The University of Kansas

Technical Report

EDS HP Final Report

EDS, an HP Company
J. Walther, L. Sackman, M. Gatewood,
J. Spector, S. Hill, J. Strand

ITTC-FY2010-TR-41420-16

December 2009

Project Sponsor:
Oak Ridge National Laboratory
Award Number 4000043403

0 Amendment History

Append document status to the following table (for example, Draft, Final or Release #).

CR# (optional)	Document Version#	Approval Date	Modified By	Section, Page(s)and Text Revised
	0.1	09 Feb 2009	Sackman, Larry	Initial Creation

CONTENTS

TABLES

1 Project Process

The purpose of the EDS effort was to produce an integrated SensorNet and Trade Data Exchange architecture and field tested in a rail environment of sensing prototype for intermodal transport. This goal was successfully achieved. An integrated SensorNet and Trade Data Exchange environment was designed, implemented, and demonstrated with two rail field trials. The effort resulted in two filed demonstrations of end-to-end operability of the use cases selected and defined with stakeholders (KCS).

For convenient reference, the following is a review of EDS' project process.

Milestone 1	**Planning and Architecture Phase**
	In this first phase, EDS formed the project team and engaged stakeholders to ensure their business and operational requirements were identified and documented. EDS finalized the project scope document, prepared the project management plan, finalized the business-technology processes and developed the enterprise architecture developed the test plan.
Milestone 2	**Hardware Specification and Procurement Phase**
	In the second phase, EDS specified and procured the servers to host the Trade Data Exchange (TDE) architecture and procured the Hi-G-Tek sensors. In addition, EDS developed the test scenarios for the operational field tests.
Milestone 3	**SensorNet Configuration and Deployment Phase**
	The third milestone involved SensorNet devices configuration, integration and deployment, plus core feature enhancement and system testing.
Milestone 4	**TDE Integration and Testing Phase**
	The fourth milestone involved integration of the SensorNet configuration with the SmartPort TDE architecture and two operational field tests: (1) a short-haul test in the KC metropolitan area and (2) a long-haul test.

2 Project Deviations

As the project progressed, the needs and requirements of stakeholders and the technologies selected necessitated modifications to EDS' original statement of work. A change order, Subcontract 2007-023 M1 executed in August 2008, redefined EDS' scope in terms of schedule, budget and operational tests. The following sections detail the modifications specified in the change order.

2.1 Schedule Modifications

EDS' original project schedule had a July 7, 2007, planned start date and a December 31, 2008, planned finish date. In accordance with the statement of work, the original schedule incorporated four deliverable-based milestones: (1) Planning & Architecture, (2) Hardware Specification & Procurement, (3) SensorNet Configure & Deploy and (4) TDE Integration/Testing. Table 1 shows the original planned and finish date for each phase.

Table 1

Deliverable	Original Planned Start	Original Planned Finish
Planning & Architecture	July 2007	September 2007
Hardware Specification & Procurement	October 2007	December 2007
SensorNet Configure & Deploy	January 2008	June 2008
TDE Integration/Testing	July 2008	December 2008

Following the August 2008 change order, EDS modified the project schedule to reflect the planned dates shown in Table 2.

Table 2

Deliverable	Project Planned Start	Project Planned Finish
Planning & Architecture	July 2007	September 2007
Hardware Specification & Procurement	October 2007	December 2007
SensorNet Configure & Deploy	January 2008	December 2008
TDE Integration/Testing	January 2009	August 2009

2.2 Budget Modifications

The original project budget allocated $26,617.00 for computer equipment, $253,378.00 for sensing devices and $38,040.00 for travel. During Phase 2, Hardware Specification & Procurement, it became apparent that the original budget allocated more than would be required for computer equipment, sensing devices and for travel. Within the change order, KUCR and EDS agreed to reallocate budget dollars from these categories to labor. Table 3

shows EDS' original budget allocation, the changes allowed by the change order and the resulting project budget.

Table 3

Description	Original Budget	Change	Project Budget
Labor	$430,875.00	$155,721.00	$586,596.00
Telecomm	$1,500.00	$3,500.00	$5,000.00
Computer Equipment	$26,617.00	($14,617.00)	$12,000.00
Sensing Devices	$253,378.00	($230,378.00)	$23,000.00
Travel	$38,040.00	($18,040.00)	$20,000.00
TOTAL SUBCONTRACT	***$750,410.00***	***($103,814.00)***	***$646,596.00***

2.3 Operational Field Tests

A major aspect of the EDS contribution to this research was developing a relationship with the rail stakeholder, in this case KSC, defining the priority scenarios with the stakeholders, and coordinating and participating in rail field trials. While the specific nature of the field tests changed over time, two successful field trials were conducted: one in the US, and the second originating in Mexico and completing in the US. After reviewing customer requirements and priority business cases, EDS acquired the Hi-G-Tek sensors.

The original plan (2007) subcontract specified three field tests. However, the business requirements of stakeholders and technical limitations of sensors required that modifications be included in the change order. Section 0 details the original field test, and as the project evolved, a second more specific set of field test were defined. Section 0 details the modified project field tests. Section 3.3.3 contains an overview of the two field experiments that were conducted in January and July of 2009.

2.3.1 Original Field Tests

Test 1	**International in-bound cargo through Mexico**
	Equip three to five intermodal cargo containers will be equipped with tracking and sensing devices. Tracking and sensing information will potentially include data such as door open, door close, temperature, vibration, as well as chemical and radiation profiles. Stakeholders will include an international shipper, Kansas City Southern, Mexican and US brokers and a local truck line carrier, US Customs And Border Patrol, Mexican Customs, and the Port of Lazaro Cardenas.
Test 2	**International out-bound cargo to Mexico**

	Equip one to two tractor trailer rigs with tracking and sensing devices. Monitor the rigs they travel from Kansas City, through the Laredo, TX port to a final destination in Mexico. Tracking and sensing information will potentially include data such as door open, door close, temperature, vibration, as well as chemical and radiation profiles. Stakeholders will include an International shipper or third-party logistics (3PL), Mexican brokers, a truck line carrier and Mexican Customs.
Test 3	**International in-bound cargo through US West Coast port**
	Similar to Test 1, however, the route will be through a US West Coast port of entry (for example, Seattle/Tacoma or Los Angeles/Long Beach) and travel over the Burlington Northern Santa Fe (BNSF) rail line to Kansas City, MO, intermodal transfer to truck line and delivery to ultimate destination. Tracking and sensing information will potentially include data such as door open, door close, temperature, vibration, as well as chemical and radiation profiles. Stakeholders will include an International shipper or third party logistics (3PL), US Customs and Border Patrol, a US brokers and BNSF rail line.

2.3.2 Project Field Tests

Test 1	**KC metropolitan short haul**
	Equip one to three intermodal cargo containers with tracking and sensing devices. Tracking and sensing will potentially include sensing information such as door open and door close. Stakeholders will include Kansas City Southern Rail lines.
Test 2	**Mexico port of entry to Nuevo Laredo, MX**
	One to three intermodal cargo containers will be equipped with tracking and sensing devices and monitored as they travel from a Mexican port of entry to Nuevo Laredo. Tracking and sensing will potentially include sensing information such as door open and door close. Stakeholders will include Kansas City Southern de Mexico.
Test 3	**Mexico port of entry to Guadalajara, MX**
	One to three intermodal cargo containers will be equipped with tracking and sensing devices and monitored as they travel from a Mexican port of entry to Guadalajara. Tracking and sensing will potentially include sensing information such as door open and door close. Stakeholders will include Kansas City Southern de Mexico.

2.3.3 Final Field Tests

Regrettably, the economic recession of 2008 further restricted the participation of stakeholders. As a result, the number of test was reduced from three to two. The final tests executed under the subcontract are detailed below.

Test 1	**KC metropolitan short haul**
	Equip one to three intermodal cargo containers with tracking and sensing devices. Tracking and sensing include the following data: sensor present, sensor missing, GPS, and door open and door close. Stakeholders will include Kansas City Southern Rail lines. See the ITTC technical report ITTC-FY2009-TR-41420-11 for summary and analysis of the KC metropolitan short haul trial.
Test 2	**San Luis Potosi, MX, to Nuevo Laredo, MX, to Laredo, TX, to US destination**
	One to three intermodal cargo containers will be equipped with tracking and sensing devices and monitored as they travel from a Mexican port of entry to Nuevo Laredo. Tracking and sensing include the following data: sensor present, sensor missing, GPS, door open and door close. Stakeholders will include Kansas City Southern de Mexico. A full description and analysis of this trial will be available shortly in an ITTC technical report.

3 Trade Data Exchange

3.1 Overview

The Trade Data Exchange (TDE) contains commercial shipping data. The TDE is based on a standards-based, service-oriented architecture. Hosted on a server geographically separate from the VNOC, the TDE responds to queries from the VNOC. Finally, the TDE sends startMonitoring, stopMonitoring, and getLocation messages to the VNOC.

The TDE monitors the progress of shipments from the point of origination to the point of destination. The TDE captures commercial and clearance data including the shipping list, bill of lading, commercial invoice, certificate of origin and shipper's export declaration. The TDE validates data within and across these trade documents to ensure the data is accurate, consistent and complete. Further, the TDE will monitor the progress of the documentation and notify responsible parties when errors or incompleteness pose the threat of delaying a shipment. Finally, the TDE will also forward notification to the customs broker to request verification of the trade origination documents. The customs broker accesses the TDE via the same portal to review and verify the trade documentation. The TDE will also allow for collaboration between participating shippers, third-party logistics providers, carriers and customs brokers to define and document business requirements and risk assessment requirements.

The TDE was successfully integrated with SensorNet as demonstrated with the field trials. The TDE continues to be developed and integrated into the Kansas City SmartPort with expectations of becoming operational in 2010. The TDE and SensorNet projects continue to be further integrated with separate funding to include automated data collection of changes in custody of shipments.

3.2 Lessons Learned

All of the major goals of the project were met. We were able to successfully demonstrate the integration of the TDE and SensorNet systems on a realistic scenario that demonstrated business value to stakeholders.

Through the process, we encountered a number of situations that we have learned from. These are given in the table below.

Automate startMonitoring Activity	The manual startMonitoring activity required that additional resources be available at the beginning of the short-haul and long-haul test. As a result, resources were providing support at atypical working hours. Further, the long-haul test was a 24x7 operation throughout its duration. An automated startMonitoring action would have benefited those on the train and KU ITTC resources in Lawrence during the operational tests.

Secure Greater Commitment from Operational Test Stakeholder	KCS played a vital and critical role in the ability to demonstrate the integration of the TDE with the SensorNet through extensive facilitation efforts associated with both operational tests. To their credit, KCS did provide valuable resources (using only their internal resources) in people, access and equipment. For this, the project team is grateful. However, a stronger relationship with the stakeholder may have fostered a greater investment on the part of KCS, which is critical for the long-term impact of the developed systems.
MCS Data	Moving forward, an automated feed of MCS data, rather than static data formulated by the project team, would have allowed the operational tests to reflect a better, real-world type of scenario.
Sensor Hardware	The sensor hardware from Hi-G-Tek functioned as expected during both operational tests with one exception, the parent/child capability. Hi-G-Tek was selected as the sensor hardware provider because their technology was marketed and sold as having the parent/child capability. The project team did not learn that Hi-G-Tek's hardware available in 2008 and 2009 did not include the parent/child capability. EDS worked with Hi-G-Tek to incorporate the parent/child capability into the sensor hardware procured for the project. Hi-G-Tek, however, was not able to complete implementation of the capability without adversely affecting the schedule of the long-haul test.

3.3 Future Directions

Continued Partnership	HP sees great value in continuing the partnership between KU ITTC and EDS. We see the SensorNet technology becoming an integrated component of the TDE solution. Using SensorNet as the gateway between field-deployed sensing technologies and the TDE allows the TDE to offer services wider audience of transportation industry service providers. That SensorNet keeps the TDE agnostic of sensors deployed in the field is a value proposition to all. Further, that the SensorNet can provide sensor data related to field events allows transportation stakeholders the ability to more closely monitor cargo and assets. This in turn can help the industry minimize loss due to theft and tampering, which provides a means to stakeholders to operate more efficiently in such a competitive industry.
Continued Development of the TDE	Related to the TDE specifically, EDS would very much like to keep the solution moving forward to its eventual objective: a commercial product. To that end, EDS continues to pursue sources of funds to continue development of the product.

4 Acknowledgements

The authors would like to acknowledge Kansas City Southern de Mexico for their vital participation in the long-haul rail trial; specifically, Jim Kneistadt, Head of Security, and Alan Martinez.

5 Legal Trademark Requirements

EDS

EDS and the EDS logo are registered trademarks of Hewlett-Packard Development Company, LP. HP is an equal opportunity employer and values the diversity of its people.