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Project-Team ECOO

Middleware for supporting cooperative work through Internet

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THEME COG

Activity Report

2008

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2. Overall Objectives

2.1. Overall Objectives

Keywords: *business process*, *collaboration*, *cooperation*, *cooperative editing*, *coordination*, *data consistency*, *data privacy*, *data replication*, *distributed system*, *semantic web*, *web service*, *workflow*.

ECOO is interested in the development of cooperative, distributed, and process-aware Web Information Systems.

An Information System (IS) is a particular type of work system that uses information technology to capture, transmit, store, retrieve, manipulate, or display information, thereby supporting one or more work systems.

The advent of the web has pushed new IS applications as electronic commerce, collaborative editing, e-learning, e-engineering ...A common characteristic of such applications is to be more cooperative, i.e. more human-centred, more creative by nature, and implicating more subtle machine mediated interactions, than traditionally.

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 problems of privacy and trust.

The ECOO objective is to support such applications. The work is organized in two main streams. The axis entitled PROCESS ENGINEERING is interested in process-aware information systems that manage and execute operational processes 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 cooperative applications. The axis entitled COLLABORATIVE DISTRIBUTED SYSTEMS is concerned with the development of collaborative systems but with a scientific focus on data consistency in peer to peer architectures. Interactions between these two axes are mainly governed by shared issues, especially on awareness and privacy management.

Privileged applications in our target are creative cooperative applications such as cooperative editing, co-conception, co-engineering, service orchestration in various domains such as Software Engineering, e-Commerce, e-Learning, Architecture-Engineering-Construction.

It is a strategic objective for us to develop software and to experiment it "outside the laboratory". We support too the "Open Source Software initiative", see Bonita in section 5.2, LibreSource in section 5.3, and Qualipso in section 7.1.

2.2. Highlights

In 2008:

- Sawsan Alshattnawi has defended her thesis entitled "Concurrency and Group awareness in peer-to-peer collaborative editing"; Mohsen Rouached has defended his thesis "A rigourous approach for enginneering Web services composition"; Ustun Yildiz has defended his thesis "Decentralizing business processes with quality of services constraints".

- Walid Gaaloul has joined the Telecom & Management SudParis school with an Associated Professor position; Mohsen Rouached has joined the University Claude Bernard Lyon 1 with a postdoctoral position in Mohand-Saïd Hacid's team; Ustun Yildiz has joined the Genome center of University of California in Davis in Bertram Ludascher's group.

- A new version of Bonita, Nova Bonita http://wiki.bonita.objectweb.org/, has been released. This version differs from the previous one because it is based on the Process Virtual Machine (http://docs.jboss.com/jbpm/pvm/article/)(of which Bonita is a foundation with JBPM).

3. Scientific Foundations

3.1. Workflow.

An important research direction of ECOO concerns the coordination of a distributed team based on an explicit definition of working processes.

Traditional workflow models [52], if they seem a good starting point for this modelling activity, suffer from a lack of flexibility in both control flow and data flow definition and interpretation; they are too rigid to model the subtlety of interactions characterizing creative cooperative activities.

As a consequence, different approaches have been proposed to extend the traditional workflow approach towards cooperative applications. In this context, our main stream approach is to keep a traditional process description model but with a different semantic for integrating control and data flow flexibility.

Another emerging characteristic of our approach is the consideration that, in many applications, there is not one explicit process, but several interacting processes, potentially based on different models (functional, state-based, dataflow), and in some cases not explicitly defined.

3.2. Cooperative transactions

To be able to define properties of workflow executions, activities are generally considered as black boxes executing as ACID transactions. Unfortunately, ACIDity seems antagonistic with cooperation, cooperative processes being of long duration, of uncertain development, dynamically defined and mobile. Especially, the Isolation property seems problematic for interacting activities exchanging intermediate results in complex feedback loops. To overcome the limits of traditional transaction models, several well founded or exotic models have been proposed.

Regarding the transactional issue, in the vein of [51], and in the aforementioned objective of multi-model process integration, we are concerned with the concurrency control and atomicity of transactional processes. This can be sketched in a top-down or in a bottom-up perspective. For both perspectives, we are developing a transactional framework to provide active support for transactional activities composition and composition evaluation.

3.3. Software configuration and version management

One domain in which cooperative work is organized since a long time is the software development domain. Tools such as CVS are used since several years by thousands of software developers. The *copy/modify/merge* paradigm is one of the most wide-spreaded implementation of cooperative work at a large scale. However, we have to note that this model, which synchronizes one entity at a time, if it is highly operational, suffers from some weakness regarding consistency of shared data.

The copy/modify/merge paradigm has deeply influenced our view of cooperation. But our objective is to integrate it in a more global vision for better taking into account semantic links between two or more objects, and better integrating asynchronous work phases with synchronous phases.

3.4. Real time synchronous editors

Synchronous editors allow to maintain as soon as possible the consistency of two or more copies of the same object that are concurrently modified at the same time by several users distributed through a network. Algorithms are founded on the fusion of execution traces.

We use trace fusion algorithms for everything that requests a synchronous view of several user modifications including the synchronous visualization of divergence between users modifying asynchronously copies of the same object. We extended these algorithms for enssuring a smooth and consistent transition from asynchronous to synchronous phases, especially for the reconciliation of divergent copies. We have developed a technology for specifying and implementing a generic and secure synchronizer.

3.5. Usage analysis

Cooperative work includes an important human dimension. A bad apprehension of this dimension leads inevitably to the rejection of any software solution on the field. A good study of actual usages before, during and after development is predominant.

Usage analysis is more a research topic in social sciences than in computer sciences. Our approach is to involve potential users early in the development process (participative design). Also, we ask specialists (psychologists, educationists), when possible, to conduct these analyses. We have had the opportunity to develop this strategy thanks to scientific and industrial relationships.

4. Application Domains

4.1. Application Domains

Our work aims at supporting creative cooperative applications of various natures executing on the Web : e-business, e-society, e-services ...for participants distributed in time, space and eventually in organizations.

5. Software

5.1. Introduction

The software products listed in this section have not reached the same level of diffusion. Bonita is distributed with a LGPL License and has developped its proper community. LibreSource has been released with a QPL License and a commercial license is "sold" by the Artnum Company. PROM is a joint initiative of a community of people involved in process mining. BPEL2EC and Wooki are research prototypes that we believe constitute a good basis for the development of future "popular" softwares.

5.2. Bonita flexible workflow management system

Participants: François Charoy [responsible], Oscar Barros, Claude Godart.

The first version of the *Bonita* workflow management system has been released in 2004 with a LGPL licence. A new version called *Nova Bonita* (http://bonita.objectweb.org/) has been released in 2008 with a LGPL licence (Nova Bonita exploits the *Process Virtual Machine* (http://www.onjava.com/pub/a/onjava/2007/05/07/the-process-virtual-machine.html)).

The Bonita workflow model is defined as a classical graph based one, but with an advanced execution model that allows different kinds of execution strategies: from classical and automatic, to less constrained user driven. Another difference with classical models is that process definition can be dynamic: Bonita supports direct process instantiation and execution. A new process can be created by cloning another running or finished process and then adapted to specific needs. Process fragment importation is also possible. Bonita is implemented on a J2EE application server. It is available on the application server Jonas and Jboss. It provides a definition and an execution API available as a session bean and as Web services. Integration of external components can be done inside activities using the BeanShell scripting language. Bonita is available as an ObjectWeb project on the ObjectWeb forge (http://bonita.objectweb.org/).

Bonita is a fundation, with JBPM (http://www.jboss.com/products/jbpm), of the *Process Virtual Machine* (http://www.onjava.com/pub/a/onjava/2007/05/07/the-process-virtual-machine.html).

Bonita is embedded in several largely distributed softwares.

5.3. LibreSource: services for hosting virtual teams

Participants: Pascal Molli [responsible], Jérôme Blanchard, François Charoy, Claude Godart, Gérald Oster.

LibreSource allows a virtual team to organize and its participants to cooperate. Its objective is in the vein of BSCW and SourceForge, but with an original object sharing model where copy convergence is based on the operational transformation approach which provides for a safe and generic synchronizer. In other words, LibreSource is not restricted to the synchronization of source code, but can apply to any type of data (XML for example) if the corresponding transformation operations are provided.

Another innovative point is the fact that the synchronizer can be distributed on several sites, thus providing for the modelling of (hierarchically organized) processes.

LibreSource also integrates traditional services for object sharing, communication, task management and group awareness.

LibreSource (http://www.libresource.org/) is implemented on a J2EE application server. It is available on Jonas.

5.4. PROM mining plug-ins

Participants: Walid Gaaloul [responsible], Claude Godart, Mohsen Rouached.

The ProM framework (http://www.processmining.org) is a pluggable framework developed by a community concerned with process mining. It supports a variety of process management techniques and can be extended by simply adding plug-ins. Currently, more than 30 plug-ins have been added.

We have provided this framework with mining plug-ins, whose goal is to extract a process model from a given event log without using any additional knowledge of the process. These plug-ins are results of Walid Gaaloul's thesis.

5.5. BPEL2EC: a translator from BPEL4WS specification to Event Calculus notations.

Participants: Mohsen Rouached [responsible], Walid Fdhila, Claude Godart, Pascal Urso.

BPEL2EC is a translator from BPEL process description to Event Calculus in the objective of static and dynamic verifications. This software has been initially prototyped in the context of Mohsen Rouached's Phd thesis and is now being used in the frame of the CPER PSW project (see 8.1) to validate critical properties such as correctness, completeness and conformity of Web services composition.

5.6. Wooki : a P2P Wiki system

Participants: Pascal Molli [responsible], Gérôme Canals, Julien Maire, Gérald Oster, Pascal Urso.

Wooki (http://wooki.sourceforge.net) is a P2P wiki system: a wooki network is a P2P network of wiki servers where each server stores a copy of the replicated wiki pages. Wooki uses an epidemic propagation approach to broadcast changes on the overlay network, combined with the WOOT algorithm to merge concurrent changes. Wooki is scalable, and supports dynamic networks and disconnected operations.

6. New Results

6.1. Overview

The section presents our results concerning our research work on Process Engineering and Collaborative Editing. For each of these two dimensions, first results are described and then perspectives are given.

6.2. Process engineering

6.2.1. Introduction

Processes have received a lot of attention in the last decade and succeeded in proposing workflow solutions for office automation. The topic is subject again to a lot of interests carried by the expansion of business on the Web, but with the need to satisfy new application requirements and execution contexts. We are interested in different aspects of process engineering: the introduction of the flexibility requested to model the subtlety of user interactions in creative applications; modelling and implementating consistency properties as requested by complex transactional processes; composing existing process fragments of different nature and models; abstracting a global view from a process set; tuning processes with regards to real mined executions; discovering of process models from execution logs; measuring privacy violation risk; integrating process with data flow. In addition, most of these aspects must be considered in a decentralized context in the frame of Web services and peer to peer architectures.

This year results are mainly concerned with validation of composed Web services, decentralized definition and enactment of service-oriented processes, task delegation techniques in cross domain processes, and spheres of flexibility.

6.2.2. *Static and dynamic process compliance verification*

Participants: Walid Fdhila, Nawal Guermouche, Claude Godart, Olivier Perrin, Pascal Urso, Mohsen Rouached.

Verifying the compliance of a process to its definition, i.e. to formally verify whether the process design does have certain desired properties, is very challenging. Verification can be done either a-priori, i.e., at design time, a-posteriori, i.e. after runtime to test and repair design errors, and dynamically in case of dynamic provisioning. For the a-priori part of the verification, we must be able to express the requirements using a formalism we can reason on to check if the behavioural properties are consistent (it is in this context that we have developed the translator from BPEL4WS specification to Event Calculus introduced in section 5.5). This task becomes not trivial if composition processes manage complex service dependencies. For the a-posteriori part of the verification, the execution should be auditable by providing functionalities to collect execution logs. Dynamic verification mixes these two approaches.

A first work [5], [8] attempts to apply Web service log-based analysis and process model checking techniques to provide knowledge about discrepancies between process models and related instances using a-posteriori verification. More precisely, given an event log, we verify a process composition's requirements after runtime, to provide knowledge about the context and the reasons of discrepancies between process models and related instances. This kind of verification is necessary since some interactions between Web services that constitute a process may be dynamically specified at runtime, causing unpredictable interactions with other services, and making the a-priori verification method insufficient as it only takes into account static aspects. Then, we show the ability to combine the components for monitoring the compliance of Web services compositions, and the components for discovering services at run-time [5], [32], [33]. We propose to use the specifications of the violated requirements to generate queries for discovering services that could substitute for malfunctioning services.

A second work deals with Web services composition based on data flow consideration and timed properties [21], [19], []. Thus, building a correct composition requires to consider the message choreography constraints augmented with timed properties. The aim is to allow a client who carries an abstract description of his request as the data flow he expects, to fulfil this request by interacting with the available services coherent with the requested data flow available in the right time window (e.g., in a healthcare application, once medical analyses are claimed, the result must be received within 24 hours). We have proposed a mechanism that aims at discovering the eventual implicit timed conflicts when composing Web services [20].

6.2.3. *Dynamic provisioning and monitoring of services composition*

Participants: Olivier Perrin, Ehtestam Zahoor.

A third work is concerned with the provisioning of Web services composition. We have proposed, in the context of the Associate Team INRIA VanaWeb, a framework based on the existence of an abstract composition, i.e., a process in which several services of different types can be combined together in order to achieve a given task. 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 to match 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. This allows keeping the minimal information about services, and thus ensuring the privacy of each service. It is worth noting that the degree of privacy depends on the locality of solvers. If a solver is associated to a block of services instead of a single one, then there is less privacy but we get more effciency ([29]).

Another work initiated in the frame of a master uses a pattern based strategy, called Mashup Processing Network (MPN) for building and validating mashups [40]. The idea is based on both process patterns and on Event Processing Network. It is supposed to facilitate the creation, modeling and verification of mashups. See perspectives below for more.

6.2.4. Decentralization and distributed enactment of cross-domain service-oriented processes
Participants: François Charoy, Walid Fdhila, Khaled Gaaloul, Claude Godart, Ustun Yildiz.

Current work on business process management, even when based on service oriented architectures, lacks of methodological support when decentralized processes span over several organizations and have sophisticated decentralized (at the extreme peer-to-peer) interactions. In this context, we are developing an approach to help to the decentralization of a business process. This includes the distribution of control and data constrained by management rules (QoS, privacy ...).

Based on the initial work started previous years, we have defined a theoretical framework for the decentralization of a process model, i.e. a set of operations for the distribution of a centralized process. More precisely, we have provided operations for decentralizing control and data flow definitions into a conversation integrating distribution aspects [6], [45]. To complement this first contribution, we have had a reflection on how to integrate new decentralization criteria such as privacy consideration and more generally designers' requirements related to decentralization [6], [39]. We have defined an architecture to execute such decentralized processes in the context of the existing Web services standardization effort.

One type of transparency and control supporting mechanism in human-centric decentralized collaboration is that of task delegation. In this objective we have deepened this concept in the context of heavily human-centric collaborative workflows. In general, we investigate additional delegation requirements regarding the specification of advanced security and privacy mechanisms. It addresses the modelling and mapping of access rights to tasks and respective delegation and revocation of tasks [18]. This work was conducted in the frame of an R4eGov case study to identify the key distinguishing factors regarding collaboration as opposed to coordination. A Task Management system has been developped; it can be configured with different task models supporting different kinds of behaviors, including delegation among different organisations.

6.2.5. Perspectives in process-engineering

As introduced above, Process Engineering is a very hot topic and perspectives are numerous. ECOO is well positioned on several of these topics. In the next year(s), we plan to address in priority the following questions : the first two are related to software design while the third is to software verification.

6.2.5.1. Decentralized definition and enactment of service-oriented processes
Participants: François Charoy, Karim Dahmen, Walid Fdhila, Claude Godart, Ustun Yildiz.

The objective at middle term is to generalize the work developped in Yildiz's Phd thesis by :

- capitalizing on this work and previous work on transactional patterns to develop an equiped methodolgy for the design of decentralized processes,
- introducing additional quality of service properties such as performance, trust, privacy and so on.

6.2.5.2. Cross domain process management:
Participants: François Charoy, Karim Dahmen, Joern Franke, Khaled Gaaloul, Claude Godart.

A follow-up of this year's work on Cross domain process management is the problem of coordination of activities in the context of Crisis Management. This work starts in the context of a Ph.D thesis funded by a CIFRE allocation with SAP Research - Sophia-Antipolis.

More generally, eGovernment is a very interesting study field to consider regarding services, composition of services, human services mixed with security, privacy and governance problems. A system that would both allow a citizen or a business to make a request to an administration, to follow the advance of his case in the daedalus of different organisations, to be ensured that regulations and laws are enforced for his safety and the government safety would greatly enhance the fluidity of Customer or Business to Government relationships, allowing even further refinements. This implies to be able to model government processes, from the point of view of what has to be done and from the point of view of what has to be enforced. These points of view are somehow orthogonal (one is procedural and one is declarative, one relates to functions and the other relates to both data, functions and time). Our goal is to reconcile these points of view.

6.2.5.3. Web services composition and validation
Participants: Walid Fdhila, Claude Godart, Nawal Guermouche, Olivier Perrin, Ehtestam Zahoor.

We are investigating the timed compatibility problem of a choreography in which the Web services are asynchronous and dynamically instantiable. For the best of our knowledge, these aspects are not yet handled in the exiting works on compatibility analysis. Moreover, we plan to extend our work on timed properties to consider more sophisticated timed properties.

Mashups are defined to be lightweight Web applications aggregating data from different Web services, built using ad-hoc composition and being not concerned with long term stability and robustness. We propose a pattern based approach, called Mashup Processing Network (MPN). The idea is based on Event Processing Network and is supposed to facilitate the creation, modeling and the verification of mashups. MPN provides a view of how different actors interact for the mashup development namely the producer, consumer, mashup processing agent and the communication channels. It also supports modeling transformations and validations of data and offers validation of both functional and non-functional requirements, such as reliable messaging and security, that are key issues within the enterprise context. We have enriched the model with a set of processing operations and categorize them into data composition, transformation and validation categories. These processing operations can be seen as a set of patterns for facilitating the mashup development process. MPN also paves a way for realizing Mashup Oriented Architecture where mashups along with services are used as building blocks for application development.

6.3. Distributed Collaborative Systems

6.3.1. Introduction

Distributed collaborative systems (DCS) facilitate and coordinate collaboration among multiple users who jointly fulfill common tasks over computer networks. The explosion 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 focussed on migrating DCS to pure peer-to-peer architecture. It requires developing new algorithms in order to enable collaborative editing of complex data and adapting awareness models.

This year, we made several contributions : we designed a group undo algorithm for DCS, we extended algorithms to manage complex data types such as XML, we contributed also to resolving specific issues of awareness in decentralized and P2P collaborative systems.

6.3.2. *Optimistic replication algorithms*

Participants: Pascal Molli, Pascal Urso, Stéphane Weiss.

After proposing a solution for achieving convergence based on operational transformation, we proposed this year a novel undo approach [37] based on compensation mechanism for collaborative editing systems. We showed that all existing undo mechanisms for operational transformation approach are either incorrect or limited. The correctness of our proposition has been formally proved by using the automated theorem prover SPIKE.

6.3.3. *Management of complex data*

Participants: Gérôme Canals, Claudia Ignat, Gérald Oster, Pascal Molli, Charbel Rahal, Hala Skaf-Molli.

We offered solutions not only for linear structured data such as a textual document seen as a sequence of characters, but also for complex data objects such as hierarchical documents and wikis.

We developed a multi-level editing approach [9] for maintaining consistency over hierarchical-based documents such as text and XML documents in peer-to-peer environments. The multi-level editing approach involves logging edit operations that refer to each node and a recursive application of any linear merging algorithm over the document structure. Further, we combined this approach with the TTF approach previously developed by ECOO team. This work constitutes the first approach for the reconciliation of XML documents adapted to peer-to-peer environments [25]. More precisely, we adapted the TTF approach for XML documents by developing transformation functions that satisfy the necessary properties for consistency maintenance. By satisfying these conditions we ensure that the merging algorithm is associative and commutative, allowing therefore synchronization between a set of peers in an arbitrary order.

We also investigated reconciliation of XML documents that conform to a DTD [34].

In the context of the project RNTL XWiki Concerto we studied the consistency maintenance of wiki pages in a peer-to-peer environment. We developed two solutions: one based on the WOOT algorithm and the other based on the SB/LTR algorithm. The SB/LTR algorithm uses the operational transformation mechanism for which we defined transformation functions that deal with textual data representing the content of wiki pages and metadata (attachments, annotations) [43], [17], [35].

6.3.4. *Awareness in Distributed Collaborative Systems*

Participants: Sawsan Alshattnawi, Gérôme Canals, Claudia Ignat, Pascal Molli, Gérald Oster.

Group awareness is an important factor of successful collaboration, being defined as an understanding of the activities of others which provides a context for your own activity. We focused on workspace awareness, particularly on providing awareness about the states of the shared documents in various contexts. We are interested in what information should be provided to users to prevent conflicting changes in large user groups and to understand divergence when conflicts cannot be avoided.

We investigated group awareness in the context of P2P wikis [2]. In a P2P wiki, concurrent updates may be issued at different sites and need to be merged on each site, by the servers and outside the control of users. While traditional wikis relying on a central architecture ensure that all pages have been reviewed by a user, some pages in a P2P wiki are produced by the system through an automatic merge. To overcome this problem, we introduced the idea of *concurrency awareness*. We built a concurrency awareness mechanism for a P2P wiki [13] that makes users aware of the status of the pages they access regarding concurrency: is it an edited page or a merged page? In addition, in case of merged page, it indicates which region of the page has been merged. This mechanism relies on a concurrency detection mechanism which labels the generated patches by the set of servers. Furthermore, in the context of P2P wikis we investigated the representation of the concurrent history of the wiki. While in traditional wikis histories are purely linear, our approach extends this visualisation to

incorporate additional information related to concurrency. History visualisation is based on the local timeline of version creation, indicates the concurrency status of each version (i.e. *merged* or *edited*) and highlights the concurrent part of the local history[12].

We proposed an awareness mechanism for improving collaborative work in the context of software engineering [24], [23] and collaborative writing of textual documents [26]. In version control systems such as CVS and Subversion frequently used for code development or writing of textual documents, users can work simultaneously on their shared documents and publish their changes at a later time. Unfortunately, users are not informed about concurrent changes while they work in their local workspaces. The new proposed awareness mechanism offers users the possibility of being informed by means of annotations about changes performed by other users. Users can continue working without the need of integrating concurrent changes which might lead to code that does not compile. Concurrent changes are localized by taking into account the structure of these documents (classes, methods, lines of the source code). For localizing and providing the content of concurrent changes, we used the operational transformation mechanism. The same approach of providing real-time awareness while users work in isolation was applied for the collaborative editing of textual documents that conform to a hierarchical structure. In this context we studied the tradeoff between awareness and user privacy. Users can filter details about their changes transmitted to other users according to their preferences.

We also studied awareness for the collaborative editing of web pages where we analysed changes done on a web page and all its linked pages [30]. Using edit profiles we provide the visualization of the quantity of changes of a certain type performed at different levels of the current web page (section, paragraph, sentence) and its linked pages.

6.3.5. Perspectives in distributed collaborative systems

In our current work we studied aspects of reconciliation of data and awareness in peer-to-peer networks without investigating security and privacy. However, it appears now that collaboration services provided by giant companies centralise a great quantity of information, centralisation that represents a real threat for privacy of users. Deploying collaboration services over P2P networks can be a technological solution to this issue. We will investigate the following two directions:

- Structured networks such as Distributed Hash Tables (DHTs) allow distribution of information among peers. Consequently, the central point of control can be avoided.

- The Web of Trust is also another form of P2P network. In a peer-to-peer network of trust each user can decide with whom to share their data.

We want to focus on these two approaches this year. However, we also want to continue our effort in basic replication algorithms and management of complex data on P2P network. We still have open issues on performances of replication algorithms on P2P networks. We still have to manage more and more complex data and we think that today the most complex data are ontologies.

- **Peer-to-peer structured networks**

  The most common type of structured peer-to-peer network is the DHT. In a DHT, each node is assigned and responsible for a chunk of key space while mapping of resources to key space is done using a hash function such as SHA-1. Hosted data is therefore distributed among peers rather than being replicated at all peers. In fact data is replicated over a small number of peers – generally less than ten peers – to tolerate failures. Formal results and experimentations proved that DHTs provide a high available key-data store being quasi-resilient even with a high degree of churn or a huge amount of failures. DHTs seem to be a good candidate on top of which we can build a distributed collaborative system. Unfortunately, they have an inherent limitation to collaboration: they do not support concurrent updates. Our idea is to apply optimistic replication techniques in order to maintain consistency between copies hosted by peers which are responsible of the same key. This combination would allow DHTs to support collaboration and also provide the ability to better tolerate network partitions.

- **Peer-to-peer networks of trust**

In a peer-to-peer network of trust each user can decide with whom to share his data. Users define their networks of trust containing people that they trust and with whom they wish to collaborate. We envision a collaboration model where changes done by users on their local workspaces are pushed to different channels and other users that have granted rights may pull these changes from these channels. The changes pulled by users from the communication channels are then merged with changes contained in their workspaces. We have to investigate algorithms that are best suited for this type of collaboration for data reconciliation. We will investigate collaboration over textual and multimedia documents such as audio and video documents as well as suitable awareness mechanisms for this type for collaboration. Finally, we want to combine the trust-based collaboration with the possibility of storing in a transparent way the shared data using structured networks for a high availability, fault tolerance and improved security of data.

- **Performances of replication algorithms**

  Massive collaborative editing becomes a reality through leading projects such as the Wikipedia. Such massive collaboration is currently supported with costly central service. To avoid such costs, we aim to provide a peer-to-peer collaborative editing system. Existing approaches that propose distributed collaborative distributed either do not scale in terms of the number of users or in terms of the number of editions. We aim at developing an approach that scales in these both dimensions while ensuring causality, consistency and intention criteria. We plan to evaluate the proposed approach and compare it to others with a corpus of all the editions applied on a set of the most edited and biggest page of the Wikipedia.

- **Peer-to-peer semantic wikis**

  Wikis have demonstrated how it is possible to convert a community of strangers into a community of collaborators. Semantic wikis have opened an interesting way to mix Web 2.0 advantages with the semantic web approach. P2P wikis have illustrated how wikis can be deployed on P2P networks and take advantages of their intrinsic qualities: fault-tolerance, scalability and infrastructure cost sharing. We are interested in building the first P2P semantic wiki that combines advantages of semantic wikis and P2P wikis. Building a P2P semantic wiki is challenging. It requires building an optimistic replication algorithm that is compatible with P2P constraints, ensures an acceptable level of consistency and generic enough to handle semantic wiki pages. Building a P2P wiki requires the definition of a clear model for building P2P semantic wikis. As such an algorithm forces commutativity of operations, a P2P semantic wiki will allow users to perform transactional changes on semantic wiki pages. This editing mode is particularly useful in semantic wikis because producing a consistent change often requires changing many wiki pages in one session [31].

6.4. Interoperability

Participants: Khalid Benali, Nacer Boudjlida, Chen Dong.

In the area of inter enterprise cooperation we are faced to the classical matching problem due to the use of different models by the various cooperating enterprise. Even if this issue is a historical database problem tackled through schema integration approaches, this domain has been renewed in the context of web XML schema integration, or in MDA approaches, or ontology approaches for knowledge representation, or in enterprise modeling.

In the continuation of an initial work on semantic-based and model-based solutions for interoperability, Nacer Boudjlida and Chen Dong applied and experienced the variety of semantic annotation types (structural, terminological and behavioural) [16], [4] in the frame of dynamic web services discovery [15], [42], [4].

Integration and model transformation technics, as well as common ontologies definitions allow discovering and defining semantical correspondences between an enterprise knowledge and its collaborators' one. This allows performing an integration solution or a communication solution between their systems by using specific methods such as model driven engineering ones. This model driven engineering approach is now well accepted for interoperability between enterprises. Our approach for interoperability based on an MDA architecture uses

meta models mapping to ensure interoperability of application models [14]. We define the interoperability between two applications through classification of identified mapping between their respective meta models.

Khalid Benali has contributed to a work for verifying the conformity of a process model [36].

7. Contracts and Grants with Industry

7.1. European IP Qualipso (2006-2010)

Participants: Pascal Molli [Responsible], Jérôme Blanchard, François Charoy, Claude Godart, Gérald Oster.

The goal of the QualiPSo integrated project (No 034763) is to define and implement technologies, procedures and policies to leverage the Open Source Software development current practices to sound and well recognised and established industrial operations (http://www.qualipso.org/).

ECOO is especially concerned with the specification and the design of the Qualipso factory.

7.2. RNTL Xwiki Concerto (2006-2009)

Participants: Gérôme Canals [Responsible], Claudia Ignat, Julien Maire, Pascal Molli, Gérald Oster.

XWiki Concerto (http://concerto.xwiki.com/) is a 2006 RNTL project which aims at developing a Wiki web application running on top of a P2P network and supporting mobile users with a variety of devices (from smartphones to desktops). The main scientific challenge is the design and implementation of an optimistic replication mechanism for the dissemination and merge of concurrent updates occurred on different copies of a shared document. This mechanism should not use a reference copy and should support sites that frequently join/leave the overlay network. The partners of the project are: XperNet (XWiki editor), Mandriva (Linux editor), ENST, EISTI, Objectweb and the INRIA Projects ATLAS and ECOO.

8. Other Grants and Activities

8.1. Regional actions

This PSW (Proof of Services Web, 2007-2008) project of the CPER MISN, axis "safety and security of systems", aims at developing a formal technique framework for Web services composition in order to address security and safety issues. A first goal is the specification of a formal framework for a flexible composition of Web services. These Web services are viewed as base components of service-oriented architectures. A second goal concerns the use of automated formal proof techniques at different stages of the composition process. Finally, a third goal is to create (and/or adapt) automated formal proof environments to master efficiently the behavior of software components in order to validate critical properties such as correctness, completeness and conformity. PSW has started at the end of 2007.

8.2. National actions

8.2.1. COPS

COPS (Composition Of Policies and Services, 2006-2008) is an ARA action interested in modelling security properties, composition of web services integrating security properties and guaranties, and monitoring of services conversations for preserving security policies. COPS involves LORIA Nancy, IRIT Toulouse, LIF Marseille and MS R&D Cambridge.

8.2.2. Icrisis

The ICRISIS project (funded by MEDD, 2007-2009) aims to produce a conceptual and technological framework to support and execute crisis simulations. It allows to prepare, execute and analyze crisis simulation involving students or professionnals. Crisis management is a major concern in our society. It is very important to provide future and actual managers with a pedagogical framework to allow them to learn how to act and react in a highly unanticipated situation. Regarding ECOO, this project is a challenge because crisis management is a case where the limit of classical process management solutions is reached. Reactivity, adaptivity and flexibility, human interactions are in this context required to the extreme. During this year, we have started to define a language to express crisis scenario. Rather than taking a classical workflow approach, we took an event driven approach. A scenario is described as a sequence of events that are propagated to students under the control of the animation team. Multiple scenarios can be used to drive the experimentation. A prototype has been developed, but it is not yet integrated in the existing platform. Partners of the project are Laego Team of Ecole des Mines (Leader of the project), Beta-Nancy 2, LabPsyLor from Nancy 2 and UPV, Erpi from ESGI, LSG from ENSIC. Participants to the simulation come from the SDIS 54, the Nancy prefecture, France Bleu.

8.2.3. ADT Galaxy

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 will work 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 will target the definition of a new common language to manipulate dynamically adaptive distributed SOA-based systems, encompassing application and middleware layers. This common language will take 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.

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

8.2.4. Others

Ecoo participates to the working groups *Services Web* and *UbiMob* (Ubiquity, Mobility) of GDR I3 and to the GDR MACS ECI.

We participate to several contracts with national enterprises (7.1,cf. 7.2).

We collaborate with several French laboratories and universities in the context of the INTEROP V-Lab (see 8.3).

Khalid Benali is Programm chair of INFORSID 2009 and has been Program Committee member of Inforsid 2008.

Gérôme Canals has been or is Program Committee member of BDA 2008, Inforsid 2008, Ubimob 2008 and 2009.

8.3. European actions

8.3.1. IP Qualipso (2006-2010)

Participants: Pascal Molli [Responsible], Jérôme Blanchard, François Charoy, Claude Godart, Gérald Oster.

The goal of the QualiPSo integrated project (No 034763) is to define and implement technologies, procedures and policies to leverage the Open Source Software development current practices to sound and well recognised and established industrial operations.

ECOO is especially concerned with the specification and the development of the Qualipso factory.

8.3.2. *Interop V-Lab.*

The INTEROP V-Lab (http://www.interop-vlab.eu/) has been officially created in Brussels on March 2007 as an international non-profit making association (serving the international interest). In this context, Nancy played also a leading role in the definition of the so-called INTEROP V-Lab "pole" (a partner of the INTEROP V-Lab): the Grande Region pole. The Grande Region pole encompasses Luxembourg (Centre de Recherche Public Henri Tudor), Belgium (University of Namur) and North-Eastern France (Nancy Université: UHP Nancy 1 and Nancy 2) and it is defined as a Scientific (International) Interest Group (Groupement d'Intérêt Scientifique or GIS). Its attachment to the INTEROP V-Lab is still runing.

8.4. International Actions

8.4.1. *Conference program committees and organizations*

We will organize the 9th IFIP I3E conference on e-Business, e-Services and e-Society in Nancy (23-26 September 2009).

Khalid Benali is or has been PC member of the IC on Web and Information Technologies (ICWIT) 2009 and of several workshops. He has reviewed papers for "IEEE Transactions on Systems, Man and Cybernetics".

Nacer Boudjlida has been or is program committee member of ESA-Interop (International Conference on Interoperability of Enterprise Systems and Applications) 2008 and 2009, CAISE (Computer Assisted Information Systems) 2008, 2009, MCSEAI 2008, and of several workshops. He organized a session at IFAC World Congress 2008.

Gérôme Canals is I3E 2009 organization chair. He has been PC member of ICCTA (International Conference on Information and communication Technologies: from theory to application) 2008.

François Charoy has been PC member of ICEBE (International Conference on Business Engineering) 2008, ICIW 2009 and 2009, CTS 2008 and 2009, and of several workshops.

Claude Godart is general chair of I3E 2009. He has been program co-chair of the "Software Engineering for e-Business" track in ICEBE 2008. He is member of the editorial board of "Advance in enterprise systems" and "International Journal of E-adoption" journals. He is editorial guest of a special issue of the "World Wide Web journal". He reviewed papers for "Computer & Industrial Engineering", "Data and Knowledge Engineering", "IEEE Transactions on Service Computing", "IEEE Transactions on Systems, Man and Cybernetics", "Information Systems", "Information Systems Frontiers", and "World Wide Web" journals. He has been or is senior program committee member of BPM (Business Process Management) 2008 and 2009. He has been or is PC member of CAISE 2008 and 2009, CEC/EEE 2008 and 2009, Collaborative Computing (CollaborateComm) 2008, EDOC (The enterprise computing conference) 2008 and 2009, HPCC (High Performance Computing and Communications) 2009, Saint (Symposium on Applications and the Internet) 2008 and 2009, and SCC (Service Computing Conference) 2008.

Claudia Ignat has been or is PC member of Group 2009 and of several workshops. She reviewed papers for the "Computer Supported Cooperative Work" journal.

Jacques Lonchamp has been or is PC member of WBE (International Conference on Web-based Education) 2008 and 2009, CSEDU (International Conference on Computer Supported Education) 2009, ICALT (International Conference on Advanced Learning Technologies) 2009. He reviewed papers for "Journal of Computer-Supported Collaborative Learning", "Computers & Education", "Interacting With Computers", "Internet and Enterprise Management".

Pascal Molli has been PC member of ICEIS (Conference on Enterprise Information Systems) 2008 and 2009, ICCTA 2008, ENC (Mexican International Conference On Computer Science) 2008, ISIS (International Conference on Signal-Image Technology @ Internet-based Systems) 2008 and several workshops. He reviewed papers for "IEEE Transactions on Parallel and Distributd Systems", "IEEE Transactions on Computers" and "Computer Supported Cooperative Work".

Gérald Oster reviewed papers for "IEEE Transactions on Parallel and Distributd Systems" and was PC member of several workshops.

Olivier Perrin is or has been Program Committee member of BPM 2008 and 2009, SITIS 2008, and of several workshops. He reviewed papers for "Information Systems Frontiers" and "Software and Systems Modeling" journals.

Hala Skaf-Molli is or has been PC member of ICEIS 2008 and 2009, ICCTA 2008, and of several workshops.

Pascal Urso has reviewed papers for "IEEE Nigerian section journal".

8.4.2. *Postdoctoral cooperation*

Adnene Guabtni, ECOO Phd has joined in June 2007 Fethi Rabhi and Boualem Benatallah at University of New South Wales in Sydney, Australia, for two years.

Mohsen Rouached has joined Mohand-Saïd Hacid's team at University Claude Bernard Lyon 1.

Ustun Yildiz has joined the Genome center of University of California in Davis in Bertram Ludascher's group.

8.4.3. *Co-advisory of thesis*

Thesis of Charbel Rahhal with University Lebanese of Beyrouth (2006-2009): collaborative editing processes for peer-to-peer networks (Pascal Molli).

Thesis of Ustun Yildiz with University of Luxembourg and CRPGL (Centre de Recherche Public de Luxembourg (CRPGL))(2004-2008): process decentralization and decentralized process management (Claude Godart).

Thesis of Hassina Talantikite and thesis of Abdelmalek Boudries with Béjaïa University, Algeria (Nacer Boudjlida)

Thesis of Salah Hamr with Constantine University, Algeria (Nacer Boudjlida).

8.4.4. *Associate Team INRIA VanaWeb*

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

8.4.5. *Tunisie, eGov, INRIA-DGRST project*

This project involves the ECOO LORIA team-project from Nancy, the SOC team from the IRIT lab in Toulouse and the SOIE team from ENSI in Tunis.

The Egov project is a franco-tunisian project funded by the DGRST and INRIA. Its goal is to combine multi-agent technology and workflow technology to enhance the flexibility of process execution involving multiple government agencies. During this year, we have started to study different dimensions of the modelisation of the Tunisian process for company registration, from a centralised point of view to a decentralised one. We have also started to work on the problem of communication and of security between the different partners of the cooperation. The complete process model has been developped and implemented on Bonita.

8.4.6. *South America, Semantic-based support for Collaborative Design Activity, Stic-Amsud project*

The project includes Loria/Ecoo and Loria/Orpailleur, Lifia-UNLP (Argentina), SCC-Universidade de Sao Paulo (Brasil), and UTFSM-Valparaiso (Chile)

This project is to apply Semantic Web technologies to better support computer-based collaborative design systems. It will deal with the problem of building software support for collaborative design activities guided by domain knowledge. This infrastructure uses domain ontologies to help designers in assembling design components by helping them in searching adequate components, detecting conflicts, searching related documents, finding people with the adequate skills, etc. This design work can be done by several people distributed in time, space and organizations. The main research lines are knowledge representation for design activities and processes, support for collaborative design activities, with a particular focus on coherence/divergence support, coordination and awareness, knowledge management for design processes.

9. Dissemination

9.1. Scientific Community Animation

François Charoy is member of the Administration Council of University Henri Poincaré Nancy 1.

Claude Godart has been head of the recruitment committee of the University Henri Poincaré Nancy 1 (Computer Sciences, 27th section) from 2004 to 2008. He is study director of the research master degree "Distributed Services and Networks". He is member of the Scientific Committee of the Laboratory of Computer Sciences of Littoral (LIL). He has been evaluator for France Telecom R&D (World Class Jury), evaluator for LAFMI (French/Mexican Laboratory), Professor at CEA/EDF/INRIA summer school (theme: Cooperative Work), evaluator of a laboratory for the CENAR (Comité National d'Evaluation des Activités de Recherche, Tunisia), evaluator of ANR projects. He has been general chair of BPM 2005, WISE 2007 and will be general chair of IFIP I3E 2009.

Hala Skaf-Molli has been co-organizer of the First Autumn School in Information Systems at Al Baath University- Homs Syria.

Pascal Urso is member of the Scientific Council of University Henri Poincaré Nancy 1.

9.2. Teaching

ECOO 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 third cycle (ESIAL, ESSTIN, research and professional masters).

Nacer Boudjlida is responsible for the Computer Sciences department of Faculty of Sciences and technologies. He is study director of the professional master degree "Software Engineering".

Gérôme Canals is study director of the professional licence degree "Web programming".

Claude Godart is responsible for the Computer Sciences department of ESSTIN. He is study director of the research master degree "Distributed Services and Networks".

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