White Paper: Scope of the Smart Roadside Initiative

This white paper was developed collaboratively by FMCSA and FHWA with support from RITA.

Purpose

The purpose of this white paper is to characterize the United States Department of Transportation's (USDOT)'s current Smart Roadside Research in terms of its scope, objectives, functions and its relationship to IntelliDrive^{SM}. This paper will help identify for the USDOT management and its transport industry partners the appropriate activities and corresponding resources for Smart Roadside.

Background

The Smart Roadside Initiative began a few years ago when a representative cross-section of the commercial vehicle community attended the 2008 Smart Roadside Workshop. The participants at the workshop agreed that commercial vehicle safety, security, and mobility systems should be linked into a coordinated and comprehensive roadside program. This agreement was made independent of the IntelliDrive program (Vehicle Infrastructure Integration at the time) and a Workshop sponsored by Federal Motor Carrier Safety Administration (FMCSA), the Federal Highway Administration (FHWA) and Florida Department of Transportation (FDOT) was held in 2008 where the stakeholder community identified goals and objectives; along with individual projects that should be part of the program. While a number of the independent projects were initiated and are currently underway, their overall coordination under the Smart Roadside Initiative lost momentum and needs to be rejuvenated as stakeholders continue to support this concept.

Smart Roadside is currently a mode-specific item in the USDOT ITS Strategic Research Plan, 2010-2014 however it is a multi-modal initiative that includes not only FMCSA and FHWA, but also the National Highway Traffic Safety Administration (NHTSA), the Federal Transit Administration (FTA) and the Research and Innovative Technology Administration (RITA) due to its synergies with IntelliDrive. Although the concept has been around for a while, the Smart Roadside plan must now be revisited due to advances in strategy, technology and intelligent transportation systems (ITS) implementations that have been made since the 2008 workshop where it was initially defined.

There are numerous commercial vehicle systems in various stages of existence today – private-sector and public-sector – and the concept of Smart Roadside encompasses many of them in some capacity. There is a need to articulate what Smart Roadside is and describe what and how it relates to IntelliDrive.

Description of Smart Roadside

The vision for the Smart Roadside Initiative that was shared with stakeholders at the 2008 workshop has not changed and is stated in the following paragraph.

> The vision for the Smart Roadside is one in which commercial vehicles, motor carriers, enforcement resources, highway facilities, intermodal facilities, toll facilities, and other nodes on the transportation system collect data for their own purposes and share the data seamlessly with the relevant parties, in order to improve motor carrier safety, security, operational efficiency, and freight mobility. This vision will be achieved through the application of interoperable technologies and information sharing between in-vehicle, on-the-road, and freight

facility systems. Whenever possible, the Smart Roadside will leverage stakeholders' current technology investments in order to augment existing programs and support new activities.[1]

In addition to articulating the vision, stakeholders representing the private- and public-sectors who attended the workshop, recommended that FMCSA and FHWA actively pursue Smart Roadside with the following goals, which continue to be valid:

- Enhance roadside enforcement operations through improved screening and automation of inspection/compliance checks.
- Provide enhanced road condition and traffic information to support commercial vehicle route planning and to support improved access to intermodal ports, urban pick-up, and delivery locations.
- Identify key components (e.g., motor carrier, commercial vehicle, commercial driver, cargo) and communicate with commercial vehicles in real-time at highway speeds.
- Ensure that the necessary standards, protocols and architecture are developed to support both interoperable operations across the country and appropriate data privacy requirements.

Table 1 contains a subset of the major desired capabilities that stakeholder would like to see supported by Smart Roadside. This list reflects the high-level user needs that will receive initial focus.

Table 1. Smart Roadside Major Desired Capabilities

Real-time traffic, weather, special event, and truck parking information shared with driver
Vehicle sensor data collected at the roadside shared with private-sector maintenance systems
Unique vehicle identifier shared with the enforcement agencies
Routing clearance information shared with driver
Vehicle size and weight shared with enforcement agencies
Origin/destination information shared to determine routing information
Construction and time restriction information shared with driver
Real-time driver/carrier/truck information shared with enforcement agencies for inspection decisions
Roadside inspection results (violation and non-violation) shared with Federal enforcement agencies
Emissions data shared with carriers and agencies to calculate carbon footprint

In addition to the vision and goals defined for Smart Roadside, the current commercial vehicle environment must be addressed in this initiative. The current commercial vehicle environment consists of numerous Federal, state, regional, and private-sector programs that use a combination of manual, semi-automatic, and advanced technologies to support safety, mobility and security. The effectiveness

[1] Summary of 2008 Smart Roadside Workshop, Key Findings and Stakeholder Recommendations, June 2008, FMCSA Document 7661-230

of these programs will be greatly improved by the Smart Roadside concept as relevant and appropriate data is shared among the current systems and they are integrated in a collaborative fashion.

Figure 1 below shows the numerous projects that are currently targeted for being part of Smart Roadside. These projects will facilitate the success of Smart Roadside by providing the necessary applications and supporting the seamless movement of data.

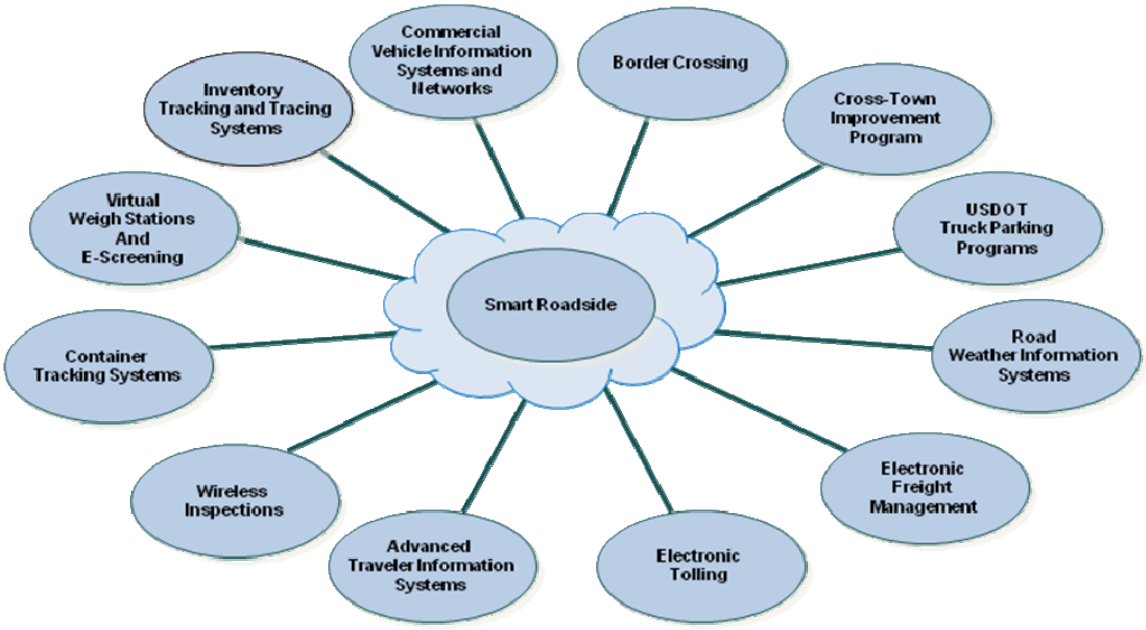

Figure 1. Roadside Programs/Projects for Integration or Interoperability with Smart Roadside

Smart Roadside is not a government-only concept. Rather, it embraces industry partners including motor carriers, terminal operators, distributors, shippers, and vehicle manufacturers as well as Federal, state, and local commercial vehicle agencies.

The unification of all these projects cannot happen all at once; therefore a systematic approach to realizing Smart Roadside must be set in motion and the IntelliDrive initiative is expected to enable most of the interoperability required. Additionally, some of these projects require additional research to increase automation by applying more advanced technologies than are currently being applied.

Smart Roadside can be simply described as a system deployed at strategic points along commercial vehicle routes to improve safety, mobility and efficiency of truck movement and operations on the roadway.

As previously indicated, many of the projects shown in Figure 1 will be enabled by the broader IntelliDrive program. For example, Advanced Traveler Information Systems and Road Weather Information Systems have already been identified as IntelliDrive applications; while E-Screening, Truck Size & Weight, Wireless Roadside Inspection (WRI), Truck Parking, Environment, and Smart Freight Mobility (dynamic route guidance and real-time traffic monitoring to support Electronic Freight Management (EFM) and Cross-Town Improvement Project (C-TIP)) are targets for **initial** Smart Roadside deployment. Additional functions shown in Figure 1 are expected to be facilitated by Smart Roadside and IntelliDrive in the not too distant future.

Description of IntelliDrive

IntelliDrive is the key focus of the USDOT ITS Program and is defined in the "ITS Strategic Research Plan, 2010-2014" as "a cross-modal, research initiative that aims to create safe, interoperable connectivity between vehicles (automobiles, trucks, motor coaches, transit vehicles, rail, and other fleets), infrastructure, and mobile devices."

Examples of IntelliDrive applications include:

- In-vehicle and roadside systems knowing the speed and location of an approaching vehicle for crash avoidance applications.
- Vehicle probe information for use in mobility, environment and planning applications.
- Vehicle information for improving real-time traffic, traveler and weather applications.

These applications could be developed for all vehicles, including commercial vehicles. The commonality between the vision for Smart Roadside and the critical success factors identified for IntelliDrive are shown in Table 2 below. Operational efficiency is not specifically identified as an IntelliDrive critical success factor; however, it is a prerequisite for most carriers if critical IntelliDrive data is to be accessed and processed by Smart Roadside systems.

Table 2. Smart Roadside Strategic Goals Alignment with IntelliDrive Goals

Strategic Goals	Smart Roadside	IntelliDrive*
Improve vehicle safety	✓	✓
Improve vehicle security	✓	✓
Improve vehicle operational efficiency	✓	✓
Improve vehicle mobility	✓	✓
Improve vehicle impact on environment	✓	✓
Apply advanced interoperable technologies	✓	✓
Share information in the vehicle, at the roadside, and in off-road systems	✓	✓
Sustainable system with stakeholder partnerships	✓	✓

** Focus is on all vehicles*

Table 2 illustrates that Smart Roadside strategic goals align with and may be considered analogous to "IntelliDrive for commercial vehicles;" therefore it is essential that the execution of these two initiatives are seamless.

Smart Roadside as a Functional Subsystem of IntelliDrive

To ensure a seamless execution of Smart Roadside and IntelliDrive, it is necessary to consider Smart Roadside as a functional subsystem of IntelliDrive. As stated earlier, a systematic approach to developing this subsystem is required for success. Based on government consensus across the modes, the initial Smart Roadside safety research includes four main applications: 1) E-Screening, 2) Truck Size and Weight, 3) Wireless Roadside Inspection (WRI), and 4) Truck Parking. In addition, **Environment** and **Smart Freight Mobility** applications will also be included in the initial Smart Roadside research. Smart Roadside, in part, is designed to extend truck inspection capabilities away from the traditional fixed site environment to the roadside while the vehicle is in motion.

The four targeted applications are in various stages of operation and deployment as described below.

- E-Screening is a key component of the information collection systems and communications networks that support commercial vehicle operation – referred to as the Commercial Vehicle Information Systems and Networks (CVISN). E-Screening defined at the highest-level is when a commercial vehicle is identified automatically and assessed for safety while the vehicle is in motion. With E-Screening, safe and legal vehicles are allowed to continue on their route. Enforcement resources can be used to target unsafe vehicles and carriers. Currently, E-Screening occurs at fixed stations and on-demand verification sites.

- Truck Size and Weight researchers conducted an Enforcement Study in 2008 and 2009 to develop the foundation for roadside technologies that can be used to improve truck size and weight enforcement. Outcomes of this study include a concept of operations for a virtual weigh station and a virtual weigh station/e-Permitting architecture. The virtual weigh station concept will further increase the number of electronic screenings and depending upon the virtual weigh station configuration, will provide a more enhanced safety and credentials assessment.

- WRI research is being done to increase the number and frequency of safety inspections at the roadside and obtain data about the commercial vehicle and its driver. This safety data is termed the Safety Data Message Set (SDMS) and can be transmitted directly from the vehicle to the roadside and from a carrier system to a government system. The initial SDMS will contain basic identification data (for driver, vehicle, and carrier), the driver's log, a small set of vehicle measurement data, and selected vehicle status information. Enforcement systems and staff will use the SDMS to support E-Screening and inspections at locations such as staffed roadside sites, virtual weigh stations, and on-demand verification sites.

- Truck Parking research currently includes two projects, which will provide commercial vehicle parking information so that commercial drivers can make advanced route planning decisions based on hour-of-service constraints, location and supply of parking, travel conditions, and loading/unloading.

Figure 2 below shows the data that is necessary to be communicated between Smart Roadside and the initial applications. Environment and Smart Freight Mobility data are still under analysis. A total of 34 elements are passed between Smart Roadside and the four safety applications.

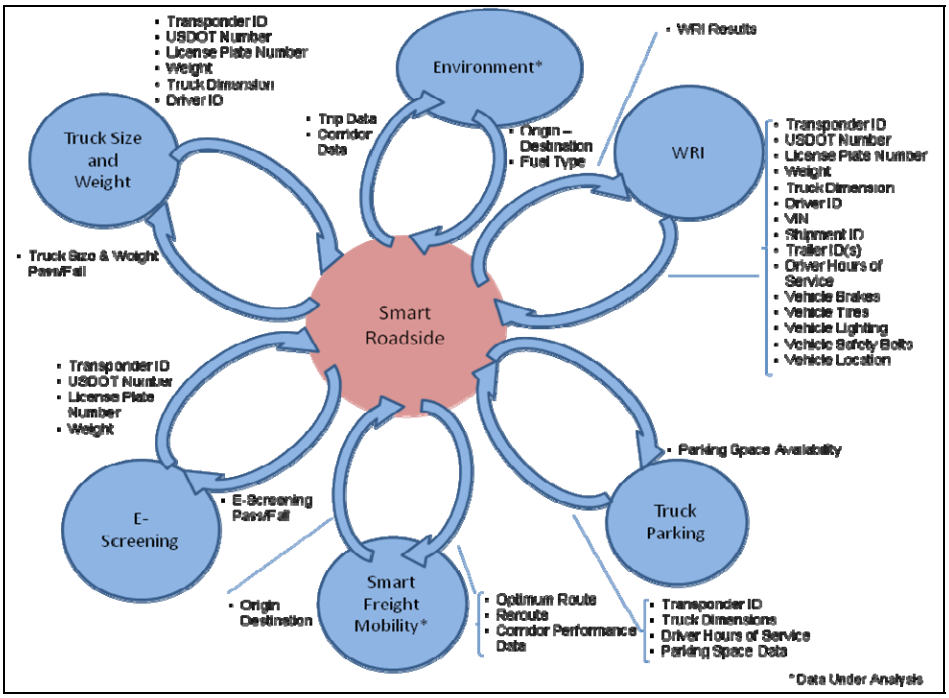

Figure 2. Data Communicated Between Smart Roadside and Initial Applications

Figure 2 shows that if the four safety applications are independently developed, there will be unnecessary duplication of data transmitted to the Smart Roadside system. One of the challenges of Smart Roadside is to eliminate this duplication and ensure efficiency and accuracy. If the duplicate data are eliminated, then the number of elements can be reduced to 23 as shown in Table 3 below. Cursory analysis is already showing approximately 33 percent reduction of communication. Even greater improvement is expected with further analysis.

Table 3. Application Data Flows

Data \ Application	E-Screening	Truck Size & Weight	Wireless Roadside Inspection	Truck Parking	Environment*	Smart Freight Mobility*
Transponder ID						
USDOT Number						
License Plate Number						
Weight (e.g, static scale, WIM, self-weight)						
SAFER Carrier Snapshot (safety & credentials data)						
SAFER Vehicle Snapshot (safety & credentials data)						
Pass/Fail Data (screening decision)						
Truck Size & Weight Pass/Fail Data						
WRI Results						
Truck Dimensions						
Driver Identification						
Driver History						
Tractor ID (VIN)						
Shipment ID						
Trailer ID(s)						
Driver Log (Hours of Service)						
Vehicle Measures -Brakes						
Vehicle Measures - Tires						
Vehicle Measures - Location						
Vehicle Status - Lighting						
Vehicle Status - Safety Belts						
Parking Space Data						
Parking Space Availability						

** Data Under Analysis*

Figure 3 illustrates data input, Smart Roadside processing, and data output if duplicate data are eliminated.

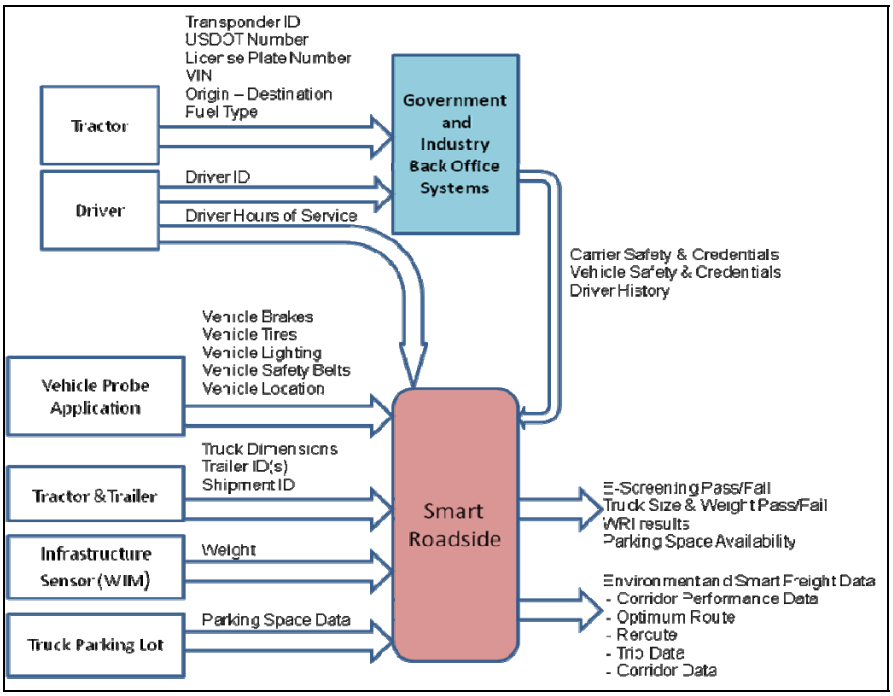

Figure 3. Smart Roadside Data Flows

Figure 3 illustrates the need for an integrated approach to Smart Roadside.

Summary

As stated earlier, Smart Roadside is a concept where private- and public-sector motor carrier systems will continue to operate as intended, and where information collected for one purpose can be shared to serve multiple stakeholders and uses. The objective is to apply advanced technologies to create more efficient and streamlined processes and to share data in real time or near-real time to maximize its utility.

When Smart Roadside is realized, commercial vehicles will be screened electronically, and on-board sensors will provide most of the information that are currently captured by manual inspections.

Many of the data transactions envisioned for Smart Roadside are similar to those identified for IntelliDrive. Currently, data and message standards are being developed, revised, prototyped, and tested for the IntelliDrive program. It is imperative that the Smart Roadside Initiative and IntelliDrive programs are coordinated so as to leverage related activities and to ensure the efforts result in a comprehensive implementation that meets the needs of all stakeholders.

For More Information –

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