THE MOTOR CARRIER EFFICIENCY STUDY
2010 ANNUAL REPORT TO CONGRESS

Pursuant to Section 5503(d) of the
Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
(P.L. 109-59)
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EXECUTIVE SUMMARY

Section 5503 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users set aside funding for the study of the application of wireless technology to improve the safety and efficiency of trucking operations in the United States: the Motor Carrier Efficiency Study (MCES). The purpose of the funding is to promote government partnerships with the motor carrier and wireless technology industries, to identify and test promising applications and devices in a "real-world" environment, and to promote the adoption and use of successful wireless solutions by a broad array of motor carriers. The Secretary of the U.S. Department of Transportation (DOT) is also required to transmit an annual report to Congress on the programs and activities carried out under Section 5503.

The Federal Motor Carrier Safety Administration (FMCSA) was delegated authority by the Secretary for administering this program and has completed specific actions pursuant to its provisions. The FMCSA organized the MCES into two phases. Phase I consists of identifying inefficiencies in motor carrier transportation plus the evaluation of potential safety and productivity benefits from wireless technology solutions. Phase II consists of field demonstration tests of promising wireless technologies that address the problem areas identified in Phase I, summarized in Table 2 of the Appendix.

This annual report summarizes the key 2010 accomplishments of the five MCES field demonstration projects initiated in 2008, 2009, and 2010. The demonstration projects are Wireless Drayage Updating (WDU), Wireless Roadside Inspection (WRI), Fuel Monitoring and Operations Management Systems, Cargo Theft Prevention, and International Border Electronic Screening.

In 2010, the WDU and Cargo Theft Prevention projects were completed while the WRI and Fuel Monitoring and Operations Management Systems projects began data collection. These projects addressed key inefficiencies identified in the MCES Phase I study. Two remaining problem areas related to border crossing will be addressed by the International Border Electronic Screening Demonstration Project. Table 2 in the Appendix expands the table from the Phase I study by adding a column that maps the Phase II projects back to the inefficiencies. The last Phase I topic to be addressed, Driver Turnover, is outside the scope of the MCES field demonstration objectives.

The FMCSA is committed to working with the wireless technology and motor carrier industries as well as with State commercial motor vehicle (CMV) safety agencies to evaluate and promote wireless technology solutions that improve CMV safety and efficiency. Updates to the Phase II initiatives not completed in 2010 will be provided in the 2011 annual report to Congress.

BACKGROUND

As stated in Section 5503, the specific objectives of the Motor Carrier Efficiency Study (MCES) include the following:

- Identify inefficiencies in freight transportation.
- Evaluate safety and productivity improvements made possible with wireless technologies.
- Demonstrate wireless technologies in field tests.

In addition to the objectives, the scope of the MCES consists of the following five program elements:[1]

- Fuel monitoring and operations management systems.
- Radio frequency identification technology.
- Electronic manifest systems.
- Cargo theft prevention.
- Roadside safety inspection systems.

Phase I was completed in January 2008, and the findings were documented in a final report.[2]

Activities of Phase II focused on applications within the broad program areas mentioned previously and were based on findings from Phase I as well as input from the multimodal team representatives from the Federal Highway Administration's (FHWA) Office of Freight Management and the Research and Innovative Technology Administration's Joint Program Office for Intelligent Transportation Systems.

WIRELESS DRAYAGE UPDATING DEMONSTRATION PROJECT

As mentioned above, FMCSA partnered with other DOT agencies in the Phase I research to identify freight transportation problem areas and promising wireless technologies to address them. This partnership proved so successful and beneficial that FMCSA continued it in some Phase II field demonstrations.

The FHWA has ongoing freight mobility field tests that provide a unique leveraging opportunity for Phase II demonstration funds. Specifically, FHWA is conducting the Cross-Town Improvement Program (C-TIP) in Kansas City, Missouri, in partnership with metropolitan planning organizations, several Class I railroads, the Port of Kansas City, the States of Missouri and Kansas, and several other public and private sector stakeholders.

The C-TIP provided a terrific opportunity to quickly demonstrate wireless technologies that address certain key Phase I MCES inefficiencies, including empty intermodal truck trips, incident-related congestion, and waiting to load and unload truck trailers. Although estimated savings for incident-related congestion avoidance were unknown, the Phase I final report[3]

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[1] As discussed in *The Motor Carrier Efficiency Study 2007 Annual Report to Congress*, FMCSA updated the minimum set of program elements listed in Section 5503(b) to include the modified Fuel Monitoring and Operations Management Systems and the new Roadside Safety Inspection Systems program elements to broaden the wireless safety technology applications under this program.

[2] The final report, *Motor Carrier Efficiency Study Phase I Final Report,* February 2009, is online at www.fmcsa.dot.gov/facts-research/research-technology/report/RRT_09_015_MCES.pdf.

[3] *Motor Carrier Efficiency Study Phase I Final Report,* page 20, www.fmcsa.dot.gov/facts-research/research-technology/report/RRT_09_015_MCES.pdf.

estimated that motor carriers could save $2.7 billion annually in avoiding empty miles travelled and over $3 billion annually from not having to wait to load or unload shipments at distribution centers, ports, and other points of freight interchange.

Within the WDU project, the following associated field demonstrations were conducted as part of C-TIP in 2010:

- Wireless Load Notification and Selection.
- Truck-Specific Congestion Avoidance.
- Wireless Facility Queuing Notification and Management.
- Dynamic Route Guidance Information.

The demonstrations were performed in a concurrent and integrated fashion to allow a holistic evaluation of the WDU solution as a component of the overall C-TIP system. The following sections describe the field demonstrations and project team activities.

The WDU project is an open architecture solution that uses low-cost wireless technology as an interface between drayage (intermodal or port) truck drivers and dispatchers who access three other C-TIP components, Intermodal Exchange,[4] Real-Time Traffic Monitoring,[5] and Dynamic Route Guidance.[6]

In the WDU project, each participating truck was outfitted with a truck-mounted driver interface device (T-MDID) linked wirelessly to the C-TIP system. For the C-TIP pilot, the iPhone was selected for the T-MDID because of its ability to lock the device from being used if the truck is moving. The T-MDID is the primary link for the truck drivers to participate in the C-TIP pilot demonstration. Through the T-MDID/iPhone, drivers sent location and trip status information and received trip assignments, traffic information, and notification of suggested route changes based on traffic conditions.

The devices are wireless, have Global Positioning System (GPS) capability, and have a viewing screen and interface capability for the truck driver's use. Safety requirements for in-cab use included the following: 1) the device does not allow the driver to interface while the vehicle is moving; 2) the device was mounted in a location that did not obstruct the driver's view outside the vehicle; and 3) the device was mounted in a location within easy reach that did not hinder or prevent any other aspects of vehicle operation.

Wireless Load Notification and Selection

This application, by employing a combined load matching function, allowed participating companies to use the Wireless Load Notification and Selection application (i.e. shippers, railroads, freight forwarders, etc.) and motor carriers to coordinate operations so that trucks returning to the originating terminal can bring a return load, rather than returning empty. Information on loads was directed to the iPhone and motor carriers logged into a Web site to indicate which loads they could support within their resource constraints. The system applied business rules agreed upon by the participating shipping companies and motor carriers to provide the resulting load assignments (work orders) to each motor carrier in a combined dispatch

[4] Intermodal Exchange (IMEX) – Open architecture software that enables a collaborative dispatch management model among rail lines, truckers, facility operators, and public traffic management systems.
[5] Real-Time Traffic Monitoring – Real-time monitoring and distribution of route-specific travel time and congestion information utilizing IMEX and the metropolitan area traffic management system.
[6] Dynamic Route Guidance – Dynamic routing via travel time algorithm using available data to predict travel time.

format. The motor carrier dispatcher then assigned loads to individual truck and driver combinations based on current location, proximity to the originating facility, and estimated time of arrival information, and transmitted the information wirelessly to the T-MDID in the cab of the truck.

Truck-Specific Congestion Avoidance

This application provided a wireless link to existing and newly emerging traffic information. It allowed drivers to receive traffic data that is particularly applicable to their operations. If alternatives existed, the application provided truck-specific alternate routing information to reduce potentially costly delays. Recurring and updated data regarding the position of each motor carrier's vehicles were accessed through the T-MDID and automatically provided to the C-TIP system. This data were then used by the Real Time Traffic Monitoring (RTTM) and Dynamic Route Guidance (DRG) component of C-TIP to calculate the most efficient route from each vehicle's current location to its planned destination. The calculation uses pickup and delivery requirements present in the motor carrier's dispatch system and traffic data obtained from the appropriate traffic operations center. Each vehicle's location was obtained wirelessly through satellite-based (GPS) cellular technology capabilities resident in the T-MDID/iPhone. Traffic updates and routing advisories generated by RTTM-DRG were relayed to the drivers through the same T-MDID.

Wireless Facility Queuing Notification and Management

This application relied on the use of real-time location and trip status information obtained from the T-MDID of inbound trucks, coupled with automated arrival assignment software, to adjust arrival appointments, and to provide the terminal operator a means to ensure continuous operations without the need to physically queue trucks at the facility gate. Changes in arrival appointments, including such information as parking space number, were transmitted back to the inbound truck drivers through the T-MDID, thereby alleviating the pressure associated with potentially missing appointments or waiting in long lines.

A contractor-led team, working in conjunction with the public and private sector stakeholders, completed the WDU system requirements work for the demonstrations in the fall of 2009 and are in the process of completing the integrated design requirements of WDU with the other C-TIP system components. The integrated design testing was completed, and the combined WDU field demonstration tests with motor carriers began in October of 2010. However, due to a weakened economy and a reduction in overall freight demand, there was an inadequate amount of inbound and outbound trips, resulting in less than optimal participation by the motor carriers. Therefore, this test is being currently deferred and will be combined with the FHWA's Freight Advanced Traveler Information System (FRATIS) testing. Final evaluation results addressing the FRATIS tests' outcomes and findings are expected to be available by late 2012.

Dynamic Route Guidance Information

A DRG test was preformed as part of C-TIP in Kansas City, Missouri, from October 2010 to April 2011. The test was an attempt to determine how improved routing decisions for freight carriers could improve current roadway travel times based on the use of current and projected traffic conditions. The DRG system provided route guidance information using two methodologies, predetermined routes and en route guidance. Predetermined routes are computed as near as possible to the truck dispatch time and prescribe turn-by-turn directions from origin to destination. En route guidance is based on continuously-computed information, and as a truck

approaches an intersection, the driver would be provided with what action to take at the intersection (i.e., whether to go right, left, or straight). Both predetermined and en route guidance data used in the test enabled vehicles to move between origins and destinations inexpensively and avoiding heavy congestion. Preliminary estimates indicate improvements as high as 22 percent in travel times for freight carriers that participated in the test. Additional testing of DRG will commence in future studies planned under the FRATIS initiative.

WIRELESS ROADSIDE INSPECTION DEMONSTRATION PROJECT

In August 2008, FMCSA initiated the WRI demonstration project, which will evaluate how effectively current commercial mobile radio services (CMRS)—including onboard computers and wireless fleet management tracking systems—can check driver, vehicle, and motor carrier safety status while the CMV is moving. The FMCSA is conducting the WRI project in partnership with several wireless technology providers, motor carrier companies, and the State of Tennessee Department of Safety.

According to a 2003 FMCSA study,[7] there were 3 million truck inspections with a violation rate of 73 percent (including a 23 percent out-of-service rate). In that same year, there were 177 million roadside truck weighs[8] with a violation rate of 0.29 percent.

New technologies and enforcement strategies could dramatically increase the number of times a CMV and its driver are examined, which could lead to better-targeted enforcement, create a greater deterrence to operating unsafely, and reduce the number of truck and bus crashes. The FMCSA's WRI project will evaluate the feasibility and value of assessing commercial drivers and vehicles up to 25 times more often than is possible using current approaches and existing personnel capacity.

A "wireless inspection" is a process where public sector entities (personnel and systems) examine the condition of the vehicle and driver by assessing data collected by onboard systems. The collected data, which are termed the Safety Data Message Set (SDMS), are delivered via wireless communications in real-time to public sector infrastructure. The SDMS will contain basic identification data (i.e., driver, vehicle, carrier, container, and cargo), record-of-duty status, and vehicle condition data that are typically collected manually by safety inspectors during current roadside inspections. The roadside enforcement sites that will query and receive SDMSs from CMVs are envisioned to include fixed roadside weigh stations, unmanned remote sites on bypass routes and State borders, and mobile police cruisers. Depending on the availability of enforcement resources, interdiction strategies acting on the SDMS will include both real-time and non-real-time scenarios.

The WRI project will evaluate the potential benefits to both the motor carrier industry and government. Potential benefits to industry include keeping safe and legal drivers and vehicles moving on the highways without having to stop at roadside stations. The Phase I final report[9] estimates that motor carriers could save $215 million annually by reducing the number of weigh station stops. Also, according to the 2003 FMCSA study cited above, potential annual safety

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[7] "Development and Evaluation of Alternative Concepts for Wireless Roadside Truck and Bus Safety Inspections," FMCSA, 2003, www.fmcsa.dot.gov/facts-research/research-technology/report/wireless-inspection-report.pdf.
[8] 177 million truck weighs consist of 82 million conducted by roadside officers and 95 million conducted by weigh-in-motion machines.
[9] *The Motor Carrier Efficiency Study Phase I Final Report,* page 20, FMCSA, 2009, online at www.fmcsa.dot.gov/facts-research/research-technology/report/RRT_09_015_MCES.pdf.

benefits of a fully deployed WRI system are estimated to include 253 lives saved, 6,192 injuries avoided, and 17,611 property-damage-only crashes prevented.

The WRI project is currently in its pilot testing phase. In 2009, the WRI Concept of Operations document was updated and work began on the WRI architecture for a fully deployed system. The WRI testing of CMRS technologies and the FMCSA's centralized system prototype began in August 2010 in Tennessee. The pilot testing in Kentucky and New York began in October 2010. The data collection period concluded in January 2011. An evaluation of the safety and productivity benefits for motor carriers and for government CMV safety agencies was completed by July 2011 and a decision will be made on whether to proceed to a full field operational test involving several States and motor carriers. The purpose of the field operational test would be to evaluate the policy, information technology and infrastructure needs, and economic viability of conducting tens of millions of wireless roadside inspections in support of Compliance, Safety, Accountability and the Agency's topic priorities of 1) raising the bar to enter the motor carrier industry, 2) maintaining high safety standards to remain in the industry, and 3) removing high-risk carriers, drivers, and service providers from operating.

FUEL MONITORING AND OPERATIONS MANAGEMENT SYSTEMS DEMONSTRATION PROJECT

The MCES Phase I report estimated that wireless technology solutions could provide significant fuel savings for some motor carriers. For example, one motor carrier with 150 trucks was able to save $1.6 million in fuel and maintenance costs by using technologies to monitor driver performance and reduce excessive speeds. In September 2009, FMCSA awarded a contract to test and evaluate the benefits of available fuel monitoring and operations management systems. A key safety question that will also be evaluated is whether a fleet's use of wireless technology to actively monitor drivers' fuel use also helps reduce driver fatigue.

In 2010, FMCSA tasked a contractor with carrying out the fuel monitoring/safety study. A Baltimore-based motor carrier fleet volunteered 46 new Volvo trucks, each of which is equipped with Volvo Link and GreenRoad Technology, to participate in the study. Volvo Link Technology gathers "fuel economy" data (data on fuel consumption per trip). GreenRoad Technology gathers "safety" data (data on when and where hard braking, sudden acceleration, hard turn, and abrupt lane departures have occurred). Both technologies are GPS-enabled and use cell phone links to communicate location-stamped, time-stamped, onboard monitoring data to a data center. In addition to gathering safety data, GreenRoad Technology provides real-time feedback to drivers on the nature of their driving through a tiered (red, yellow, and green) light box interface. The drivers have been trained on how to interpret the lights.

The study is comprised of two phases. The first phase focuses on gathering fuel economy data with the Volvo Link Technology active and the GreenRoad Technology inactive. This data will serve as a baseline for the second Phase of the study when GreenRoad Technology is also activated. The first phase of data gathering ended on February 14, 2011. The second Phase of data gathering commenced on February 15, 2011. The study is expected to be completed by November 2011 with a final report due in December 2011.

CARGO THEFT PREVENTION DEMONSTRATION PROJECT

The purpose of the "Evaluation and Testing of Truck-Based Cargo Theft Prevention Technologies" program was to gather and compile information for motor carriers to become better informed about the scope of cargo theft in the United States, commercially available

wireless cargo theft prevention products, and how each performed against an established set of functional requirements.

The program consisted of the following three major objectives:

- Perform research and literature review on the extent of cargo theft problem, potential wireless solutions, and the associated risk and threat scenarios.
- Establish the basic functional requirements that relate to identified risk and threat scenarios.
- Test and perform field evaluations with wireless solutions volunteered by technology partners.

Literature review and research concluded that the methods for reporting cargo theft are not consistent, that a single repository for collecting reports on such incidents does not exist, and that there are many commercially available wireless cargo theft prevention systems with substantially varying capabilities.

From the list of 29 technologies identified during a technology scan, mature systems from four providers (Freightwatch, SteelSafe, SkyBitz, and OnAsset Intelligence) were selected for further testing based on their ability to meet the below basic functional requirements (FR) established by the team:

FR1 – Systems must electronically detect unscheduled or unauthorized trailer/truck operations or detour.
FR2 – Systems must detect an attempt at tampering or disabling.
FR3 – Systems must electronically notify authorized individuals of a theft or attempted theft.
FR4 – Systems must detect a trailer breach.
FR5 – Systems must detect and track an untethered trailer.

With the test plan established and approved, evaluations began on FreightWatch's Geo F-1, SteelSafe's Immobilizer, SkyBitz's GLS400, and OnAsset Intelligence's ContainerSafe devices. The results from these tests pertaining to their ability to meet the FRs are summarized in Table 1. Testing was completed in December 2010, and the final report will be published by the end of December 2011.

Table 1: Summary of System Compliance to Functional Requirements

	Functional Requirement Met				
System	**FR1**	**FR2**	**FR3**	**FR4**	**FR5**
Freight Watch Geo F-1	YES	YES	YES	NO	NO
SteelSafe Immobilizer	YES	YES	YES	NO	NO
SkyBitz FLS400	YES	YES	YES	YES	YES
OnAsset Intelligence Container Safe	YES	YES	YES	YES	NO

INTERNATIONAL BORDER ELECTRONIC SCREENING DEMONSTRATION PROJECT

Approximately 90 percent of incoming Mexican and Canadian trucks currently utilize transponders to alert enforcement personnel that a truck has entered the inspection area. However, a significant effort is still spent trying to make this determination by identifying the truck through conventional means such as license plate numbers. The purpose of the International Border Electronic Screening Demonstration Project, initiated in 2010, is to examine potential enhancements to current enforcement procedures used at border crossings and to utilize the existing vehicle transponders issued by the U.S. Customs and Border Protection to assist

FMCSA and State truck and bus safety inspectors in targeting and removing high-risk operators. This project meets the MCES objective to demonstrate wireless technologies in field tests and is within the scope of the "Radio frequency identification technology" program element.

For this project, transponder readers will be installed at four ports of entry (two on the Mexican border and two on the Canadian border) that will transmit a message to motor carrier safety enforcement personnel on either a handheld device or to an interface in the inspection station about the arrival of trucks flagged for a safety inspection.

The goals are to have more time spent on actual inspections than on screening incoming trucks and to reduce the delays of safe and legal Mexican and Canadian trucks and buses crossing the border. This activity addresses two of the last remaining elements of activities in the MCES Phase I field test, Paperwork Delays at the Border and Processing Capacity at Borders. The scope of this project does not include the FMCSA's planned cross-border long-haul Mexican trucking program.

The FMCSA awarded a 3-year contract for this project in June 2011.

APPENDIX

Table 2. Identified Inefficiencies and Corresponding Phase II Demonstration Projects

Inefficiency	Potential Gain to Carriers	Potential Gain to Society	Phase II Project
Time Loading and Unloading	$3.08 billion annually	$6.59 billion annually	Wireless Drayage Updating
Waiting in Ports	$900 million annually	Unknown	Wireless Drayage Updating
Paperwork Delay at Borders	$23 million annually	$50 million annually	International Border Electronic Screening Demonstration
Time in Weigh Stations	$215 million annually	$461 million annually	Wireless Roadside Inspection
Incident-Related Delay	Unknown	Unknown	Wireless Drayage Updating
Urban Routing Problems	Unknown	Unknown	Wireless Drayage Updating
Management Tools	Unknown	Unknown	Fuel Monitoring and Operations Management
Vehicle Safety	Unknown	$1.55 billion annually	Wireless Roadside Inspection
Driver Safety	Unknown	$1.35 billion annually	Wireless Roadside Inspection
Compliance Review Inspections	Unknown	$23.1 million annually	Wireless Roadside Inspection
Processing Capacity at Borders	$211K per Owner/Operator annually	Unknown	International Border Electronic Screening Demonstration
Driver Turnover	$8,200 per driver	Unknown	Not applicable
Excessive Speed	$1.6 million annually for one 150-truck carrier	Unknown	Fuel Monitoring and Operations Management
Cargo Theft and Pilferage	Unknown	$15-30 billion annually	Cargo Theft Prevention
Empty Intermodal Moves	$21 million annually in Chicago alone	Unknown	Wireless Drayage Updating
Empty Miles	$2.7 billion annually	Unknown	Fuel Monitoring and Operations Management
Vehicle Maintenance	$320 million annually	Unknown	Fuel Monitoring and Operations Management

LIST OF ACRONYMS

CMRS	Commercial Mobile Radio Services
CMV	Commercial Motor Vehicle
C-TIP	Cross-Town Improvement Program
DRG	Dynamic Route Guidance
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FR	Functional Requirements
FRATIS	Freight Advanced Traveler Information System
GPS	Global Positioning System
MCES	Motor Carrier Efficiency Study
RTTM	Real Time Traffic Monitoring
SDMS	Safety Data Message Set
T-MDID	Truck-Mounted Driver Interface Device
DOT	U.S. Department of Transportation
WDU	Wireless Drayage Updating
WRI	Wireless Roadside Inspection