli.

The objective of the project is to offer concepts and mechanisms for the creation, manipulation and the emergence of shared knowledge in large communities. Our initial hypothesis is that the shared knowledge will emerge during collaborative editing of semantically annotated content shared by a community: members of a community work together to create shared annotated content that gradually move from an unstructured towards a structured and formalized content.

Our approach is to use a class of existing tools: semantic wikis. A wiki is an online asynchronous collaborative editor. It allows you to edit content through a web browser. A semantic wiki is an extension of traditional wikis by adding semantic capabilities. The semantic annotations can be imported from well-defined ontology. The aim of the project is to extend the working modes in semantic wikis for including:

- Capabilities to edit ontologies. This will transform the semantic wiki into a collaborative ontology editor.
- Peer-to-peer and optimistic replication capabilities. This allows supporting scalability and choosing knowledge propagation and integration by community.
- Mechanism to manage divergence and the different viewpoints.

The participants of the project are: SCORE and Orpailleur team from LORIA and Lifia-UNLP (Argentina)

The project is funded by international scientific cooperation program MINCyT (Argentine)/INRIA-CNRS (France)

8.4.4. Postdoctoral Cooperation

- Mario Lezoche, PhD from CNR (National Research Council), Roma, Italy, post-doc stay from November 2010 till September 2011.

8.4.5. Co-advisory of PhD Thesis

- PhD Thesis of Hassina Talantikite entitled “Les Web Services Complexes : Découverte, Composition, Sélection, et Orchestration”, with Béjaïa University, Algeria : defense done in Januray 2010 (Nacer Boudjlida)
- PhD Thesis of Salah Hamri, entitled “Interopérabilité des systèmes de workflow”, with Constantine University, Algeria : defense done in November 2010 (Nacer Boudjlida)
- 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)
- PhD Thesis of Charbel Rahhal with University Lebanese of Beyrouth (2006-2010): Distributed Semantic Wikis on Peer-to-Peer Networks (Pascal Molli and Hala Skaf-Molli).

9. Dissemination

9.1. Animation of the scientific community

- We have organized the 9th IFIP I3E conference on e-Business, e-Services and e-Society in Nancy (23-26 September 2009).
- Khalid Benali has been PC member of IFIP I3E 2010, I-ESA 2010, INFORSID 2010 and of several workshops. He has reviewed papers for IEEE Transactions on Systems, Man and Cybernetics and published a special issue of ingénierie des systèmes d’information (Hermès-Lavoisier) [38].

- Nacer Boudjlida is a member of the *prime board* of the program committee of CAISE (Computer Assisted Information Systems) 2011 as he was a member of the one of I-ESA'2010 (International Conference on Interoperability of Enterprise Systems and Applications). He also acted 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 doctorial symposium of I-ESA'2010. He was also a reviewer for the Entreprise Information Systems Journal.
- Gérôme Canals has been PC member IFIP I3E 2010 International Conference and of the ACM SAC 2010 track on Web Applications. Gérôme Canals is the co-chair of the "Mobilité et Ubiquité" french national working group (GDR I3).
- François Charoy has been PC member of ICEBE (International Conference on Business Engineering) 2010, CTS 2010, DG.O 2010 and of several workshops. He chaired the CAISE 2010 PhD Forum in place of Boualem Benattalah.
- Claude Godart 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) 2010, Collaborative Computing (CollaborateComm) 2010, EDOC (The enterprise computing conference) 2010, IEEE Conference on Commerce and Enterprise Computing 2010, IEEE CLOUD Computing 2010, IEEE International Conference on Web Services 2010 IFIP I3E 2010. He has been member of the evaluation committee of the ANR Arpege section.
- Claudia-Lavinia Ignat has been or is PC member of Group 2010, CDVE 2010 and 2011, ICEBE 2010 and several workshops. She reviewed papers for the "Computer Supported Cooperative Work", "Cooperative Information Systems" and "Information Sciences" journals.
- Jacques Lonchamp has been or is PC member of WBE (International Conference on Web-based Education) 2010, CSEDU (International Conference on Computer Supported Education) 2010, ICALT (International Conference on Advanced Learning Technologies) 2010, . 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".
- Pascal Molli has been PC member of ICEIS (Conference on Enterprise Information Systems) 2010, LMO 2010, and several workshops. He reviewed papers for "IEEE Transactions on Parallel and Distributed Systems", "IEEE Transactions on Computers" and "Computer Supported Cooperative Work".
- Gérald Oster was a PC member of CoopIS 2010 (International Conference on Cooperative Information Systems) and Agile Tour - Nancy 2010. He reviewed papers for "Entreprise Information Systems" journal.
- Olivier Perrin has been Program Committee member of I3E 2010, and of several workshops (TCoB 2010, GRCIS 2010). He reviewed in 2010 papers for IEEE Transactions on Services Computing, Journal of Data Management, Information Systems Frontiers and Software and Systems Modeling journals.
- Hala Skaf-Molli has been PC member of Program DEXA 2010, ICEIS 2010 (11th International Conference on Enterprise Information Systems). She has also reviewed paper for World Wide Web journal.

- 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.
- Pascal Molli is member of the "Comité Technique Paritaire" of University Henri Poincaré Nancy 1.
- Gérôme Canals was member of the INRIA Nancy-Grand Est CDT committee until June 2010.

- 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.
- Gérald Oster is member of the Administration Council of ESIAL. He participated to the recruitment committee of one Assistant Professor position of University Henri Poincaré, ESIAL.

SCORE members were member of the following PhD defense committees:

- Stéphane Weiss, PhD, Université Henri Poincaré Nancy 1, October 2010 (Pascal Molli, Pascal Urso)
- Charbel Rahhal, PhD, Université Henri Poincaré Nancy 1, November 2010 (Pascal Molli, Hala Skaf)
- Khaled Gaaloul, PhD, Université Henri Poincaré Nancy 1, September 2010 (François Charoy, Claude Godart)
- Mahmoud Bahramgi, PhD, Université Blaise Pascal Lyon 1, December 2010 (Claude Godart)
- Khaled Gaaloul, PhD, Université Henri Poincaré Nancy 1, September 2010 (François Charoy, Claude Godart)
- Nawal Guermouche, PhD, Université Henri Poincaré Nancy 1, June 2010 (Olivier Perrin, Claude Godart)
- Guillaume Hoffmann, PhD, Université Henri Poincaré Nancy 1, December 2010 (Claude Godart)
- Mohammad Ashiqur Rahaman, PhD, Eurecom, May 2010 (François Charoy)
- Wassim Bouaziz, PhD, Université Toulouse 1, Spetember 2010 (François Charoy)
- Pierre Colomb, PhD, Université Blaise Pascal Clermont Ferrand II, December 2010 (Olivier Perrin)
- Alberto Portilla Flores, PhD, Université de Grenoble, October 2010 (Olivier Perrin)
- Bruno Claudepierre, PhD, Universié Paris I, Pantheon, Sorbonne, December 2010 (Khalid Benali)

SCORE members were members of the following Habilitation defense committee:

- Chirine Ghedira, HDR, Université Blaise Pascal Lyon 1, December 2010 (Claude Godart)
- Daniela Grigori, HDR, Université Versailles-Saint-Quentin, December 2010 (Claude Godart)
- Olivier Perrin, HDR, Université Henri Poincaré Nancy 1, June 2010 (Claude Godart)

9.2. Vulgarisation

- Claudia Ignat participated to the visit of Youth Enterprise Association (AJE - Association Jeunesse Entreprise) on 8th of April 2010 at INRIA Nancy Grand-Est. She gave an overview of the different types of activities performed by a researcher at INRIA.
- Nacer Boudjlida was a co-organizer and a speaker at a scientific day on interoperability on May 2010 (sponsored by the Nancy's Charles Hermite Federation of Research Labs). The audience was composed with academic and industrial people.

9.3. 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 degree level.

- 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).

- 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..
- Pascal Molli is co-responsible of the professional Master degree speciality ”Software Engineering” at the Lebanese University in Tripoli, Lebanon. He is also co-responsible of the professional Master degree speciality ”Software Engineering” at the University Henri Poincaré Nancy 1.
- Hala Skaf-Molli is co-responsible and co-founder of the professional Master degree speciality ”Software Engineering” at the Lebanese University in Tripoli, Lebanon. She represents the University Henri Poincaré Nancy 1 in the submitted European project TEMPUS “Master’s degree in Enterprise Systems Engineering”, the evaluation results will be available in December.
- Olivier Perrin is responsible for the professional licence degree ”Web programming”.
- 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.

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