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TRIDEC

COLLABORATIVE, COMPLEX AND CRITICAL DECISION-SUPPORT IN EVOLVING CRISES

Annual Public Report 2012

TRIDEC is developing new approaches and technologies for intelligent information management in collaborative, complex and critical decision processes in earth management. The key target is the design and implementation of a collaboration infrastructure of interoperable services efficiently supporting the intelligent management of both dynamically increasing volumes and dimensionality of relevant information. This will enable multiple decision makers to respond quickly via a collaborative decision-support environment.

TRIDEC integrates software services development and computational methods with collaborative technologies. TRIDEC will establish rapid, on-demand interoperability of inherited legacy applications and tools. Collaborative computing is used to make them work together to establish the decision-support enterprise system of services. This will allow to deliver timely critical information to decision makers during evolving crisis situation in natural crises or subsurface development.

The TRIDEC consortium consists of ten partners from the drilling industry, information technology and research, developing pilot applications for two core domains of earth management, namely natural crisis management and industrial subsurface exploration. The project will be concluded in August 2013.

1 Summary of Activities

In the second project year, the TRIDEC consortium has essentially concentrated its efforts on the following major topics:

1. Activities started with the validation of developmental results of the 1st phase of TRIDEC, comprising the core components including **middleware, knowledge base, workflow management and decision support components as well as both application prototypes**.
2. Scenarios, stories and use cases resulting from the first year requirement analysis of TRIDEC helped to compile specific user and system requirements for the design of the system, the development of the core components and second application prototypes.
3. Preparation of an overall architecture document through a dedicated Architecture Task Force, especially addressing the system-of-systems (SoS) nature of the TRIDEC system. The architecture document comprises different perspectives, e.g. components and the information viewpoints. It also includes concepts for the system integration, e.g. via an enterprise service bus (ESB), and also approaches the management and processing of events.
4. Development of the second demonstrator of the mid-weight system, by extending the existing light-weight system to integrate a full enterprise service bus and security services, allowing operators of the data acquisition sites to help protect the confidentiality and integrity of their data. This task also integrates an extended knowledge base and decision support sub-systems to support prescribed workflows for more extensive thematic services. The second demonstrator was released in October 2012.
5. Maintenance and extension of structures and procedures needed for project management and project execution including consortium meetings, compilation of status reports, readjusting of project Milestones and Deliverables and conference calls to coordinate independent software development activities.
6. Fostering of collaboration and communication within the project by updating and extending the information exchange facilities such as the TRIDEC Project Portal. The portal has become a central information hub for both public information and project information management for the consortium and the Technical and Scientific Advisory Board (TAB).

The achievements constitute the solid ground for further elaboration of requirements thus providing the profound basis for the design and effective development of the next generation of more complex TRIDEC demonstrators scheduled for 2013.

2 Progress in Important Working Areas

TRIDEC focused on the following core working areas**:** requirements engineering, design and system architecture, the development of a service platform and two application demonstrators in earth management, i.e. in natural crisis management and industrial subsurface exploration.

The main objectives of TRIDEC are included in the core working areas:

- Construction of a robust, scalable service infrastructure supporting the integration and utilisation of existing resources including distributed sensor systems, monitoring facilities and geo-information repositories as well as simulation, processing and data fusion systems.
- Development of services for the flexible management and configuration of system resources especially sensor systems including the configuration of discrete sensor networks and tasking of sensors in order to realise intelligent observation and monitoring strategies.
- Design and implementation of a knowledge base for intelligent information management providing essential context information for the aggregation, storage and retrieval of large volumes of information, e.g. about system components, prognostic models, rules, data and information models, ontologies, as well as past crisis events and simulated data for system tests.
- Construction of tools for the design and execution of complex information logistic processes and workflows steering ingest and fusion of data as well as rules for the selection of context information delivered by the TRIDEC knowledge base.
- Design and implementation of an adaptable framework for collaboration and decision-support environments enhancing complex business processes including the intelligent management of crisis situations and the systematic testing of system features and training of decision makers.

TRIDEC focuses on two application fields, namely natural crisis management (Tsunami use case) and industrial subsurface exploration (Drilling Operations use case). Both fields have a very high social and economical relevance and represent only two examples of the broad applicability of the innovative TRIDEC concept. Detailed progress reports are given below.

2.1 Service Platform Development

Flexible service orchestration and easy adoptable decision support workflows are very important to address the complexity and diversity of crisis management scenarios and contingency plans. The design and development process of the TRIDEC event driven service platform includes architecture and core components, knowledge base, services orchestration and decision support workflows, to enhance the overall scalability and resilience.

One of the key activities of TRIDEC addresses the elicitation of end-user requirements. In this process, scenarios, stories and use cases captured specific user requirements. The resulting functional and non-functional system requirements for both application fields, Natural Crisis Management (NCM) and Industrial Subsurface Development (ISD) have been compiled in a system requirements document. Based on this, the TRIDEC Architecture Task Force specified the architecture with an emphasis on the SoS federated nature of the system. A SoS consists of a set of independent information systems that have to cooperate in order to realise complex collaborative tasks.

The TRIDEC SoS addresses real-time crisis management. Therefore very high standards in terms of information and event management as well as performance and resilience requirements exist. Special attention was put on the fact that the architecture has to be applied to completely different scenarios (NCM and ISD).

The structure of the TRIDEC architecture guided the research and development activities of the TRIDEC service platform and its core components, knowledge base, as well as services orchestration and decision support workflows at the end of the 2nd phase of the TRIDEC development cycle.

A key element enabling SoS implementation was the design and development of a message-oriented middleware (MOM). Development was refocused from the initial aim of a single MOM abstraction Application Programming Interface (API) providing access to two different MOM implementations (Apache Qpid, QS-MOM), to support just a single MOM (Apache Qpid) instead. Scalability and resilience support was enhanced with an improved MOM resilience model ensuring guaranteed message delivery, broker replication and broker load balancing.

For the TRIDEC knowledge-based service components, the crucial achievements in Y2, apart from the successful integration into the TRIDEC SoS, were the development of fusion and modelling services for both TRIDEC application scenarios. For this, a hybrid technical approach was adopted, consisting of a triple store specialising in the management of increasing meta-information, while a dedicated relational database was put in place for the management of observation data.

2.2 Application Development

The development of pilot applications for the demonstration of the TRIDEC system in both application fields Natural Crisis Management (NCM) and Industrial Subsurface Exploration (ISD) has progressed as planned.

For the application prototype NCM test bed, the light-weight NCM system was extended to integrate a full enterprise service bus and security services in order to allow operators of the data acquisition sites to help protect the confidentiality and integrity of their data. The key objectives were the adaption of the sensor integration platform (SSB) and the Command and Control User Interface (CCUI) [Figure 1] to comply with the SoS concept. Also, demand access to tidal harmonics components from the knowledge base was developed, paralleled by the early integration of the matching tsunami modelling scenario algorithms. Investigations on the application of new sensors continue, ranging from social media reports and GPS to unmanned aerial vehicles (UAV).

Demonstrations of the current NCM system took place during the second TRIDEC Milestone meeting at the premises of the Kandilli Observatory and Earthquake Research Institute of the Bogazici University, Istanbul (KOERI). KOERI is a member of the TRIDEC consortium and responsible for tsunami early warning in Turkey. For the upcoming UNESCO-IOC ICG/NEAMTWS activities planned for November 2012, the latest mid-weight NCM system demonstrator has been deployed at KOERI and the Instituto Portuguese do Mar e Atmosfera (IPMA) in Portugal. Here the NCM demonstrator is additionally used for training and evaluation. The NCM demonstrator was furthermore presented in the European Crisis Management Laboratory (ECML) at the Joint Research Centre (JRC) in Ispra, Italy. Another TRIDEC NCM demonstrator was set-up at the Meteorological, Climatological and Geophysical Agency (BMKG) in Jakarta, Indonesia. After the integration of the existing sensor network and extensive subsequent system tests, the demonstrator was handed over to the BMKG.

For the Industrial Subsurface Drilling application (ISD), the main goal was to provide relevant information about upcoming, potentially critical situations and how these situations can be avoided for the drilling crew on a rig or the monitoring crew in the data centre. The first prototype of the Drilling Support System supported drilling at a single rig, based on historical data delivered by a Data Stream Simulator. The second period objectives for ISD were the provision of relevant information about upcoming, potentially critical situations and their avoidance, focusing on the scenarios of stuck pipe events and abnormality detection for single rigs. Three major drilling state detection services were implemented and their performance benchmarked, both for large volumes of meta-information and observation data. A successful test was conducted at the Ketzin drilling site in Brandenburg, Germany.

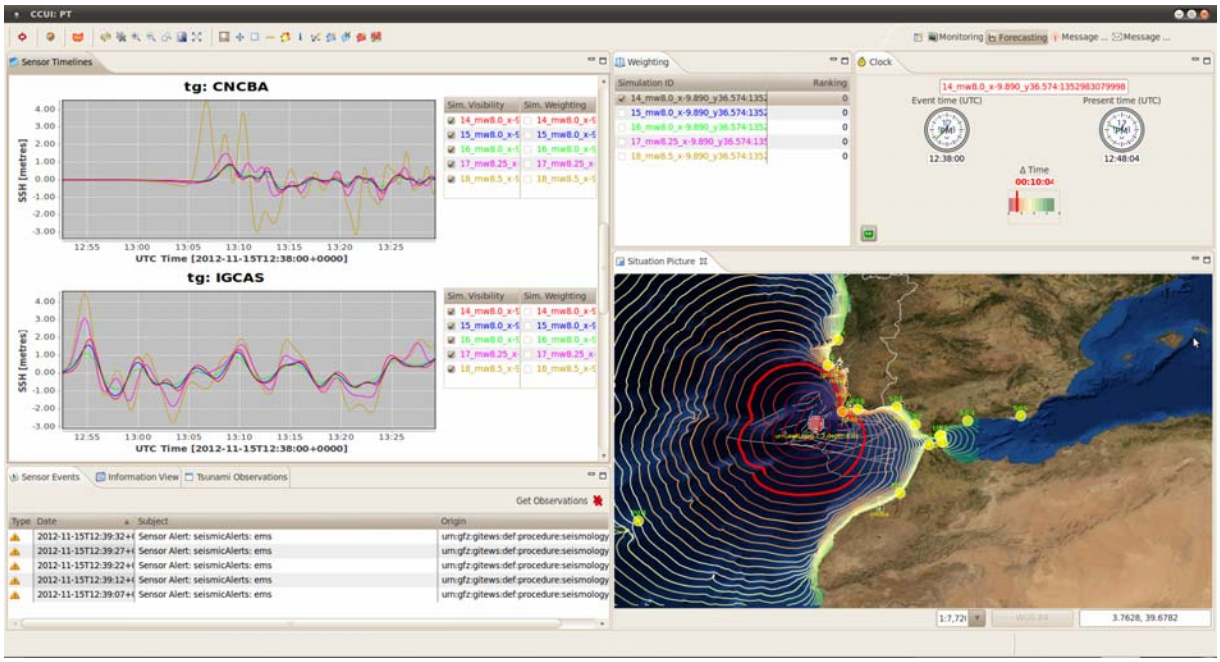

Figure 1: The mid-weight NCM demonstrator's Command and Control User Interface (CCUI).

2.3 User Involvement, Promotion and Awareness

User involvement is important for the design, development and validation of the TRIDEC system. The consortium fostered the growth of a network of authorities and industry partners as well as research institutions.

To communicate the projects achievements, the TRIDEC project website was continuously updated to inform the general public about the achieved results while the online project portal is used as a central point of information for consortium members and the TRIDEC Technical and Scientific Advisory Board (TAB).

Project results and work in progress have been distributed by printed information such as the project fact sheet and dissemination materials (project presentation, image brochure and TRIDEC leaflet). Results and on-going activities of the TRIDEC project were announced within the respective scientific communities via active participation in congresses, conferences and other scientific or technical meetings.

The TRIDEC mid-term event, held during the European Geosciences Union (EGU) General Assembly 2012 in Vienna, Austria, served as a meeting place for TRIDEC partners and invited guests to reflect on the achieved status, the challenges ahead and application scenarios in other domains.

In addition, the EGU session NH5.7/ESSI1.7 "Architecture of Future Tsunami Warning Systems" was held by the TRIDEC consortium, serving as a major forum to disseminate the recent scientific achievements in TRIDEC on an international level.

Key events successfully targeted within the second project year:

- The First ICSU World Data System Conference: Global Data for Global Science (Kyoto, Japan: September 3–6 2011)
- European Conference on Machine Learning and Principles (ECML PKDD) (Athens, Greece: September 5–9, 2011)
- GeoEnergy Celle e.V. and GEBO in Cooperation with DGMK, International Conference for Advanced Drilling Technology (Celle, Germany: September 12–13, 2011)
- Intergeo 2011 (Nuremberg, Germany: September 27–29, 2011)
- 17th Middle East Oil & Gas Show and Conference (MEOS 2011) (Manama, Bahrain: September 28, 2011)
- 8th session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-eastern Atlantic, the Mediterranean and connected seas (Santander, Spain: November 22–24, 2011)
- Workshop: Tiefengeothermie Sachsen (Dresden, Germany: November 24, 2011)
- GMES Thementage Deutschland 2011, Workshop on Catastrophe and Crisis Management (Munich, Germany: November 24–25, 2011)
- World Petroleum Congress (Doha, Qatar: December 4–8, 2011)
- AGU 2011 (San Francisco, USA: December 5–9, 2011)
- ISCRAM 2012 (Vancouver, Canada: April 22–25, 2012)
- EGU 2012 (Vienna, Austria: April 22–27, 2012)
- TRIDEC Mid-Term Event (Vienna, Austria: April 25, 2012)
- FOSS4G-CEE: Free and Open Source Software for Geospatial in Central and Eastern Europe (Prague, Czech Republic: May 21–23, 2012)
- 9th PPRD South “Prevention and Preparedness” workshop for staff-level officials: “Tsunami emergency preparedness in Mediterranean coastal zones (Stromboli (Messina), Italy: May 28–June 3, 2012)
- XXII International Offshore and Polar Engineering (ISOPE) Conference (Rhodos, Greece: June 17–22, 2012)
- Agit 2012: Applied Geoinformatics Symposium (Salzburg, Austria: July 4–6, 2012)
- 5th ISCRAM Summer School “The Role of Social Media in Crisis Management” (Tilburg, Netherlands: August 15–24, 2012)

3 Future Work

In TRIDEC's third project year, the mid-weight versions for the NCM and ISD demonstrators will be extended with a fully functional multi-bus supporting multimedia streaming as well as advanced decision support system (DSS) and knowledge base sub-systems. In order to respond to evolving crisis conditions the multi-bus system supports the dynamic composition of individual workflows that can be orchestrated and controlled at runtime. Full thematic pilot applications will be implemented for NCM and ISD scenarios.

4 Further Information

Further information and up to date status reports can be obtained from the TRIDEC website at http://www.tridec-online.eu or via mail (tridec-contact@gfz-potsdam.de).

4.1 Consortium

The TRIDEC Consortium includes following ten partners:

Helmholtz Centre Potsdam, GFZ German Research Centre for Geosciences, CeGIT Centre for GeoInformation Technology (Germany) http://www.gfz-potsdam.de/

University of Southampton, IT Innovation Centre (United Kingdom) http://www.it-innovation.soton.ac.uk/

Queen Mary and Westfield College, University of London - Department of Electronic Engineering (United Kingdom) http://www.elec.qmul.ac.uk/

Joanneum Research Forschungsgesellschaft GmbH – Institute of Information Systems & Information Management (Austria) http://www.joanneum.at/en/digital.html

Fraunhofer - IOSB - Fraunhofer-Institute of Optronics, System Technologies and Image Exploitation (Germany) http://www.iosb.fraunhofer.de/servlet/is/6974/

TDE Thonhauser Data Engineering GmbH (Austria) http://www.tde.at/

Q-Sphere Limited (United Kingdom) http://www.q-sphere.com/

Instituto Portuguese do Mar e Atmosfera – IPMA (Portugal) http://www.meteo.pt

Alma Mater Studiorum - Universita di Bologna – Department of Physics (Italy) http://www.df.unibo.it/

Bogazici Universitesi - Kandilli Observatory and Earthquake Research Institute (Turkey) http://www.koeri.boun.edu.tr/eng/topeng.htm

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