TAPAS

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Trusted and QoS-Aware Provision of Application Services

TAPAS
Periodic Management Report
PM1 – PMR1

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Project Co-ordinator: Newcastle University

Partners: Adesso, Dortmund – Germany; University College London – UK; University of Bologna – Italy; University of Cambridge – UK

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WORK PROGRESS OVERVIEW

The TAPAS project officially started on 1 April 2002. The overall objective of the TAPAS project is to develop novel methods, tools, algorithms and protocols that support the construction and provisioning of Internet application services. The project will achieve the overall objective by developing QoS enabled middleware services capable of meeting Service Level Agreements (SLAs) between application services and will enhance component based middleware technologies such that components can be deployed and interact across organisational boundaries. The project will develop notations for expressing SLAs to enable specification of QoS, such as the availability as well as trust relationships. SLA trust specifications will be used for deriving service invocation primitives enriched with authentication, non-repudiation mechanisms, with or without the involvement of trusted third parties. Middleware services and architectures will be developed using open source application servers and widely used component technologies such as CORBA and Java.

The primary aim during the first six months of the project was to bring together all project members and Industrial Advisory Board (IAB) members and launch work on all the work packages. This was achieved in two stages. The first brought together all the partners at the 1st Project Closed Workshop held in Bologna – University of Bologna (I), April 4-5 2002.

The second was a meeting with the IAB in Cambridge, UK, 8-9 July, which was represented by the following, who were able to attend. A further interim project meeting (technical) has been held at UCL with Adesso.

At the workshop partners presented an overview of their research contributions in plenary sessions and at the following IAB meeting, the members provided input on further developed work that had been carried out between April and July.

The 1st plenary workshop allowed all project members to become familiar with the overall workplan of the project and to interact directly with existing and potential collaborators. This has been enhanced by the 2nd plenary workshop, which was held in Newcastle, UK 5-6 September, 2002.

Adesso work in the first 6 months has been on Deliverable D1 in the field of application hosting requirements. We incorporated the helpful suggestions and comments from the Cambridge and UCL teams.

We have chosen to emphasize transport level SLAs and their interaction with ASP's SLAs, since this seems pragmatic in today's Internet, where modification to the IP layer is nigh-on impossible.

The document exploits the industrial ASP knowledge of adesso regarding state-of-the-art SLAs and ASP scenarios. It identifies the technological standards that should be employed by TAPAS, based on the ASP and software development experiences from Adesso, based on the discussion of current standard SLAs we then focus on the coarse-grain subjects of SLAs, which have to be included in future SLAs and their formal specifications. The document concludes with technical and commercial

success criteria, to which TAPAS results will be compared. In this section we formally identify the requirements together with their motivation according to technological issues like tool support for SLA modelling and deployment and according to commercial criteria such as decrease of costs in an ASP application life cycle.

From our industrial point of view it must be said, that monitoring facilities are clearly highly requested at the moment, while other TAPAS results like formal modelling will show it's benefit in a mid-term time-range.

During the first six months of the TAPAS project, the work at the **University of Bologna** has focused on two principal activities; namely, we have investigated:

1. issues of design of end-to-end QoS architectures, suitable for deployment within the context of the TAPAS project, and
2. issues of trust management.

As part of activity i) we have carried out, firstly, an analysis of the design issues involved in the provision of end-to-end QoS in geographically distributed environments, and an assessment of a number of end-to-end QoS architectures proposed in the literature, including TAO, RT CORBA, Agilos, and QuO. As a result of this activity, we have proposed an end-to-end QoS architecture based on QoS adaptive middleware services in this context, QoS adaptation is enabled by a QoS parameter monitor that performs both periodical and event based monitoring of QoS parameters. (This work was described at the TAPAS kick-off meeting, held in Bologna on 5 - 6 April 2002.)

Secondly, we have evaluated a number of candidate middleware platforms that can be used for the purposes of the TAPAS project. In particular, we have examined both the SUN J2EE platform, and its open source implementation JBoss.

Finally, based on the results of our work above and on discussions we had with our project partners, we have developed an initial architectural proposal in which the Java Enterprise abstraction of container is extended to incorporate services for end-to-end QoS provisioning and maintenance; namely, a configuration service, a run time support service, and a trust management service. These services will be based on the network control architecture that will be developed as part of Task 2. (This work was introduced first at the TAPAS-IAB meeting in Cambridge, in July 2002, and described in detail at the TAPAS project meeting held in Newcastle last September.)

As part of activity ii), we have examined a number of trust management systems, including the Grid CAS and the Globus Toolkit GSI, Pics, Policymaker, Keynote, RBAC, RT, and OASIS, and proposed to extend the OASIS system, for the purposes of TAPAS, to incorporate mechanisms that can manage effectively dynamic trust relationships. (This work was described in detail at the TAPAS project meeting held in Newcastle last September.)

As mentioned earlier, the above activities have greatly benefited from discussions with the partners involved in the development of WP1; in particular, their work on application hosting requirements, QoS networking requirements, and SLA

specification has provided us with crucial input for our work.

UCL has participated in the requirements definition (spearheaded by Adesso) through organization of a workshop and detailed feedback on two earlier drafts. UCL has produced a first draft of a Service Level Agreement language, which was circulated to all partners and discussed at the Newcastle workshop. As a result, UCL has started intensive discussions with Bologna on QoS-aware component execution. Davide Lamanna is in Bologna this week. UCL has also started to work on analysis methods for components. We have completed work on analyzing for quantitative properties (e.g. deadlock freedom, liveness and safety). The approach taken to analyze for quantitative properties of distributed components will involve mapping UML profiles (particularly the Real-Time and Scheduling profile and the EJB profile) to formalisms, such as queuing networks or stochastic process algebras and this work has commenced.

At **Cambridge**, Dr Panos Gevros has been appointed as the RA on the project in the Computer Laboratory at the University of Cambridge. Dr Gevros previously worked at UCL, and his thesis was on differentiated services using end-to-end mechanisms, and specifically using modified TCP.

The work in the first 6 months has been on Deliverable D1, and has been a collaboration largely between Adesso and Cambridge with very helpful input from UCL. We have chosen to emphasize transport level SLAs and their interaction with ASP's SLAs, since this seems pragmatic in today's Internet, where modification to the IP layer is nigh-on impossible.

The deliverable brings up another important issue - the interactions between ISPs (interconnections, policies, peering arrangements etc.), as they affect drastically the service offered by the ISP and therefore are particularly relevant to the ASP (and every ISP client).

Related to the above is the issue of redundancy in the interconnections (aka multi-homing) and routing control; this applies equally to ISPs and its clients. Given the inherent randomness in Internet performance and the fact that absolute guarantees are notoriously difficult to provide (except maybe in a limited scope) we argue that network SLAs should be structured as "options" contracts. These contracts will derive their values from the potential (or expected) levels of network performance and they will be in discount compared to contracts, which offer absolute guarantees (because they carry with them additional risk). In this way the scope of the SLAs could be considerably extended - in many cases even end-to-end – something, which with the current practices seems impossible.

This opens up a new topic for research.

The deliverable includes several examples of commercial ISPs IP level SLAs too. We are trying to abstract from the IP, transport and application layer, and synthesize a realistic

Service-level agreement model that can be fed into the service specification work at UCL, and later into implementation work, and then in the end, be verified by measurement with the auction application in the last year of the project.

At **Newcastle** two researhers have been appointed (Givanna Ferrari, Antonio de Ferdinando).

The TAPAS project believes that an ASP will increasingly be called upon to host distributed applications that make use of a wide variety of Internet services provided by different organisations. This naturally leads to the ASP acting as an intermediary for interactions for information sharing that cross organisational boundaries. However, despite the requirement to share information and services, autonomy and privacy requirements of organisations must not be compromised. Organisation will therefore require their interactions with other organisations to be strictly controlled and policed.

We have examined what does it mean for inter-organisational interactions to be 'strictly controlled and policed'? From the viewpoint of each party involved, the overarching requirements are (i) that their own actions meet locally determined policies; and that these actions are acknowledged and accepted by other parties; and (ii) that the actions of other parties comply with agreed rules and are irrefutably attributable to those parties. These requirements imply the collection, and verification, of non-repudiable evidence of the actions of parties who interact with each other.

We have built an experimental middleware platform that implements the abstraction of information sharing between organisations]. It is assumed that each organisation has a local set of policies for information sharing that is consistent with the overall information sharing agreement between the organisations (this agreement can be viewed as a business contract between organisations). The safety property of our system ensures that local policies of an organisation are not compromised despite failures and/or misbehaviour by other parties; whilst the liveness property ensures that if all the parties are correct (not misbehaving), then agreed interactions will take place despite a bounded number of temporary network and computer related failures.

Essentially, our middleware resembles a transactional object replica management system where each organisation has a local copy of the object(s) to be shared. Any local updates to the copy by an organisation ("proposed state changes" by the organisation) are propagated to all the other organisations holding copies for local validation; a proposal comprises the new state and the proposer's signature on that state. Each recipient produces a response comprising a signed receipt and a signed decision on the (local) validity of the state change. All parties receive each response and a new state is valid if the collective decision is unanimous agreement to the change. The signing of evidence generated during state validation binds the evidence to the relevant key-holder. Evidence is stored systematically in local non-repudiation logs.

Another strand of activity has been concerned with examining middleware support for component replication (e.g., replication of EJBs). Graham Morgan presented the ideas at the TAPAS workshops. Basic architecture has been finalised and implementation has started. We are also examining the use of feedback control theory in QoS control of middleware services. Giovanna Ferrari presented her preliminary ideas at the second TAPAS workshop and at the Cabernet Radical Workshop.

PROJECT MANAGEMENT AND CO-ORDINATION:

Plans for progressing all work packages were agreed by the Executive Board, with particular attention being given to deliverables due after 6 months:

D1 Application hosting and Networking Requirement Document

D16 Dissemination and Use Plan

The deliverable "D19 - Project Presentation" has already been produced and is available from: http://www.newcastle.research.ec.org/tapas/index.html

In addition, work has started ahead of schedule in the other work packages (reflected in the effort figures).

The project's coordination infrastructure has now been established. Communication is primarily by project mailing list supported by an internal and public web server.

Further technical meetings have been arranged as follows:

- Bologna, Newcastle and UCL to meet before the end of Dec.2002
- 3rd Project Closed Workshop to be held at Adesso, Dortmund, Germany (D), February 10-11, 2003.

CONFERENCE MEETINGS:

TAPAS project members attended the following conferences during the first six months of the project:

Jon Crowcroft attends the Global Grid Forum meeting, where he co-chairs the working group on High Performance Network requirements.

3rd, International Workshop on Software Engineering and Middleware, Orlando, Florida attended by W. Emmerich

23rd International Conference on Software Engineering, Orlando, Florida, May 2002 attended by W. Emmerich

3rd. International Workshop on Software Performance (WOSP), Rome, July, 2002 attended by D. Lamanna and J. Skene

ACM SIGCOMM 2002, Pittsburgh, USA, 23-25 August, attended by Jon Crowcroft

W. Emmerich: 17th IEEE Int. Conference on Automated Software Engineering, Edinburgh, Sept 2002.

2nd IEEE International Conference on Peer-to-Peer Computing, Linköping, Sweden, 5-7 Sept. 2002, attended by E Turrini.

Santosh Shrivastava and Paul Ezhilchelvan: IEEE/IFIP International Conference on Dependable Systems and Networks (DSN-2002), June 2002, Washington DC

Santosh Shrivastava: Workshop on Future Directions in Distributed Computing (FuDiCo), Bertinoro, Italy, June 02.

Santosh Shrivastava, Fabio Panzieri, Jon Crowcroft: IST Broadband Networking Conference, Bucharest, October 02.

Giovanna Ferrari attended 7th Cabernet Radical Workshop, Bertinoro (FC), Italy, 13-16 Oct. 2002.

COOPERATION WITH OTHER IST PROJECTS:

Santosh Shrivastava, Fabio Panzieri, Jon Crowcroft: participated in a Cluster meeting on engineering of service functionality that was held during the IST Broadband Networking Conference, Bucharest, October 02.

Santosh Shrivastava, Graham Morgan attended the ADAPT project (IST-2001-37126)

Kickoff meeting in Madrid, Sept 02; TAPAS and ADAPT have specific collaboration on trust management.

PUBLICATIONS:

W. Emmerich: Distributed Component Technologies and their Software Engineering Implications. In: Proceedings of 24th Int. Conference on Software Engineering, Orlando, Florida. pp. 537-546. ACM Press. 2002.

N. Mezzetti, F. Panzieri, "The Data Grid: Security and Privacy Issues", Proc. 4th European Dependable Computing Conference, Toulouse (F), 22-25 Oct. 2002.

G. Lodi, " Endo-to-end QoS-aware Middleware Services", 7th Cabernet Radical Workshop, Bertinoro (FC), Italy, 13-16 Oct. 2002.

E. Turrini, "A Platform for Request Routing in Content Distribution Inter-networks", 7th Cabernet Radical Workshop, Bertinoro (FC), Italy, 13-16 Oct. 2002.

E. Turrini, F. Panzieri, "Using P2P Techniques for Content Distribution Internetworking: A Research Proposal", in proceedings of the 2nd IEEE International Conference on Peer-to-Peer Computing, Linköping, Sweden, 5-7 Sept. 2002.

N. Cook, S.K. Shrivastava and S.M. Wheater, “Distributed Object Middleware to Support Dependable Information Sharing between Organisations”, IEEE/IFIP International Conference on Dependable Systems and Networks (DSN-2002), June 2002, Washington DC.

S.K. Shrivastava: Middleware for supporting inter-organisational interactions, Proceedings of Workshop on Future Directions in Distributed Computing (FuDiCo), Bertinoro, Italy, June 02.

PROBLEMS AND (POSSIBLE) REMEDIAL ACTIONS:

In producing the effort figures for Newcastle, it was realized that the figures used in the Description of Work, do not reflect the reduction in man hours allocated to the Co-ordinator's administrative total at the negotiation meeting in Brussels (21 Dec. 2001). At this meeting, the percentage administration effort was reduced to 37.5% (down from 75%), and the clerical effort was reduced to 25% (down from 50%).

In addition, the quoted figures do not take into account the uncosted effort of permanent staff who will be giving some time to the project.

The effort figures supplied with this document, do reflect this change.