THE MOTOR CARRIER EFFICIENCY STUDY
2008 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)
March 2010

BACKGROUND

Section 5503 of the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users set aside funding to examine the application of wireless technology to improve the safety and efficiency of trucking operations in the United States. 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 specific objectives of the Motor Carrier Efficiency Study (MCES) include the following:

- Identify inefficiencies in freight transportation.
- Evaluate safety and productivity improvements made possible through 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.

The Federal Motor Carrier Safety Administration (FMCSA) was assigned responsibility 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 and the evaluation of potential safety and productivity benefits from

[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 element to broaden the wireless safety technology applications under this program.

wireless technology solutions. Phase II consists of field demonstration tests of promising wireless technologies that address inefficiencies identified in Phase I.

In January 2008, FMCSA completed Phase I and documented its findings in a final report.[2] This 2008 annual report summarizes the key activities in Phase II of the study. The executive summary of the Phase I report is attached as Appendix A to this document.

Based on findings from the Phase I study, FMCSA, along with its multimodal team with 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, has focused Phase II pilot demonstrations on applications within the broad program areas mentioned previously.

In these demonstrations, promising wireless technologies are being deployed under realistic operating conditions, and industry and government partners are assessing the degree to which the solutions improve safety and operations consistent with the program objectives and elements. The goal for these pilot tests is to provide sufficient evidence to support investment decisions for the Federal Government, technology providers, and the user community.

By way of this report, FMCSA is reporting on two field demonstration projects initiated in 2008, including Wireless Drayage Updating (WDU) and Wireless Roadside Inspection (WRI).

WIRELESS DRAYAGE UPDATING DEMONSTRATION PROJECT

As mentioned above, FMCSA partnered with FHWA and other DOT agencies in the Phase I research to identify inefficiencies and promising wireless technologies that address specific inefficiencies. 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 program provided a terrific opportunity to quickly demonstrate wireless technologies to address certain key Phase I MCES inefficiencies including: empty intermodal truck trips; incident-related congestion; and waiting to load and unload truck trailers. The Phase I final report[3] estimated that motor carriers could save more than $3.9 billion annually from not having to wait to load or unload shipments at distribution centers, ports, and other points of freight interchange.

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

Through an agreement with FHWA, the WDU demonstration project was initiated in August 2008. The WDU 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 two other C-TIP components, Intermodal Exchange[4] and Real-Time Traffic Monitoring.[5]

In the WDU project, each participating truck will have a truck-mounted driver interface device (T-MDID) which will be linked wirelessly to the C-TIP system. The T-MDID will be the primary link for truck drivers to participate in the C-TIP pilot demonstration. Through the T-MDID, drivers will send location and trip status information and receive trip assignments and traffic information. The T-MDID will be able to send, receive, and enter data.

The devices will be wireless, GPS enabled, and will have a viewing screen and interface capability for the motor carrier driver's use. Safety requirements for in-cab use will include the following: 1) the device will not allow the driver to interface while the vehicle is moving, 2) the device will not be mounted in a location that obstructs the driver's view outside the vehicle, and 3) the device will be mounted in a location within easy reach and not where it hinders or prevents any other aspects of vehicle operation.

Within the WDU project, the following associated field demonstrations will be conducted:

- Wireless Load Notification and Selection.
- Truck-Specific Congestion Avoidance.
- Wireless Facility Queuing Notification and Management.

Wireless Load Notification and Selection

This application would allow railroads and motor carriers to coordinate operations so that trucks returning to the originating terminal could bring a return load, rather than returning empty, by employing a combined load matching application (most likely operated by a third party). Railroads would post their load movement needs in advance, and motor carriers would log onto a Web site and indicate which loads they could support within their resource constraints (i.e., the number of available trucks and drivers during the needed movement window). The system would apply business rules agreed upon by the participating railroads and motor carriers to provide the resulting load assignments to each motor carrier in a combined dispatch format. The motor carrier dispatcher would then assign loads to individual truck and driver combinations based on current location, proximity to the originating facility, and estimated time of arrival information, and then transmit the information wirelessly.

Truck-Specific Congestion Avoidance

This application would provide a wireless link to existing and newly emerging traffic information. This application would allow drivers to receive traffic data that is of particular

[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.

applicability to their operations. In the event that alternatives exist, this application would provide truck-specific alternate routing information to reduce potentially costly delays. Information regarding the position of each of a motor carrier's vehicles would be accessed from the C-TIP Real Time Traffic Monitoring module. This information would be used to determine the most efficient route from each vehicle's current location to its planned destination (using pickup and delivery requirements resident in the motor carrier's dispatch system) by applying traffic data obtained from the appropriate traffic operations center. Each vehicle's location would be obtained through either a satellite-based asset tracking solution or a cellular technology application. Traffic updates and routing advisories would be generated by the third-party provider and relayed to the drivers through the same wireless technology used to track their position.

Wireless Facility Queuing Notification and Management

This application would rely on the use of real-time location and status information obtained from 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, would then be transmitted back to the drivers through the wireless applications of the inbound trucks, thereby alleviating the pressure associated with potentially missing appointments or waiting in long lines.

A contractor-led team completed the WDU system requirements work in the fall of 2009 and will begin a 3-month field operational test in the spring of 2010. Final evaluation results are expected to be available by March 2011.

WIRELESS ROADSIDE INSPECTION DEMONSTRATION PROJECT

Also 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 commercial motor vehicle (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,[6] 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[7] with a violation rate of 0.29 percent (515,587 citations).

New technologies and enforcement strategies could dramatically increase the number of times a CMV and its driver are examined, leading to better-targeted enforcement, creating a greater deterrence to operating unsafely, and reducing the number of truck and bus crashes. The

[6] "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.
[7] 177 million truck weighs represents 82 million conducted by roadside officers and 95 million conducted by weigh-in-motion machines.

FMCSA's WRI project will evaluate the feasibility and value of assessing commercial drivers and vehicles up to 30 times more often than it is possible using current approaches.

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 real-time and non-real-time scenarios.

The program 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[8] estimates that motor carriers could save $215 million annually by reducing the number of weigh station stops. Also, according to the FMCSA study cited above, potential annual safety 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.

Potential benefits to government also include the support this program would offer to the FMCSA's Comprehensive Safety Analysis (CSA) 2010 Program, which is currently undergoing operational model testing within FMCSA. The purpose of the CSA 2010 initiative is to develop more effective and efficient methods for FMCSA, together with industry and State partners, to achieve its mission of reducing CMV crashes, fatalities, and injuries.

In addition to the CMRS testing in Tennessee, FMCSA is also working with other States to evaluate other wireless communications technologies for WRI. Under separate funding, FMCSA is working with the State of New York to test the WRI application using radio-frequency identification technology, and with the State of Kentucky to test WRI by using high-speed cameras to read license plates and DOT number markings on moving CMVs.

The WRI project is currently in its pilot testing phase. The WRI testing of CMRS technologies will begin in February 2010 and conclude in early 2011. An evaluation of the safety and productivity benefits for motor carriers and for government CMV safety agencies will be completed by July 2011 and followed by a decision 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 infrastructure, and economic viability of conducting tens of millions of wireless roadside inspections in support of CSA 2010 and other agency goals.

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[8] *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.

TOPICS FOR FUTURE DEMONSTRATION PROJECTS

In 2009, FMCSA expects to initiate additional demonstration projects that address inefficiencies in the MCES program areas, including fuel monitoring, operations management systems, and cargo theft prevention.

Fuel Monitoring and Operations Management Systems

The MCES Phase I report estimated that wireless technology solutions could provide significant fuel savings for some motor carriers. For example, 1 motor carrier with 150 trucks was able to save $1.6 million in fuel and maintenance costs due to using technologies to monitor driver performance and reduce excessive speeds. In September 2009, FMCSA awarded a contract to test and evaluate benefits of available fuel monitoring and operations management systems. A key safety question that will also be evaluated is whether or not a fleet's use of wireless technology to actively monitor driver fuel use also helps reduce driver fatigue. The field demonstration results will provide an independent assessment of cargo theft prevention technologies to assist motor carriers considering purchasing this type of wireless solution. The contract will be awarded to a qualified firm under the Section 8(a) set aside program. The project is expected to be completed in 12 months.

Cargo Theft Prevention

The MCES Phase I report estimated losses due to cargo theft to be $15 to $30 billion annually. In September 2009, FMCSA awarded a competitive procurement to conduct a field demonstration and evaluation of commercially available truck-based cargo theft prevention technologies. The FMCSA will use performance-based contracting for this effort. The product of the field demonstration will be an evaluation of the costs, benefits, advantages, and disadvantages of cargo theft prevention technologies. Similar to the fuel monitoring project above, the independent performance results from the evaluation will assist motor carriers considering purchasing this cargo theft prevention technologies. The project is expected to conclude in December 2010.

With these new projects, FMCSA will be funding demonstration projects that address key inefficiencies noted in the Phase I study. Table 1 below expands an existing table from the Phase I study by adding a column that maps the Phase II projects back to the inefficiencies.

Table 1. 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	
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 Ops Mgmt
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	
Driver Turnover	$8,200 per driver	Unknown	
Excessive Speed	$1.6 million annually for one 150-truck carrier	Unknown	Fuel Monitoring and Ops Mgmt
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 Ops Mgmt
Vehicle Maintenance	$320 million annually	Unknown	Fuel Monitoring and Ops Mgmt

Summary

The FMCSA is committed to working with the wireless technology and motor carrier industries as well as with State CMV safety agencies to evaluate and promote wireless technology solutions that improve CMV safety and efficiency.

With Phase I of the Motor Carrier Efficiency Study completed, FMCSA has initiated Phase II field demonstration activities including the Wireless Drayage Updating project and the Wireless Roadside Inspection project in 2008. In 2009, FMCSA launched two additional field demonstrations that focus on fuel monitoring and operations management systems and on cargo theft prevention technologies. Updates on all four of these initiatives will be provided in the 2009 report to Congress.

APPENDIX A
EXECUTIVE SUMMARY OF THE MOTOR CARRIER EFFICIENCY STUDY PHASE I REPORT (2009)

PURPOSE

Phase I of the Motor Carrier Efficiency Study (MCES) focused on the application of wireless technologies to overcome common motor carrier inefficiencies. This Final Report summarizes findings in the areas of wireless technologies (in general); motor carrier inefficiencies and potential economic gains in overcoming inefficiencies; proposed wireless applications; and the estimated benefits and costs of applying the proposed technology solutions within the motor carrier industry.

PROCESS

The study was divided into several work tasks:

- Gathering and analyzing existing literature regarding freight system inefficiencies and the potential application of wireless technologies to these inefficiencies.
- Compiling pertinent background information for the analysis of the safety benefits and efficiencies that can be achieved through the use of various wireless technologies.
- Completing stakeholder outreach sessions and individual interviews to capture information regarding baseline freight performance, user needs, performance measures, and feedback regarding technology options.
- Isolating the inefficiencies recognized as most pressing by motor carriers and identifying evidence of their effects to evaluate potential solutions.
- Analyzing wireless technology solutions via feedback from industry representatives in Expert Resource Groups and conducting a benefit–cost analysis (BCA) using the Freight Technology Assessment Tool (FTAT).
- Completing task reports, including this final project report.

The MCES literature review examined common motor carrier inefficiencies extracted from more than 200 individual published sources and/or offered by industry experts. Where appropriate, these inefficiencies were examined in the context of various motor carrier industry segments (truckload, less-than-truckload, intermodal, etc.). In addition, the literature review provided a primer with detailed specifications for current and emerging wireless technologies.

The Study Team, under the direction of FMCSA, completed eight stakeholder outreach sessions around the United States, and the team identified high-priority inefficiencies in order to narrow the list of potential challenges to which wireless technology solutions might be applied. Since an in-depth quantitative analysis of every inefficiency identified during the literature review was considered too large an undertaking for the scope of this study, the Study Team prioritized inefficiencies based on their relative importance to the motor carrier community.

The Study Team also examined the degree to which individual inefficiencies could be clearly defined, in both qualitative and quantitative terms, by members of the motor carrier community. Inefficiencies that met these basic conditions, and were cited on multiple occasions by Stakeholder Session participants as being significant issues for their operations, were examined in depth.

A viability analysis provided useful information regarding the relative opportunities and challenges associated with pursuing pilot demonstrations for nine technology applications that might mitigate the effects of the identified inefficiencies. A BCA was developed for these scenarios using FTAT, a decision support tool that evaluates potential effects of emerging technologies on the performance of the transportation supply chain from qualitative and quantitative perspectives.

STUDY FINDINGS

The MCES literature review revealed that motor carrier operations, specifically profitability and safety, are subject to a broad array of inefficiencies that result in financial losses estimated at tens of billions of dollars per year. In all, the Study Team identified 43 types of inefficiencies across the following 7 categories:

- Equipment/asset utilization.
- Fuel economy and fuel waste.
- Loss and theft.
- Safety losses (i.e., crashes).
- Maintenance inefficiencies.
- Data and information processing.
- Business and driver management.

The literature review served as the basis for discussion with motor carriers during the MCES Stakeholder Sessions. Table 1 summarizes the top inefficiencies identified by the stakeholder groups in the Stakeholder Sessions.

Table 1. Inefficiencies Identified by MCES Stakeholder Groups

Stakeholders	Priority Inefficiencies
Private Fleets	• Hours of service • Fuel waste due to excessive speed
Less-than-truckload (LTL) Carriers	• Waiting for unloading • Congestion delay
Truckload (TL) Carriers	• Waiting for unloading • Fuel waste due to excessive speed
Pick-up and Delivery	• Congestion delays

Stakeholders	Priority Inefficiencies
Cross-Border Carriers	• Waiting time—cross-border wait times (processing, paperwork, infrastructure/capacity limitations) • Congestion delay
Intermodal Carriers (Rail)	• Waiting for loading • Lack of backhaul
Intermodal Carriers (Port)	• Waiting for loading • Chassis roadability
Expedited Carriers	• Congestion delays
Public Sector	• Safety (Crashes, noncompliance) • Intelligent Transportation System (ITS) integration (limited applications for motor carriers)
Private-Sector Technology	• Waiting for loading/unloading • Poor routing, scheduling, and out-of-route miles

The results of the detailed inefficiency analysis conducted as part of the study are shown in Table 2. The total effects of these inefficiencies are significant. Based upon high-level calculations performed by the Study Team, it is estimated that the motor carrier community incurs financial losses of tens of billions of dollars per year.

Table 2. Identified Inefficiency Effects

Inefficiency	Potential Gain to Carriers	Potential Gain to Society
Time Loading and Unloading	$3.08 billion annually	$6.59 billion annually
Waiting in Ports	$900 million annually	Unknown
Paperwork Delay at Borders	$23 million annually	$50 million annually
Time in Weigh Stations	$215 million annually	$461 million annually
Incident-Related Delay	Unknown	Unknown
Urban Routing Problems	Unknown	Unknown
Management Tools	Unknown	Unknown
Vehicle Safety	Unknown	$1.55 billion annually
Driver Safety	Unknown	$1.35 billion annually
Compliance Review Inspections	Unknown	$23.1 million annually

Inefficiency	Potential Gain to Carriers	Potential Gain to Society
Processing Capacity at Borders	$211K per Owner/Operator annually	Unknown
Driver Turnover	$8,200 per driver	Unknown
Excessive Speed	$1.6 million annually for one 150-truck carrier	Unknown
Cargo Theft and Pilferage	Unknown	$15-30 billion annually
Empty Intermodal Moves	$21 million annually in Chicago alone	Unknown
Empty Miles	$2.7 billion annually	Unknown
Vehicle Maintenance	$320 million annually	Unknown

Table 2 summarizes the potential gains for overcoming these inefficiencies for both carriers and for society, where societal gains include potential environmental, safety, and traffic congestion benefits (among many others) associated with overcoming the inefficiencies noted. Entries of "unknown" indicate that empirical evidence sufficient to calculate potential benefits was not available.

The Study Team, working from suggestions offered by motor carrier stakeholder representatives, formulated high-level concepts for the following nine proposed wireless technology applications:

- **Virtual Queuing**—an application to reduce waiting for loading and unloading by allowing consignees to monitor and dynamically reschedule dock operations to compensate for delays due to congestion, traffic incidents, or delays in a truck's departure from the shipment origin.
- **Driver Acuity Monitoring**—an application to permit a carrier to remotely monitor driver behavior characteristics indicative of fatigue and adjust the remaining hours of service accordingly.
- **Variable Speed Limiter**—an application to allow the carrier to alter the governed maximum speed remotely, based on any combination of factors deemed appropriate by the carrier. Additionally, it could link to a database of posted speed limits, and as a truck passed from one zone to the next, the speed governor would be adjusted automatically.
- **Border Crossing Compliance Notification**—an application to provide pre-screening status information available prior to a driver's arrival at the border, which could significantly reduce delay and idling and improve safety.
- **Border Crossing Tracking Compliance**—an application that allows motor carriers to comply with emerging shipment tracking requirements from U.S. Customs and Border Protection (CBP) and provides a means for information regarding border crossing travel times to enhance border operations.
- **Truck-Specific Congestion Avoidance**—an application to link to existing traffic information and truck-specific alternate routing information.

- **Chassis Roadability Notification—**an application to give drivers access to chassis maintenance data and inspection history upon entering a storage facility or terminal.
- **Cross-Town Intermodal Interchange**—an application to reduce empty trips and congestion-related delay, and improve safety and the environment.
- **Untethered Trailer Tracking—**an application that allows asset owners and shippers to monitor the integrity and location of goods and equipment, which may mitigate theft and pilferage and enhance security.

The results of the execution of the FTAT calculations offer some interesting insights into the potential benefits of the various proposed applications. As the information in Table 3 shows, the benefit–cost ratios (BCR) and internal rates of return (IRR) for the applications span a broad range of values.

Table 3. Combined FTAT Calculation Results

Scenario	Supply Chain Segment	Inefficiency	Solution	BCR	IRR
1	International Border	Paperwork delay at border	Border Crossing Compliance Notification	.08	-48.05%
2	International Border	Processing delay at border	Border Crossing Tracking Compliance	5.2	73.78%
3	Port to Inland Destination	Waiting time in container ports	Virtual Queuing	2.64	35.85%
4	Port to Inland Destination	Vehicle safety (crashes, noncompliance)	Chassis Roadability Notification	0.21	-33.29%
5	Closed-Loop Pick-Up and Delivery	Incident-related congestion	Truck-Specific Congestion Avoidance	1.96	38.5%
6	Closed-Loop Pick-Up and Delivery	Waiting, loading and unloading	Virtual Queuing	1.62	18.98%
7	Rail Intermodal	Empty trips	Cross-Town Intermodal Interchange	8.92	216.76%
8	Rail Intermodal	Waiting, loading, and unloading	Virtual Queuing	2.33	30.98%
9	Long-Haul Truckload	Fuel waste due to excessive speed	Variable Speed Limiter	3.86	54.26%
10	Long-Haul Truckload	Theft and pilferage	Untethered Trailer Tracking	2.47	33.22%

Several applications—notably, the Border Crossing Tracking, Virtual Queuing, Variable Speed Limiter, Cross-Town Intermodal Interchange, and Untethered Trailer Tracking Systems—offer estimated benefit–cost ratio (BCR) values in excess of 2:1. These are promising results, particularly when the lowest internal rates of return (IRR) for these applications exceeds 30 percent (it is noted that the application of Virtual Queuing to the closed-loop supply chain segment results in a lower value). The results for most of the applications improve as the level of deployment increases, and if they can be deployed by carriers already using wireless devices (e.g., cellular telephones or satellite tracking systems) for other purposes.

Caution is warranted when examining these figures. For example, the Study Team assumed that the operating environment would be conducive to the use of the application, and that maximum estimated benefits would be realized. This is unlikely in all scenarios. For instance, because making the necessary staffing changes within international border crossing compounds (namely, the reassignment or increase in number of staff by CBP to accommodate surges in demand) presents a number of operational challenges, and because a large portion of the border user population would need to be equipped with devices in order for the data to be reliable enough to warrant such measures, it is unlikely that the full benefit will be realized from the deployment of the Border Crossing Tracking Compliance application.

CONCLUSIONS

With few exceptions, the common thread running through the priority inefficiencies is delay caused at least in part by the actions (or lack thereof) of a party other than the carrier. Perhaps more evident, however, is that each inefficiency may be mitigated by improving the quality, accuracy, and timeliness of data held by one or more of public and private sector stakeholders, and the degree to which the data are exchanged and used for decision-making.

Under such circumstances, wireless technologies, which are first and foremost mechanisms to accurately capture and exchange information, appear to offer significant relief to the carrier community. Given that an enhanced level of situational awareness is vital to mitigating these inefficiencies, it is logical that wireless systems that promote that enhancement would be of some value.

In fact, enhanced situational awareness would likely have a profound positive effect on several other inefficiencies—namely, those associated with vehicle and driver safety. Better knowledge about vehicle, operator, and roadway conditions should contribute significantly to reducing driver- and vehicle-caused crashes and drivers operating at speeds in excess of those warranted by roadway conditions.

Better situational awareness can help to counter cargo theft and pilferage and reduce empty trips, both of which represent significant costs for motor carriers. Simply knowing when and/or where a shipment has been tampered with or infiltrated would allow carriers to define and implement more effective security solutions. Likewise, knowing the locations and delivery requirements of other intermodal loads could allow dray haulers to allocate resources better to meet customer needs.

Based on the evidence, technology may provide creative solutions to real, specific needs. The role of wireless systems is unclear, but the analysis suggests it holds potential for measurable positive effects.

Near-Term Opportunities

In the near term (less than 10 years), the combination of a large existing deployed base, mature infrastructure, and high levels of user confidence make technologies such as satellite tracking, digital cellular, and radio frequency identification (RFID) attractive as bases for additional applications. The applications suggested and supported as viable by the motor carriers that participated in the study reinforce their preference for leveraging existing systems over the development and deployment of entirely new systems. For example, two currently available systems—RFID for weigh station bypass and Untethered Trailer Tracking—already yield significant net effects for users.

One primary uncertainty is the ability of these systems to accommodate future information exchange needs, both on an individual device basis and on a network-wide basis. As more users seek increasingly sophisticated capabilities, the overall demand for information will increase, leading to the need for more robust systems and networks.

Longer-Term Opportunities

Many of the wireless technologies examined in this study have barely begun to be deployed. Some offer compelling combinations of data transfer capacity, range, and potential convenience of use, but too little is known about how useful they may be in the trucking environment, where reliability, ruggedness, and low cost are of paramount importance.

Over the next 10 to 20 years, significant advances may improve the performance and affordability of wireless technologies. As cellular, RFID, and satellite-based systems have advanced dramatically over the previous 20 years, components are likely to be made smaller and more energy-efficient. Battery life, which has long been a challenge to deploying stand-alone devices for tracking and security of trailers, will be extended due to the significant investment being made in other sectors—most notably the automotive industry.

As wireless networks become ubiquitous and commercial entities add new services, information systems will become more accessible, perform at higher speeds, and deliver increasing value to users. Commercial vehicle manufacturers will likely continue to package on-board electronics that will rely on wireless communications for remote monitoring and control of vehicle systems including safety-related items (e.g., brake performance, tire pressure, and driver awareness monitoring) and efficiency-related items (e.g., fuel delivery, engine control parameters, and driver evaluation and education tools).

This new level of transparency will likely enable motor carriers to incrementally lower operating costs and improve profitability. Decisions regarding routing, driver assignment, and maintenance scheduling will be made more effectively, and component failures will be detected before trucks are placed out of service—either due to inspection violations or to the failures themselves. As new trucks are delivered and older trucks are retired, the level of deployment of wireless systems—including some that are several generations old—will expand to include a larger percentage of the trucks on the Nation's roadways.

Perhaps the most significant wireless technology advances will be new levels of connectivity between fleet owners and assets (both equipment and personnel), fleet assets and customers, between different assets, and the assets and cargo being transported. This connectivity will allow significantly more coordinated operations and increased productivity across all segments of the motor carrier community. This level of connectivity will also permit the development of intelligent freight delivery management tools that can make full use of real-time information regarding prevailing business conditions, traffic congestion, weather, traffic incidents, and public safety conditions, and allow trucks and cars to operate safely in close proximity.

To this point, the catch phrase associated with freight efficiency has been visibility. The next generation of wireless devices will be tasked with facilitating the evolution to intelligent freight—freight that knows where it is, where it needs to go, and how best to transport itself to its destination in a safe, efficient, secure manner, including which carriers and drivers are suitable to move it. This can only occur when communication barriers are removed and unimpeded interconnectivity and interoperability is possible.