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Triple Space Communication

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EXECUTIVE SUMMARY

In this report, we summarize the outward activities of TripCom.

First, the project has produced many scientific publications; it has been promoted in public talks and keynotes; and the consortium organized events for industry outreach and for research cooperation. The project has succeeded in bridging research from Semantic Web, middleware, coordination and also mobile computing paradigms.

Second, the project results are being considered within standardization activities which means the state-of-the-art has been pushed with not only academic research but with implementation experience in extending the currently available technology standards.

Third, the project results and the accumulated knowledge will be put into further use in running Internet infrastructure research projects such as SOA4All and LarKC.

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Abstract (for dissemination)	This deliverable summarizes the outward activities of the TripCom project, and evaluates their impact.
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LIST OF ABBREVIATIONS

ANSI	American National Standards Institute
BSD	Berkeley Software Distribution
DAWG	Data Access Working Group
DBMS	Database Management Systems
ER	Entity Relationship
FOAF	Friend Of a Friend
HTTP	Hyper Text Transfer Protocol
iTQL	Interactive Tucana Query Language
JRDF	Java RDF
LAN	Local Area Network
LGPL	GNU Lesser General Public Licence
N3	Notation 3
N3QL	N3 Query Language
NDM	Oracle Spatial Network Data Model
OASIS	Organization for the Advancement of Structured Information Standards
ORDI	Ontology Representation and Data Integration
OWL	Web Ontology Language
OWLIM	OWL In Memory
RDBMS	Relational DBMS
RDF	Resource Description Framework
RDFS	RDF Schema
RDQL	RDF Data Query Language
ROI	RDF Input/Output
SAIL	Storage And Inference Layer
SOFA	Simple Ontology Framework API
SOAP	Simple Object Access Protocol
SeRQL	Sesame RDF Query Language
SEQUEL	Structured English Query Language
SPARQL	SPARQL Protocol And RDF Query Language
SQL	Structured Query Language
STREP	Specific Targeted Research Project
TCP	Transmission Control Protocol
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
W3C	World Wide Web Consortium
WSDL	Web Service Description Language
WSMO	Web Service Modeling Language
XML	Extensible Markup Language
YARS	Yet Another RDF Store
YARSQL	YARS Query Language

1 INTRODUCTION

TripCom is a Specific Targeted Research Project (STREP) aiming to “change the Internet usage through computers just as the Web revolutionized the Internet usage through humans.” The project partners combine their expertise to bring the Web paradigm of “persistently publishing and reading data” to Web services, so that also automated software systems share the benefits of Web architecture.

Apart from the pre-defined deliverables that have been produced in this project, there have also been outward activities, such as publication and event organization, which have allowed the project to disseminate its results even before the work was done. Such dissemination has improved the impact of the project, increasing its end value. In particular, the main research areas where TripCom has disseminated its work have been Tuple spaces, Web services, Semantic Web, EAI (Electronic Application Integration) and eHealth.

This deliverable presents an overview of the impact of TripCom throughout the project duration. The following chapters each list the external activities in a particular category, and briefly analyze them in terms of activity per partner or work package.

2 PUBLICATIONS

Scientific publishing has been the primary dissemination channel for the results of a project such as TripCom. The following lists enumerates the publications that came out of the work in TripCom.

1. E. Della Valle, D. Cerri, A. Ghioni, and D. Cerizza. *Seamlessly and Securely sharing health care data with Triple Space Communication*, The Int'l Trade Event and Conf. for eHealth, Telemedicine and Health ICT (Med-e-Tel), Luxemburg, 5-7 April 2006.
2. D. Fensel, R. Krummenacher, and M. Zaremba. *The Role of Semantic Technology*, Semantic Technology - A European Perspective during WWW2006, Edinburgh, Scotland, 23-26 May 2006.
3. D. Cerizza, E. Della Valle, D. Foxvog, R. Krummenacher, and M. Murth. *Towards European Patient Summaries based on Triple Space Computing*, Proc. of 1st European Conf. on eHealth, Fribourg, Switzerland, 12-13 October 2006.
4. E. Della Valle, D. Cerri, A. Ghioni, D. Cerizza. *Triple Space Communication an infrastructure for seamlessly and securely sharing healthcare data*. In the Official Journal of the European Association of Hospital Managers, November 2006.
5. Emanuele Della Valle, Dario Cerizza, Reto Krummenacher, Lyndon J. B. Nixon, Elena Paslaru-Bontas Simperl, Doug Foxvog. *A proposal for Building the European Patient Summary using Triple Space Computing*, Workshop for W3C Semantic Web Health Care & Life Sciences, International Semantic Web Conference (ISWC), Athens, Georgia, Nov 6, 2006.
6. Axel Polleres and Roman Schindlauer. *SPAR2QL: From SPARQL to rules*. In International Semantic Web Conference (ISWC2006 - Posters Track), Athens, GA, USA, November 2006. Poster.
7. Joskowicz, G., e. Kühn, M. Murth. *The XD Model - Extending XML and DOM to Standards Based Coordination*. In Proceedings of the 10th IASTED International Conference on Software Engineering and Applications (SEA), Nov. 13-15, 2006, Dallas, Texas, USA.
8. D. Foxvog, C. Bussler. *Ontologizing EDI Semantics*, Advances in Conceptual Modeling - Theory and Practice, Springer, Berlin/Heidelberg, ISBN 978-3-540-47703-7, pp. 301-311, 2006 at the First International Workshop on Ontologizing Industrial Standards (OIS) of the 25th International Conference on Conceptual Modeling (ER 2006), in Tucson, USA
9. Karastoyanova, D.; Lessen, T. van; Nitzsche, J.; Wetzstein, B.; Wutke, D.; Leymann, F.: *Semantic Service Bus: Architecture and Implementation of a Next Generation Middleware*. In Proceedings of the 2nd International Workshop on Services Engineering (SEIW) 2007, in conjunction with ICDE 2007. Istanbul, Turkey, April 16, 2007.

10. Francisco, D. de; Perez, N.; Foxvog D.; Harth A.; Martin D.; Wutke D.; Murth M.; Paslaru E.: *Towards a Digital Content Services Design Based on Triple Space*. In proceedings of the 10th International Conference on Business Information Systems (BIS). Poznan, Poland 25-27 April 2007.
11. Axel Polleres. *From SPARQL to rules (and back)*. In Proceedings of the 16th World Wide Web Conference (WWW2007), Banff, Canada, May 2007.
12. Dieter Fensel, eva Kuhn, Frank Leymann and Robert Tolksdorf: *Queues Are Spaces - Yet Still Both Are Not The Same?*, Technical Report, May 2007.
13. Nitzsche, J.; Wutke, D.; Lessen, T. van: *An Ontology for Executable Business Processes*. Workshop on Semantic Business Process and Product Lifecycle Management (SBPM 2007), in conjunction with ESWC 2007. Innsbruck, Austria, June 7, 2007.
14. Michal Zaremba and Omair Shafiq, *Semantically Enabled Service Oriented Architectures (SESA)*, in Proceedings of the the 1st European Semantic Technology Conference (ESTC), 31 May - 1 June 2007, Vienna, Austria.
15. E. Simperl, R. Krummenacher and L. Nixon: *A Coordination Model for Triplespace Computing*, In 9th Intl Conf. on Coordination Models and Languages (Coordination), Springer Verlag, June 2007.
16. R. Krummenacher, E. Simperl, L. Nixon, D. Cerizza, E. Della Valle: *Enabling the European Patient Summary Through Triplespaces* In 20th IEEE International Symposium on COMPUTER-BASED MEDICAL SYSTEMS, Maribor, Slovenia, June 20-22, 2007 (**Best Paper Award**)
17. L. Nixon, E. Simperl, D. Cerizza, E. della Valle and R. Krummenacher: *Enabling Collaborative eHealth Through Triplespace Computing* In the 16th IEEE International Workshops on Enabling Technologies: Infrastructures for Collaborative Enterprises (WETICE), Workshop on Interdisciplinary Aspects of Coordination Applied to Pervasive Environments: Models and Applications (CoMA), Paris, France, June 18-20, 2007.
18. D. de Francisco, J. M. EliceGUI, D. Martin, M. Murth, and D. Wutke, *Using Triple Spaces to Implement a Marketplace Pattern*, In proceedings of the 1st Workshop for Space Based Computing as Semantic Middleware for Enterprise Application Integration (SBC 2007), Vienna, Austria, 2007.
19. Martin, D.; Wutke, D.; Scheibler, T.; Leymann, F.: *A Comparison of Messaging and Spaces Based on Enterprise Application Integration Patterns*. 11th IEEE International EDOC Conference (EDOC 2007). Annapolis, Maryland U.S.A., October 15-19, 2007.
20. D. de Francisco, J. EliceGUI, N. Perez Crespo and H. Munoz Frutos.: *TripCom: Comunicacion de Agentes y Servicios Web por Medio de Espacios Triples*. Telecom I+D 2007, October, Valencia (Spain)
21. Reto Krummenacher, Elena Simperl, and Dieter Fensel: *An Ontology-Driven Approach To Reflective Middleware*. 2007 IEEE/WIC/ACM International Conference on Web Intelligence. Silicon Valley, USA, November 2-5, 2007.

22. Reto Krummenacher: *Ontology-Driven Management of Semantic Spaces*. Doctoral Consortium of 6th Int'l Semantic Web Conference and the 2nd Asian Semantic Web Conference. Busan, Korea, November 11-15, 2007.
23. ZhangBing Zhou, Sami Bhiri, Ke Ning, Laurentiu Vasiliu, Doug Foxvog and Walid Gaaloul: *Better Behavioral Description for Dynamic Semantic Web Services Collaboration*. In Proceedings of the 3rd International Conference on Semantics, Knowledge and Grid (SKG 2007). Xi'an, China., 2007.
24. Brahmananda Sapkota, Sanaullah Nazir, Tomas Vitvar, Ioan Toma, Laurentiu Vasiliu and Manfred Hauswirth: *Semantic Overlay for Scalable Service Discovery*. In Proceedings of CollaborateCom 2007, 12-15 November, 2007.
25. R. Krummenacher, E. Simperl and D. Fensel: *Towards Scalable Information Spaces*. Workshop on New forms of reasoning for the Semantic Web: scaleable, tolerant and dynamic, ISWC 2007
26. Wutke, D.; Martin, D.; Leymann, F.: *Model and Infrastructure for Decentralized Workflow Enactment*. 23rd ACM Symposium on Applied Computing (SAC2008). Fortaleza, Brasil, March 16 - 20, 2008.
27. Martin, D.; Francisco, D. de; Krummenacher, R.; Moritsch, H.; Wutke, D.: *An Architecture for a QoS-Aware Application Integration Middleware*. 11th International Conference on Business Information Systems (BIS 2008). Innsbruck, Austria 5-7 May 2008.
28. Wutke, D.; Martin, D.: *Facilitating Complex Web Service Interactions Through a Tuplespace Binding*. Distributed Applications and Interoperable Systems (DAIS'08). Oslo, Norway, June 04 - 06, 2008.
29. Omair Shafiq, Francois Scharffe, Daniel Wutke, German Toro del Valle, *Resolving Data Heterogeneity issues in Open Distributed Communication Middleware*, in proceedings of 3rd International Conference on Internet and Web Applications and Services (ICIW 2008), June 8-13, 2008 - Athens, Greece.
30. ZhangBing Zhou, Sami Bhiri, Lei Shu, Kaizhu Huang, Laurentiu Vasiliu, Manfred Hauswirth. *A Scenario-View Based Approach to Analyze External Behavior of Web Services for Supporting Mediated Service Interactions*. In Proceedings of the IEEE International Conference on Services Computing (SCC'08). Hawaii, USA. 2008.
31. ZhangBing Zhou, Brahmananda Sapkota, Emilia Cimpian, Doug Foxvog, Laurentiu Vasiliu, Manfred Hauswirth, Peng Yu. *Process Mediation Based on Triple Space Computing*. In Proceedings of the 10th Asia Pacific Web Conference (AP-Web'08). Shenyang, China, 2008.
32. ZhangBing Zhou. *A Scenario-View Based Approach for Supporting Mediated Web Service Interaction*. In Proceedings of CAiSE Doctoral Consortium 2008 (CAiSE-DC) - Montpellier, France. 2008.
33. Philipp Obermeier and Lyndon Nixon: *A Cost Model for Querying Distributed RDF Repositories*, Advanced Reasoning on the Web workshop, European Semantic Web Conference (ESWC) 2008, Tenerife, Spain

34. Waseem Akhtar, Jacek Kopecký, Thomas Krennwallner, Axel Polleres: *XSPARQL: Traveling between the XML and RDF worlds - and avoiding the XSLT Pilgrimage*. In *The Semantic Web: Research and Applications*, 5th European Semantic Web Conference (ESWC 2008), pp. 432-447, Springer LNCS 5021, June 2008, Tenerife, Spain
35. Lyndon J. B. Nixon, Elena Simperl, Reto Krummenacher and Francisco Martin-Recuerda: *Tuplespace-based computing for the Semantic Web: a survey of the state-of-the-art* *The Knowledge Engineering Review*, Volume 23, Issue 02, June 2008, pp 181-212
36. Reto Krummenacher, Elena Simperl, Dario Cerizza, Emanuele Della Valle, Lyndon J. B. Nixon, Doug Foxvog. *Enabling the European Patient Summary Through Triplespaces*, special issue supplement of *Computer Methods & Programs in Biomedicine* (CMPB).
37. Reto Krummenacher, Elena Simperl and Dieter Fensel: *Scalability in Semantic Computing: Semantic Middleware*. Special Session on Scalability in Semantic Computing: the European View, 2nd IEEE Int'l Conference on Semantic Computing, Santa Clara, CA, USA, August 2008.
38. Zhangbing Zhou, Sami Bhiri, Lei Shu, Ke Ning, Laurentiu Vasiliu and Manfred Hauswirth: *Behavioral Analysis of Web Services for Supporting Mediated Service Interoperations* *Proceedings of the Tenth International Conference on Electronic Commerce (ICEC 2008)*. Innsbruck, Austria.
39. Reto Krummenacher: *The Smartest Space of All: A Global Space of (Machine-Understandable) Knowledge*. Invited Talk at the 1st Russian Conference on Smart Spaces, St. Petersburg, Russia, September 2008.
40. Brahmananda Sapkota, Sanaullah Nazir, Manfred Hauswirth, Tomas Vitvar: *Scalable Architecture for Web Service Discovery*. In *Proceedings of the 3rd International ICST Conference on Scalable Information Systems*, Vico Equense, Italy, 2008.
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42. Nixon, L.; Teymourian, K.; Martin, D.; Wutke D.: *Triple Space as a Global Semantic Coordination Middleware*. 17th IEEE International Workshop on Enabling Technologies: Infrastructures for Collaborative Enterprises, EU Project Showcase (WETICE'08). Rome, Italy, June 23 - 25, 2008.
43. Kia Teymourian, Lyndon Nixon, Daniel Wutke, Reto Krummenacher, Hans Moritsch, Eva Kühn and Christian Schreiber. *Implementation of a novel semantic web middleware approach based on triplespaces*. In *IEEE International Conference on Semantic Computing*, pages 518-523, ICSC 2008, August, 2008, Santa Clara, California, USA

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44. Martin, D.; Wutke D.; Leymann F.: *EFWN - A Petri Net Dialect for Tuplespace-based Workflow Enactment*. 15. Workshop Algorithmen und Werkzeuge für Petrinetze. Rostock, Germany, September 26 - 27, 2008.
 45. Martin, D.; Wutke D.; Leymann F.: *A Novel Approach to Decentralized Workflow Enactment*. 12th IEEE International EDOC Conference (EDOC 2008). Munich, Germany, September 15 - 19, 2008.
 46. Francisco, D. de: *Triple Space Communication for Enterprise Application Integration*. The Sixth Summer School on Ontological Engineering and the Semantic Web (SSSW'08), Cercedilla (Madrid, Spain).
 47. de Francisco, D.; de Francisco, M.; Perez, N. & Toro, G.: *Triplespaces as a Semantic Middleware for Telecommunication Services Development* International Symposium on Distributed Computing and Artificial Intelligence 2008, Salamanca (Spain), Springer Verlag, Advances in Soft Computing Series, October 2008.
 48. Lyndon Nixon, Dario Cerizza, Emanuele Della Valle, Elena Simperl, Reto Krummenacher: *Enabling collaborative eHealth through triplespace computing* in UbiCC Journal Volume 3 (ISSN 1992-8424) Special Issue Coordination in Pervasive Environments
 49. De Francisco Marcos D.; Toro Del Valle G., Jb Nixon L.: *Towards a Multimedia Content Marketplace Implementation based on Triplespaces*, 7th International Semantic Web Conference (ISWC 2008), October 26-27 Karlsruhe (Germany)
 50. De Francisco Marcos D.; Toro Del Valle G., Jb Nixon L.: *Towards a Multimedia Content Marketplace Implementation based on Triplespaces*, 7th International Semantic Web Conference (ISWC 2008), October 26-27 Karlsruhe (Germany)
 51. ZhangBing Zhou, Sami Bhiri, Walid Gaaloul, Lei Shu, Manfred Hauswirth *Behavioral Compatibility of Web Services: A Scenario-View Based Approach*. In Poster at CoopIS 2008
 52. Martin, D.; Wutke D.; Leymann F.: *Using Triplespaces to Enact Petri Net-Based Workflow Definitions*. 10th International Conference on Information Integration and Web-based Applications & Services (iiWAS2008). Linz, Austria, November 24 - 26, 2008.
 53. ZhangBing Zhou, Sami Bhiri, Manfred Hauswirth *Control and Data Dependencies in Business Processes Based on Semantic Business Activities*. In Proceedings of the 10th International Conference on Information Integration and Web-based Applications Services (iiWAS 2008) Linz, Austria, 2008.
 54. ZhangBing Zhou, Sami Bhiri, Walid Gaaloul, Manfred Hauswirth *Developing Process Mediator for Supporting Mediated Web Service Interactions*. In Proceedings of the 6th IEEE European Conference on Web Services (ECOWS 2008) Dublin, Ireland, 2008.

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55. Kopp, O.; Martin, D.; Wutke D.; Leymann F.: *On the Choice Between Graph-Based and Block-Structured Business Process Modeling Languages*. Modellierung betrieblicher Informationssysteme (MobIS 2008). Saarbrücken, Germany, November 27 - 28, 2008.
 56. Kia Teymourian and Lyndon Nixon. *Efficient content location in massively distributed triplespaces*. In 5th OnTheMove, International Workshop On Semantic Extensions to Middleware: Enabling Large Scale Knowledge Applications, Monterrey, Mexico, 2008.
 57. Wutke D.; Martin D.; Leymann F.: *Tuplespace-based Infrastructure for Decentralized Enactment of BPEL Processes*. 9. Internatiale Tagung Wirtschaftsinformatik (WI 2009): Business Services: Konzepte, Technologien, Anwendungen. Vienna, Austria, February 25 - 27, 2009.
 58. Martin Murth, eva Khn, *Knowledge-Based Coordination with a Reliable Semantic Subscription Mechanism*, Coordination Models, Languages and Applications, Special Track on the 24th ACM Symposium on Applied Computing (SAC'09) March 8 - 12, 2009, Waikiki Beach, Honolulu, Hawaii, USA.
 59. Wutke, Daniel; Martin, Daniel; Leymann, Frank: *A Method for Partitioning BPEL Processes for Decentralized Execution*. In: Kopp, Oliver (ed.); Lohmann, Niels (ed.): Proceedings of the 1st Central-European Workshop on Services and their Composition, ZEUS 2009, Stuttgart, Germany, March 2–3, 2009.
 60. Wieland, Matthias; Martin, Daniel; Kopp, Oliver; Leymann, Frank: *SOEDA: A Methodology for Specification and Implementation of Applications on a Service-Oriented Event-Driven Architecture*. In: Proceedings of the 12th International Conference on Business Information Systems (BIS 2009). Poznan, Poland April 27-29, 2009.
 61. Marcel Karnstedt, Kai-Uwe Sattler, Manfred Hauswirth, Brahmananda Sapkota, Roman Schmidt, *A DHT-based Infrastructure for Ad-hoc Integration and Querying of Semantic Data*. In Proceedings of the twelfth International Database Engineering & Applications Symposium (IDEAS'08) Mnster, Germany, 2008.
 62. Sanaullah Nazir, Brahmananda Sapkota, Tomas Vitvar, *Personalized Web Service Discovery*. In Proceedings of 4th International Conference on Web Information Systems and Technologies, Funchal, Madeira, Portugal, 2008.
 63. Marcel Karnstedt, Kai-Uwe Sattler, Michael Ha, Manfred Hauswirth, Brahmananda Sapkota, Roman Schmidt, *Estimating the Number of Answers with Guarantees for Structured Queries in P2P Databases*. In Proceedings of 17th Conference on Information and Knowledge Management (CIKM'08), Napa Valley, USA, 2008.
 64. Marcel Karnstedt, Kai-Uwe Sattler, Michael Ha, Manfred Hauswirth, Brahmananda Sapkota, Roman Schmidt, *Approximating Query Completeness by Predicting the Number of Answers in DHT-based Web Applications*. In Proceedings of the Tenth International Workshop on Web Information and Data Management (WIDM'08) Workshop at 17th Conference on Information and Knowledge Management (CIKM'08), 2008.
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In summary, there have been 64 publications. As expected, the major research partners LFUI, CEFRIEL and USTUTT have produced most papers. Importantly, the use case work packages have produced significant output as well; papers about the use cases demonstrate the practical applications of TripCom technology.

It is worth pointing out that these publications cover all the target dissemination areas, i.e., Tuple spaces, Web services, Semantic Web, EAI and eHealth.

The table below summarizes the types of publications.

Classification	Number of publications
eHealth	9
EAI	8
Semantic Web	26
Web Services	15
Tuple spaces	7
Conference	35
Workshop	20
Journal	6
Poster	4

3 KEYNOTES AND TALKS

Apart from publications, also speeches by key representatives of the project are a very effective way of dissemination. The following table lists the keynotes and other invited talks that have promoted triplespace computing.

- LFUI & D. Fensel: *Service Web 3.0: A Paradigm Shift in Computer Science*, Keynote at Semantic Technology Annual Conference 2007, Seoul, Korea
- LFUI & D. Fensel: *Semantically Enabled Service-Oriented Architectures: A Paradigm Shift in Computer Science*, Keynote at International Conference on Artificial Intelligence and Applications, AIA 2007, Innsbruck, Austria
- LFUI & D. Fensel: *A Semantically Enabled Service Oriented Architecture*, Invited Talk at Web Intelligence (WI) meets Brain Informatics (BI) (WImBI 2006) Workshop, Beijing, China
- LFUI & D. Fensel: *Semantically Enabled Service-oriented Architectures*, Keynote at 5th International Symposium on Software Composition, Vienna, Austria
- LFUI & D. Fensel: *Role of Semantic Technology including Triple Space Computing, the web for machines*, Invited Talk at European Perspective panel at WWW2006 (May 2006, Edinburgh, UK).
- USTUTT & F. Leymann: *Workflow-Based Cooperation and Coordination in a Service World*, Keynote at Business Processes - Today and tomorrow, Dortmund, Germany
- USTUTT & F. Leymann: *Web Services: Origin, State of the Art and Next Steps*, Keynote talk at Semantics 2006, Vienna, Austria
- USTUTT & F. Leymann at Gartner EXP Forum, Frankfurt, Germany
- USTUTT & F. Leymann: *Services and Their Composition: A Quality Perspective*, Keynote talk at Conquest 2006, Berlin, Germany
- USTUTT & F. Leymann: *Semantische Dimension von SOA*, Keynote talk at SOA Kongress, Mainz, Germany
- CEFRIELD & D. Cerizza: *Development of a patient summary at European level*, Presentation at the EPS at the COCOON Conference, Venice, Italy, February 27, 2007
- STI & R. Krummenacher: *TripCom*, Invited talk at SOA4All Architecture Kick-Off Meeting, May 2008, Grenoble, France
- STI & R. Krummenacher: *TripCom*, Invited talk at the LarKC Plenary Meeting, Jul 2008, Amsterdam, the Netherlands
- STI & R. Krummenacher: *TripCom*, Invited talk at 1st Russian Conference on Smart Spaces, Sep 2008, St Petersburg, Russia

Clearly, triplespace computing in general and TripCom in particular have had significant presence in speeches at diverse fora.

4 EVENTS

Large projects, such as EC-funded Integrated Projects (IPs), often sponsor or even organize events such as conferences in order to gain further visibility and dissemination opportunities. Such sponsorship is uncommon from smaller projects with more limited budgets. Nevertheless, TripCom partners have organized the events shown in the following table.

July, 2006	Space Computing Alliance visiting DERI Innsbruck. Dr. Bernard Angerer from GigaSpace Technologies Inc. initiated potential collaborations between the TripCom consortium and the US-based Space Computing Alliance with a short visit to DERI Innsbruck.
May, 2007	SBC 2007: Space Based Computing as Semantic Middleware for Enterprise Application Integration, at 1st European Semantic Technology Conference, Vienna, Austria
June 2008	Workshop at Coordination Models and Applications: Knowledge in Pervasive Environments (CoMA), at the 17th IEEE International Workshops on Enabling Technologies: Infrastructures for Collaborative Enterprises (WETICE), Rome, Italy
August 2008	Workshop on Middleware for the Semantic Web: Enabling a Web of Knowledge and Services, at the Second IEEE International Conference on Semantic Computing (ICSC), Santa Clara, CA, USA
September 2008	Triple SpaceComputing: Large-Scale Integrated Knowledge Applications, tutorial at the Future Internet Symposium, Vienna, Austria
November 2008	Workshop on Semantic Extensions to Middleware: Enabling Large Scale Knowledge Applications, at the On The Move Federated Conferences (OTM), Monterrey, Mexico

Extending the project termination deadline TripCom will host and organize the following events:

- **FIS 2009:** In association with STI International TripCom partially initiated the Future Internet Symposium (FIS) in Berlin, Germany, September 2-3 2009.
- **Med-e-tel 2009:** TripCom will be present at Med-e-tel in Luxembourg, April 1-3 2009. Med-e-tel is a leading international forum for education, networking and business in the area of e-Health, Telemedicine and Health ICT.
- **CoMa, WETICE 2009:** TripCom will organize the workshop *Coordination Models and Applications: Knowledge in Pervasive Environments (CoMa)* at the

17th IEEE International Workshops on Enabling Technologies: Infrastructures for Collaborative Enterprises (WETICE) in Groning, the Netherlands, June 2009.

- **SEMELS, OTM 2009 - 2013:** TripCom was offered the option of hosting the workshop *Semantic Extensions to Middleware: Enabling Large Scale Knowledge Applications* at the On The Move Federated Conference(OTM) for the next consecutive five years.

5 WEB SITES

Web sites have been an important dissemination channel for projects such as TripCom. The main project web site at tripcom.org presents an overview of the project, its mission and the consortium, but also a detailed description of the work: a listing of the publications and deliverables; a frequently updated news page and a list of events that are relevant to the project, and also a reading list for background in space-based computing, semantic technologies, electronic data interchange, security and trust, and also eHealth — a major use case. With all this information, the web site has become an important source of (triple) space computing information and has improved awareness about TripCom in the relevant communities.

In addition, the publicly available software deliverables from TripCom project are hosted at sourceforge.net, the de facto location for open source projects.

6 COLLABORATIONS

During the lifetime of the project, TripCom members successfully collaborated with other projects and cooperations:

- **LarKC:** The LarKC project uses TripCom expertise (deployment, scalability evaluation) for the realization of their Thinking@Home concept. Reto Krummenacher had an invited talk at the LarKC Plenary Meeting in Amsterdam, The Netherlands.
- **SOA4ALL:** The SOA4All project uses TripCom technology to realize the Service Web. TripCom participated at SOA4All meetings dedicated to architecture issues. Reto Krummenacher had an invited talk at the SOA4All Architecture Kick-Off Meeting in Grenoble, France.
- **Nokia Research:** Nokia Research Center showed strong interests in TripCom's results with respect to their research on triple space solutions for mobile devices. At the 7th project meeting in Galway, Ireland, Ian Oliver from Nokia research gave a talk about "A Distributed Triple Space Computing Platform".
- **SUPER:** Together with SUPER, TripCom jointly worked on the development of the BPEL ontology. Also, TripCom was presented at the SUPER plenary meeting in Sofia, Bulgaria.

7 STANDARDIZATION

The technologies created by TripCom have an effect on standardization activities, mainly in the scope of Semantic Web Services. Organizations such as the World Wide Web Consortium (W3C) and OASIS (originally SGML Open) are currently working on relevant technologies in this area. Additionally, work package 7 has been contributing to standardization in the area of Electronic Application Integration (EAI), which is done within the United Nations Centre for Trade facilitation and Electronic Business (UN/CEFACT) and the International Organization for Standardization (ISO).

The effects of project involvement in standardization have been notable. First, the involved project members have gained insight into the new (proposed) standards, keeping the developed technologies up to date with the specifications that have the backing of the industry. As an example of this effect, LFUI was involved in W3C efforts around WSDL 2.0 and SAWSDL (Semantic Annotations for WSDL and XML Schema), and both standards are to be used in the project, increasing interoperability with existing and future technologies in related areas.

Second, by being involved in standardization, the project results can affect the future standards, propagating the research and evaluation results and increasing the visibility of the project. For instance, W3C has recently launched SPARQL Working Group who is chartered to extend new features to the SPARQL query language which was used in the project work. LFUI and Profium are already W3C members and participate in this working group's work.

Involvement in standardization carries a cost on the potential for exploitation of the accrued intellectual property. W3C imposes a royalty-free licensing requirements for any prospective W3C Recommendation, whereas OASIS supports Reasonable And Non-Discriminatory (RAND) licensing, i.e., the owners of patents can ask a reasonable license fee from the implementors of that technology. The two approaches both have their pros and cons; the TripCom project partners will evaluate the best applicable approach to any new standard proposals.

8 SUMMARY AND FUTURE OUTLOOK

In this impact report, we have summarized the outward activities of the project partners, separately or in cooperation, which have been relevant to the aims of TripCom. The most important indicator of the impact of a research project such as TripCom is its output in scientific publications and the impact on standards.

The further areas of impact are public talks that promote triple space computing; events organized to discuss the research results and to foster industry cooperation; and finally also the project web sites, which are not limited to describing the project itself but serve as a source of information from triple space computing paradigm.