ADAPT

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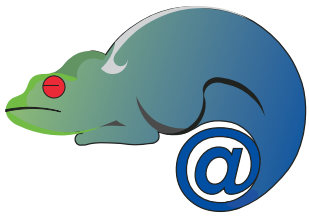
Middleware Technologies for Adaptive and Composable Distributed Components

Progress Management Report 2



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1 Executive Summary

The ADAPT project is interested in developing support for the creation of adaptable web services. Web services have been proposed as a platform independent middleware solution that can interconnect components and applications across organizations. Two kinds of web services can be distinguished. Basic web services, those that do not rely on other services. And composite web services that invoke other web services to achieve their functionality. One of the main challenges being faced in the web service arena is how to achieve dynamically adaptable services. That is, services that adapt themselves to the changing environment. The way to achieve this adaptability is different in basic and composite services. For basic services, a generic infrastructure to build dynamic web services is needed. This generic infrastructure will enable the creation of web services that can adapt dynamically (i.e., while being online) to events such as site failures, site recovery, reconfigurations and changes in the load. On the other hand, adaptability in composite services takes a different form. Composite service adaptability consists in adapting the composition to changes in its constituent services. Additionally, what is especially interesting is the ability to predict the properties of the composition out of the properties of its constituent services.

2 Project Rationale and Exploitation Plan

2.1 Rationale

The presence of numerous basic services over the Internet is creating a new business opportunity for providing value added, inter-organisational services by composing multiple basic services into composite services. ADAPT will develop the technology, software infrastructure and a working system capable of defining, enacting, and monitoring inter-organisational business processes and supporting related coordination activities. The results of ADAPT will be open source and of interest to wide scientific and industrial communities, and will include: 1) Tools for creation of self-descriptive basic services built over commonly-used middleware; 2) a middleware platform for composite service creation and management, allowing enterprises to publish the services they provide, use services available globally in a secure manner as components of a composite service, specify its structure in a visual programming language, automatically compile the description into an executable process, and deploy and monitor the execution of such composite processes. The composite service middleware platform will contain re-configuration and self-repairing features to enable a composite service to adapt itself to changes caused by insertion or withdrawal of services, changes in network conditions and changes in user requirements. The project will develop demonstrator applications; the main demonstrator being a long running one (such as a travel planning e-service) through which the project will demonstrate composition, monitoring, management and dynamic adaptability to various changes both in the execution environment and in the system configuration.

2.2 Exploitation Plan

The exploitation of open-source software is usually carried out by one or more organizations that assume the maintenance of the product and provide support to its users.

The first group of these organizations are companies that are devoted to provide consultancies on open-source software such as Andago, Alcove, I+D Agora. We plan to publicize ADAPT results among them to foster their use. The clients of these companies are clients looking for open-source solutions and therefore they are very adequate for exploiting ADAPT results. Apart from communicating them the

advances taken in ADAPT, we plan to invite them to the open workshops organized by our consortium to guarantee an appropriate dissemination and foster the exploitation of ADAPT results by these organizations. In the Free/Open Source Software Projects Concertation Meeting organized by the Commission, we met a number of companies interested in exploiting ADAPT results. Just to name a few: IDEALX, Conecta, Jaluna, Minoru. These contacts will be very helpful for exploitation purposes.

A second group of organizations that can be interested in exploiting ADAPT results are those that maintain the software products that will be enhanced by ADAPT, such as PostgreSQL, JBoss, and MySQL. We think that an effective technology transfer is feasible in which the technology developed by ADAPT will influence future versions of their software. We will exploit the close contacts that the different partners keep with these organizations (McGill with PostgreSQL, Arjuna and Bologna with JBoss, Madrid with MySQL).

A third group of organizations that can be interested in exploiting ADAPT results are non-for-profit organizations that promote and support open-source/free software, such as Free Software Foundation Europe and ObjectWeb. These organizations can host some of the ADAPT contributions as projects. In fact, Madrid has already opened a project in ObjectWeb for this purpose.

Universidad Politénica de Madrid.

UPM has contacted ObjectWeb representatives at the ObjectWeb conference held in Paris November 2003 to explore the possible open-source exploitation of its contributions as ObjectWeb hosted projects. Initial interest has been shown in three contributions from UPM: Middle-R, a middleware for database replication, the J2EE Activity Service based transaction engine for advanced transaction models, and the WS-CAF support for transactional web services.

Prof. Ricardo Jiménez-Peris and Marta Patiño-Martínez joined ObjectWeb as individual members. After the first informal meeting, a presentation was made at the ObjectWeb Architects meeting in Seville in January 2004 that resulted in the acceptance of JASS (J2EE Advanced tranSaction Support) as ObjectWeb hosted project. This project includes the J2EE Activity Service and web service interoperability support.

In February 2004, UPM team attended the ObjectWeb JOnAS Developers Workshop at Grenoble (23-24th February 2004) and presented the projects JASS and Middle-R. Discussions were held with the development teams of JOTM, GOTM, JOnAS, and Bonita to enable the integration of JASS with these ObjectWeb projects.

UPM is still deciding the best open-source exploitation path for Middle-R. UPM is currently considering the possibility to exploit Middle-R as an ObjectWeb project and its integration with C-JDBC (a complementary ObjectWeb project). A meeting was held with the project leader of C-JDBC, Dr. Emmanuel Cecchet at INRIA Rhône-Alpes in February 2004 to discuss the different alternatives to integrate Middle-R with C-JDBC.

UPM has also established contacts with MySQL to integrate in the production version two services required by Middle-R. Contact with MySQL co-founder, David Axmark, has been successful and MySQL has expressed its interest in including the services in the production version. Contacts are kept with Brian Aker, Director of MySQL Architecture.

Contact has also been established with PosgreSQL through Prof. Bettina Kemme (McGill) to include these services in the production version of ProsgreSQL.

UPM signed a contract Sept. 2003 with Microsoft Research Cambridge to extend Middle-R to Microsoft SQLServer and Windows XP (in an open-source fashion).

Università di Bologna.

The main software contribution in which Bologna is involved, a component replication framework, will be distributed as a SourceForge project (http://sourceforge.net/projects/j2ee-adapt/), under the Lesser GNU Public License (LGPL).

Bologna has been invited by the JBoss team to attend a JBoss advanced tutorial in Rome. Contacts with JBoss lead developers Marc Fleury and Sacha Labourey have been established to discuss future directions of JBoss clustering code.

ETH Zurich.

JOpera is the main result contributed by ETH to the project. Right now, most of JOpera was prior art developed as part of other projects. After the decision to adopt JOpera as the main composition engine of the ADAPT project, work has started to make JOpera as open system. JOpera is already available in binary form and can be downloaded under a Berkeley license. For the eventual release of the source code, the actual form of the license will depend on the nature of support and the degree of integration of standards like BPEL. We continue the efforts to clarify these issues.

McGill University.

McGill University heavily participates in the replication efforts within the PostgreSQL community. The Postgres-R replication effort hosted at Gborg (PostgreSQL related projects) has their current contributions mainly coming from McGill University. The efforts on Postgres-R are partly integrated into the ADAPT project. Licensing is under the Berkeley/BSD license according to PostgreSQL policy.

The replication strategies that are currently implemented at McGill use the component replication framework developed at the University of Bologna, and hence, will follow the same licensing policy, namely the Lesser GNU Public License (LGPL). McGill is currently investigation the possibility to distribute the replication software as a SourceForge project.

University of Trieste.

Trieste will distribute its software as a SourceForge project, under the Lesser GNU Public License (LGPL). The main contribution from Trieste, JBora, runs on top of Spread. Spread is distributed and licensed by Spread Concepts LLS (http://www.spread.org)

Newcastle University.

Newcastle is taking part in a UK funded demonstrator project on virtual organisations for chemical industries. Use of technologies developed within ADAPT will be an essential aspect of the project. In particular, service composition and orchestration techniques currently being developed within ADAPT will be highly relevant.

Arjuna Technologies Ltd.

Within ADAPT, Arjuna has written proof of concept software used by project partners that we intend to make open source. We have constructed a specification for the ADAPT demonstrator using royalty free specifications and examples and we intend to make the demonstrator software open source. We have licensed an implementation of ArjunaTS (to the ADAPT project) as a fully functional transactional

service while open source alternatives mature. We are continuing to have an active partnership with JBoss group and we continue to feedback improvements to their open source offering. We continue to interact with JacORB to improve their open source offering. However, Arjunas main task now is to push forward with the development of the Web Services Composite Application Framework (WS-CAF) specification to provide a single standard for transaction coordination and a non-proprietary royalty free standard for the industry. In this regard, during the past twelve months, Arjuna has:

- released the first public version of WS-CAF with Sun, Oracle, IONA and Fujitsu, in August 03.
- worked with our collaborators to initiate an OASIS technical committee on WS-CAF and submitted our specifications. The specifications will produce open standards in the area of Web services context, coordination and transactions and will be royalty free. This is in marked contrast to the work by IBM/Microsoft/BEA on WS-C/T.
- participated in many teleconferences and face-to-face meetings, in Boston (December 03), New Orleans (April 04) and in San Fransisco (July 04) with all of the TC members. Arjuna has worked on the formation of the TC which now includes HP, Attachmate, Booz Allen Hamilton, Iopsis, WebMethods, Systinet, SeeBeyond, Cyclone Commerce and Choreology. We are working through the WSContext issues to achieve a stable and implementable specification.
- worked within the TC on the formation of an interoperability demonstration subcommittee. This group will define a basic example that will allow different vendors implementations of WS-Context to interoperate. Weve taken the WS-I example and shown where WS-Context can fit into that. This is on going work and the example will evolve as we move on to WS-CF and WS-TXM.
- accepted an invitation to co-author the WS-MessageDelivery specifications. This specification was submitted to the W3C in April 04 and were co-authored with Oracle, Sun, Nokia, Cyclone Commerce, IONA, Enigmatec and SeeBeyond. Subsequently Arjuna is examining how the WS-Message Delivery and WS-Addressing specifications could be incorporated within WS-CAF.
- joined the OASIS WS-Resource Framework (WS-RF) effort from IBM; this is IBMs attempt to push Web services technology into the Grid arena.
- published a paper on a comparison between WS-Context and WS-RF.
- continued to talk to IBM, Microsoft and BEA about closer collaboration between them and the WS-CAF technical committee.
- worked closely with IBM on the WS-C/WS-T interoperability toolkit and workshop.

3 Project Objectives

The main goal of ADAPT is to develop the technology and software infrastructure necessary for defining, enacting, and monitoring inter-enterprise business processes that are implemented as composite services with guarantees of availability, scalability and adaptability not only to changing network conditions and user requirements but also to reconfigurations and repairs. ADAPT will also provide middleware support for available and dynamically adaptive basic services that will be used to build higher level composite services.

4 Achievements and Project Status

The second year has been mainly devoted to software development of month 18 and 24 deliverables and prepare for the integration to be performed during the third year.

Universidad Politénica de Madrid.

The Distributed Systems Lab (LSD) has concentrated its effort on two contributions: Middle-R, middleware for database replication, and JASS, Java Advanced tranSaction Support.

Development in Middle-R is centered on:

- The middleware itself is being evolved from a very constrained research prototype to an open-source product.
- A JDBC driver for Middle-R has been developed to enable interoperability with J2EE.
- Adaptability support has been developed (such as dynamic load balancing and adaptive load control) in the prototype version in which the performance evaluation has been performed. Now it is being migrated to the production version.
- Online recovery has been implemented to enable recovery without disrupting regular processing in a prototype version and now it is being migrated to the production version.

The effort in JASS has concentrated on:

- Support for advanced transactions in J2EE. This support follows the recent J2EE Activity Service specification. This includes the implementation of the Activity Service and the implementation of a High Level Service supporting open nested transactions (as suggested in the first year review, we have moved from a generic transactional engine to the support of a particular advanced transaction model). An implementation of the basic functionality has been completed and has been the basis of deliverable D4 Transactional Engine.
- Support for web service interoperability with transactional services. This support has adopted one of the specifications currently being developed, the recent Oasis WS Coordination Activity Framework (WS-CAF) championed by the ADAPT industrial partner, Arjuna.

Università di Bologna.

In Brussels, at the 12-month review meeting, we presented a proposal for a replication framework, which would allow different replication algorithms to be plugged into a J2EE server. Since then, we have refined and completed the design of this framework. A fully functional prototype has been implemented and its performance measured using an industry-standard benchmark (ECperf). Replication algorithms have been developed within the framework at both Trieste and McGill, making use of the reliable group communication software developed by Trieste. Together, these components will constitute ADAPT deliverable D3 Replication Tool.

ETH Zurich.

ETH Zurich has been working on the composition engine for Web services (JOpera). The work has been focused on improving the front end (visual language, expressiveness), making the code more robust, and starting to consider development possibilities for supporting messaging as part of the execution engine. Messaging will be an important feature to support recently proposed standards for Web service composition such as BPEL and BPML. Some highlights of the activity in this period include:

- In the plenary meeting of December, 2003, it was decided that JOpera will be the main composition engine within the project
- JOpera has been made publicly available on the web in binary form (Berkeley license). There have been nearly 300 downloads so far and we already have a few users who are using the system in semi-production settings (for grid computing).
- Work on messaging support has commenced based on initial performance and functionality analysis of existing tools
- Work on porting the interface and tools of JOpera to Java has started (the main engine runs in Java but many of the tools and the GUI were developed in a different context and now need to be aligned with the goals of ADAPT)
- Analysis of BPEL and BPML continues to study ways to support these standard specifications while avoiding licensing issues. The current approach is to provide a language more general and powerful than BPEL so that BPEL is seen as a subset of the JOpera language.
- The publication effort around JOpera has now started to increase. A paper was presented in October (see publications), there are two journal and one conference submissions pending acceptance.
- Several tutorials and courses where ADAPT will be presented have been submitted or are being planned for the coming months

McGill University.

The distributed information systems lab of McGill university made the following technical contributions during year 2 of the project.

- EJB Replication.
  - Using the replication framework provided by the University of Bologna, McGill has implemented a replication strategy for EJBs providing automatic failover in case of system crashes, and online recovery of restarting components. The replication strategy takes into account the transactional semantics of web-service requests. Performance evaluations show an acceptable overhead that compares favorable with existing approaches.
  - Development of replication strategies that allow more advanced transactions models has started
  - Development of an infrastructure to use the replicated components not only for fault-tolerance but also for load balancing has started.

- Postgres-R.
  - An update-everywhere, eager replication strategy has been integrated into the PostgreSQL kernel (normal processing and handling of crashes). Implementation and initial testing has been completed. Performance evaluations show low response times, and good scalability. We hope that the new software will be soon posted on the GBorg webpage to be tested by the internet community. It extends the existing version considerably by moving from master-slave to the more flexible update-everywhere execution model.
  - Development of an online-recovery module has started.

University of Trieste.

Trieste has implemented a replication algorithm for Axis-based web services based on the replication framework provided by Bologna. The algorithm allows replicating (volatile) Java objects exposed to remote clients as web services. The service exhibits the same consistency guarantees about the order of execution of operation requests as its non-replicated implementation. Such guarantees are preserved in spite of server replica failure, network failure (either between server replicas or between a client and a server replica) and irrespective of when the failure occurs. Moreover, the service guarantees that in case a client sends an update request multiple times, there is no risk that the request be executed multiple times. No hypothesis about the timing retransmission policy of clients are made, e.g., the very same request might even arrive at different server replicas simultaneously.

Trieste has implemented a tool for collecting and exposing performance-related data of servers that expose Axis-based web services. The tool consists of a set of sensors, each tailored to a specific performance index (e.g., throughput, latency). The tool allows specifying dynamically which web services should be monitored, with which sensors, and with which configuration for each sensor. The tool is fully transparent in that web services are not aware of its presence (sensors are implemented by means of Axis handlers). The tool is configured through a dedicated web service, meant to be accessed only by the server administrator. This tool is being integrated with the replication framework provided by Bologna. Basic Services can thus expose performance-related data, either for administration purposes or for use by Composite Services.

Trieste has also performed a major internal restructuring of the JBora group communication tool. This restructuring has led to a significant performance improvement in environments with a large number of threads (up to a few hundreds), which is the typical scenario in replicated Basic Services (EJB and servlet containers usually associate one thread with each client request). The restructuring was also necessary in order to support adaptive message packing with pluggable packing policies. Numerous experiments with various message packing policies have been made, in order to better understand the effects of message packing on throughput and latency.

Newcastle University.

Newcastle has collaborated with Zurich and Arjuna on work on composite services. An analysis tool for veryfying correctnes properties of composite services has been developed using the SPIN model checker. This work is described in deliverable report D8. A paper on Notations for the specification and verification of Composite Web Services has been written and will be presented at 8th IEEE/OMG International Enterprise Distributed Object Computing Conference (EDOC 2004), September 2004, Monterey, CA. Newcastle has worked on security aspects of composite Web services, in collaboration with the TAPAS

project. This work is described in the deliverable report D12. A paper on non-repudiable service interactions has been presented at IEEE/IFIP International Conference on Dependable Systems and Networks (DSN 2004), Florence, June 2004.

Arjuna Technologies Ltd.

Arjuna has concentrated on the Demonstrator Specification (D17), the updated Evaluation Plan (D16) which has been reshaped to take account of the reviewers comments and Demonstrator Basic Services (D18). In fact, one of the aims of the ADAPT project - supporting the construction of composition of services has provided an interesting challenge when specifying the ADAPT demonstrator. This is because, basing the demonstrator on a single uniform design would not show composition - as a single design would have been designed to be composable. Hence the ADAPT demonstrator is based on two different designs for a Supply Chain Management system: WS-Is (Web Services Interoperability) Sample Application Specification and the RosettaNets Order Management (Cluster 3) Standards. We are monitoring the XML Common Business Library (xCBL) to see if that standard can play a part in the ADAPT demonstrator. WS-Is Sample Application Specification and RosettaNets Order Management Standards are sufficiently different in their design that composition is challenging, but possible for some interactions. Also, the relevant service that makes up the systems can be implemented as an ADAPT Basic Service. It is this implementation work that has occupied the majority of our resource over the last six months. It is progressing well and is on track to be delivered on schedule in month 30. So, combining WS-I and RosettaNet is a good approach for specifying a demonstrator for the ADAPT project. In addition, Arjuna has continued to work closely with Newcastle University to progress work on composite service specification and analysis.

5 Adherence to Workplan

5.1 Resource Usage

- UPM. 44 person-months (estimate). There is an increase in the workforce to compensate for the delays in the contracts of the first year.
- UniBo.
  - Actual: 33 person-months (12+11+10 for Vuckovic, Patarin, Maverick, respectively).
  - Scheduled: 24 person-months.
- ETHZ. 18 person/month (as scheduled).
- McGill.
  - Hired staff: 12 months by a PhD student, 4.2 months by a technician (scheduled 2.8, 1.4 months of technician were moved over from the first year).
  - Permanent staff: 1.2 months
- Trieste.
  - Hired staff: 12 person-months (as scheduled)
  - Permanent staff: 4 person-months

- UNEW. 6 person months of additional effort plus 12 person-months of scheduled effort (period Sept 03-sept 04).
- Arjuna.
  - Staff: 12 person-months (as scheduled).
  - Funding usage: (estimate) 66, 231 Euro (scheduled 79, 776 Euro)

5.2 Deliverable Schedule Update

- The deliverables: revised D16 Updated Evaluation Plan (delivered in month 12, and asked for revised versions by months 18 and 24), D17 Demonstration Plan, have been delayed for three weeks (till 21st March 2004).
- The deliverable Analysis Tools has been delayed to month 24.
- The delivery date of month 24 deliverables have been advanced from 1st September to 23rd August to allow two weeks between the delivery date and the review meeting date.

5.3 Modifications to Workplan

There are no modifications to the workplan except for the delay of deliverable Analysis Tools. Since, there are no dependencies from other deliverables on this one, the rest of the workplan remain as planned.

6 Cooperation in the Project

6.1 Fourth ADAPT Plenary Workshop. Bologna, 11-12 December 2003.

The workshop was organized around the deliverables of month 18 and 24. Presentations on the different deliverables were made by the corresponding leaders followed by a discussion session:

- For the deliverable D8 Analysis tools, it was decided a change of leadership from Zurich to Newcastle and that the contributions from Newcastle would form the core of this deliverable. It was also decided to ask for 6-month postponement to enable the readjustment.
- Regarding the revised version of DUP solicited by reviewers, Madrid made a presentation on the ten most representative open source licenses and the implications of each one.
- A presentation by Trieste was made on deliverable D2 Reliable Communication showing what would constitute the bulk of this deliverable.
- Madrid made a presentation proposing as contents for deliverable D4 Transactional Engine an implementation of the recent J2EE Activity Service specification. It was agreed that it was an adequate election for supporting advanced transactions in J2EE applications.
- A discussion session was devoted to reshape deliverable D16 Updated Evaluation Plan. It was decided that each partner should propose quantitative evaluations of each of the software deliverables being produced.

- For the deliverable D3 Replication Tool a presentation was made by Bologna on the architecture for replication of EJBs. Discussions followed on the open issues related to the integration of EJB replication and database replication.
- A presentation was made by Zurich on the proposed contributions for D10 CS Availability Container and D11 Adaptability Container based on their new Java workflow engine. The consortium agreed on the appropriateness of the contributions for both deliverables. It was decided to change the leadership of D11 from Bologna to Zurich. It was also decided that their workflow would be the core component of deliverable D14 CS Middleware.
- Arjuna made a presentation on the possibilities for the demonstration application. A discussion followed on the most appropriate kind of application to show the different aspects of the basic and composite services. The deliverable D17 Demonstrator Specification will summarize the demonstration application.
- Newcastle made a presentation on deliverable D12 Security report.

Talks and schedule available at: http://adapt.ls.fi.upm.es/bologna-dec-2003-meeting.htm

6.2 Fifth ADAPT Plenary Workshop. Trieste, 5-6 July 2004.

- Two sessions were devoted to the contributions to the deliverable D3 Replication Tool. The application server replication framework was presented by Bologna. Bologna, Trieste and McGill presented their different replication algorithms integrated in the framework. Madrid and McGill presented their contributions to database replication.
- A discussion session about the integration of the different replication tools for basic services. In this session it was discussed how to apply the replication tool to the advanced transactional engine, which replication algorithms kept in the production version, and the integration with the two database replication tools, Postgres-R and Middle-R. It was also discussed how to deal in a consistent way with the interaction between the replicated application server and the replicated database.
- Two sessions were devoted to the composite services contributions. Zurich presented their contributions to D10 CS Availability Container, D11 CS Adaptability Container, and D14 CS Middleware. Zurich presented the JOpera, the new Java workflow tool including its support for availability and adaptability. Newcastle presented its contributions to D14 CS Middleware around the analysis tool. Madrid presented its contributions to D14 CS Middleware around the support for advanced transactions for web services, a Java implementation of WS-CAF.
- The executive board met and decided the location and dates for the workshops and meetings during to be held in the last year. It also elaborated a first draft for the review meeting agenda. A strategy for finalizing the project and integrating all contributions was established.
- One session was devoted to deliverables at project global level that included D12 Security Report by Newcastle and D18 Demonstrator of Basic Services by Arjuna.
- Another session was devoted to the integration of basic services and composite services.
- Finally, an overall plan for the last year of the project was discussed and agreed.

6.3 Other Cooperation

- Review Meeting, Brussels, 17th October, 2003.
- Bilateral Meetings between Newcastle and Arjuna.
- Cooperation between Madrid and Montreal on database replication. Several phone meetings.
- Workshop on Basic Services held in Madrid among Madrid, Bologna and Trieste in June 2004.
- Cooperation between Bologna, Trieste, and Montreal on application server replication. Several phone meetings.
- Cooperation between Madrid and Arjuna regarding J2EE Activity Service and OASIS WS-CAF via electronic means.
- Cooperation between Newcastle and Zurich on analysis tools.

7 Coordination with other Projects/Programmes

Universidad Politécnica de Madrid

- Prof. Ricardo Jiménez-Peris, Prof. Marta Patiño-Martínez, and Mr. Francisco Pérez-Sorrosal attended the ITEA OSMOSE Workshop (Sevilla, 14-15th January 2004) to explore synergies between the projects. Integration of JASS with JOnAS and JOTM will be the result of the cooperation between OSMOSE and ADAPT.
- Cooperation with TAPAS has been established (via Newcastle, coordinator of TAPAS) in the scope of deliverable D12 Security report to exploit results from TAPAS.
- UPM participated as core member (as coordinator of ADAPT) in the Coordination Action proposal on Service Engineering (UNISERVE) that stemmed from the cluster of projects on the same topic set up by the Commission. The proposal was submitted to the second call of FP6.
- Microsoft Research is funding the extension of Middle-R to support SQLServer under grant MS-2003-193. These results will be open-source with the same licensing as Middle-R.
- UPM is participating as a partner in the OSIRIS EUREKA/ITEA proposal that has been granted the ITEA label. Currently the preparation of the corresponding national proposals is undergoing. In this project, that will start just after ADAPT finishes, the results for advanced transactions in Java and Web Services will be integrated with other ObjectWeb projects such as the Bonita ObjectWeb workflow engine. Other results as the BPEL4WS parser and the visual composition tool delivered by UPM and discarded later in favor of JOpera will be exploited in cooperation with Bull one of the ObjectWeb founders.
- UPM is coordinating a National research project proposal (in cooperation with Universidad Rey Juan Carlos) in which its ADAPT contributions will be extended to pervasive computing and high performance computing. The project has just been accepted by the Spanish Ministry of Education and Science and will start in January 2005.

- A meeting was held with Prof. José Ramón González de Mendívil at Universidad Pública de Pamplona to discuss a potential cooperation between a national project he is leading and UPM in the context of ADAPT. Synergies were found and a cooperation will be started to explore the application of soft computing techniques to the adaptive capabilities of Middle-R.
- A meeting was held with Prof. Rui Oliveira and his lab at Univerdad do Minho during 23rd-24th July 2004 to discuss a potential cooperation between ADAPT and the recently granted GORDA FP6 project on database replication.

ETH Zurich

- ETH Zurich has held contacts recently with MS Research (US) regarding the development of support for Web service composition.

McGill University

- Prof. Betinna Kemme is participating in the recently granted Spanish research project coordinated by UPM as researcher.

Arjuna Technologies Ltd.

- Dr. Stuart Wheater and Dr Mark Little participated as Advisory Board members on TAPAS and attended numerous meetings with the TAPAS team at Newcastle University.
- Dr. Stuart Wheater attended TAPAS meeting (February 04).
- Dr Mark Little and Dr Malik Saheb attended WS-CAF meeting in Boston, US (December 03).
- Dr Mark Little attended WS-Choreography meeting in Cambridge, UK (18th December 03).
- Dr Mark Little attended a WS-T feedback conference hosted by Microsoft in Seattle (April 04)
- Dr Mark Little attended a WS-CAF meeting in New Orleans, US (April 04).
- Dr Malik Saheb attended a WS-CAF meeting in San Francisco, US (July 04).
- Dave Ingham attended a WS-CAF EU experts meeting in Brussels (May 04)
- Dr Mark Little attended a WS-BPEL meeting in Heidelberg (May 04)
- Participation in the EUCOSM project proposal, where WS-CAF amongst other open standards was to be used.
- Participation in the CELTIC project ADPO, where WS-CAF was to be used as a standard. ADPO has been awarded the CELTIC label and will go forward. Unfortunately, however, the UK is unable to fund participation in CELTIC at this moment in time and Arjuna has had to withdraw.

8 Promotion/Information Dissemination

8.1 Standardization Bodies

The following standardization bodies have been identified as the most relevant for ADAPT:

- World Wide Web Consortium (W3C): “The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. ”
- OASIS: “OASIS is a not-for-profit, global consortium that drives the development, convergence and adoption of e-business standards.”
- Java Community Process (JCP): “Java Community Process (JCP) is the way the Java platform evolves. It is an open organization of international Java developers and licensees whose charter is to develop and revise Java technology specifications, reference implementations, and technology compatibility kits.”

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- Arjuna has joined OASIS, JCP, and W3C.
- Arjuna is leading the WS-CAF specification at Oasis.
- Arjuna is leading the J2EE Activity Service specification at JCP.
- Arjuna is a co-author on the WS-MessageDelivery specifications at W3C.
- Arjuna has joined the OASIS WS-Resource Framework (WS-RF) effort.

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- UPM has joined Oasis and become a member of the Technical Committees of WS-CAF and BPEL4WS.
- UPM has joined JCP in order to participate in the J2EE Activity Service specification.

8.2 Publications

- J.M. Milán-Franco, R. Jiménez-Peris, M. Patiño-Martínez, and B. Kemme. Adaptive Database Replication. ACM/IFIP/USENIX Middleware Conference. Oct. 2004. Toronto, Canada.
- R. Jiménez-Peris, M. Patiño-Martínez, G. Alonso, and B. Kemme. Are Quorums an Alternative for Data Replication? ACM Transactions on Database Systems, Vol. 28, N. 3, Sept. 2003, pp. 257-294, ACM Press.
- Nick Cook, Paul Robinson and Santosh Shrivastava, Component Middleware to Support Non-repudiable Service Interactions, IEEE/IFIP International Conference on Dependable Systems and Networks (DSN 2004), Florence, June 2004, pp. 605-614.

- S.J.Woodman, D.J.Palmer, S.K.Shrivastava, S.M.Wheater, Notations for the specification and verification of Composite Web Services, 8th IEEE/OMG International Enterprise Distributed Object Computing Conference (EDOC 2004), September 2004,**?** Monterey, CA.
- A. Bartoli, V. Maverick, S. Patarin, J. Vuckovic and H. Wu. A Framework for Prototyping J2EE Replication Algorithms. Int. Symposium on Distributed Objects and Applications (DOA), Cyprus, Oct. 2004.
- H. Wu, B. Kemme, and V.Maverick. Eager Replication for Stateful J2EE Servers. In Proc. of the Int. Symposium on Distributed Objects and Applications (DOA), Cyprus, Oct. 2004.
- A. Bartoli. Implementing a replicated service with group communication. Journal of Systems Architecture. Elsevier. To appear.
- C. Pautasso, G. Alonso: Visual Composition of Web Services Proc. of the 2003 IEEE Symposia on Human Centric Computing Languages and Environments (HCC 2003), Auckland, New Zealand, October 2003.
- Chenliang Sun, Yi Lin, Bettina Kemme. Comparison of UDDI Registry Replication Strategies. IEEE International Conference on Web Services, San Diego, California, pp. 218-225, July 2004.
- A. Bartoli, M. Prica, and E. Antoniutti. A replication framework for program-to-program interaction across unreliable networks and its implementation in a servlet container. Technical report, DEEI University of Trieste, 2004. Accepted for publication in Concurrency and Computation: Practice and Experience (subject to minor revisions).
- Cesare Pautasso, Gustavo Alonso: JOpera: a Toolkit for Efficient Visual Composition of Web Services, to appear in: International Journal of Electronic Commerce (IJEC)
- Cesare Pautasso, Gustavo Alonso. From Web Service Composition to Megaprogramming. Proc. of the 5th VLDB Workshop on Technologies for E-Services (TES-04), Toronto, Canada, August 29-30, 2004.
- Mark Little, Jim Webber. Introducing WS-CAF - More than just transactions, Web Services Journal
(http://www.sys-con.com/webservices/articleprint.cfm?id=737).
- V. Maverick. *Object Model for Pluggable J2EE Replication Strategies*. Università di Bologna, Technical Report. Feb. 2004.
- Mark Little, Jim Webber published a paper on a comparison between WS-Context and WS-RF (Reference: http://www.sys-con.com/story/?storyid=44675).
- S. Wu and B. Kemme. Postgres-r(si): Combining replica control with concurrency control based on snapshot isolation. Technical report, School of Computer Science, McGill University, 2004. Submitted for publication.

8.3 Dissemination activities

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- One of the contributions of the project, the database replication middleware was presented in an invited talk at Universidad Pública de Navarra, (Pamplona, 28th November 2003) by Prof. Marta Patiño-Martínez.
- The project was presented in an invited talk at Universidad Pública de Navarra (Pamplona, 28th November 2003) by Prof. Ricardo Jiménez-Peris.
- Prof. Ricardo Jiménez-Peris attended the ObjectWeb Conference (Paris, 20-21 November 2003) to establish contacts with ObjectWeb representatives to explore the open-source dissemination of Madrid contributions through ObjectWeb. Meetings were held with representatives of the following projects: JOTM (transactional engine), GOTM (new transactional engine), Bonita (workflow system), JaWee (workflow visual editor), and JOnAS (EJB-based application server).
- Professors Ricardo Jiménez-Peris and Marta Patiño-Martínez joined ObjectWeb as individual members.
- Presentation of the results of ADAPT regarding dynamically adaptive database replication at the Network of Excellence Cabernet Workshop. Porto Santo, Madeira (Portugal). Nov. 2003. J. M. Milán-Franco, R. Jiménez-Peris, M. Patiño-Martínez. Towards Dynamically Adaptive Replicated Databases.
- Presentation of *JASS: J2EE Advanced tranSaction Support* at ObjectWeb Architects Meeting (Sevilla. 13th January 2004) by Prof. Ricardo Jiménez-Peris.
- Presentation of JASS architecture at ObjectWeb JOnAS Developpers workshop (Grenoble, 23-24 February 2004).
- Presentation of Middle-R status at ObjectWeb JOnAS Developpers workshop (Grenoble, 23-24 February 2004).
- UPM has been awarded with a grant from Microsoft Research Cambridge in a competitive call (RFP, request for proposals) closed January 2004 for creating curricular materials on distributed systems that will cover technology from ADAPT.
- UPM was invited to the Dagstuhl seminar on Atomicity in System Design and Execution held during April 25-30, 2004 at Dagstuhl (Germany). Prof. Ricardo Jimenez-Peris attended the workshop and presented the ADAPT results on adaptive database replication.
- Prof. Ricardo Jiménez-Peris and Prof. Marta Patiño-Martínez have participated in the CaberNet vision document (http://www.newcastle.research.ec.org/cabernet/) in the context of the Cabernet Network of Excellence on Dependable Distributed Systems in a chapter on group communication. In this chapter, the work on Middle-R from UPM and McGill and the work on Postgres-R from McGill are referenced. The ADAPT project is listed in the list of Cabernet related projects.
- One of the contributions of the project, the adaptive database replication middleware was presented in an invited talk at Universidad do Minho, (Braga, Portugal, 23rd July 2004) by Prof. Ricardo Jiménez-Peris.

- Prof. Marta Patiño-Martínez and Ricardo Jiménez-Peris participated in IEEE Int. Conf. on Dependable Systems and Networks 2004 held in Firenze (Italy) at the end of June 2004. They presented an overview of the work on adaptive replication in Middle-R as a fast abstract.

ETH Zurich

- Talk to representatives of the Hasler foundation by Prof. G. Alonso and C. Pautasso. The talk covered JOpera and the work around the ADAPT project.
- Industry course titled ”Web Services: Concepts, Architectures and Applications” at ETH Zurich (9th and 10th of February, 2004). By Prof. G. Alonso, C. Pautasso, D. Joensson. The project was discussed and JOpera demonstrated to an audience of industry representatives.
- Talk on Web services at Uni. Stuttgart by Prof. G. Alonso. The ADAPT project was presented and a brief demo of JOpera given. 11th February, 2004.
- Talk on *Visual Composition in Web services* by C. Pautasso presenting JOpera at the 2003 IEEE Symposia on Human Centric Computing Languages and Environments (HCC 2003), Auckland, New Zealand, October 2003.
- Graduate course ”Web services”. University of Aalborg (Denmark). 10-13 May, 2004. Practical exercises completed using the ADAPT composition platform
- Graduate course ”Web services”. Lappeenranta University of Technology, Finland, August 9-13, 2004. Practical exercises completed using the ADAPT composition platform

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- Presentation of WS-CAF at XML 2003, Philadelphia (December 2003): http://www.arjuna.com/library/technical/2003-12-XML2003-WebServicesTransactions-paper.pdf
- Presentation of WS-CAF at the High Performance Transactions Systems workshop, Asilomar (October 2003): http://research.sun.com/hpts2003/).
- worked with the Grid community to show how they can leverage WS-CAF.
- Arjuna has re-engaged with the W3C WS-Choreography working group in an attempt to pass on the experiences gained whilst completing ADAPTs service specification deliverable.

University of Newcastle

- Newcastle members participated in the first International conference on service oriented computing, Trento, Dec 03. The workflow management system, DECS (described in the deliverable report D7) was presented at a poster session.

University of Trieste

- Prof. Alberto Bartoli has presented the ADAPT project in a lecture given at the inauguration of the academic year of the University of Trieste, in presence of the Italian Minister of Innovation and Technologies, Mr. Lucio Stanca.

9 Conclusion

The project is progressing according schedule. Some deliverables have been reshaped to accommodate them to changes in scientific and standards arena.

10 Appendices

10.1 Updated Consortiums Relevant Persons Working and/or Associated to the Project

- UPM.

  Permanent staff: Prof. R. Jiménez-Peris, Prof. M. Patiño-Martínez.

  Hired staff: Mr. Francisco Perez, Mr. Alberto Martínez, Mr. Damián Serrano, Mr. Cayse Llorens, Mr. Jorge Salas, and Mr. David Jimenez.

  Mr. Jesús Milán, is collaborating in the project although currently without a contractual link.

- UniBo.
  - Permanent Staff: Ozalp Babaoglu
  - Hired Staff: Vance Maverick, Simon Patarin, Jaksa Vuckovic.

- ETHZ.
  - Permanent staff: Prof. Gustavo Alonso.
  - Hired staff: Mr. Bioern Bioernstad and Mr. Cesare Pautasso

- McGill.
  - Permanent staff: Prof. Bettina Kemme.
  - Hired staff: Mr. Huaigu Wu (PhD), Mr. Shuqing Wu (technician 1), and Mr. Yi Lin (technicians 2).

- Trieste.
  - Permanent staff: Prof. Alberto Bartoli.
  - Hired staff: Mr. Milan Prica.
  - Without contractual link: Mr. Etienne Antoniutti di Muro, Mr. Giovanni Masarin, Mr. David Piccolo.

- UNEW.
  - Permanent staff: Prof. Santosh Shrivastava, Dr. Graham Morgan.
  - Hired Staff: Mr. Simon Woodman, , Douglas Palmer.

- Arjuna. Staff: Dr. Stuart Wheater, Dave Ingham, Dr. Mark Little, Dr Malik Saheb.