Wireless Roadside Inspection Phase II: Final Report

The Federal Motor Carrier Safety Administration (FMCSA) Wireless Roadside Inspection (WRI) Program is demonstrating the feasibility and value of electronically assessing truck and motorcoach driver and vehicle safety. Electronic assessments (or WRIs) can occur at least 25 times more often than physical roadside inspections. Pilot tests were conducted to prototype, test, and demonstrate the feasibility and benefits of electronically collecting safety data messages (SDMs) from in-service commercial vehicles and performing WRIs using three different communication systems. This report addresses the results of these pilot tests.

TECHNOLOGY

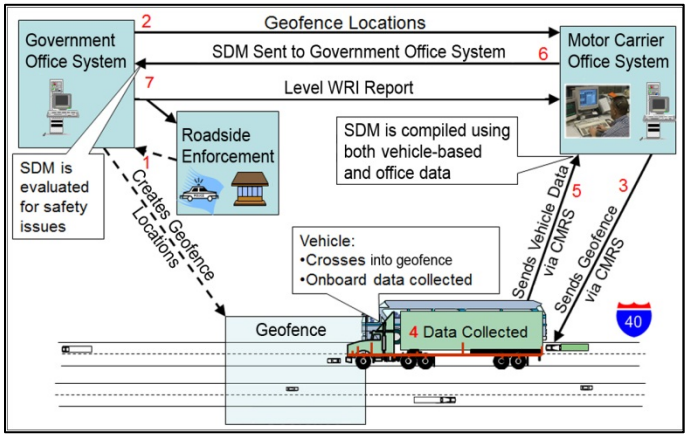
This report provides a summary of the results of the WRI Pilot Tests, where the objective was to prototype, test, and demonstrate the WRI system using different communication methods and to demonstrate its operational feasibility. The results of this phase demonstrate the capability to increase commercial vehicle inspections and to potentially realize significant improvement in commercial vehicle safety without increasing the burden on enforcement or compliant operators.

WRI is designed to follow processes similar to physical safety inspections, but it does so electronically. As a commercial vehicle travels, it encounters a predetermined WRI location at which a roadside transceiver, a license plate reader (LPR) system, or a "geofence boundary" is located. Rather than detour the commercial motor vehicle (CMV) into a physical weigh station, public sector entities (e.g., officers, inspectors, and systems) issue an electronic request for driver and CMV compliance data without impeding the vehicle's travel.

Phase II of the WRI Program has supported prototyping three different WRI communication methods and a WRI government office system (GOS), as well as testing and demonstrating all four in CMV operations. The four pilot tests conducted were:

- **New York Dedicated Short-Range Communication (DSRC) WRI Pilot Test.** The technology in this test used direct 5.9 gigahertz (GHz) DSRC between the vehicle and roadside to request and receive an SDM.
- **Tennessee Commercial Mobile Radio Services (CMRS) WRI Pilot Test.** The technology in this test used CMRS to trigger a request and obtain the SDM (see Figure 1).
- **Kentucky Universal Identification (Universal ID) WRI Pilot Test.** The technology in this test used optical readers or radio frequency (RF) transponders to identify commercial vehicles and request an SDM from the motor carrier through the Internet.
- **GOS Pilot Test, supporting operations in all three States.** The prototype GOS was essentially a processing unit for receiving and identifying SDMs from Federal, State, and motor carrier systems via the Internet.

Figure 1. Flowchart. Carrier-to-government system communications via CMRS.



Together, the pilot tests were designed to assess the feasibility of the WRI strategy and the ability of the prototyped WRI system to support screening, assessments, and interdiction by inspectors and enforcement.

LEVELS OF WIRELESS ROADSIDE INSPECTION

For this study, three different levels of WRIs were defined, as follows:

- WRI Low: The most basic alternative, comprising a minimal SDM. Under this alternative, available

information is limited to the unique identification of the carrier, the vehicle, and the driver.

- WRI Medium: A report from the electronic logging device (ELD) would supplement the data captured in WRI Low, including all hours-of-service (HOS) logbook information.
- WRI High: Includes identification and ELD data and a reading of in-vehicle weight sensors to assess compliance with weight regulations, a reading of additional onboard sensors to assess the status of brakes, lighting, and seatbelts, and readings of tire pressure, temperature, and vehicle location.

In examining the data that could be extracted from vehicles using the range of potential WRI systems, the research team wanted to determine how that information related to real world crashes, fatalities, and injuries. By using the Large Truck Crash Causation Study (LTCCS), researchers estimated the percent of crashes that could have been prevented had roadside enforcement used any of the three WRI systems (see Table 1).

Table 1. Estimated percent of all reportable crashes, fatalities, and injuries preventable by levels of WRI.

WRI Level	Crashes	Fatalities	Injuries
Low	1.20%	0.99%	1.38%
Medium	1.61%	1.18%	1.67%
High	3.50%	1.40%	3.28%

PROCESS

To assess the outcome of the WRI Pilot Test, the evaluation team developed a detailed evaluation plan that was not only specific to individual platforms, but also spanned across all platforms. The evaluation team used a quantitative evaluation to collect and analyze the transmitted wireless data (timestamps, sensor data, etc.) and a qualitative evaluation to collect system performance information from the project participants.

FINDINGS

The CMRS (TN) platform produced the most data but also encountered data delivery challenges and relatively long latency times. The Universal ID (KY) platform produced some desirable results but included manual steps that proved untenable, and the identification technology (LPR) was unsuitable in poor weather situations. DSRC (NY) produced very limited results and did not connect with the GOS. Nonetheless, the limited performance was promising and worthy of further investigation because—based on other completed research—it is known that DSRC technology can work in a WRI environment (although its downside is cost to States and carriers for roadside equipment and for vehicle transponders). The issues with testing were not based on flaws in the technology, but based on the limited availability of New York State Department of Transportation (NYSDOT) personnel to participate in the testing.

Finally, the GOS's strict data validation requirements presented many challenges with accepting and processing data from all platforms. Even in the context of a pilot test with active partners, the data formatting and security authentication method was complicated, and it proved difficult to provide successful inspections. An expanded test that includes less-engaged partners would need to include much more simplified data formatting and processing requirements.

COST-BENEFIT ANALYSIS

Cost-benefit evaluation identified two sources of potential benefits from WRI: safety benefits from reducing the number of CMV crashes (identified using the previously mentioned analysis of the LTCCS), and cost savings from avoidance of infrastructure damage caused by overweight large trucks. Some options considered for WRI appear to have a positive net benefit, while others do not. Analysis demonstrates a positive net benefit for a WRI that includes a unique identification of the carrier, vehicle, and driver, a report from the ELD (including all HOS logbook information), and onboard weight sensor data. Although issues were encountered with some aspects of each communications path, none were deemed insurmountable, and the cost benefits were derived from theoretical systems in which these issues were overcome.

CONCLUSIONS

In this phase, it was determined that WRI could benefit enforcement; Federal, State, and local agencies; the CMV industry; and society at large. The pilot tests supported the hypotheses that the overall benefits of WRI would include improved CMV safety and corresponding reductions in crashes, property damage, injuries, and fatalities.

While a number of system and technical issues in establishing secure, reliable communications would need to be addressed in the next phase, no fundamental technological obstacles were found that would prevent further development and successful deployment of a national WRI system. The implementation of WRI used in Phase II is not sufficiently mature for deployment at this point; however, the technical challenges moving forward could be addressed through careful and skilled engineering, analysis, and design in a large-scale field operational test.

To view the full report, please visit: http://www.fmcsa.dot.gov/safety/research-and-analysis/publications?keywords=&title=&author=&year=&to=&page=0