



DEMONSTRATION OF THE RADIO FREQUENCY IDENTIFICATION TRANSPORTATION SECURITY AND SAFETY SYSTEM

Technology Demonstration Summary

Laredo, Texas, October 15, 2003

Co-sponsors

U.S. Department of Energy and Laredo Transportation Association

In Collaboration with

Laredo Development Foundation
Southwestern Motor Transportation, Inc.
Powers International, Inc.

November 14, 2003

Prepared by

Eli Maestas and Dr. Richard Jimenez
Applied Sciences Laboratory, Inc.
Albuquerque, New Mexico

This report is made available by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any employee, makes any warranty, expressed or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness on any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of originators expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

EXECUTIVE SUMMARY

Since September 11, 2001, there has been an obvious effort at all levels of government to improve the Nation's security. There are new laws like the Patriot Act, and the 2002 Trade Act. There is a new Federal Department of Homeland Security. And, there is a new Bureau of Customs and Border Protection (CBP) with programs like C-TPAT (Customs Trade Partnership Against Terrorism) and CSI (Container Security Initiative). More recently, FAST (Free and Secure Trade) and PAPS (Pre-Arrival Processing System) are new southern land-border initiatives.

It is also clear that there is serious concern over the tremendous volumes of container and trailer ingress into the United States each year – estimated to be 16 million shipments, of which only a fraction are inspected. New CBP rules concentrate on encouraging voluntary participation of shippers and carriers in these programs. Along with selecting security-conscious firms which by virtue of their participation in CBP programs are likely to have fewer inspections, come added risks actually brought about by fewer inspections.

- ◆ If a terrorist is to target a container or trailer in which to place contraband materials or a weapon of mass destruction, it seems likely to select the container or trailer least likely to be inspected.
- ◆ Programs which require a pre-arrival manifest, like CSI's 24-hour rule, or the PAPS or FAST 30-minute to one-hour rule (depending on what program with which a carrier complies), may cause a delay between a trailer's arrival on the Mexican side at the land port-of-entry and its actual crossing into the United States.

As a result of the above risks and mandates, the U.S. Department of Energy's National Border Technology Partnership Program (NBTPP) seeks and selects emerging technologies to demonstrate and encourage their deployment along the U.S.-Mexico border region. The technologies that are selected must meet NBTPP screening criteria and show promise for complementing the above requirements to mitigate ensuing issues that impact public health and safety and environmental security.

In the case of cargo vehicles, all mechanical barriers are physically on the outside of the conveyance and do not provide protection from entry through the floor or through the roof or sides of the trailer or container.

A new security technology specifically designed without external attachments has been developed that shows promise to revolutionize the shipments of cargo in trailers and containers into the United States.

On October 15, 2003 – in partnership with the Laredo Transportation Association, the Laredo Development Foundation (LDF), Southwestern Motor Transport Inc., and Powers International, Inc. (Powers) – NBTPP sponsored a demonstration of Power's transportation security technology in Laredo, Texas. The Radio Frequency Identification (RFID) technology is capable of detecting the unauthorized intrusion and breach of a locked truck trailer or cargo container. The security system also reports the time and date of the unauthorized event.

We believe the widespread application of the demonstrated breach detection technology can become a viable tool for governmental authorities to better enable them to efficiently conduct their border oversight and control mission. In addition, it provides shippers, brokers and carriers the capability of accurately knowing real-time information and the status of their shipments while in transit.

TECHNOLOGY DESCRIPTION

The technology applies the novel Radio Frequency Identification (RFID) methodology to detect, record, and transmit surreptitious breaches into a sealed container destined for a U.S. port. This security device reconfigures and uniquely applies technology already approved and used by the U.S. Departments of Transportation and Defense, and the U.S. Customs and Border Protection (CBP) with respect to border crossings for North American trade at U.S. land ports. Frequencies used are in accordance with U.S. law and the laws of the nations in which foreign ports are located.

The Powers' RFID technology employs multiple sensors that electronically "paint" the interior of a trailer or container. Any entry into the container in any manner is detected by a series of multiple proprietary sensors actively working in unison. The breach notification is immediately transmitted by radio frequency into a transceiver, which, in turn, transmits the breach event. The data, indicating the date and time of the unauthorized entry, is sent to the Internet through a landline utilizing proprietary software, although future applications will use a commercial satellite communication system similar to Orbcomm.¹ Figure 1 illustrates the sensors used in the demonstration.



Figure 1. Transducer RFID sensors

The combination of RFID transmissions and communication links afforded by the software forwards the breach information through appropriate secure Internet access. Thus, the purpose of the Powers security system is to detect, record, broadcast, and communicate to the user and/or to the CBP authorities information pertaining to one or multiple surreptitious breaches or penetrations into an already sealed container destined for or crossing into a U.S. port of entry.

¹ Orbcomm is a commercial provider of low-level satellite secure communication services. The company's clients include NATO, large commercial companies like Daimler-Chrysler, and some government agencies.

The RFID technology is also designed to record trade and/or manifest data that can be transmitted automatically to CBP or the user (shipper or carrier) at appropriate checkpoints or on demand. These trade and manifest data are consistent with, and applicable to current CBP programs like Custom Trade Partnership Against Terrorism (C-TPAT), Container Security Initiative (CSI), Pre-Arrival Processing System (PAPS), and Fast And Secure Trade (FAST).

The RFID sensor units are programmable with data storage capacity up to 64 kilobits, equivalent to about 3 double-spaced pages of information text. The shipping and trade data programmed into the unit may include such information as shipper, consignee and purchaser codes, bill of lading and manifest information, and identification numbers plus other information used in international shipping commerce.

The security technology utilizes the following major components: RFID-based transponder sensors with internal battery power supply; antennas; special activation and deactivation keys used to load and unload data/instructions into the sensors; base stations to automatically scan the departure and arrival of the shipment at the origin and destination; personal computer with online database capability to access the internet; and service connection to a low-level satellite communications system plus propriety software to operate the system.

The active reusable sensors are constructed to be mechanically robust, chemically tolerant, and functional in temperatures ranging between -50 degrees C to + 70 degrees C. The self-energized transponder unit is battery powered with a 10-year activation life. The system utilizes reliable existing passive and active RFID technology with activation and de-activation accomplished using a special access key.

Although not part of the demonstration, the system is capable of incorporating a global positioning system (GPS) feature within its logic to record or report on the precise location of a trailer or container at any time, plus the location of an unauthorized breach or whenever the unit is opened. It is possible to convert the GPS-reported coordinates to correspond to the exact location on a highway map of each intrusion into the trailer or container using the same computer system.

DEMONSTRATION PLANNING AND EXECUTION

Demonstration Planning

On September 5, 2003, a planning meeting was held in Laredo, Texas to formalize the participation of the local transportation industry and U.S. Customs and Border Protection of the RFID technology demonstration. Present at the meeting were representatives of 15 organizations from the transportation industry from the U.S. and Mexico. The participants included carriers, brokers, shippers, consultants, transportation associations, academia and local and federal government officials. The key partners in the demonstration committed financial and in-kind assistance necessary to insure the successful notification, attendance and execution of the planned demonstration activities. The date of the demonstration was set for October 15, 2003, with the prior day allocated for Powers International personnel to set-up the equipment, establish communication linkages, plus perform preliminary testing to ensure the demonstration was conducted without problems.

In addition to Powers International supplying the breach detection system, the Laredo Development Foundation (LDF) agreed to host the demonstration at its facilities near the cargo side of the Laredo International Airport. The facilities include a conference room capable of holding 50 people with appropriate audio/visual equipment and Internet communications connections. Additionally, LDF provided an area suitable for static display of the Powers sensors, support hardware and computers. LDF also provided adequate ingress and egress driveways and parking space for the large tractor-trailers and additional space for use to simulate breaching the trailers. LDF is located in a remote part of the city, allowing for an easily controlled demonstration along streets without heavy traffic patterns.

The Southwestern Motor Transport, a truck carrier with a local terminal volunteered to provide supplies, the tractor, trailer, cargo container and driver necessary to conduct the demonstration. TransMaritime provided the test cargo container.

Demonstration

The demonstration was conducted on October 15, 2003. As planned, the demonstration was repeated four times throughout the day in 2-hr intervals. This allowed local and regional attendees to participate either during the morning or afternoon hours so as to not interfere with their normal work commitments. The demonstration included a briefing of the RFID system capabilities followed by the actual demonstration of a simulated breach into a trailer or container in which the sensors monitored and reported the event (i.e., breached condition) via the Internet communications link.



Figure 2. Tractor-trailer and cargo container



Figure 3. Simulated breach through trailer door



Figure 4. Hasp with pin removed



Figure 5. Computer screen with breach notification

Figures 2 through 5 illustrate the sequence of the test. Figure 2 illustrates the tractor-trailer and cargo container used. Figure 3 depicts a simulated breach of the trailer by removing the pin in the hasp of the trailer door. Figure 4 shows the hasp with pin removed. Figure 5 is the RFID system computer screen showing notification that the trailer door has been breached. The RFID sensors were mounted on the

interior of both the trailer and cargo container. The demonstration utilized an origin and destination chokepoint, where the system is activated and secured during each demonstration cycle.

The status of the trailer, as indicated by the computer software revealed that the cargo container had been breached. Notification of the breached condition was downloaded from the Internet in real time and displayed for the participants by a computer that projected onto a view surface in the conference room of the LDF. The actual breach took place across the street from the LDF facilities.

During each of the 2-hr blocks of the demonstration, complete cycles of all the events were repeated. Thus, attendees had sufficient time to see a presentation, view the actual simulated breach and computer screen alert and transmission of data, and to ask pertinent questions.

CONCLUSIONS AND RECOMMENDATIONS

Shipping industry experts from the City of Laredo, Ciudad Nuevo Laredo, and other participants observed the validity and usefulness of the Powers International state-of-the-art security monitoring system that is designed specifically for the truck and container transportation industry. ***Feedback from the participants reveals the Powers security system does indeed fulfill a missing security need.*** The system is perceived as potentially responsive to the current requirements imposed by CBP to improve the flow of international commerce, particularly with respect to sanctions meeting national security requirements.

The participants were informed of the capabilities of the system to incorporate GPS technology into the logic of the sensors and computer code software. A number of the observers expressed a desire to witness an improved security system using the GPS features, since such a system would provide additional information that is needed in monitoring the location of trailers or cargo even if no unauthorized breach occurred.

As a result of feedback, an alternate paradigm security system has been developed incorporating RFID breach detection with satellite position coverage and secure communication transmissions. The new paradigm will allow for worldwide monitoring in real time of unauthorized breaches along with position detection. Preliminary discussions with the Nogales, Arizona trucking industry to conduct a demonstration using this concept have been initiated. The principal partners in the demonstration would be the Fresh Produce Association of the Americas and the Nogales, Sonora trucking association (CAADES), as well as the Nogales, Arizona U.S. Customs and Border Protection office. These organizations are supportive of a security demonstration of the combined monitoring technology incorporating both breach and locating features. Another possible demonstration site is the truck transportation industry in the El Paso and Ciudad Juárez sister city communities.

ORGANIZATION PARTICIPATION

The organizations that participated in either the planning meeting on September 5, 2003 and/or the transportation security technology demonstration on October 15, 2003 in Laredo, Texas are listed below.

Applied Sciences Laboratory, Inc.
Association of Laredo Freight Forwarding Agents
Customs Brokers Association of Mexico
D B Hastings, Inc
Dvtrace, S.A de V.C.
Emerson Electric, Inc.
Extra Transportes, S.A de V.C.
ICF Consulting, Inc.
International Business Machines, Inc.
Laredo Development Foundation
Laredo Licensed Customs Brokers Assoc.
Laredo Morning Times Newspaper
Laredo Police Department
National Customs Advisory Board
Powers International, Inc.
Proeza Transport International, S.A de V.C.
R & T Truck, Inc.-Laredo Cotton Transfer
Roadway Express, Inc.
Schneider Logistics, Inc.
Southwestern Motor Transport, Inc.
Super Transport Logistics International, LLC
TransMaritime, Inc.
U.S. Bureau of Customs and Border Protection
University of Texas-Center for Transportation Research

ACKNOWLEDGMENTS

The demonstration of the RFID sensors and associated computer system to detect the breaching of a trailer or cargo container was supported through the efforts of the NBTPP as part of the initiatives to protect public health and safety, environmental and physical security of hazardous or high value materials in transit. The valued partners of the RFID system demonstration are highlighted below.

- ◆ Powers International Inc. of Belmont, North Carolina provided the solid -state RFID transponder sensors, antennas, computers and computer code software plus access to low level satellite communication systems and/landlines.
- ◆ Southwestern Motor Transport Inc., San Antonio, TX provided supplies and the trailer, tractor, and driver to conduct the demonstration using a fully operational over-the-road vehicle; TransMaritime, Inc. of Laredo supplied a cargo container.
- ◆ The Laredo Development Foundation of Laredo, Texas provided the conference room facilities for use of the participants, off road parking lot to simulate breaching the trailers and computer access lines.
- ◆ The Laredo Transportation Association supported the demonstration for the benefit of its members and other transportation related firms in the industry, representatives coming from both the U.S. and Mexico.