

# Smart Roadside Initiative

## Concept of Operations

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16. Abstract The Smart Roadside Initiative (SRI) is one of several USDOT research and development projects intended to improve the efficiency and safety of the Nation's roadways by providing for the exchange of important safety and operational information. This goal of this project is to define a framework to connect commercial vehicles, motor carriers, enforcement resources, highway facilities, intermodal facilities, toll facilities, and other nodes on the transportation system in order to provide more complete, timelier, and better operations-driven information exchange. This framework will provide a foundation upon which technology can be built to meet operational needs for improving motor carrier safety, security, operational efficiency, and freight mobility, and enhancing protection and maintenance of infrastructure. This document is a Concept of Operations for a system that will be used to: <ul style="list-style-type: none"> <li>• uniquely identify commercial motor vehicles;</li> <li>• locate, analyze and make available to users information about the vehicles, the carriers that own and/or manage them, and the drivers that operate them, in order to facilitate electronic screening;</li> <li>• facilitate the delivery of information regarding truck parking facilities; and</li> <li>• support the development and delivery of functionality consistent with the US DOT's V2X Cooperative Systems program.</li> </ul> This Concept describes current operations, user needs for enhancement, justification for changes, proposed operational policies and constraints and expected outcomes, as well as sample scenarios for the application of the system. It will serve as a resource for development of engineering requirements for prototype SRI applications and SRI architecture, and support decision makers in their assessment of SRI systems.			
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# 1 Scope

## 1.1 Identification

This document describes the concept of operations (ConOps) for the Smart Roadside Initiative (SRI) for the delivery of capabilities related to wireless roadside inspections, electronic screening/virtual weigh stations, universal electronic commercial motor vehicle (CMV) identification and truck parking. The SRI program is a multi-faceted US Department of Transportation (USDOT) initiative aimed at improving the efficiency and safety of the Nation's roadways by providing for the exchange of important safety and operational information among the users and caretakers of the system.

## 1.2 Document Overview

The Smart Roadside Initiative began a few years ago when a representative cross-section of the CMV community attended the 2008 Smart Roadside Workshop. The participants at the workshop agreed that CMV safety, security, and mobility systems should be linked into a coordinated and comprehensive roadside program. Smart Roadside is now an approved mode-specific item in the USDOT Intelligent Transportation Systems (ITS) Strategic Research Plan, 2010-2014. There is now a recognized need to initiate work to perform a Needs Analysis and develop a Concept of Operations for the Smart Roadside Initiative.

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, to provide for enhanced protection and maintenance of infrastructure. This vision will be achieved through the application of interoperable technologies and information sharing among 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.*

While the original scope for the goals of Smart Roadside Initiative (SRI) was broad, aspects of that vision are being advanced through the USDOT's connected vehicle initiative. The primary focus of the SRI remains constant: improve the effectiveness of traditional enforcement activities conducted

at weigh/inspection stations by moving compliance checks to the roadside. In doing so, enforcement is better able to focus limited resources on vehicles requiring more extensive measurements and inspection. Forecasts of truck travel demand made by the American Trucking Association and the Federal Highway Administration (FHWA) point to significant increases in the short and medium term; the importance of removing legally loaded and operating vehicles from enforcement queues cannot be overstated.

SRI is part of the USDOT's connected vehicle initiative. Connected vehicle technology can change our transportation system as we know it by enabling safe, interoperable, networked, wireless communications among vehicles, infrastructure and passengers' personal communication devices. Connected vehicle technology will enable cars, trucks, buses and other vehicles to "talk" to each other with in-vehicle or aftermarket devices that continuously share important safety and mobility information. This wireless communication will be able to talk to roadside weigh/inspection stations as well.

A key component of the USDOT connected vehicle initiative is to use wireless communications to facilitate the high-speed transfer of data and to support:

- Safety applications that enable a vehicle to have 360 degree awareness and can inform the operator of hazards and situations he or she cannot see;
- Mobility applications that will improve overall transportation system performance by accessing pertinent information from thousands of anonymous vehicles through a connected, data-rich travel environment; and
- Traveler information applications that provide travelers with real-time information, including CMV-specific information, about congestion and travel conditions to enable more informed decisionmaking.

Within the overall connected vehicle initiative, the SRI represents the subset of CMV applications focused on roadside enforcement. Work is also being done in the USDOT on vehicle-to-vehicle active safety applications for CMVs under the Connected Commercial Vehicle Integrated Truck and Retrofit Safety Device projects and an advanced freight traveler information application under the Freight Advanced Traveler Information System (FRATIS) project. Many of the component applications included within the scope of SRI are currently deployed or are under development and testing. The SRI program is being designed to operate in a telecommunication-rich environment that facilitates data sharing among these component applications to enable real-time information sharing at the roadside – vehicle to roadside, vehicle to vehicle, and roadside to driver – and be fully interoperable with the other programs within the connected vehicle initiative. The expected benefit of SRI is to expand the sources and types of information available at the roadside to improve CMV safety and enhance mobility.

The current CMV 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 of these programs will be greatly improved by the SRI concept as relevant and appropriate data is shared among the current systems and they become integrated in a collaborative fashion. The ideal Smart Roadside "system," when deployed,

will improve the safety, mobility, and efficiency of truck movement and operations on the roadway by facilitating:

- The integration of external systems that enhance the exchange of information for CMV operations to support roadside operations (i.e., the integration of roadside applications with these external information systems that provide information on CMV safety history and credentials status);
- Access to information at roadside, including information that will enable the identification of the driver and vehicle as well as the motor carrier; and
- The deployment of supporting infrastructure at strategic points along CMV routes to support the exchange of information.

The purpose of this document is to communicate a concept for the SRI that bridges the gap between users' needs and visions and developers' technical specifications. This concept is detailed throughout this document, which reflects the quantitative and qualitative system characteristics of SRI from the users' and operators' perspectives organized by potential applications. The initial activities within this task are related to the extraction of user needs associated with the four programs identified for initial focus.

The structure of this ConOps is based on the Institute of Electrical and Electronics Engineers (IEEE) Standard 1362-1998 *IEEE Guide for Information Technology, System Definition, Concept of Operations (ConOps) Document*. Consistent with this Standard, this ConOps document consists of the following sections:

- Section 1 provides an overview of the project scope and an introduction to the ConOps document.
- Section 2 lists the documents used for background information or as a source of user needs. Many of these documents are artifacts from the vehicle-infrastructure integration (VII) initiative.
- Section 3 provides an overview of the current system. This system is the basis for analyzing the needs and capabilities to be considered for use in the revised system.
- Section 4 discusses the user needs, the process followed to identify and define them, and the justification for the definition of this concept.
- Section 5 describes the proposed concept, including its scope, operational environment, operational policies and constraints, major system services, and interfaces to external systems and subsystems.
- Section 6 provides a set of scenarios developed to illustrate the system's support for the needs defined in Section 4, as delivered using the conceptual system described in Section 5. Each scenario includes a brief textual description of the scenario.
- Section 7 provides a summary of the operational, organizational, and developmental impacts of the proposed system.
- Section 8 discusses the improvements provided by the proposed system, its disadvantages and limitations, and any alternatives or trade-offs considered.

The intended audience for this ConOps includes the USDOT, transportation managers (including State and local DOTs), enforcement officers, vehicle manufacturers, information service providers, fleet managers, motor carrier companies, State agencies involved with CMV safety and credentialing, application developers, and potential core system acquirers, implementers, operators, and maintainers.

## 1.3 System Overview

The “SRI system”<sup>1</sup> is not an individual system, but rather a collection of tools, methods, and standards that together have the potential to transform the way CMV operators, safety enforcement personnel, and other authorized users access, apply, and manage information. The SRI system and the components that will be developed under its umbrella will effectively do three things:

- Streamline the methods and mechanisms used to locate and access information, thereby accelerating and improving the accuracy of decisionmaking processes;
- Provide an electronic means both to identify CMVs at highway speeds and to manage the exchange of information between vehicles and infrastructure-based systems; and
- Enable the delivery of a broad variety of applications that enhance safety and mobility.

The foundational element of the SRI system is the establishment of open standards-based connectivity to the variety of systems that are currently in place at the Federal, State, and local levels, both within government and among current and future commercial systems. This connectivity is essential to the timely information exchange that underpins the SRI system. One of the key reasons for this is to enable system users the flexibility to implement components/modules of the system suited to the needs of the user and to enable previous automated tools to be integrated into the SRI system.

The second major element is the mechanism by which users will access information. This information, which will be used to facilitate a broad range of operational and policy decisions, must be presented to users in a concise, consolidated fashion. These user interfaces are intended to be single points of access that will use standardized information access mechanisms, although presentation formats will be user-customizable.

The third major element is the communications link between the moving CMV and the rest of the SRI network. The ultimate goal is to provide for electronic identification of the vehicle, carrier, and driver, and to allow for the information exchanges necessary to support a variety of location-based services. The system must be “technology agnostic,” meaning that it must accommodate any communications channel that provides the requisite performance, reliability, and information security.

The common characteristic for all three major elements is a focus on enhancing the user experience by streamlining access to information, improving decisionmaking, and providing a means for delivering new capabilities. An overarching element of this vision is that SRI must fit into and support an information exchange environment that allows for the rapid movement of what are potentially

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<sup>1</sup> The term “SRI system” is used throughout this document for simplicity.

very large data sets. This is essential not only to meet the performance requirements inherent in the delivery of the capabilities envisioned for CMV operations, but also to ensure that it leverages technology that may also be used for vehicle-to-vehicle (V2V) safety applications. This extends beyond the simple ability to use any such technologies to promote the development and adoption of methods and mechanisms that ensure SRI functions do not compromise the low-latency data exchanges necessary to support those safety functions. Sections 4 and 5 of this document discuss the proposed SRI system in detail.

## 2 Referenced Documents

- This section contains a listing of documents referenced during the development of this ConOps.
- IEEE Std. 1362 – IEEE Guide for Information Technology, System Definition, Concept of Operations (ConOps) Document, 22 Dec 1998 (R2007)
- VII Core System Concept of Operations (ConOps), Prepared for USDOT Research and Innovative Technology Administration, 19 Apr 2011
- Concept of Operations (ConOps) for Wireless Roadside Inspection, Baseline V1.0, USDOT Federal Motor Carrier Safety Administration, May 2010
- White Paper, “The Scope of Smart Roadside,” Draft, 02 Apr 2010
- Wireless Roadside Inspection System Requirements Document (Pre-Pilot Test), USDOT Federal Motor Carrier Safety Administration, Feb 2010
- Smart Roadside Initiative DRAFT Concept of Operations – Overview (Briefing), 11 Jan 2011
- Smart Roadside Initiative DRAFT Concept of Operations – Enhanced Electronic Screening (Briefing), 21 Oct 2010
- Smart Roadside Initiative DRAFT Concept of Operations – Integrating Public- and Private-Sector Data (Briefing), 24 Nov 2010
- Smart Roadside Initiative DRAFT Concept of Operations – Performance-Based Standards and an Architecture Framework (Briefing), 22 Apr 2011
- Smart Roadside Initiative DRAFT Concept of Operations – Sharing Information – Establishing a Common Framework (Briefing), 26 May 2010
- Smart Roadside Initiative DRAFT Concept of Operations – Streamlined/Accelerated Inspections –Wireless Roadside Inspections and Traditional Inspections (Briefing), 30 Jun 2010
- Smart Roadside Initiative (SRI) Prioritization of Potential SRI Applications – Tasks 2 and 3: Technical Memorandum 3, SAIC, , October, 2011
- Smart Roadside Initiative (SRI) User Needs: A Summary of Findings – Tasks 2 and 3: Technical Memorandum 3, SAIC, June, 2011
- Smart Roadside Initiative (SRI) Application Analysis and Assessment of Deployed Systems and Current Research – Tasks 2 and 3: Documentation Review of Deployed Systems and Documentation Review of Current research/Emerging Systems, SAIC, June, 2011
- WSDOT Truck Parking Study – Final Report, Washington State Department of Transportation, December 2005
- Concept of Operations for a Virtual Weigh Station, FHWA, June 2009
- I-95 Corridor Coalition Truck Parking Initiative, Concept of Operations Version 4.0, FHWA, November 24, 2010
- I-95 Corridor Coalition Truck Parking Initiative, System Design Version 1.2, FHWA, November 24, 2010

- Draft Concept of Operations, Federal Highway Administration Truck Parking Initiative, Improved Parking Information and Reservations for Truckers, FHWA, January 14, 2011
- Universal Truck Identification System: Concept of Operations, Draft Concept of Operations Document (Version 1.1), FHWA, November 15, 2010
- Business Model for Electronic Permitting/Virtual Weigh Station Architecture Version 2.1, FHWA, June 4, 2010
- Best Practices Data Inventory for Electronic Permitting/Virtual Weigh Station Architecture, Draft Version 1.0, FHWA, December 9, 2010
- CSA Safety Measurement System (SMS) Methodology, Version 2.1, FMCSA, December 2010
- SAE Std J2735 - Dedicated Short Range Communications (DSRC) Message Set Dictionary Version 1.0, FHWA, September 25, 2009
- IEEE Std 1609 - Family of Standards for Wireless Access in Vehicular Environments (WAVE) Version 1.0, FHWA, September 25, 2009
- IEEE Std 802.11p – Approved Amendment to Std 802.11 WIRELESS LOCAL AREA NETWORKS (LANs), Draft Version, FHWA
- Statement of Work – Smart Roadside Initiative, USDOT, June 2010

## 3 Current System or Situation

Mechanisms currently in place for promoting and providing for safe CMV operations take many forms. The examination of individual vehicles for safety defects and compliance with administrative requirements (e.g., registration, operating authority, etc.) is conducted using a combination of manual processes and an assortment of technology tools and supporting systems. The result is that the number of inspections conducted is limited by the availability of trained inspection professionals, the time necessary to locate needed information, and the physical constraints of the facilities where inspections are conducted. Further, those inspection activities require trucks to stop, increasing fuel consumption, creating traffic congestion at inspection station entry and exit points and delaying shipments. This section describes the current processes and systems for determining the identification of individual vehicles, assessing which vehicles to inspect, and conducting inspections.

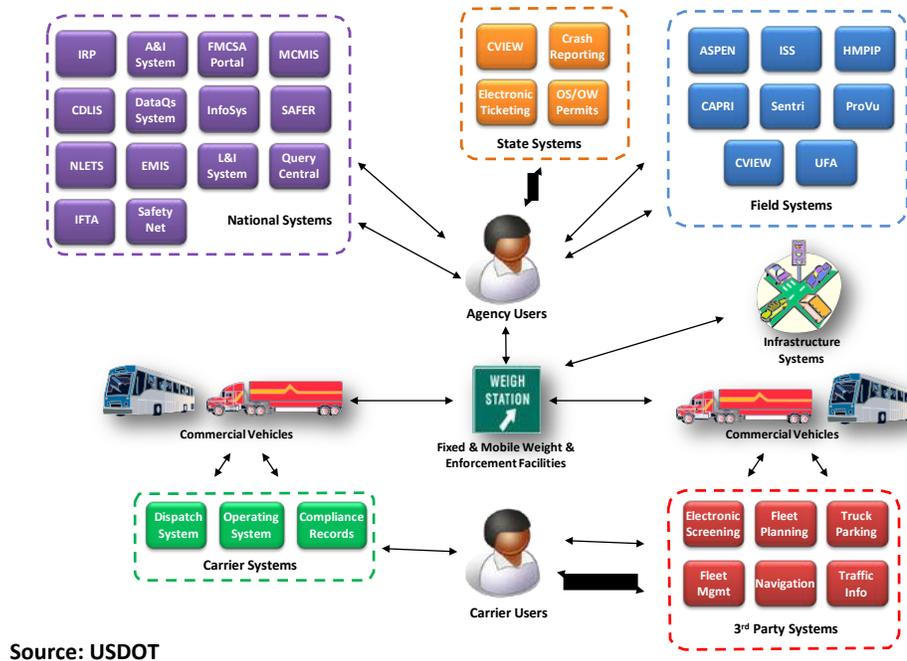
### 3.1 Background, Objectives, and Scope

The US Department of Transportation (USDOT) works with trucks in a number of ways. The National Highway Traffic Safety Administration (NHTSA) sets and enforces safety performance standards for motor vehicles and motor vehicle equipment. Federal Motor Carrier Safety Administration (FMCSA), the Federal Highway Administration (FHWA) work closely with State-level enforcement agencies and motor carriers to identify processes, procedures, and mechanisms to evaluate over the road operations and ensure that motor carriers engaged in interstate commerce are safe and legal. This includes examining vehicles for safety deficiencies, reviewing driver logs and credentials, determining whether the vehicle does not meet applicable size and weight requirements, has the appropriate over-dimensional permits (if applicable), and is traveling on an approved route (if carrying an oversize load). The current system consists of a set of systems, automated tools, and methods that provide decision makers with enhanced and expanded access to historical safety and compliance data. This information makes it possible for enforcement agencies to conduct vehicle screenings and determine which vehicles require closer inspection and measurement.

Figure 1 depicts the wide variety of systems currently used for CMV operations management and compliance verification activities and for capturing and disseminating information related to government agency operations.

Most notable among the characteristics of the current environment is the preponderance of one-to-one linkages between users and the various system elements. This trait typically manifests itself in the multiple steps that a user—whether a motor carrier employee or a representative from a government agency—must undertake to locate, extract, interpret, and apply the data and information necessary to make operational decisions. Each of the individual systems, which are depicted in the diagram below and summarized in section 3.6, have been designed and implemented to perform specific functions, often independent of the function of the others. The result

is a collection of functional elements that require the user to engage in a significant number of separate decision-support activities. Additionally, several key operational elements (i.e., truck parking facilities and infrastructure facilities) have at best limited connection both within and among States.



**Figure 1. Overview of Current Commercial Motor Vehicle Information Systems**

The ultimate outcome at the roadside is that a safety enforcement official is able to gather and analyze only a very small portion of the information necessary to assess whether a vehicle or driver needs to be examined more closely or if the vehicle can proceed to complete its trip without delay. Depending upon the resources available, the officer may be able to examine the output from a weigh-in-motion (WIM) system to determine weight compliance or a roadside sensor to verify compliance with dimensional restrictions within a few seconds. However, additional screening requires that he or she connect to and request information from different systems, few of which can consolidate more than a small number of data points and present them quickly enough for an officer to make a determination as the vehicle proceeds at mainline speeds. In effect, much of the data and information that is of value in such a setting takes too much time to obtain, process, and act upon as a vehicle passes a screening and inspection point.

Since the early 1990's, the USDOT has been engaged in various technology development and deployment efforts aimed at improving the quality of CMV safety data collected. These efforts, which have been conducted under the umbrella program called Commercial Vehicle Information Systems and Networks (CVISN), have resulted in significantly improved access to safety and registration records as well as risk-assessment tools that facilitate selecting vehicles for inspection.

Even with these enhancements in place, much of the burden for screening vehicles for inspection, conducting inspections, and reporting results falls upon CMV inspectors stationed at roadside inspection facilities. In spite of considerable effort to standardize data sets and enforcement procedures, the current system is an inherently complex approach that is difficult to apply fairly and evenly. More importantly, present inspection methods cover a relatively small portion of the number of vehicles currently using the roadway system. This will become more of a challenge in the future as the percentage of freight carried by trucks is expected to increase from about 60% in 2002 to 67% by 2035, with overall goods movement expected to increase from about 19 million tons to 37 million tons during the same time period.<sup>2</sup> This places increased importance on the ability to quickly and efficiently evaluate vehicles, drivers, and carriers for compliance with safety and vehicle size and weight requirements, processes for which both FMCSA and FHWA are working to improve.

Aside from the CMV safety screening challenges presented, the current nature of system-to-system connectivity presents barriers to the broad implementation and use of other value-added functionality. There is a need for a single point of access to give law enforcement officials all the information needed for a quick decision. For instance, the Freight Advance Traveler Information System (FRATIS) initiative seeks to leverage advancements in technology to promote the coordinated movement of loads to reduce empty trips and the application of dynamic route guidance (DRG) to reduce travel delay for CMVs. This initiative depends heavily upon the application of open architecture and a many-to-many systems connectivity approach to achieve its objectives. The establishment of individual system-to-system connections is neither practical nor capable of producing the level of cooperative operations and information sharing necessary to deliver these capabilities. A broader, open architecture-based model is essential to providing a single point of access.

Additionally, these systems, as well as new and emerging systems to deliver truck parking information, are not in any way connected to other systems currently in use. Nor, in many cases, are infrastructure systems such as 511 traveler information systems or advanced traffic management systems. While they may remain separate as they mature and evolve, there is a need to examine how efforts to connect vehicles and infrastructure can be leveraged to deliver these services in a manner that makes them accessible and reliable to the largest possible number of users in the shortest period of time possible.

Finally, the current system is characterized by the significant presence of human-in-the-loop activities. In other words, much of what happens related to the movement of information and the decisions made based on that information is dependent upon manual intervention. In the current system, users are as often information exchange intermediaries as they are appliers of decision logic based upon that information. The user must find disparate information, collect it into something meaningful, and interpret it to make decisions. More effective information support systems are needed to correct this situation.

## 3.2 Operational Policies and Constraints

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<sup>2</sup> Source: FHWA "The Freight Story 2008," [http://ops.fhwa.dot.gov/freight/freight\\_analysis/freight\\_story/large.htm](http://ops.fhwa.dot.gov/freight/freight_analysis/freight_story/large.htm)

### 3.2.1 Existing Operational Policies

The FMCSA and the FHWA have promulgated extensive regulations governing motor carrier safety and size and weight enforcement, as summarized in Table 1 below. The majority of operational policies currently in place at the State level are developed to implement and comply with Federal regulatory requirements.

**Table 1. Existing Operational Policies**

Policy	Current System
North American Standard (NAS) Inspection Program	Motor carrier inspections are done using the seven levels of inspection established in the North American Standard Inspection Program, described in section 3.3.1.1.
NAS Inspector Certification and Training	The program requires that all inspectors be trained and certified and specifies that inspectors must conduct a certain number of inspections annually to maintain their certification.
Size and weight Enforcement	FHWA regulations, described in section 3.3.1, require that States prepare and submit an annual truck size and weight enforcement plan. Enforcement is conducted by the States, and a State may tailor its plan to meet specific requirements.
USDOT Numbers	Interstate motor carriers are required to obtain a USDOT number. This number is used as the unique identifier for the motor carrier.
Compliance, Safety, Accountability (CSA)	CSA is FMCSA's new safety and enforcement program. Under this program the methodology used to assess motor carrier safety ratings has been expanded to include performance data not included in the former SafeStat methodology.

Source: USDOT

### 3.2.2 Existing Operational Constraints

**Table 2. Existing Operational Constraints**

Constraint	Current System
Lack of unique identifier for all motor carriers	The USDOT number for interstate motor carrier can be read by roadside reader. States are now requiring intrastate DOT numbers that include a number and unique identifier, but this is not a standard practice across all States
Inability at present to identify driver	Drivers are identified manually through an enforcement action or inspection. No electronic means is currently deployed that enables the identification of a driver.
Lack of consensus on unique Identifiers	There is no agreement on what should constitute a unique identifier for the motor carrier, the driver, or the vehicle
Limited coverage on National and State highways	Fixed facilities tend to be on the Interstate system. States use mobile patrols and “plug and play” facilities to conduct size, weight, and safety enforcement, but States do not have the resources for coverage of all highways used by CMVs, and as truck use on non-Interstate facilities increase and State resources continue to decline, the gap between the necessary human resources and those that are available continues to widen.
Limited communications to support roadside operations—vehicle-to-vehicle or vehicle-to-roadside	Pre-clearance programs issue “green light/red light” through a transponder. Information exchange between enforcement personnel at fixed facilities or between States using hand-held communication devices or electronic mail.
Lack of common protocols and standards to support roadside operations	At present, CMV roadside operations lack common communication protocols and common standards.

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Constraint	Current System
Lack of interoperability	States frequently use vendor systems to support CMV credentialing and roadside safety associations. These systems are technically interoperable but institutional issues limit the exchange of data among vendor systems.
Lack of physical infrastructure to support roadside communications	As noted in section 3, a number of vendors are deploying roadside applications that support SRI functionality. However, these applications are relatively new and do not have a widespread deployment. Resource constraints have also limited States' ability to deploy these applications.

Source: USDOT

## 3.3 Description of the Current System

### 3.3.1 Regulatory Framework

Motor carrier operations for both the public and private sectors are based on regulatory requirements promulgated by FMCSA for safe operations and credentialing, by FHWA for size and weight regulations, and by NHTSA for highway and motor vehicle safety. Existing regulations governing motor carrier operations are established in the Code of Federal Regulations (CFR). The regulatory framework is designed both to correct deficiencies through enforcement and preclude deficiencies through preventive maintenance and driver compliance with regulatory requirements. FMCSA's current implementation of its Compliance, Safety, and Accountability (CSA) program continues this emphasis on preventing deficiencies and promoting increased compliance.

The current regulatory requirements established for CMV enforcement and operations are summarized in Table 3 below.

**Table 3. FMCSA and FHWA Commercial Motor Vehicle Regulations**

Agency	Title	Policy Impacts by Section
Federal Motor Carrier Safety Administration	49 CFR Part 390	General Federal Motor Carrier Safety Regulations.
	49 CFR Part 382	Establishes legal blood alcohol limits for commercial drivers. Requires that motor carriers maintain a drug and alcohol testing program.
	49 CFR Part 383	Establishes requirements for obtaining and maintaining a commercial driver's license (CDL).
	49 CFR Part 392	Establishes requirements for driving CMVs and obtaining necessary operating authority.
	49 CFR Part 395	Establishes hours-of-service, including maximum hours on duty, maximum driving hours within hours on-duty, and required off-duty rest periods.
	49 CFR Part 396	Establishes requirements for how motor carriers inspect, repair, and maintain their CMVs. Establishes requirements for drivers to conduct pre- and post-trip inspections and report results.
	49 CFR Parts 100-185	Establishes the Hazardous Materials program and define hazardous materials.
	49 CFR Part 397	Establishes the requirements for the transport of hazardous materials, including special driver certifications and vehicle/trailer placarding requirements.
Federal Highway Administration	23 CFR Part 658	Prescribes national policies that govern truck and bus size and weight; sets Federal limits on combination vehicle size, weight, and length; identifies State designated routes accepted by the Federal government on the National

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U.S. Department of Transportation

Agency	Title	Policy Impacts by Section
		Network.
	23 CFR Part 657	Establishes requirements for annual State size and weight enforcement plans and certification.

Source: USDOT

### 3.3.1.1 Commercial Motor Vehicle Safety Enforcement (General Federal Motor Carrier Safety Regulations)

Enforcement of the above FMCSA safety regulations is currently accomplished through the North American Standard Inspection Program (NASI). The NASI establishes a uniform approach to CMV compliance and enforcement efforts throughout North America. The NASI focuses on CMV inspections using vehicle and driver safety criteria most often associated with crashes and also complies with the requirements of 49 CFR Part 390 Federal General Motor Carrier Safety Regulations.

There are seven levels of inspection established under the NASI. The most comprehensive is a Level I North American Inspection that includes an examination of at least the following items:

- Commercial driver's license;
- Medical examiner's certificate and waiver, if applicable;
- Alcohol and drugs;
- Driver's record of duty status as required;
- Hours of service;
- Seat belt;
- Vehicle inspection report;
- Brake system, coupling devices;
- Exhaust system;
- Frame;
- Fuel system;
- Turn signals;
- Brake lamps;
- Tail lamps;
- Head lamps;
- Lamps on projecting loads;
- Safe loading (weight compliance);
- Steering mechanism;
- Suspension;
- Tires;
- Van and open-top trailer bodies;
- Wheels and rims;
- Windshield wipers; and
- Emergency exits on buses and hazardous materials (HM) requirements, as applicable.

The other levels of inspections include:

- Level II – Walk Around Driver/Vehicle Inspection. Includes the same elements as Level I but is done without physically getting underneath the vehicle.
- Level III – Driver-Only Inspection. Includes all elements related to the driver but no vehicle elements.
- Level IV – Special Inspections. Typically a one-time examination of a particular item and may include special research on certain type vehicles.
- Level V – Vehicle-Only Inspection. An inspection of the NASI Level I vehicle components without a driver being present.
- Level VI – Enhanced NASI Inspections for Radioactive Shipments. This includes enhanced inspection procedures for certain radiological shipments.
- Level VII – Jurisdictional mandated CMV inspection. These inspections are mandated by a particular jurisdiction and do not necessarily meet the NASI Level I criteria.

Through NASI, additional inspection procedures have been established for motor coach operators and hazardous materials carriers.

At present there are several ways a CMV may be selected for inspection. As with the actual inspections themselves, however, these are based on decisions made by roadside inspectors and enforcement personnel. While these personnel may have access to electronic information about a motor carrier, the decision to select a vehicle for inspection is often based on the inspector's experience, intuition, and knowledge of the motor carriers that travel a particular route on a regular basis. An inspector may know that a certain company has a history of poor operations and may flag that company's vehicles for inspection. Inspectors may also select a vehicle for inspection if the vehicle does not appear to be well maintained. Finally, inspectors often select vehicles at random as they pass over a scale at a weigh station.

Inspectors have access to FMCSA and State systems that provide information on a motor carrier's safety history. States use the Inspection Selection System (ISS) to assist with identifying motor carriers for inspection. The ISS uses a series of algorithms that evaluate a motor carrier's performance against safety criteria and then generates a numerical safety rating for a particular carrier. With the implementation of the FMCSA's CSA initiative, ISS has been updated to incorporate the CSA's Behavior Analysis and Safety Improvement Categories (BASIC) program. Under BASICS, each motor carrier is evaluated under seven criteria and then given a summary safety rating. States may use these systems to identify a motor carrier with poor safety ratings and then target that carrier's vehicles for inspection activities.

### **3.3.1.2 Commercial Motor Vehicle Size and Weight Enforcement (FHWA Regulation Enforcement)**

Size and weight enforcement programs are currently implemented by States under the provisions established in 23 CFR 657 and 23 CFR 658 as summarized in Table 3. 23 CFR 657 requires that

States submit an enforcement plan and certify that they are delivering adequate enforcement activities. Both are required to be submitted annually. 23 CFR 658 applies only to weight limits for the Interstate Highway System. FHWA's interest in weight enforcement is tied to single and tandem axle weights, gross vehicle weight limits, and the bridge formula.<sup>3</sup>

States operate fixed weigh and inspection facilities where CMVs exit the highway system and pass over a static scale that measures per-axle and gross vehicle weight combinations. When the queue becomes too long in a static facility, the enforcement personnel close the station until the queue is reduced. This allows trucks that may be non-compliant to pass the weigh station without notice. States are increasing their use of WIM, in which a scale is embedded into a main-line roadway or a weigh station access roadway. This allows trucks at highway speeds to be identified and weighed regardless of whether fixed weigh stations are closed. WIM fits with the concept of the Smart Roadside discussed in this paper.

States also use sensor technology that measure vehicle height, weight, and length to determine if vehicles are operating within tolerance guidelines. If a vehicle is identified as not being in compliance, the vehicle may be hand-measured by enforcement personnel to determine whether any dimensional restrictions have been exceeded.

States perform size and weight enforcement using mobile teams that carry portable scales. They also use "plug and play" facilities; i.e., facilities where a static scale is installed but is operated on a periodic basis by mobile enforcement personnel. These facilities are equipped with access to power and roadside communications infrastructure to support operations. When used, enforcement personnel quite literally "turn on the power" and direct CMVs into these facilities using dynamic message signs posted upstream of the facility.

States may designate weight limits on roadways not included in the Interstate Highway System. Trucks traveling on non-Interstate highways are subject to laws and regulations under the jurisdiction of State and local governments. States may also issue over-weight and over-dimensional permits to CMVs that allow the transportation of such freight, but only on certain roadways and under specified conditions. The right to issue these permits is "grandfathered" among the States; that is, those State laws in operation at the time Federal limits were codified take precedence over Federal regulations. Movements of loads of a size and/or weight beyond what the highway system was intended to accommodate are also accommodated through a State issued permit (for example, mega-loads such as manufactured housing).

The Surface Transportation Assistance Act of 1982 established dimensions for CMVs that are not subject to State-issued permitting, as provided for in 49 CFR 658 Appendix B. The STAA of 1982 guarantees mobility of federally recognized CMVs traveling on the national network and reasonable access thereto. 49 CFR Part 658 also addresses longer combination vehicle dimensions and the

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<sup>3</sup> The bridge weight formula is used to determine the appropriate maximum gross weight for a CMV based on axle number and spacing. The formula is used to prevent the concentrated weight on a truck's axle from producing stress on bridge members. For an overweight truck to comply with the formula, more axles must be added, the distance between axles must be increased, or weight must be removed.

roadways they are permitted to travel on; e.g., the “ISTEA freeze” or the “LCV freeze.” The freeze provision, which prohibited any modification of truck size and weight limits—leaving most States with a maximum gross weight limit of 80,000 lbs., is contained in 23 CFR Part 658 Appendix C. Weigh-in-motion is a key technology identified by FHWA for the effective enforcement of truck weight limits, in particular given the projected increases in goods movement by 2035.

### 3.3.1.3 Compliance, Safety and Accountability

FMCSA’s new CSA enforcement and compliance program<sup>4</sup> has three core components:

1. **The Safety Measurement System (SMS)** –this system quantifies the on-road safety performance of carriers and drivers to identify candidates for interventions, determine the specific safety problems a carrier or driver exhibits, and to monitor whether safety problems are improving or worsening. SMS identifies unsafe carrier and driver behaviors that lead to crashes using all safety-based roadside inspection violations and has replaced the SafeStat system, which only used out-of-service violations and moving violations.
2. **The Intervention Process** – under this process, a variety of options, including a warning letter or a focused investigation, can be used instead of a full compliance review, which had been the only option in the past. The focus is on identifying what caused violations to happen and determining how to prevent them from continuing to occur.
3. **The Safety Fitness Determination** - proposed approach, dependent on future rulemaking.

The SMS calculates safety performance of carriers in seven BASICs categories. These categories, and their associated Federal regulations, include:

1. Unsafe Driving - Operation of CMVs by drivers in a dangerous or careless manner (Parts 392 and 397);
2. Fatigued Driving (Hours-of-Service) - Operation of CMVs by drivers who are ill, fatigued, or in non-compliance with the HOS regulations. This BASIC includes violations of regulations pertaining to logbooks as they relate to HOS requirements and the management of CMV driver fatigue (Parts 392 and 395);
3. Driver Fitness - Operation of CMVs by drivers who are unfit to operate a CMV due to lack of training, experience, or medical qualifications (Parts 383 and 391);
4. Controlled Substances/Alcohol - Operation of CMVs by drivers who are impaired due to alcohol, illegal drugs, and misuse of prescription or over-the-counter medications (Parts 382 and 392);
5. Vehicle Maintenance - Failure to properly maintain a CMV (Parts 393 and 396);

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<sup>4</sup> FMCSA, “Compliance Safety Accountability – Resources” Web page, available at: <http://csa.fmcsa.dot.gov/resources.aspx>.

6. Cargo-Related - Failure to properly prevent shifting loads, spilled or dropped cargo, overloading, or unsafe handling of hazardous materials on a CMV (Parts 392, 393, 397, and Hazardous Materials); and
7. Crash Indicator – Motor carrier histories or patterns of high crash involvement, including frequency and severity, based on information from State-reported crashes.

A carrier's measurement for each BASIC depends on the number of adverse safety events (violations related to that BASIC or crashes), the severity of violations or crashes, and when the adverse safety events occurred (more recent events are weighted more heavily).

### 3.3.2 Current System Components

States are deploying a number of technologies to support CMV safety and size and weight enforcement. This section briefly summarizes the technologies and supporting programs currently in operation at the State level.

#### 3.3.2.1 Weigh-In-Motion

WIM is used to determine whether per-axle and gross vehicle weights are within specified tolerance guidelines or whether a vehicle should be weighed on a static scale to obtain authoritative weights. Sensors incorporated into WIMs measure approximate vehicle axle weights as the vehicle moves across them. The system determines the gross vehicle weight and vehicle classification based on its axle weights and axle spacing. WIM scales are traditionally used to sort trucks by weight on the approach ramp either to a weigh station or on the mainline about a mile upstream of a weigh station. States rely on mainline WIM sorters when land is not available for a ramp sorter or when truck traffic volume is too high to accommodate all trucks for ramp sorting. Mainline WIM scales combined with variable message signs provide a call-in signal to drivers suspected of carrying loads that exceed the weight limits.

#### 3.3.2.2 Virtual Weigh Stations

States are also investing in virtual weigh stations. These are remote facilities that are equipped with WIM, a reader that can capture a vehicle's DOT number, transponder number, or license plate number, and communications equipment that transmits this information from the roadside to a fixed facility or mobile enforcement unit. Virtual weigh stations at present are also equipped to communicate with passing CMVs and are used by States to identify vehicles that warrant additional enforcement or inspection actions.

#### 3.3.2.3 Electronic Screening and Pre-Clearance Programs

Electronic screening or pre-clearance programs are programs that allow motor carriers to by-pass a weigh and inspection facility. Motor carriers are required to register with these programs and must meet certain safety criteria to qualify for a by-pass, known commonly as a "green light." Qualifying motor carriers receive an electronic notification authorizing them to by-pass weigh stations (a green light). For this process, CMVs must carry a transponder that contains a unique identifier. As a CMV

approaches a weigh station, a roadside reader detects the unique identifier and matches this against a list of motor carriers that are “pre-cleared,” that is qualify to receive a by-pass. The fixed facility may over-ride the system and direct trucks carriers to pull into a weigh & inspection station for additional size and weight enforcement, and possibly for a full safety inspection to verify that the participating carrier is maintaining its vehicles appropriately and continues to meet program participation criteria.

Pre-clearance programs enroll motor carriers and determine if their safety histories and ISS scores warrant the approval of pre-clearance. As part of the approval to participate in these programs, the motor carriers must agree to a random number of “red lights,” that is, signals to enter a weigh and inspection facility for further enforcement action. This is done to ensure that participating motor carriers are maintaining their safety records and ISS scores at levels that meet pre-clearance program criteria.

A commercially available product includes the deployment of multiple roadside sensors to identify and automatically screen passing CMVs without requiring them to stop. It is currently being used in several States. This solution, which provides functionality very similar to that envisioned under the SRI electronic screening/virtual weigh station capability, is a modular software platform for screening at weigh/inspection stations that:

- Accepts hardware sensor inputs for weighing, measuring, and identifying the truck and its features;
- Interfaces to a variety of data sources;
- Applies agency defined screening rules;
- Generates user alarms based on screening results;
- Sends information to the trucks regarding how to respond; and
- Confirms that the vehicle driver is following instructions.

Effective electronic screening and preclearance programs require reliable, real-time database access and low-latency response in order to provide a reliable by-pass/pull-in indication to the driver before they reach the turn-off ramp. Near real-time access and accurate information exchanges are critical for preventing turn-off ramp congestion and false alerts. However, systems deployed within the CVISN framework currently a single transponder or other communications device with similar functionality with universal identification capability to support multiple applications such as electronic screening, safety assurance, fleet management, asset management, tolling, parking, and other CMV transactions.

#### **3.3.2.4 Truck Parking Information**

At present, very few operational systems exist that commercial drivers can access to gain information about the availability of truck parking. Some private parking facilities offer parking availability information through mobile phone applications. However, these systems rely on cumbersome manual data collection and are not widely deployed. The National Association of Truck Stop Operators (NATSO) has an outreach campaign to enable truck stop operators to promote their

facilities and also maintains a directory of truck stop locations. However, these services do not provide real-time information on truck parking availability. Commercial drivers rely on information provided by a dispatcher or “word of mouth” from other drivers to identify available spaces and also make frequent use of public rest stop parking facilities rather than venture off their routes to see if a private facility has available spaces.

ITS-based systems are under development in California, Michigan and Minnesota, as well as along the I-95 corridor from Connecticut to North Carolina. These projects are in various stages of development, and are supported through the SAFETEA-LU Section 1305 Truck Parking Facilities Program.

### **3.3.2.5 Universal Commercial Motor Vehicle Identification**

No single method for universal truck identification currently exists. Interstate carriers are required by Federal Motor Carrier Safety Regulations (49 CFR Part 303) to obtain a USDOT number, but there is no corresponding requirement for intrastate carriers. A number of States are now requiring intrastate carriers to obtain a USDOT number. FMCSA has modified the application that issues USDOT numbers so that a USDOT number issued for an intrastate carrier includes an identifier that links the number to the State of domicile for the carrier. However, at present there is not a consistent process in place for issuing intrastate carriers identification numbers, and there is substantial variation among States on how this is done.

License plates are issued by States as a unique means of identifying vehicles, and DOT numbers serve as unique identifiers for motor carrier companies. State-issued intrastate identification numbers identify companies but not individual vehicles. No single system exists currently to issue a universal truck identification number, though every vehicle has a unique vehicle identification number (VIN). VIN numbers are regulated by NHTSA (49 CFR Part 565).

### **3.3.2.6 Wireless Technologies**

Radio Frequency Identification (RFID) and Commercial Mobile Radio Services (CMRS) are the two primary forms of wireless technology deployed currently. RFID is commonly used for electronic tolling applications and pre-clearance programs and typically involves the installation of a transponder device in the cab of the truck.

CMRS is used for information exchange between vehicle and carrier systems. CMRS uses existing cellular and satellite service provider connections. Hence, applications that use cellular connections require a subscription from a wireless service provider to establish communications between mobile units (vehicles, smart phones, etc.) and other systems. As such devices pass within the broadcast range of fixed data access points, a standard Ethernet-type connection is established to exchange information with back office applications. Systems that use satellite-based communications services for connectivity typically do not provide a high-speed, bi-directional connection for data services due to the relatively high connectivity cost. High-speed, bi-directional connectivity allows for faster throughput and data flows to and from computers and users. Published in 1994, IEEE Standard 1284 defines high-speed bi-directional connectivity and parallel communications, which provides for the exchange of data signals simultaneously over parallel channels.

The USDOT, in its V2V cooperative systems initiative, is focusing on testing and evaluating Dedicated Short Range Communications (DSRC) for its potential impact on safety, mobility, and environmental enhancement applications. This work will provide input to NHTSA on whether to pursue rulemaking to require DSRC radios on newly manufactured light vehicles. The DSRC protocol stack consists of three parts: IEEE std 802.11p, the IEEE standard 1609 family of standards (there are four at present 1609.1 through 1609.4); and the Society of Automobile Engineers (SAE) standard J2735. All three come into play in transmitting messages using DSRC. J2735 can also be used for describing messages transmitted using non-DSRC media.

DSRC can also be used to transmit messages that are not “transportation-related.” The Federal Communications Commission (FCC) allowed for commercial use of the DSRC frequency, as long as crash-imminent, safety-related messages got the highest priority. Auto companies (and other private firms) could use DSRC to transmit messages to vehicles that were not strictly “transportation-related.” This latter message is an à la carte message is composed entirely of message elements determined by the sender, allowing for flexible data exchange.<sup>5</sup> This technology is still emerging and manufacturers are gradually developing products that apply it.

### 3.3.2.7 Telematics Service Providers

Third-party companies such as Qualcomm, PeopleNet, XATA, and Teletrac offer equipment option packages for a fixed monthly fee to collect and store various diagnostic data, fault code data, and vehicle performance information for later download. Carriers use this information to plan vehicle maintenance and/or to monitor driver performance. Electronic on-board recorders (EOBRs), which run as an application on these telematics devices, represent another source of information with the potential to support electronic screening and wireless roadside inspections. These devices capture and store a broad array of vehicle- and driver-specific data principally for the purpose of verifying compliance with driver HOS requirements. Currently, no wireless standard for exchanging data between the EOBR and any other on-vehicle or roadside equipment exists, nor has a standard means for automatically authenticating the driver and logging driver information, such as HOS, been decided upon. Nonetheless, these devices offer a potentially rich data source for SRI applications. However, the FMCSA will be proposing standards for data and wireless transfer related to electronic HOS records in its planned Supplemental Notice of Proposed Rulemaking related to EOBRs in 2013.

This information is conceptually available to be shared with government and enforcement agencies. In order for applications such as electronic pre-screening for inspection by-pass to be viable, however, data would need to be provided in near real-time. Third-party providers and their motor carrier customers have cooperated with USDOT initiatives in the past by providing access to data, typically in aggregate form. Given that some SRI-related functionality is related to enforcement and

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<sup>5</sup> USDOT Research and Innovative Technology Administration, Intelligent Transportation Systems Joint Program Office, “ITS Fact Sheet: SAE J2735 – DSRC Message Set Dictionary.” Available at: [http://www.standards.its.dot.gov/fact\\_sheet.asp?f=71](http://www.standards.its.dot.gov/fact_sheet.asp?f=71)

compliance verification, the degree to which carriers will voluntarily share this information by instructing their Telematics Service Providers to supply the data is unknown.

### 3.4 Modes of Operation for the Current System or Situation

There are effectively three modes of operation currently in effect for delivering CMV, carrier, and driver screening:

- **Manual** – In locations where the mode of operation is manual, all vehicles are required to enter an open weigh and inspection station and come to a stop on a static scale. As the vehicle is stationary, an enforcement officer interacts directly with the driver to obtain and review documentation, including registration and operating authority, CDL, any necessary permits, and driver’s logs. The officer may, at his discretion, refer the vehicle for a safety inspection in accordance with the levels specified in section 3.3.1. Most of these activities are replicated when an enforcement officer sets up a temporary roadside weigh and inspection station.
- **Augmented** – Many weigh and inspection stations have some level of automation, with devices and methods to access information from and provide information to various systems both on-site and at other locations, such as State or Federal databases. These systems and processes are intended to provide additional information to the enforcement official on site, and to record the results of screening and inspection activities at the station. Some of these capabilities may also be available to an officer at a temporary inspection location.
- **Automated** – Certain facilities across the United States are equipped with systems that perform automated electronic screening or pre-clearance functions. When a fixed facility is open, these systems detect individual vehicles, capture a weight from a WIM system, and execute safety screening logic to determine whether a vehicle can by-pass the facility or must pull in for closer inspection. Functions are currently limited to the assessment of a carrier’s safety rating, the measurement of a vehicle’s weight, and the application of random inspection selection criteria.

### 3.5 User Classes and Other Involved Personnel

Federal and State government agencies cooperate with motor carriers to share in the effort of CMV safety compliance enforcement and monitoring. Furthermore, there are other third-party entities that play a prominent role in safety efforts. Generally speaking, there are two categories of current system users: those who use them to conduct operations on a daily basis and those who use them to track performance, set or analyze policy, and/or analyze data in the aggregate. It is useful to assign informal designations for these categories (no specific formal designations exist) for the purposes of this system. Users who access and use systems for daily operations will be referred to herein as Tier I users, and those who use them principally for after-the-fact policymaking and assessment actions will be referred to as Tier II users. With those designations in place, current users are categorized as follows:

**Table 4. Users and Categories**

User Designation	Description
<b>Tier I Users</b>	
CMV Enforcement Officer	Enforcement personnel (typically at the State level) tasked with screening vehicles, drivers, and carriers for inspection, conducting CMV inspections, and operations and maintenance of weigh stations.
CMV Driver	Individuals who operate trucks or buses on public roadways.
Motor Carrier	Companies (including owner/operators) that maintain responsibility for registration and operation of CMVs.
CMV Enforcement Supervisor	Enforcement personnel tasked with directing the activities of CMV enforcement officers.
Third Party Providers	Independent providers of electronic screening, electronic tolling, periodic inspection, fleet management telematics, and traveler information services.
<b>Tier II Users</b>	
Motor Carrier Safety Assistance Program (MCSAP) Lead Agency Manager	Individual within the lead agency responsible for implementation and management of the MCSAP within a given State jurisdiction.
FMCSA Personnel	Federal staff responsible for formulating and coordinating CMV safety policy and analyzing results of implementation.
FHWA Size & Weight Personnel	Federal staff responsible for formulating and coordinating CMV size and weight policy and analyzing results of implementation.
NHTSA Personnel	Federal staff responsible for setting and enforcing safety performance standards.
Other State Agency Personnel	State staff responsible for issuing credentials and permits, and monitoring compliance with regulatory requirements (e.g., departments of transportation; bureaus of motor vehicles; departments of revenue or commerce; departments of public safety; public utility commissions; and state police agencies).
CMV and Equipment Manufacturers	Manufacturing entities whose products must conform with safety and regulatory compliance requirements.
Motor Carrier Customers	Shippers, logistics companies, and motor coach customers that are concerned about and wish to obtain carrier safety data, including safety scores.

\* Motor carriers are referred to generically as business entities that operate CMVs.

Source: USDOT

Within each State, multiple agencies have their own operational roles and responsibilities in ensuring transportation safety and efficiency and maintaining their own databases, processes, and procedures for CMV compliance. These systems are not necessarily directly connected, but information sharing and correlation across multiple data sets often takes place as a part of executing daily duties related to CMV safety.

### 3.5.1 Profiles of User Classes

The organizational structure of entities engaged in CMV safety assurance can best be described as a collection of public agencies, associations, and private sector entities that provide an interlocking—and sometimes overlapping—set of functions aimed at ensuring safe operations. As the information in Table 1 indicates, the various organizations have complementary roles with

respect to the operation of current systems. However, to fully grasp how these entities interact, it is useful to understand the larger roles and responsibilities.

At the Federal level, the FMCSA, FHWA, and NHTSA have the responsibility to set standards for both safety and trucking-related information collection. These standards apply to vehicles, drivers, and motor carriers. Additionally, these USDOT agencies capture and maintain information related to safety performance and provide information to States regarding the fitness of each of the above-named groups. Finally, the agencies fund and direct research efforts—like SRI—that are aimed at identifying and evaluating new mechanisms for improving safety.

State agencies maintain the responsibility for performing a number of activities related to CMV safety, including:

- Conducting vehicle and driver inspections;
- Reporting inspection results for use by other jurisdictions;
- Administering out-of-service violations;
- Administering registration, permitting, and operating authority issuance and verification;
- Conducting compliance verification, including vehicle, axle, and axle set weight-limit compliance;
- Verifying oversize and overweight permits;
- Establishing and maintaining public rest areas;
- Providing key services related to congestion and hazards on roadways; and
- Managing State information systems containing safety-related data.

The Commercial Vehicle Safety Alliance (CVSA) is an important partner in the effort to ensure CMV safety. CVSA is an international, not-for-profit organization comprised of local, State, Provincial, Territorial and Federal motor carrier safety officials and industry representatives from the United States, Canada, and Mexico. CVSA member jurisdictions are represented by various departments and ministries of transportation, public utility and service commissions, state police, and highway patrols. In addition, CVSA has several hundred associate members who are committed to helping the Alliance achieve its goals: uniformity, compatibility and reciprocity of CMV inspections and enforcement activities throughout North America by individuals dedicated to highway safety and security.

The third organizational element related to CMV safety responsibilities is the motor carrier community. This community of professionals has the primary responsibility to comply with regulatory mandates, to maintain the safe operation of their vehicles, and to train and monitor drivers to ensure they are compliant. The carrier community regularly cooperates with Federal and State initiatives aimed at improving safety and efficiency, including participation in pilot projects, existing screening programs, and research efforts such as this one.

The final element in the body of CMV safety assurance is the third-party provider community. These entities provide services such as electronic screening, periodic inspection services, and traveler information. Some of these services are delivered free of charge to carriers as the result of being funded in part by public dollars. Others are delivered for a fee, either to carriers or jurisdictions.

### 3.5.2 Interactions among User Classes

Interactions among user classes pertinent to this system generally fall into three categories: CMV administration, compliance, and operations. Administrative interactions encompass those actions undertaken to complete and keep current records, such as the filing of registration and operating authority documentation. Compliance interactions include everything related to inspection and screening activities. Operations interactions include things such as the collection and dissemination of traffic data. Each interaction entails the exchange of information—some to meet regulatory requirements and some to meet specific operational objectives.

The safe and efficient movement of goods and people requires the collection, exchange, and examination of a large amount of such information. Whether this information pertains to licensing, credentialing, permitting, safety records, screening outcomes, roadway information, or any number of other functions, it must be gathered, shared, and applied in a manner that supports decisionmaking and is consistent with regulatory and policy guidelines. Some of this information is exchanged through automation, and some is exchanged through paper documentation.

Information sharing occurs for various purposes, at various points, and by various means. Administrative and safety compliance activities drive a significant amount of information exchange—what are often referred to as “back office” exchanges—which occur through the connections among systems at various levels, or through the filing of and access to paper or electronic records by the most basic means (e.g., e-mail, fax, on-line applications, or websites). Compliance information exchanges also take place at roadside weigh and inspection facilities, where CMV enforcement personnel interact directly with drivers to examine documentation manually, inspect vehicles, and administer violations when they occur. Information also changes hands during compliance reviews conducted by CMV enforcement personnel at carrier facilities. These exchanges encompass everything from manual review of documentation and inspection of vehicles and facilities to the review of electronic records. Compliance-related information also changes hands along the roadway among vehicles, States, and third party automated electronic screening and pre-clearance programs.

Compliance screening and inspection activities require and result in extensive information exchanges among CMV enforcement personnel, their respective chains of command (i.e., CMV enforcement supervisors), and MCSAP lead agency managers. These activities also drive exchanges with Federal agencies—specifically the FMCSA and FHWA, where safety, size, and weight policies are established and outcomes are assessed.

Operational information spans a very broad spectrum. Carriers and CMV drivers exchange information continuously to support business operations. This includes everything from pick-up and delivery instructions and status information to routing and roadway conditions. This can occur through simple verbal conversations or through a variety of fleet management tools. Carriers and agencies interact by sharing information that captures and communicates roadway conditions. This exchange allows agencies to gain a better picture of transportation network performance and detect and manage incidents. It also allows carriers and drivers to identify and avoid delays.

### 3.6 Support Environment

As discussed in section 3.3, the government agency systems used for managing CMV compliance represent a far-reaching collection of types, uses, and configurations. This section offers a summary of ownership, operations and maintenance responsibility, and technical highlights for the various systems. There are three general classifications of systems illustrated in Table 5:

- National Systems –These are nationwide information systems operated at the State and Federal government levels.
- Field Systems –These systems are operated on field laptops.
- State Systems –These are nationwide information systems operated at the State government level.

**Table 5. Existing Government Agency CMV Compliance Systems**

System Owner	System Title	System Location	Type of Application	Additional Information
FMCSA	Analysis and Information	National	Web-based	Legacy system
FMCSA	DataQs	National	Website	
FMCSA	Enforcement Management Information System	National	Web-based	
FMCSA	FMCSA Portal	National	Website	
FMCSA	Information Systems Website	National	Website	
FMCSA	Licensing and Insurance	National	Client-server Web-based	Legacy system
FMCSA	Motor Carrier Management Information System	National	Web-based front end access Oracle database	Legacy system
FMCSA	Query Central	National	Web-based with connectivity to multiple FMCSA systems	Data sources include MCMIS, SAFER, L&I, PRISM, CDLIS, SCT and LIFIS (SCT and LIFIS contain Mexican carrier and driver information)
FMCSA	SAFER	National	Website with store and forward mailbox, secondary databases, and communications links	
FMCSA	Aspen	Field	Laptop, designed to run on Windows	Legacy system
FMCSA	Compliance Analysis and Performance Review Information (CAPRI)	Field	Laptop, designed to run on Windows	Legacy system
FMCSA	Hazardous Materials Package Inspection Program (HMPIP)	Field	Browser-based	

System Owner	System Title	System Location	Type of Application	Additional Information
FMCSA	Inspection Selection System (ISS)	Field	Laptop, designed to run on Windows	Uses local data base that can be updated monthly through a Web service. Linked to Aspen to auto-populate carrier ID and address information. Ability to connect to SAFER to update carrier information
FMCSA	Sentri	Field	Laptop, designed to run on Windows	New application designed to integrate and replace existing field systems. Currently used for performing safety audits.
FMCSA	CaseRite	Field	Laptop, designed to run on Windows	
FMCSA	Uniform Fine Assessment (UFA)	Field	Laptop, designed to run on Windows	Legacy system
FMCSA	SAFETYNET	National	Oracle based client-server, runs on MS Windows servers	System used by states and FMCSA field locations to upload inspection and crash reporting data to MCMIS
State	CVIEW (Commercial Vehicle Information Exchange Window):	State	Designed to operate on PC or Laptop	Generally vendor provided
State	International Registration Plan (IRP)	State	Designed to operate on PC or Laptop	Legacy system
State	International Fuel Tax Agreement (IFTA)	State	Designed to operate on PC or Laptop	Legacy system
State	Crash Reporting Systems	State	Designed to run on Laptop	
State	Ticketing Systems	State	Hand-held device	Wireless connectivity and printing capability
AAMVA	CDLIS	National	Nation-wide information system accessible from PCs, Laptops and hand-held devices using the CDLIS Access application	
NLETS 501(c)(3) nonprofit organization	NLETS	National	Nation-wide information system accessible from PCs, Laptops, hand-held devices	NLETS is owned by States Uses Multi-Protocol Label Switching (MPLS). Accessible via the Web and wireless cloud

Source: USDOT

# 4 Justification for and Nature of Changes

As noted in section 3.1, the projected increases in goods movement and CMV traffic demonstrate the need for the development of the SRI. The enforcement community has limited resources, and SRI has the potential to provide additional tools to maintain enforcement programs that ensure motor carriers remain compliant with Federal and State requirements and continue to operate safely. This section and its subsections describe the rationale for the development of this system. Specifically, this section contains information that defines Smart Roadside-related capabilities that do not currently exist, or that fall short of the stated needs and preferences of the intended users, which are outlined in the sections that follow. As described in section 3, many functions related to the identification, screening, and inspection of CMVs require a significant level of manual action or intervention. States are currently reducing staff and budgets, which would make maintaining current levels of inspection, much less increasing them, problematic. Many States are facing hiring freezes even when Federal funds are available to help cover staff and other resource costs.

Additionally, there is currently no deployed system that offers truck parking capabilities, though at least two are under development as described in section 3.3.2. This section below describes why it is important that this system address the gap between current and desired capabilities.

## 4.1 Justification for Changes

The Smart Roadside Initiative represents an opportunity to enhance significantly both the performance and the inherent value of activities related to CMV safety compliance. By providing a framework for robust interfaces among CMVs, roadside systems, and the broad array of users, the SRI concept of operations has the potential to address many of the gaps in the current roadside operating environment and to expand considerably the exchange of information to support roadside operations. A high-level overview of how SRI may address each of these gaps is summarized in Table 6 below.

**Table 6. SRI Prototype Applications and Gap Resolutions**

Constraints	SRI Application	Current System	SRI Prototype Solution
Lack of unique identifier for all motor carriers	Universal Truck Identification	USDOT number for interstate motor carrier can be read by roadside reader although accuracy decreases as travel speed increases.  States are now requiring intrastate DOT numbers that include number and unique identifier for base state, but this is not a standard practice across all States.	Unique identifier for motor carrier, driver and vehicle accessed electronically. Will be used by both interstate and intrastate motor carriers

Constraints	SRI Application	Current System	SRI Prototype Solution
Inability at present to identify driver and vehicle	Universal Truck Identification	Identification of driver requires manual inspection by enforcement personnel. Vehicle can be identified by license plate readers or manual inspection.	Unique identifier for motor carrier, driver and vehicle accessed electronically. Will be used by intra and interstate motor carriers.
Limited Coverage on National and State highways	Virtual Weigh Station Wireless Roadside Inspection	Fixed facilities tend to be on interstate system. States use mobile patrols and “plug and play” facilities to conduct size and weight and safety enforcement.	Will demonstrate how VWS and WRI can be deployed to expand coverage.
Limited communications to support roadside operations – vehicle to roadside	SRI communications infrastructure	Pre-clearance programs issue “green light/red light” through a transponder. Information exchange between enforcement personnel at fixed facilities or between States use radio, hand-held communication devices, or electronic mail.	SRI communications infrastructure will support expanded information exchange to support roadside operations, including information exchange between enforcement personnel within a State and between States and motor carriers.
Lack of common protocols and standards to support roadside operations	SRI Communications Infrastructure SAE J2735 Standard		The adoption of the SAE J2735 Standard will help establish a common format for message sets.
Lack of physical infrastructure to support roadside communications	SRI Physical Infrastructure	As noted in section 3, a number of vendors are deploying roadside applications that support SRI functionality. However, these applications are relatively new and do not have a widespread deployment. Resource constraints have also limited States’ ability to deploy these applications.	The results of the prototype may provide States with information on what types of equipment work best and equipment specifications.
Lack of Operational Truck Parking Program	Truck Parking	Two operational tests are underway along the I-5 Corridor and along the I-95 Corridor. Others are also being developed.	Through the prototype an additional test of a potential truck parking system will be conducted to provide space availability information to the driver.

## 4.2 Description of Desired Changes

As part of the SRI program, the USDOT and States are funding the development of new capabilities to exchange information among roadside equipment, back office systems, and CMVs that are moving at mainline speed. These capabilities will be developed with the following four focus areas in mind:<sup>6</sup>

<sup>6</sup> Findings from USDOT Smart Roadside Workshop, 2008 (available at: <http://www.fmcsa.dot.gov/facts-research/art-smart-roadside.htm>)

- Universal Commercial Motor Vehicle Identification – provides the capability to identify each vehicle on the road and electronically access credentials and safety information in government and industry databases related to the vehicle, the driver, and the motor carrier. Represents an enabling function for the delivery of a variety of other capabilities, including those below.
- Electronic Screening/Virtual Weigh Station – provides functionality for automatically collecting data on CMV weight, size, and other information to facilitate efficient, high-throughput electronic screening.
- Wireless Roadside Inspections – an enhanced form of electronic screening, this could include functionality to obtain and evaluate carrier, vehicle, and driver information automatically and then issue inspection reports simultaneously to roadside enforcement and motor carriers on vehicles traveling at slow and mainline speeds.<sup>7</sup>
- Truck Parking Programs – provide drivers and carriers with a convenient, near real-time approach for accessing information about parking facility location, available parking spaces, and other amenities during trips.

## 4.2.1 Capability Changes

One of the purposes of this ConOps is to identify how new capabilities can be added. At an aggregate level, the most significant new capability will be the ability to exchange information at roadside. This includes exchanging information between roadside enforcement personnel and a CMV and between roadside enforcement personnel at multiple locations. The end result is that enforcement personnel will have better access to more information and will be better able to identify and target non-compliant carriers for enforcement actions.

Within this enhanced roadside information exchange framework, specific new capabilities will include, but not necessarily be limited to:

- The ability to capture detailed information about a vehicle, its owner, and its operator while the vehicle travels at-speed on a mainline roadway;
- The ability to access rapidly and without manual intervention additional information about the vehicle, carrier, and driver regarding operating credentials status and key safety performance data;
- The ability to execute certain automated inspection actions without requiring the vehicle to come to a stop;
- The ability to access authoritative information sources to ensure that all relevant information necessary to take action is reliable and up-to-date;
- The ability to exchange information between the vehicle and roadside systems;
- The ability to ensure that CMVs are compliant with size and weight requirements; and
- The ability to locate and use information related to the availability of facilities adequate to ensure a driver can obtain needed rest.

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<sup>7</sup>Findings from USDOT Smart Roadside Workshop, 2008 (available at: <http://www.fmcsa.dot.gov/facts-research/art-smart-roadside.htm>)

## 4.2.2 System Processing Changes

This system is intended to identify potential information exchange and processing opportunities that will enable better decisionmaking by enforcement personnel, carriers, drivers, and other authorized users. The development of the specific decision-support applications will require substantial input from end users; however, this concept outlines what type of processing might take place at various points and the intended outcomes of that processing. These changes might include, but not be limited to:

- Executing logic designed to offer enhanced recommendations to enforcement personnel regarding whether to inspect a given vehicle or driver more closely;
- Processing inspection history data to determine more comprehensively whether screening functions are appropriate or in need of change to increase or decrease the relative frequency of inspection of individual vehicles or drivers;
- Implementing requests and responses that enable users to conduct both pre-defined and ad hoc queries to gain information through a single interface; and
- Formulating output that is accessible via an assortment of fixed and mobile system user access points that fully leverages the range of the potential SRI function set.

## 4.2.3 Interface Changes

Because this concept will add capabilities using a combination of existing and new systems, interface changes are anticipated at several levels. These changes will come in two forms: system- to-system interfaces designed to connect new systems to existing systems and user interfaces to allow for interaction between users and various system elements. Interface changes are expected to include:

- A “universal” interface that supports information exchange among the new SRI system elements (e.g., enhanced electronic screening, WRI, etc.), the existing systems at the immediate roadside (via a local area network, for example), and existing government, carrier, and third-party systems (via a wide area network);
- Local user interfaces through which individual users can access information, interact with the SRI and other system elements, and receive notifications; and
- Any interfaces necessary for the elements of the SRI system to communicate with each other, including roadside equipment and on-vehicle devices.

## 4.2.4 Operational Changes

Among the principal reasons for implementing a new system is the opportunity to effect change in the nature of the work conducted by CMV owners, operators, and compliance enforcement officials. Achieving the goal of enhancing safety by dramatically increasing the number of inspections will require operational changes. Among the changes that will need to take place are the following:

- Implementing new, auditable processes by which inspections may eventually be conducted without the execution of manual actions (e.g., review of credentials, operating authority documents, driver’s logs, etc.);

- Developing and refining criteria by which a determination can be made whether to require a truck to undergo a manual inspection;
- Formulating and vetting procedures and safety requirements for the use of roadside or vehicle-installed devices; and
- Implementing procedures and rules regarding the storage and use of data related to inspections and their results.

## 4.3 Priorities among Changes

In order to gain a comprehensive understanding of the scope of the proposed changes, it is important to examine what users expect a new SRI-based “system” to deliver in terms of capabilities and function prioritization. As a part of the actions undertaken as precursor activities to the development of this system, researchers gathered input from those enforcement and motor carrier professionals who represent potential users as well as from system developers.<sup>8</sup> This input has been refined to create a set of user needs and a summary of prioritized applications.

### 4.3.1 Prioritization Process

The process for prioritizing potential SRI applications was to identify existing technologies and systems that:

- Address core functional objectives of the SRI;
- Have been deployed successfully;
- Are used, or likely to be used, in the marketplace;
- Can be integrated to deliver enhanced SRI functionality; and
- Comply with the national Intelligent Transportation System (ITS) architecture.

The objective is to integrate and augment technologies to address both enforcement and industry user needs. With this general prioritization framework in place, the Research Team sought input from the user community regarding the needs and concerns from which the priorities could be formulated.

Identifying, developing, and prioritizing user needs and potential applications involved extensive stakeholder input. The Research Team conducted an Enforcement Community User Needs Workshop at the April 2011 CVSA Spring Meeting in Chicago, Illinois. The meeting included a presentation of the SRI applications currently being deployed by the State of Missouri and a breakout session facilitated by members of the Research Team.

Motor carrier user needs were developed through:

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<sup>8</sup>Findings from USDOT Smart Roadside Workshop, 2008 (available at: <http://www.fmcsa.dot.gov/facts-research/art-smart-roadside.htm>)

- Interviews conducted at the February 2011 American Trucking Associations Technology and Maintenance Council meeting in Tampa, Florida;
- An Industry Executive Focus Group conducted in Atlanta, Georgia, in March 2011; and
- A driver survey conducted at the Mid-America Trucking Show held in Louisville, Kentucky, in March-April 2011.

In addition, the Research Team conducted site visits to Missouri and New Mexico, two States that are currently deploying SRI applications. Two other site visits to Colorado and North Dakota were also conducted, but those sites were using very limited technologies. The Research Team used these site visits to gain an understanding of State deployment challenges and system operations.

The Research Team then analyzed the results of these activities and developed a preliminary set of user needs, which incorporated the feedback from three webinars that included representatives from the enforcement community (June 1, 2011), the motor carrier and developer communities (July 21, 2011), and USDOT (June 16, 2011) to validate the identified user needs and prioritization of applications and obtain consensus from the stakeholder groups. The user needs and application prioritization were then finalized and presented in a technical memorandum.<sup>9</sup>

### 4.3.2 User Needs and Concerns

For State motor carrier safety enforcement users responsible for ensuring carrier, vehicle, and driver compliance with safety regulations, the needs and concerns identified include operating under limited staff and budget and the desire for user (inspector) friendliness. The general conclusion was that there needs to be more automation and that systems should require less user training, have improved human interface(s) and ease-of-use, and provide more accurate and current data to increase utilization and value. In addition to these general needs, enforcement users indicated that the system should:

- Accommodate visual inspections and manual data entry:
  - Consideration should be given to automatic inspection “credit” and safety score updates based on this;
- Provide WIM measurements that enable enforcement personnel to identify and flag vehicles for additional weight checks using a static scale;
- Provide dimension measurements that enable enforcement personnel to identify and flag vehicles for additional size measurements;
- Provide parallel feeds of data for both enforcement and carrier systems concurrently and in real-time;
- Provide flexibility to “interrogate” vehicles in both fixed and ad-hoc locations;
- Make inspection results available at locations down-stream;
- Maintain accurate, up-to-date, and reliable data that can support evidentiary needs for use in legal proceedings;

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<sup>9</sup>Findings from USDOT Smart Roadside Workshop, 2008 (available at: <http://www.fmcsa.dot.gov/facts-research/art-smart-roadside.htm>)

- Provide a means to ensure that data is uncorrupted, verifiable, and secure;
- Be user-friendly, easy to use, understandable, and beneficial to the roadside inspector; and
- Be integrated into existing work flows/work processes.

For potential motor carrier users, which include motor carrier management personnel and drivers who will rely on SRI as a means to provide data essential to conducting screening and inspections and who may use it to access parking data or other services, the needs and concerns include data privacy, security, transparent access, enforcement uniformity, and consideration of cost impacts (especially for smaller carriers). In addition to these general needs, carriers also stipulated that the system should:

- Use transponders for identification purposes only, and that these not be tied to personal information;
- Notify them of “automatic” and any other inspections in real-time, and use these inspections to update their CSA scores;
- Require minimal additional equipment to be installed in vehicles and limit driver distraction;
- Contribute to the minimization of delays;
- Leverage existing technologies whenever possible; and
- Use technology that provides a rapid return on investment (ROI).

Based upon this input, and analysis of pre-defined SRI technical and operational characteristics, the research team formulated a set of user needs, which are provided below. It is important to recognize that the input received from the user communities represents a combination of needs and operational preferences and expectations. The preferences and expectations are more appropriately considered as guidance for operational policies and constraints, which are discussed in detail in section 5.2 of this document. Hence, the needs referenced here represent specific expectations regarding capabilities made available through the concept of operations.

**UN01 – The system must be able to identify CMV power units uniquely.**

The underlying operational premise for delivering SRI functionality is that every individual vehicle can be uniquely identified and separated from all surrounding vehicles. Furthermore, each vehicle must be able to be tied to a carrier. This user need must be met in order to deliver any functionality related to the inspection or screening of any vehicle.

**UN02 – The system must support the exchange of data between the CMV and the roadside without requiring the vehicle to stop.**

The ability to exchange data at high speed is fundamental to the execution of CMV electronic screening and virtual weighing activities (WIM and VWS) without expanding existing weigh and inspection facilities or inspection workforces, or requiring compliant vehicles to stop. It is also useful for the delivery of truck parking information, as well as a variety of other safety and operations data to vehicles. This capability is essential to minimize travel delays for safe, legal CMVs.

**UN03 – The system able must provide the ability to pass data collected from CMV to external systems.**

An extensive array of off-site support system providers (Federal, State, carrier, and third party) exist that store and process safety-related data and information, including several systems of record that are used to establish safety ratings and deliver additional value-added information to the CMV and its driver. Conveying data to these systems is essential for SRI to support the execution of capabilities in each of the four functional areas and to facilitate other value-added functionality.

**UN04 – The system must provide the ability to receive data from external systems.**

Data and information stored in the aforementioned Federal, State, carrier, and third-party service provider systems—particularly enforcement systems of record—represent authoritative systems for both performing electronic screening and roadside inspections as well as delivering information related to the location and reservation of parking. Receiving data from these systems is essential for SRI to support the execution of capabilities in each of the four functional areas and to facilitate other value-added functionality.

**UN05 – The system must provide the ability to efficiently and effectively exchange data between external systems and local users at the roadside or in the CMV.**

The vehicle user (i.e., the driver and other motor carrier personnel) and roadside user (i.e., a CMV safety enforcement officer) are the first-line users of the SRI applications and must have the ability to interact with the various SRI applications in a manner that allows for timely, efficient, well-informed decisions. These decisions will be driven by user-defined operational requirements associated with each of the four functions included in this concept and will balance safety, efficiency, and mobility enhancements.

**UN06 – The system must provide protection against unauthorized access to and use of data.**

Some of the information exchanged through the various elements of the system can be considered sensitive, particularly information that pertains to individual persons and their movements. Given that the system cannot be deployed successfully without the existence of a broad array of interconnected systems, the risk exists for data and information to be accessed and compromised by outside parties. This risk must be minimized to the greatest extent possible.

**UN07 – The system must allow a vehicle operator to interact with it in a safe manner during vehicle operation.**

The SRI system is first and foremost an enabler for safety enhancement. Distracting a driver during vehicle operation runs counter to the central purpose of the SRI program, and every effort must be made to ensure that the level of attention required for the driver to access functionality is kept to a minimum. Additionally, information provided to the vehicle operator must be prioritized in accordance with the SAE J2735 Message Prioritization Standard.

**UN08 – The system must be consistent with the ITS National Architecture and associated standards.**

As a program that is under the ITS Program, SRI and supporting core systems must conform to the National ITS Architecture which includes the CVISN architecture, or clearly specify where architecture modifications are necessary to deliver desired capabilities. It must also support interoperability with other existing and emerging systems whenever possible.

**UN09 – The system must facilitate the integration of data from multiple sources into one or more cohesive, reusable datasets.**

Where UN03, UN04, and UN05 specify the need to accommodate data and information exchange, this need speaks specifically to the need for SRI to provide the ability to integrate data received from roadside devices with data received from in-vehicle systems and make that data available to the external systems described in UN03 and UN04 while distributing data to roadside and in-vehicle systems. Information from multiple sources will need to be accessed and analyzed simultaneously in order to deliver the specified capabilities.

**UN010 – The system must include information capture and processing functionality that meets specific CMV operations needs (e.g., truck parking and enforcement screening applications).**

The SRI is an enabling system, meaning that it must support the data collection, information formulation and dissemination, and decision-support systems that will be developed to conduct specific functional operations using an open architecture.

**UN011 – The system must provide applications data in sufficient time to support decision making at the roadside.**

The very nature of capabilities such as WRI and ES/VWS make it essential that data be captured, processed, and communicated quickly enough to allow for timely decisions on the part of roadside enforcement personnel. This is particularly true when the results of these activities indicate that a vehicle should be stopped for additional inspection.

**UN012 – The system must be able to identify, uniquely and reliably, which CMV driver is actually operating a CMV.**

Many roadside safety screening activities include the assessment of driver qualifications and fitness for duty. The underlying operational premise for delivering SRI functionality is that every individual driver can be specifically identified. Furthermore, each driver must be able to be tied to the vehicle being operated. This user need must be met in order to deliver any functionality related to the inspection or screening of any driver.

**UN013 – The system must be able to support the identification of trailing equipment pulled by uniquely identifiable CMV power units.**

The underlying operational premise for delivering SRI functionality is that every individual piece of trailing equipment can be specifically identified. Furthermore, each piece of trailing equipment must be able to be associated with the vehicle power unit being operated.

**UN014 – The system must operate in a V2X cooperative systems environment.**

SRI is being developed simultaneously with other telecommunication-based systems that will enhance highway safety, mobility, and environmental stewardship. Applications being developed to serve these other systems will be in operation in the same roadside environment as that of SRI. By providing for a broad set of potential uses and focusing on implementation of interoperable technologies, SRI establishes greater value and more attractiveness to potential users, which should help to offset costs incurred during deployment and use.

### **4.3.3 User Information Needs**

If enforcement officers are conducting screening or inspection activities to determine whether a vehicle or driver warrants closer review, or if a driver is trying to locate and reserve a parking space, the SRI-based applications will provide them with additional information and allow them to make better-informed choices.

A useful way to illustrate the potential functionality of an SRI application, particularly with regard to how it might facilitate decisionmaking, is to examine the actions that each user is called upon to take, then work backward from those actions through the decisions that must be made to determine what actions are appropriate, to the information that is needed to make the decisions. The end result is a view of the processes from start to finish from a user's perspective.

Tables 2 through 8 provide this information for each of the users identified earlier. The contents of each of the tables comprise:

- Accomplishments Sought – these are the actions and outcomes the user is tasked with accomplishing;
- Decisions Needed – these are the decisions that the users must make in order to determine appropriate actions;
- Information Requirements – this is what the users need to know in order to make well-informed decisions; and
- Data Sources – this is a listing of the various existing and potential information sources and where they exist or would exist.

**Table 7. CMV Enforcement Officer User Information Needs**

Users	Accomplishments Sought	Decisions Needed	Information Requirements	Data Sources				
				Federal	State	Carrier	Vehicle	Other*
Uniformed CMV Enforcement Officer	<ul style="list-style-type: none"> <li>• Selectivity for inspection</li> <li>• Screening for secondary inspection</li> <li>• Secondary inspection</li> <li>• Verification of completed actions</li> <li>• Communicate results</li> <li>• Enforcement Action</li> </ul>	<ul style="list-style-type: none"> <li>• By-pass or pull in</li> <li>• Release or secondary</li> <li>• Level of inspection</li> <li>• Type of remedial action</li> <li>• Denial of access</li> <li>• Enforcement action required</li> </ul>	<ul style="list-style-type: none"> <li>• Vehicle identity</li> <li>• Carrier identity</li> <li>• Driver identity</li> <li>• Credential status – carrier, driver, vehicle</li> <li>• Safety history – carrier, driver, vehicle</li> <li>• Policy and operations guidance</li> <li>• Vehicle weight</li> <li>• Vehicle dimensions</li> <li>• HAZMAT cargo data</li> </ul>	<ul style="list-style-type: none"> <li>• ISS</li> <li>• L&amp;I</li> <li>• UCR</li> <li>• CDLIS</li> <li>• NLETS</li> <li>• NCIC</li> <li>• MCMIS</li> <li>• SAFER</li> <li>• HAZMAT/ Restricted Cargo Rules/ Regs</li> <li>• SAFER past inspection data base</li> </ul>	<ul style="list-style-type: none"> <li>• CVIEW</li> <li>• IRP</li> <li>• IFTA</li> <li>• DMV</li> <li>• PUC</li> <li>• Law Enf./ Criminal Info Sys</li> <li>• OS/OW Permit.</li> <li>• In-Road/ Roadside sensors</li> <li>• Dispatch</li> <li>• CMV info support system</li> </ul>	<ul style="list-style-type: none"> <li>• DOT #</li> <li>• CDL #</li> <li>• Manifest (cargo specific)</li> <li>• Periodic insp. data</li> </ul>	<ul style="list-style-type: none"> <li>• VIN</li> <li>• Sensors</li> <li>• EOBR</li> <li>• License Plate #</li> </ul>	<ul style="list-style-type: none"> <li>• 3rd party screening system</li> <li>• CDL# (Driver)</li> <li>• Isotope reader</li> </ul>

\*Other designation indicates that a host for the identified data source is either a known third party, or has not been identified

Source: USDOT

**Table 8. CMV Driver User Information Needs**

Users	Accomplishments Sought	Decisions Needed	Information Requirements	Data Sources				
				Federal	State	Carrier	Vehicle	Other*
CMV Driver	<ul style="list-style-type: none"> <li>Minimization of travel delay</li> <li>Avoidance of crashes</li> <li>On-time delivery</li> <li>Compliance with safety regulations</li> </ul>	<ul style="list-style-type: none"> <li>Route optimization</li> <li>Route selection</li> <li>Rest stop location</li> <li>Vehicle safety</li> <li>Departure time</li> </ul>	<ul style="list-style-type: none"> <li>HOS status</li> <li>Vehicle condition</li> <li>Travel time</li> <li>Parking availability</li> <li>Road conditions</li> <li>Environmental conditions</li> <li>CDL endorsements</li> <li>Credential and permit status</li> </ul>	<ul style="list-style-type: none"> <li>HAZMAT/Restricted Cargo Rules/Regs</li> <li>Query Central -MCMIS</li> </ul>	<ul style="list-style-type: none"> <li>Roadside sensors</li> <li>TMCs</li> <li>OS/OW Permit.</li> <li>Cargo specific permits</li> <li>DMV</li> <li>PUC</li> <li>Parking System</li> </ul>	<ul style="list-style-type: none"> <li>Dispatch</li> <li>OS/OW Permit.</li> <li>Cargo specific permits</li> </ul>	<ul style="list-style-type: none"> <li>Sensors</li> <li>EOBR</li> <li>Placards</li> <li>License Plate #</li> </ul>	<ul style="list-style-type: none"> <li>Parking System</li> <li>Routing system</li> <li>Nav. System</li> </ul>

\*Other designation indicates that a host for the identified data source is either a known third party, or has not been identified

Source: USDOT

**Table 9. Motor Carrier User Information Needs**

Users	Accomplishments Sought	Decisions Needed	Information Requirements	Data Sources				
				Federal	State	Carrier	Vehicle	Other*
Motor Carrier	<ul style="list-style-type: none"> <li>• Minimization of travel delay</li> <li>• Avoidance of crashes</li> <li>• On-time delivery</li> <li>• Compliance with safety regulations</li> </ul>	<ul style="list-style-type: none"> <li>• Route optimization</li> <li>• Route selection</li> <li>• Rest stop location</li> <li>• Vehicle safety</li> <li>• Departure time</li> <li>• Dispatch/Re-dispatch</li> </ul>	<ul style="list-style-type: none"> <li>• HOS status</li> <li>• Vehicle condition</li> <li>• Travel time</li> <li>• Parking availability</li> <li>• Road conditions</li> <li>• Environmental conditions</li> <li>• CDL endorsements</li> <li>• Credential and permit status</li> <li>• Roadside enforcement results</li> <li>• Driver reports</li> <li>• Change in driver status</li> </ul>	<ul style="list-style-type: none"> <li>• HAZMAT/Restricted Cargo Rules/Regs</li> <li>• Query Central -MCMIS</li> </ul>	<ul style="list-style-type: none"> <li>• Roadside sensors</li> <li>• TMCs</li> <li>• OS/OW Permit.</li> <li>• Cargo specific permits</li> <li>• DMV</li> <li>• PUC</li> <li>• Parking System</li> </ul>	<ul style="list-style-type: none"> <li>• Dispatch</li> <li>• OS/OW Permit.</li> <li>• Cargo specific permits</li> <li>• Equip. pool</li> <li>• Driver pool</li> <li>• Delivery req'ts.</li> </ul>	<ul style="list-style-type: none"> <li>• Sensors</li> <li>• EOBR</li> <li>• Placards</li> <li>• License Plate #</li> </ul>	<ul style="list-style-type: none"> <li>• Parking System</li> <li>• Routing system</li> <li>• Nav. System</li> <li>• Driver</li> </ul>

\*Other designation indicates that a host for the identified data source is either a known third party, or has not been identified

Source: USDOT

**Table 10. CMV Enforcement Supervisor User Information Needs**

Users	Accomplishments Sought	Decisions Needed	Information Requirements	Data Sources				
				Federal	State	Carrier	Vehicle	Other*
CMV Enforcement Supervisor	<ul style="list-style-type: none"> <li>Quality control</li> <li>Meeting performance requirements</li> <li>Communication of results</li> <li>Timeliness of reporting</li> <li>Safety investigations and enforcement actions</li> </ul>	<ul style="list-style-type: none"> <li>Manage &amp; allocate resources</li> <li>Application of policy</li> </ul>	<ul style="list-style-type: none"> <li>Trooper inspections</li> <li>Monthly trooper performance data</li> <li>Types and locations of violations</li> <li>Types and locations of accidents</li> <li>Policy guidance/updates</li> <li>Trooper ID numbers</li> <li>Reporting timeliness</li> </ul>	<ul style="list-style-type: none"> <li>MCMIS</li> <li>SAFER</li> <li>A&amp;I</li> <li>SAFETYNET</li> </ul>	<ul style="list-style-type: none"> <li>Law Enf./ Criminal Info Sys</li> <li>SAFETYNET</li> <li>Crash reporting system</li> <li>CMV info support system</li> <li>Dispatch</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>3<sup>rd</sup> party screening system</li> <li>Other States</li> </ul>

\*Other designation indicates that a host for the identified data source is either a known third party, or has not been identified

Source: USDOT

**Table 11. MCSAP Lead Agency Manager User Information Needs**

Users	Accomplishments Sought	Decisions Needed	Information Requirements	Data Sources				
				Federal	State	Carrier	Vehicle	Other*
MCSAP Lead Agency Manager	<ul style="list-style-type: none"> <li>Quality control</li> <li>Meeting performance requirements</li> <li>Communication of results</li> <li>Timeliness of reporting</li> <li>Safety investigations and enforcement actions</li> </ul>	<ul style="list-style-type: none"> <li>Manage &amp; allocate resources</li> <li>Application of policy</li> </ul>	<ul style="list-style-type: none"> <li>Monthly trooper performance data</li> <li>Types and locations of accidents</li> <li>Policy guidance/updates</li> <li>Reporting timeliness</li> <li>Program reviews</li> </ul>	<ul style="list-style-type: none"> <li>MCMIS</li> <li>SAFER</li> <li>A&amp;I</li> <li>SAFETYNET</li> <li>DataQ</li> <li>Query Central</li> </ul>	<ul style="list-style-type: none"> <li>Law Enf./Criminal Info Sys</li> <li>SAFETYNET</li> <li>Crash reporting system</li> <li>CMV info support system</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>3<sup>rd</sup> party screening system</li> <li>Other States</li> </ul>

\*Other designation indicates that a host for the identified data source is either a known third party, or has not been identified

**Table 12. FMCSA Personnel User Information Needs**

Users	Accomplishments Sought	Decisions Needed	Information Requirements	Data Sources				
				Federal	State	Carrier	Vehicle	Other*
FMCSA Personnel	<ul style="list-style-type: none"> <li>Meeting performance requirements</li> <li>Communication of result</li> <li>Program funding &amp; implementation</li> <li>Safety investigations and enforcement actions</li> </ul>	<ul style="list-style-type: none"> <li>Definition and application of policies</li> <li>Establishment of priorities</li> <li>Allocation of resources</li> </ul>	<ul style="list-style-type: none"> <li>State performance data</li> <li>State crash data</li> <li>Policies</li> <li>Available funding</li> <li>Program reviews</li> </ul>	<ul style="list-style-type: none"> <li>MCMIS</li> <li>SAFER</li> <li>A&amp;I</li> <li>SAFETYNET</li> <li>L&amp;I</li> <li>UCR</li> <li>DataQ</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>			

\*Other designation indicates that a host for the identified data source is either a known third party, or has not been identified

**Table 13. FHWA Personnel User Information Needs**

Users	Accomplishments Sought	Decisions Needed	Information Requirements	Data Sources				
				Federal	State	Carrier	Vehicle	Other*
FHWA Size & Weight Personnel	<ul style="list-style-type: none"> <li>Meeting performance requirements</li> <li>Communication of result</li> <li>Program funding &amp; implementation</li> <li>Compliance with Federal requirements</li> </ul>	<ul style="list-style-type: none"> <li>Definition and application of policies</li> <li>Establishment of priorities</li> <li>Allocation of resources</li> </ul>	<ul style="list-style-type: none"> <li>State performance data</li> <li>Policies</li> <li>Available funding</li> <li>Program reviews</li> </ul>	<ul style="list-style-type: none"> <li>SAFETYNET</li> </ul>	<ul style="list-style-type: none"> <li>DOT permitting systems</li> <li>State annual size and weight annual certification</li> <li>WIM</li> <li>Sensors</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>

\*Other designation indicates that a host for the identified data source is either a known third party, or has not been identified

Source: USDOT

Relating the information in this manner is important because showing how actions contribute to program goals imparts discipline during the selection of technology and process improvement initiatives. Further, it communicates the expectations for organizational entities involved in deployment and operation and illustrates the logic associated with their implementation. Once each process is established, the specific functions of the component elements, the data flows necessary to support them, the individual users that execute them, and the connections between components can be defined. This is essential for the validation of the concept and the formulation of the scenarios, which are described in section 6 of this concept of operations.

## 4.4 Changes Considered but Not Included

The changes stipulated in the sections above represent a comprehensive list of the changes considered for inclusion in this system. Because this system was formulated “from the ground up” to identify mechanisms that would deliver specific capabilities, none of the considered changes have been excluded. The Research Team focused on those changes that would be needed to develop and test the prototype system with the four component applications with the greatest success.

However, because the system (which is described in section 5) is focused on providing a robust foundation for fast, secure information exchange among CMVs, carriers, agencies, and third-party service providers, it is certain that the potential exists to provide capabilities in addition to those prescribed. There are also a number of technical changes that are contingent upon the resolution of policy considerations (such agreement on what data elements and identifiers will comprise UID). The Research Team determined that addressing these directly in the development of the prototype would not be beneficial.

## 4.5 Assumptions

A number of assumptions are necessary to deliver the desired functionality as envisioned by the SRI system described in this concept of operations. These are defined at a high level in this section, with more explicit details as they relate to the specific elements of the proposed system provided in section 5. The high-level assumptions include:

- A. A common and universally accepted character string that can be uniquely tied to a registration record will serve as the basis for the unique identification of a specific tractor;
- B. A common and universally accepted character string that can be uniquely tied to a registration record will serve as the basis for the unique identification of a specific piece of trailing equipment;
- C. An identifier, which may or may not be identical to the aforementioned vehicle and trailing equipment character string(s) in format and specific characters, will be stored in an on-board system on the vehicle or in a manner that makes it visible and legible for detection by a roadside device;

- D. A common and universally accepted character string that can be uniquely tied to a driver record will serve as the basis for the unique identification of individual CV drivers;
- E. Every universal truck identification event request results in the formulation of an event identifier that is associated with the date and time, the trigger location, the requesting user, and any other important information necessary to track the specific characteristics of each request;
- F. Systems deployed at the roadside will have access to an authoritative State or other database that associates the vehicle and trailing equipment character string to the electronic identifier and to the appropriate vehicle ownership and registration records;
- G. The UID application will provide for the unique identification of a specific truck, trailer, and driver for all other SRI-related functions where such identification is necessary to deliver the desired capabilities;
- H. The identification of the vehicle can be completed simultaneously with or within a very short time period of the other SRI processes depicted herein in order to ensure information is available for rapid decisionmaking;
- I. Roadside devices for collecting and processing data to calculate size and weight (e.g., WIMs, height sensors, etc.) will be controlled from and data will be passed directly to the roadside system components;
- J. If an FMCSA-compliant on-board electronic device that records driver HOS (e.g., automatic on-board recording device (AOBRD) or EOBR) is installed on the vehicle, this device will be the source of driver HOS compliance data.
- K. If an FMCSA-compliant on-board electronic device that records driver HOS (e.g., AOBRD or EOBR) is not installed on the vehicle, the system will be configured to link to information contained within a carrier system, provided that system contains up-to-date information.
- L. Carrier credential verification will be performed where credentials data is stored (i.e., within systems that contain records considered by enforcement agencies as being authoritative);
- M. The carrier system will be notified upon the completion of any SRI event;
- N. If electronic truck parking systems are available, these will return information about availability of spaces;
- O. A motor carrier dispatcher or a vehicle owner or operator will be making requests for parking availability information;
- P. The truck may be moving when the driver receives notification regarding availability;
- Q. An individual carrier and/or driver will have the option of selecting the types of information desired;
- R. Notifications and alerts sent to a vehicle operator must be delivered in compliance with USDOT requirements regarding driver distraction;
- S. Information security methods and protocols that safeguard information and enable the delivery of needed data and information will be tested as part of the prototype test;
- T. The “common and universally accepted character string” that can be tied directly to a tractor or a piece of trailing equipment has not yet been defined; however, one option would be to use all or part of the vehicle identification number (VIN) in conjunction with the license plate number. (The use of the VIN and license plate number implies that some

mechanism has to be defined to enable SRI systems and other connected systems to associate these numbers to appropriate records.)

- U. The use of a State motor vehicle registration number, which is viable as long as each number is uniquely associated with a single tractor or trailer, is also an option for the “common and universally accepted character string.” (In either case, the character string should contain information regarding where the associated information can be located (i.e., which system contains the authoritative data).)
- V. Capabilities of the various systems deployed under SRI will vary based upon technical limitations imposed by communications service availability, as well as deployment cost. Care will need to be exercised by deploying entities to ensure that critical functionality is available to meet operational needs for each deployment.

# 5 Concepts for the Proposed System

## 5.1 Background, Objectives, and Scope

Objectives are defined as finite, measurable outcomes that when achieved contribute to the accomplishment of goals. USDOT's goals for the SRI program stipulate that the new system will add new capabilities and leverage information exchange from existing deployments, when possible, to achieve:

1. A significant increase in the number of high-quality safety assessments. It is presumed that an increase in the number of safety assessments will encourage safer CMV operations without requiring additional CMV inspection staff. Some of this safety improvement will result directly from the safety assessments, and some is expected to come about due to carrier and driver awareness of an increase in the level of scrutiny combined with an increase in the level of attention paid to driver fitness and vehicle maintenance.
2. Use of additional data to feed carrier safety ratings. Currently, safety ratings are calculated based on a limited dataset. SRI applications and services are expected to provide a means to collect more complete and current data, thereby resulting in more accurate ratings.
3. A larger number of inspection and screening events to improve safety score correlation with the propensity for safe CMV operations. Statistical correlation is difficult with a small number of inspection and screening events. A larger number of such events will allow for more effective formulation of policies and practices.
4. System-wide operating cost reductions for both carrier and enforcement entities, and mobility improvement for carriers. It is expected that safer and more streamlined CMV operations will allow for a larger number of vehicles and drivers to be evaluated without stopping. This will promote more efficient operations by reducing congestion at weigh/inspection stations, thereby reducing delays in getting goods to market and decreasing fuel consumption and reducing greenhouse gas emissions.
5. Enhancing infrastructure preservation for system operators and maintainers by increasing the frequency of size and weight screening and inspection events, without introducing travel delays for compliant vehicles.
6. Enhanced sharing of up-to-date vehicle, driver, and trailing equipment safety data across jurisdictions through enhanced system connectivity and streamlined information access.
7. Close coordination with other V2X (vehicle-to-vehicle or vehicle-to-infrastructure) cooperative systems and related research and deployment initiatives in order to maximize the return on investment in technology by government and industry stakeholders.

At the concept stage, much remains to be determined regarding how these capabilities will be provided. Yet it is important to note that these objectives and performance targets have significantly influenced this concept of operations. Delivering capabilities that accommodate the defined user needs and accomplish the above objectives will require a considerable level of interoperability and cooperative functionality among new and existing systems. For instance, systems deployed under the Expanded CVISN program constitute essential interface points to the SRI family of systems and applications. This is true of a number of existing and emerging systems, including in-road and roadside devices that are used by enforcement personnel to support inspection selection activities. With this in mind, the SRI system will include new or emerging SRI applications and connectivity to external systems to support the exchange of information.

The SRI system can best be described as a technological and operational framework for the capture and delivery of information necessary to improve decision-support systems for CMV operations and roadside enforcement. Component applications deployed through the SRI system will allow motor carrier safety enforcement personnel to conduct a thorough examination of the CMV, driver, and carrier records; examine vehicle components remotely; communicate with the CMV drivers, carriers, and State and Federal information systems; and make informed decisions regarding necessary inspection and enforcement actions. Further, applications deployed under this concept will allow motor carriers, CMV drivers, and third-party service providers to leverage communications links and information flows to enhance operational safety and efficiency. They will also improve overall productivity by providing access to key operational data and facilitating participation in expedited screening and automated inspection programs. Finally, SRI-derived applications will provide Federal transportation agencies with mechanisms both for monitoring compliance and overall program performance as well as for facilitating the identification of measures to enhance motor vehicle safety and infrastructure preservation efforts.

The SRI system framework accomplishes these objectives by defining interfaces with external systems—both fixed and mobile—that enable the data flows necessary to deliver the capabilities defined by the four main functional areas.

The scope of this concept encompasses those elements of a system that are required to supplement existing systems in order to deliver the capabilities described above. There are four separate linkages defined within the concept:

- The vehicle-to-roadside link. This element describes the information exchanged between a CMV and a roadside system, how that link is established and defined, and how it facilitates the delivery of capabilities.
- The roadside-to-back-office link. This element describes the information exchanged between the roadside and the array of back-office systems that will be used to store and process information, how that link is defined, and how it supports the delivery of the required capabilities.
- The on-board vehicle systems link. This component describes the information exchanged between the CMV and other on-board systems and the mechanisms for effecting that communication.

- The user-to-system-interface link. This component defines the nature and content of the exchanges between individual users and the other elements of the system, which include the roadside, the back-office, in-vehicle systems, and decision-support capabilities to which it provides access.

It is essential to understand that the SRI system is intended to enable the delivery of specific applications and data. Each of those applications—ES/VWS, WRI, and truck parking—represent an initial set of individual applications that will be integrated and tested using this conceptual framework. The SRI system will also test the use of a UID, which will be the key for identifying the individual motor carrier, driver, and vehicle for testing the SRI linkages described in the preceding paragraph.

This concept does not specifically define the entire functionality specific to each application, nor does it attempt to conceptualize every possible value-added application or function that could possibly be developed. Rather, it establishes a set of logical information exchanges and mechanisms for conducting specific decision-support activities related to the primary functions.

## 5.2 Prototype Operational Policies and Constraints

The sections that follow offer draft policies and constraints for consideration with respect to the SRI prototype, with the recognition that they are likely to evolve as systems are developed and deployed. The Research Team notes that the primary focus of the identified policies and constraints is to support the development and testing of the SRI prototype application. The Research Team further recognizes that many of these constraints have significant ramifications beyond the prototype and serve to identify issues that will need to be resolved to move SRI to full deployment.

### 5.2.1 Draft Operational Policies

The IEEE 1362 standard defines “operational policies” as predetermined management decisions regarding the operations of the proposed system, normally in the form of general statements or understandings that guide decision making activities. Policies limit decisionmaking freedom but do allow for some discretion. It is important to remember at this point that the SRI system represents a framework within which specific capabilities will be delivered by individual applications as part of the SRI prototype, and that these applications (e.g., WRI, ES/VWS, etc.) would be governed by policies crafted specifically for them. To the degree possible, those more specific policies are identified in section 7 along with the operational and organizational impacts of SRI implementation.

DOP01 – The SRI Prototype System shall test the technical viability of 24/7 operations, which will require some level of system monitoring by potential first-tier end users.

DOP02 – The SRI Prototype System, to the extent technically feasible, shall use existing computer hardware and communications infrastructure to demonstrate economies of scale that can be achieved in a long-term SRI deployment. The SRI prototype system shall not preclude the continued use of existing systems for retrieving and processing data.

- DOP03 – The SRI Prototype System shall be deployed and tested at a fixed facility on the National Highway System and shall also be deployed and tested in a mobile environment on selected secondary routes near the fixed facility.
- DOP04 – The SRI prototype shall use unique motor carrier, vehicle, and driver identifiers that have legal standing or can be uniquely associated with identifiers established by Federal or State statute or regulation. These identifiers must be usable in any jurisdiction within which a vehicle may operate. This is necessary to establish a clear link to data stored at an authoritative source and to minimize the likelihood confusion or inefficiency due to the duplication or ambiguity of terms. For the purpose of the SRI prototype, the unique identifiers for CMVs, drivers, and motor carriers shall be the VIN, the CDL number, and the USDOT number, respectively. The intent is to use these identifiers to test the concept of UID.
- DOP05 – For the purposes of the SRI prototype, any data upon which a screening action is based must be verifiable as being sourced from an authoritative system or system of record. This includes: identity of vehicle, driver, and carrier; current safety status of any individual vehicle system; current safety status of the driver; and current safety status of the carrier (or vehicle owner). Any application executed to complete a screening action must be verifiable as being sourced from an authoritative system or system of record.
- DOP06 – For the purposes of the SRI prototype, the prototype applications shall utilize technologies that are consistent with nationwide interoperability standards currently used for the USDOT V2X Program - SAE STD J2735, IEEE Standard 1609 and IEEE Standard 802.11p.
- DOP07 – To ensure consistency and reduce complexity during the SRI prototype test, SRI user community members should define and implement a common framework to define and test user access provisions and use restrictions while allowing for flexibility to govern access at the level of each SRI support application.
- DOP08 – The SRI prototype shall test how information capture and management procedures permit authorized users to have transparent access to data captured for identification and screening purposes and all results of these activities. Authorized users are considered to be those who are a party to such transactions. Authorized users' access to data will be based on their specific responsibilities and job requirements. Authorized users will not have unlimited access to all data captured.
- DOP09 – The SRI prototype will test how to present information to users so that users have access to data but are not able to modify data captured by SRI prototype applications.
- DOP10 – For the purposes of the SRI prototype, the vehicle-to-roadside information exchanges and system-to-system information exchanges shall minimize the quantity of data necessary to facilitate the delivery of capabilities.
- DOP11 – The SRI prototype shall ensure that motor carrier-provided data used for screening and inspection activities is authenticated and has not been replaced or corrupted during its transmission from motor carrier data sources.

## 5.2.2 Draft Operational Constraints

The IEEE 1362 standard defines operational constraints as limitations placed on the operations of the proposed system. The following draft high-level operational constraints are offered regarding the SRI system. They are categorized in the same manner as the operational policies.

- DOC01 – Driver distraction is a significant concern to USDOT and has been shown to compromise highway safety. The SRI prototype test must ensure that no component or method deployed within the SRI framework will promote the implementation of any system, device, or practice that will result in unsafe operation of a CMV by distracting the driver.
- DOC02 – Motor carrier participation is reliant on systems, staffs, and procedures not compromising business-sensitive information, so encryption tools and standards must be applied to meet the appropriate legal and business requirements. The SRI prototype must test security applications to ensure that proprietary data on motor carrier operation meets legal and business requirements.
- DOC03 – The component carrier, vehicle, and driver universal identifiers for use by SRI for both interstate and intrastate operators are not at present established in statute or regulation. The SRI prototype test must identify a suitable set of unique identifiers for intrastate carriers included in the test that enables the identification of the motor carrier, driver, and vehicle. These may include, in part or in whole, current identifiers that are established by statute and regulation (e.g., license plates, VINs, etc.).
- DOC04 – Prior to testing the SRI applications on secondary roads, the Research Team must work with State DOT and Public Safety officials to identify locations that are considered safe locations for conducting roadside enforcement. CVSA Operational Policy #5 contains guidelines on how to select a safe location for enforcement and should be used as a reference.

## 5.3 Description of the Proposed Prototype System

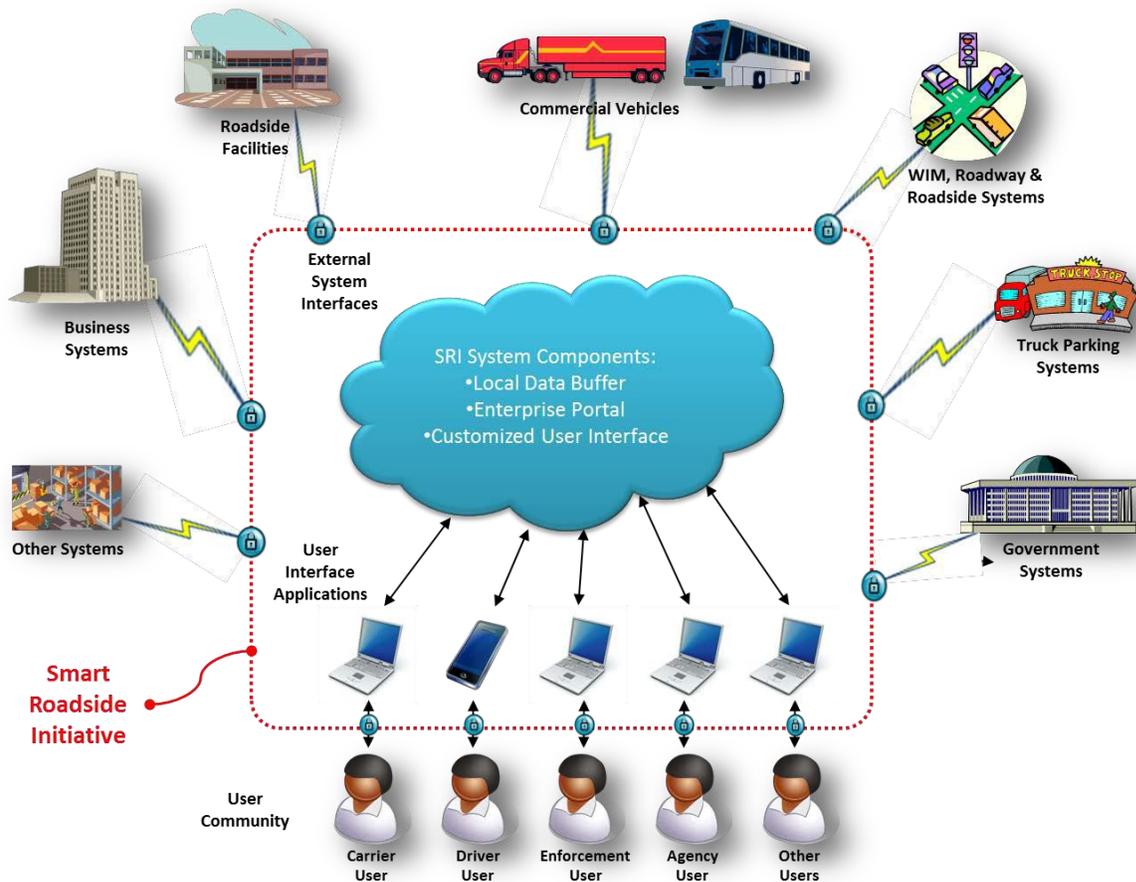
The SRI prototype system will:

- Enhance information exchange to support roadside enforcement and CMV operations;
- Develop an application that supports the universal electronic CMV identification, WRI, EW/WWS, and truck parking;
- Be developed so that future applications or information requirements can be integrated into the SRI system without requiring substantial changes to the hardware and/or software the prototype will employ. This includes identifying information needs, sources, and processes for reliable information exchange consistent with SRI requirements.

### 5.3.1 Operational Environment

Figure 2 provides a high-level framework that shows the existing operational environment and how the SRI Prototype test will be integrated into this framework.

The current operational environment, as shown in Figure 2, includes a wide range of public- and private-sector users and external systems:



**Figure 2. SRI High-Level Perspective Framework**

- User Community
  - o Private sector users include motor carriers, drivers, and third-party service providers. Third-party service providers offer services such as obtaining credentials, trip permits, or providing information on available truck rest stop facilities.
  - o Public sector users include enforcement personnel and Federal and State agency personnel. Enforcement personnel conduct roadside enforcement and inspections and both access information on motor carrier safety history and credentials status and upload information on inspections and enforcement actions. Agency personnel

- o are involved with motor carrier registration, issuing credentials and permitting, and maintaining information on motor carrier safety.
- o Other users include carrier customers, such as shippers, logistics providers, and motor coach passengers seeking safety rating information.
- User Interfaces Applications
  - o The user community frequently accesses external systems to obtain information. Government systems provide information on the status of credentials, permits, and motor carrier safety history, while business systems include shippers and receivers, who provide information on loading and delivery locations and types of freight to be moved. Truck parking facilities provide information on availability of parking spaces and facility location, and roadside systems provide information on road conditions, work zones, accidents, and weather. Enforcement roadside systems such as WIM and ES are used to ensure regulatory compliance and identification of non-compliant carriers.
- External System Interfaces (plug-in points)
  - o Government systems include all systems containing authoritative government data sets. For example, a State DMV database would be considered the authoritative source for information related to vehicle registration, and the ISS database would be considered an authoritative source for screening results data.
  - o CMVs would be the source for data related to the identification of the truck (e.g., the VIN), and for other data related to specific on-vehicle systems and components, such as brake condition, lighting systems status, and other items of interest to carriers and inspectors.
  - o Business systems include carrier systems as well as those related to the delivery of services by third-party service providers.
  - o Truck parking systems provide information regarding parking space location and availability, and any additional information would be available from the operators of the parking facilities.

The current operational environment includes a number of constraints that inhibit efficient operations, as summarized in section 3.2. The SRI prototype offers the opportunity to test how SRI applications help to address these constraints while also enhancing safety and improving mobility.

### 5.3.2 Major System Components

The SRI Prototype System is intended to integrate the information flows from external systems and enhance the exchange of information within the user community. The particular emphasis of the prototype system will be on improving the exchange of information at the roadside among CMV drivers and enforcement personnel to facilitate decisionmaking.

The SRI prototype will:

- Develop an enterprise-level application that integrates current systems and facilitates the exchange of information in a secure environment;
- Develop customized interfaces based on specific user needs and appropriate authorization; and
- Develop a local data buffer that may be used to store data on a temporary basis.

### 5.3.3 Capabilities of the Proposed System

The SRI Prototype System will be developed with the following performance characteristics:

- High-volume information exchange – the system will need to be able to identify and exchange information with multiple CMVs, particularly in high-traffic areas or at fixed facilities where CMVs enter a queue for size and weight checks.
- Speed – information exchange will need to be performed at a near real-time speed to ensure prompt decisionmaking at roadside. This will be particularly important for decisions on whether or not a CMV is permitted to by-pass a facility or is selected for additional enforcement checks.
- Reliability – the system must provide reliable information exchange with the ability to authenticate sources of data in near real-time. This is necessary to ensure that enforcement personnel are able to ascertain the status of a motor carrier, vehicle, and driver.
- Scalability – the prototype applications will demonstrate the technical feasibility of SRI; however, these are only a small component of the multitude of applications that could be developed for and supported by SRI, such as electronic payments, weather information, real-time information on accidents and congestions, etc.
- Flexibility – the system will be designed to accommodate multiple users with different user needs and requirements.

The SRI Prototype System will require a communications infrastructure that supports the exchange of information at roadside.

The system will use existing standards, or define new standards if necessary, to format message sets and ensure appropriate security and data encryption. The existing standards will include those that are supporting the USDOT V2X initiative: SAE J2735, IEEE 1609 and IEEE 8211.p.

## 5.4 Modes of Operation

The SRI Prototype System will be tested to support CMV roadside operations. The system itself will be an Enterprise Portal application that will be accessible to any authorized user.

The SRI Prototype System will be reliant on multiple external systems for exchanging information:

- Enforcement systems that are used to calculate truck size and weight;
- Enforcement and credentialing systems that provide information on motor carrier safety history and driver CDL status;

- In-vehicle systems that provide information on the driver and CMV;
- In-vehicle or motor carrier systems that provide unique identifiers for the motor carrier, vehicle, and driver as well as information on driver status (hours-of-service); and
- Systems operated by service providers such as truck rest-stop operators.

To this end, the SRI Prototype System will be dependent on the communications infrastructure that is installed to support information exchange. This will include roadside readers and a communications system that can exchange information on a near real-time basis. This near real-time data exchange is critical for ensuring that decisionmaking at the roadside is expedited: that non-compliant CMVs or drivers are identified, and that necessary enforcement actions are taken. Conversely, the near real-time exchange will also ensure that compliant CMVs and drivers are not delayed unnecessarily and that they receive the benefit of enhanced mobility as a result of maintaining compliance with safety and credentialing requirements.

Enforcement actions are conducted at fixed facilities, by mobile units, and through execution of the functions performed by certain virtual systems (for example, VWS/ES, WRI). The SRI Prototype System will be able to support the technologies that these applications are embracing as they advance in their development. The system will be available for use at multiple geographic locations. System redundancy requirements will be identified and tested for the prototype test. In addition, a maintenance plan will be developed as part of the prototype. A key component of the maintenance plan will be to test alternative times for conducting maintenance operations with minimal disruption to operations.

The prototype test will also include testing to determine what type of system back up is necessary in the event system operations are somehow degraded. As feasible, the components discussed in the preceding paragraphs will be tested in support of a 24/7 operational test. Detailed plans and requirements for these system components will be developed during the next phase of the SRI project, when system requirements are developed.

## 5.5 User Classes and Other Involved Personnel

The implementation of SRI-based systems and applications requires no changes to the user classes or other involved personnel that interact with the various systems currently in place, with the exception of the addition of the service providers that will manage truck parking systems. It is anticipated that this function could either be managed by a third-party service provider on a fee basis or operated as a service in conjunction with traffic information systems deployed and managed by State, regional, or local government entities (e.g., regional transportation management centers, corridor coalitions, etc.).

However, significant differences are expected to be manifested in the nature and frequency of interactions among roadside safety enforcement personnel and driver and carrier personnel. The SRI system is intended, in large part, to accomplish through automated means some of the actions that currently require direct personal interaction among these parties. For example, SRI is being developed to allow roadside users to examine permit documentation, conduct weight and size

evaluations, obtain CDL information, and access a broad variety of safety rating data without directly contacting other persons. SRI will not eliminate the need for that form of interaction, but it should reduce the frequency of such interaction as a percentage of the number of screening events.

Additionally, the timely presentation to a roadside officer of a significantly expanded data set will likely change the nature of the interaction between these officers and the drivers that are directed to stop their vehicles at a weigh and inspection facility. It may reduce the overall time required to conduct such a stop because the officer already will have had the opportunity to complete a significant portion of the activities typically included in such a stationary encounter.

There is also the potential for an evolution in the nature of the interactions among carriers and State and Federal officials regarding the results of SRI activities. Most notably, all parties should have ready access to a complete set of screening and inspection results, which should minimize or eliminate sources of confusion or inconsistency, thereby expediting resolution. This transparency should also facilitate more reliable and complete justification for validating or correcting the results of safety scoring.

### 5.5.1 Organizational Structure

The implementation of solutions consistent with this system will not change the organizational structures of the user classes. Staff responsibilities will change, but the Research Team does not envision that there will be any significant changes in organizational structures based on feedback from the user groups.

### 5.5.2 Profiles of User Classes

It is intended that the various users will have access to capabilities not previously available once systems are implemented, but no changes are anticipated regarding the composition of any classes. It is reasonable to assume that some level of training will be required for users to access and use systems deployed to deliver SRI capabilities; however, it is premature to identify any such requirements at this time.

### 5.5.3 Interactions among User Classes

The implementation of SRI will in all likelihood significantly increase the number of users of the system. Table 14 summarizes the expected interaction of these users, broken out by user group, with the system.

**Table 14. Users Interactions with SRI System**

User Designation	Description
<b>Tier I Users</b>	
CMV Enforcement Officer	SRI will significantly increase the quantity and quality of data available to a CMV enforcement officer and will improve his or her ability to identify non-compliant carriers and drivers. The Research Team expects that enforcement personnel will have regular interaction with the system as part of their daily enforcement activities.

User Designation	Description
CMV Driver	Drivers will need to be diligent in ensuring that hours on duty and hours driving remain compliant with hours-of-service regulations to avoid non-compliance. Drivers will also need to react to SRI messages on vehicle performance. The Research Team expects that direct driver interaction with the proposed system will be limited to responding to vehicle performance issues, although the potential exists for direct interaction with third party service providers. The Research Team expects that the most significant impact on drivers will be the increased ability of enforcement personnel to verify hours of service. This is not a direct interaction, but potentially will have a significant impact on how a driver performs his or her duties.
Motor Carrier	The Research Team anticipates that motor carrier interaction with the system will be through responding to system outputs such as notices of enforcement actions, notices of yellow lights requiring equipment maintenance, and monitoring driver hours to ensure compliance with HOS requirements.
CMV Enforcement Supervisor	CMV enforcement personnel will have extensive interaction with the system. They are often frequently involved in direct enforcement actions and will also use the system for quality control purposes to monitor officer performance.
Third Party Providers	Third party providers will potentially have extensive interaction with the system if the market for their services develops.
<b>Tier II Users</b>	
MCSAP Lead Agency Manager	There is an expectation that management will have periodic interaction with the system. The manager will make use of system outputs, in particular the analysis of data that can be used to support planning and resource allocation.
Motor Carrier Safety Program Personnel	There is an expectation that other State personnel involved with motor carrier safety programs will interact routinely with the system. The State personnel involved with programs such as CVISN and driver licensing will be involved in providing and authenticating data.
FMCSA Personnel	There is an expectation that FMCSA personnel at the Division level will have extensive interaction with the system as part of their daily activities. Also, the Service Center and Headquarters personnel will have more limited interaction in the same way as a MCSAP Lead Agency Manager.
FHWA Size & Weight Personnel	There is an expectation that FHWA Program Coordinators at the Division level will have limited interaction with the system as part of their daily activities. Interaction might consist of reviews of compliance statistics for use in compliance campaigns. Also, the Headquarters personnel will have even less interaction than Division Office personnel.
NHTSA Personnel	There is little expectation that NHTSA personnel will have extensive direct interaction with the system. Also, NHTSA personnel will have more limited interaction in the same way as a MCSAP Lead Agency Manager utilizing system outputs and reports based on data collected by the system.
Other State Agency Personnel	Procurement of SRI infrastructure and installation and deployment of SRI software will involve State agency IT. State procurement personnel will also be involved through the procurement process. If a State has a centralized IT office that establishes State policies and procedures, this office will be involved in developing technical specifications for SRI procurement and ensuring compatibility with existing State IT infrastructure and systems. Finally, if a State has a Chief Information Officer, this individual will be involved in ensuring that all SRI hardware and software application are compliant with State requirements and approving the procurement. However, once the system is procured, installed and being operated, the agency IT personnel

User Designation	Description
	responsible for system operation and maintenance will be the primary State personnel with interaction on a regular basis.
CMV and Equipment Manufacturers	The potential exists for these users to develop and manufacture system software and hardware components. To some extent, this is already happening with companies providing roadside infrastructure (readers, WIM) and other companies providing SRI and ES/VWS software applications.

### 5.5.4 Other Involved Personnel

The most significant change resulting from SRI will be within the motor carrier community because participation in SRI will require the disclosure of sensitive and proprietary data. Decisions regarding disclosure of this data will have to take place at the managerial level. In addition to accessing unique identifiers for drivers and vehicles and data from in-vehicle sensors, SRI applications will also document motor carrier route selection, driver operations, and data on the timing of a trip. This data, if compromised, would give access to proprietary business operations data. Motor carrier managers participating in SRI will need to ensure that this proprietary data is adequately protected.

An additional consideration for the motor carrier industry will arise if SRI applications include requests for trip manifests and cargo information to ensure such issues as CMVs being properly placarded if carrying hazardous materials. Disclosing the types of cargo being carried, and through a trip manifest the shipper, significantly expands the proprietary information that will be exchanged. Motor carrier managers will need to work with shippers and receivers to ensure that they are aware of SRI applications, in particular data security. Shippers and receivers may not be comfortable with proprietary information being exchanged at the roadside, and the motor carrier community will need to be assured that any concerns amongst this community are properly addressed prior to participating in SRI.

The impact on the enforcement community's command staff will not be as significant. The improved quantity and quality of data will be of significant benefit in identifying issues requiring enforcement action (high risk locations, particular types of violations) and will help the enforcement community better identify high-risk and non-compliant motor carriers and drivers.

These interactions involving the exchange of sensitive and proprietary data among user classes will require data privacy and access protocols to be developed to ensure both that information is not accessible to unauthorized users and that information is not used inappropriately by authorized users.

## 5.6 Support Environment

As part of the prototype test, the Research Team will work with the participating State agency or agencies to identify the processes and procedures that will need to be followed to install SRI technologies and applications. State enforcement agencies are supported by IT personnel who handle hardware operations and maintenance, software operations and maintenance (including the

distribution and installation of software upgrades, modifications, etc.) and communications infrastructure support. States also have established policies governing IT procurement (e.g., types of equipment, selection criteria) and policies establishing operations and maintenance procedures. Documenting these requirements and policies as part of the prototype test will help provide a checklist that other States considering SRI deployments may use as a reference.

Specific support that will be provided during the Prototype test will include:

- Installing roadside infrastructure –communications systems;
- Installing SRI software applications; and
- Supporting prototype test operations – training, software and hardware maintenance, testing.

# 6 Scenarios

## 6.1 Background

A CMV travels on a “control segment” of roadway—along the mainline or on a weigh and inspection station entrance (or “sorter” ramp)—instrumented with technologies employed by the SRI system. The scenarios that follow reference the “weigh/inspection station” as the location where enforcement personnel come into direct contact with the driver, vehicle, and load. It should be understood that the use of the term “weigh/inspection station” as used in the scenarios that follow includes both safe pull-off areas (like rest areas located along roadways) that are used by enforcement personnel as temporary inspection stations as well as fixed weigh/inspection facilities.

The SRI system equipment deployment is required along the roadway in advance of such sites so that necessary compliance checks can occur, data exchanges between the roadside and the vehicle can occur, and roadside equipment can access off-site data systems to verify driver, vehicle, and carrier compliance with relevant data maintained by CMV safety program personnel, including public licensing and credentialing agencies, tax agencies, safety program agencies, and over-size/over-weight permit offices.

## 6.2 Scenario 1: Compliant CMV – “Green Light”

The CMV enters the SRI system “control segment.” The presence of the CMV launches a series of automated measurements, information capture activities, and data exchanges between the CMV’s on-board units (OBU) and the roadside equipment (RSE), or between the OBU and off-site systems via a location-based trigger, such as a GPS-based geo-fence. Information communicated between the OBU or RSE and the off-site data systems would be used to verify compliance with credentials requirements and determine safety history status and rating. Elements of the data exchanges include:

- Exchange of unique identifiers for the motor carrier, driver, and vehicle;
- Verification that the motor carrier, driver, and vehicle are compliant with credentialing and licensing requirements;
- Verification that the motor carrier, driver and vehicle are compliant with safety program requirements (such as HOS) and that there are no outstanding warrants, out-of-service orders, or other open enforcement actions;
- Verification that the vehicle is operating within legal size and weight limits; and
- Confirmation that all vehicle systems are operating safely and no defects or potential defects are detected.

The data exchanges indicate that the CMV is compliant with all safety and credentialing requirements and no potential or actual vehicle defects are identified. The CMV is issued a “green

light” indicating that there is no need for additional enforcement action and the CMV may by-pass the weigh and inspection facility and continue its trip.

### **6.3 Scenario 2: Compliant CMV – OS/OW Permit Verification**

The CMV enters the SRI system “control segment.” The presence of the CMV launches a series of automated measurements, information capture activities, data exchanges between the CMV’s OBU and the RSE, and data exchanges between the RSE and off-site data systems used to verify compliance with credentials requirements and safety history status and rating. The automated size and weight checks indicate the CMV exceeds per-axle and gross vehicle weight legal limits.

The CMV in question has a valid size and weight trip permit that allows the CMV to travel at the per-axle and gross vehicle weights detected by the size and weight check. Information on this permit is stored electronically in the OBU, which exchanges information with the RSE. The RSE and off-site data systems exchange information and verify that the vehicle is operating legally. The CMV is issued a “green light” to by-pass the weigh and inspection facility. The “green light” may be a simple visual indicator, an audible indicator, or some combination of the two that maximizes visibility while minimizing driver distraction.

### **6.4 Scenario 3: Non Compliant CMV – “Red Light”**

The CMV enters the SRI system “control segment.” The presence of the CMV launches a series of automated measurements, information capture activities, data exchanges between the CMV’s OBU and the RSE, and data exchanges between the RSE and off-site data systems used to verify compliance with credentialing requirements and safety history status and rating.

The data exchanges between the CMV’s OBU and the RSE reveal the CMV has a potential vehicle defect that warrants further investigation. A message is passed from the RSE to the CMV to alert the driver (via a “red light” or similar method) that he is required to pull into the weigh/inspection station ahead, or proceed to another downstream manned inspection facility. The “red light” may be a simple visual indicator, an audible indicator, or some combination of the two that maximizes visibility while minimizing driver distraction. This red light would remain illuminated either for a prescribed period of time, or until it is changed by inspection personnel. Simultaneously, a message is passed from the RSE to both the motor carrier and to enforcement personnel at the weigh/inspection station that provides the unique identifier for the driver and CMV in question and states that a “red light” has been issued to alert the driver to enter the inspection area. In the event that the number of red light referrals exceeds the capacity of the inspection facility, enforcement personnel will have the option to adjust screening thresholds or conduct “triage” to determine which vehicles must stop immediately and which can proceed to downstream facilities or be allowed to continue traveling.

In instances where the carrier does not have a centralized system, notifications would be made via e-mail or through an online portal, or both. This would allow for smaller carriers to participate at lower cost.

The CMV enters the weigh/inspection facility as instructed by the “red light” alert. The driver is directed to take the CMV to an inspection area. An inspector conducts a Level I inspection, assigns appropriate violations, and, if out-of-service (OOS) violations are confirmed, places the vehicle out of service. The OOS order is then simultaneously provided to law enforcement off-site systems and the motor carrier.

## 6.5 Scenario 4: Non Compliant CMV – Illegal By-Pass

The CMV enters the SRI system “control segment.” The presence of the CMV launches a series of automated measurements, information capture activities, data exchanges between the CMV’s OBU and the RSE and between the RSE and off-site data systems used to verify compliance with credentialing requirements and safety history status and rating.

The data exchanges between the CMV’s OBU and the RSE reveal the CMV has a potential vehicle defect that warrants further investigation. A message is passed from the RSE to the CMV to alert the driver (via a “red light” or similar method) that he is required to pull into the weigh/inspection station ahead. This “red light” indicator (again, a visual indicator, an audible indicator, or some combination of the two) would remain active either for a prescribed period of time or until it is changed by enforcement personnel. Simultaneously, a message is passed from the RSE to both the motor carrier and to enforcement personnel at the weigh/inspection station that provides the unique identifier for the driver and CMV in question and states that a “red light” has been issued to alert the driver to enter the inspection area.

The CMV does not enter the weigh and inspection station and continues on its trip. The roadside telemetry exchanges the unique driver, vehicle, and motor carrier identifiers with the OBU and an automated message is generated indicating that the vehicle was identified as having a possible safety defect but is violating a “red light” alert to enter the weigh and inspection facility. The message would contain information that would allow for identification of the vehicle.

This message is passed to enforcement personnel at the weigh and inspection facility, and if the violation warrants (e.g., the vehicle presents an imminent danger), mobile enforcement personnel who are either assigned to interdict CMVs that illegally by-pass the facility or in the vicinity of the facility, are notified. The mobile enforcement personnel proceed to interdict the CMV and escort the driver and vehicle to the nearest safe location or back to the weigh and inspection facility for roadside enforcement actions. The driver is issued a citation for illegally bypassing the facility, and the enforcement personnel conduct a Level I inspection, assign appropriate violations, and, if OOS violations are confirmed, place the vehicle out of service. The inspection report and the OOS order are then simultaneously provided to law enforcement off-site systems and the motor carrier.

## 6.6 Scenario 5: Real-Time Truck Parking Information System

The CMV is operating on a roadway that possesses public and/or private truck stop parking facilities with an installed Real-Time Parking Information System. The CMV is equipped with an application within the truck’s OBU that monitors the driver’s duty status by interacting with an on-board

electronic device that records driver HOS. The CMV enters a geo-fenced region of the roadway at a pre-designated point that automatically exchanges information with the truck's OBU, which notifies the driver that the remaining HOS has reached a pre-defined threshold and that there is available parking at upcoming facilities, which are designated by exit ramp numbers. If the vehicle is moving, notifications sent to the driver will be in audible form only. Vehicles that are stationary may receive notifications in any number of audio and/or visual formats.

The moving CMV also maintains a global positioning system (GPS) based geo-fenced perimeter. At pre-designated distance points (e.g., 1,000 feet; 5 miles, 10 miles) that are stored off-site, the system automatically awakens and wirelessly queries the truck parking server for local parking availability. The participating parking facilities are geo-coded, allowing an association between the mobile CMV geo-fence and the static facilities' geo-fences.

When a CMV approaches a facility, the system will provide a final notification regarding availability, which will allow the driver to avoid entering and searching around the facility if all spaces have been filled. When a CMV enters a space, the system reduces the available count by one. When a CMV exits a space, the system increases the space-available count by one. In each case, the central server appropriately modifies the space-available calculation.

Beyond detecting the difference between occupied and vacant parking spaces, the system will differentiate between vehicle types such as recreational vehicles and double-trailer combinations. However, since any space occupation precludes the ability of a CMV to park, this information will be automatically provided to the CMV querying the availability of parking spaces.

# 7 Summary of Impacts

SRI system implementation will support the delivery of data-rich capabilities for universal electronic CMV identification, WRI, ES/VWS, truck parking, and road network information access. In particular, SRI will dramatically improve CMV safety and compliance through improved information access, timely information delivery, and enhanced decisionmaking for both public- and private-sector participants. The purpose of the following subsections is to identify potential operational impacts, organizational impacts, and impacts during development so that affected organizations may begin to prepare for SRI system deployment.

## 7.1 Operational Impacts

### 7.1.1 System Integration

Through the proposed SRI Enterprise Level application, what are now disparate systems will be integrated, and the quantity and quality of data that can be shared among various systems will be expanded significantly. This includes information exchanges between public and private systems and between private systems (e.g., truck parking and other support services).

### 7.1.2 Data Availability

- New Sources of Data. The advent of SRI applications, in particular the establishment of unique identifiers for the driver, vehicle, and motor carrier, will substantially increase the quantity and quality of data captured at the roadside. Roadside enforcement personnel will be able to identify a unique driver and vehicle operating at mainline speeds and link the driver and vehicle identities with other data obtained from in-vehicle sensors. This change will provide enforcement personnel with:
  - o *Access to data previously not available even when conducting roadside enforcement and inspection activities.* An example of this is driver hours on duty obtained from an in-vehicle device. At present this information is available only in written logbooks or EOBRs and must be matched with other data sets, such as toll receipts, payroll information, and other documentation, to verify accuracy.
  - o *Links to data on drivers and vehicles as well as to motor carrier companies.*
- Increased Sample Size. As part of making additional sources of data available, SRI also has the potential to increase substantially the number of motor carriers, drivers, and vehicles providing data to enforcement personnel that are operating at fixed facilities or at the roadside. For example, the deployment of ES/VWS and WRI will increase the number of vehicles that are brought into contact with enforcement program personnel and thus increase the quantity of data available to those personnel. While the number of

vehicles that are actually stopped for enforcement action may not change substantially, the general volume of information available on loads, transport companies, drivers, and vehicles will be increased. This is particularly true for drivers, loads, and vehicles.

- Data Management. While enforcement personnel have more access to more data, it is also important that this data not overwhelm personnel at roadside. Data will need to be presented in a concise manner that meets user needs. Simply providing data for the sake of data will result in a combination of information overload for enforcement personnel and reduced system effectiveness.
- Near real-time access to data on vehicle safety condition. At present, the primary means by which data on vehicle safety condition is obtained is through an actual inspection of the vehicle. While this process does yield positive results, as evidenced by the continuing decline in CMV fatality rates, it is a labor intensive process and requires the physical inspection of a vehicle. Through SRI, enforcement personnel will be able to obtain sensor data from vehicles that can be used to identify not only *actual* vehicle safety issues (i.e., those that require correction in order to avoid either a citation or an out-of-service order) but also *potential* safety issues. The latter offers the opportunity for proactive action on the part of motor carriers to correct defects before they become actual safety issues.
- Near real-time access to information on driver operating condition, particularly HOS. At present, HOS assessments require enforcement personnel to review a hard copy or electronic log prepared by the driver. The hours on duty, as recorded in the log, must be manually compared to other hard copy data (toll receipts, gasoline receipts, and so on) to reconstruct a driver's trip and hours on duty. While there is general acknowledgement by the motor carrier industry and enforcement personnel that this system is not efficient, electronic information on driver duty status is not available to enforcement personnel remotely. The planned-for ability to access driver duty status electronically will substantially improve the monitoring of compliance with hours of service requirements.

### 7.1.3 Changes in Procedure

- Unique Driver and Vehicle Identifiers. Enforcement personnel will be able to identify drivers and vehicles operating at highway speeds through the use of unique identifiers and roadside infrastructure. This impact, in particular the identification of the driver, addresses one of the most significant gaps in the current enforcement environment.
- Higher Quality Safety Assessments. The availability of this additional information on driver and vehicle performance will substantially improve the quality of motor carrier safety assessments performed under FMCSA's CSA program. This is particularly true of the data on driver and vehicle performance, which at present is limited.
- Improved Enforcement on Secondary and By-Pass Routes. The deployment of SRI applications such as ES/VWS and WRI on secondary and by-pass routes will enhance size and weight enforcement activities. Eliminating or reducing the ability of non-compliant CMVs to by-pass weigh stations will support the preservation of secondary and State road systems. The screening of truck size and weight enforcement on the

interstate system has been shown to be highly effective, as evidenced by the trend toward reduced numbers of citations and out-of-service orders issued for size and weight violations. Providing a similar incentive for size and weight compliance on secondary road systems will substantially reduce pavement and infrastructure damage.

#### **7.1.4 Changes in Operational Budgets**

SRI applications are proposed to be tested at three different levels:

- A facility with limited infrastructure – including scale, power, internet access only through an air card (at a rural plug and play system located in a rest stop in New England);
- A facility with an intermediate level of infrastructure – including internet access, IT and communications systems, and scale (at New York State weigh and inspection facilities located in rest stops along the New York State Thruway); and
- A state-of-the art facility equipped with electronic screening capabilities – for example, the Maryland Transportation Facility’s weigh and inspection station located on I-95 South just north of the Susquehanna River.

As a part of this three-level test, the Research Team will identify and document all hardware and equipment purchases and installations, software installations, and operations and maintenance requirements. The intent will be to provide other States with a representative list of what will need to be done to install the SRI application at different locations depending on the support infrastructure already available. The Research Team does not intend these to be estimated costs for SRI deployment; rather, the intent is to provide States with information on what equipment, hardware and software, etc., are necessary to support an SRI installation. Each State will have to cost out its own deployment options, but the proposed documentation is intended to help States identify all component parts related to deploying SRI applications.

#### **7.1.5 New Modes of Operation – System Maintenance, Support and Back-up**

As noted in section 5.4, the development and deployment of SRI applications will require identifying and developing requirements to ensure system redundancy and system maintenance—both requirements and actual maintenance operations—and developing and testing disaster recovery plans.

### **7.2 Organization Impacts**

As noted in section 5, while SRI will not in all likelihood significantly impact motor carrier or enforcement organizational structures, the impact on decision-makers and their operational responsibilities will be significant.

For the motor carrier industry, implementation of SRI and the resulting increased scrutiny on driver and vehicle safety condition at the roadside will require that motor carriers commit to a high standard of maintenance and vehicle condition monitoring, leading to safer operations. While the large majority of motor carriers currently maintains a strong commitment to safety and invests substantial

resources in ensuring compliant operations, increased enforcement access to the SRI-generated data will require even more scrutiny to ensure that potential non-compliance issues are proactively identified and resolved.

For the enforcement community, broader access to driver and vehicle safety condition data will such personnel’s ability to identify non-compliant carriers and patterns of non-compliance for enforcement action. This will impact the development of annual CMV safety plans as improved data will better enable enforcement personnel to identify violation trends, high-risk locations, and other factors that impact resource deployment. This will also impact the types of operations – strike forces, violation enforcement, size and weight enforcement – that the enforcement community will conduct. This is a positive development as States will be better able to develop accurate performance-based plans and to measure performance effectiveness, although integrating increased amounts of data into the planning process will take time and may require additional training in data analysis techniques and methodologies. Some States already outsource this analysis to other parties, such as universities, but many States rely on in-house resources. Identifying training needs will be a key component of moving SRI from a prototype to a deployed system.

A summary of expected organizational impacts is shown in Table 15 below.

**Table 15. Organizational Impacts**

User Designation	Description
<b>Tier I Users</b>	
CMV Enforcement Officer	<ul style="list-style-type: none"> <li>• Additional training in the use of SRI applications.</li> <li>• Enhanced skill levels – access to additional motor carrier, driver, and vehicle performance and safety information will result in more targeted enforcement activities.</li> </ul>
CMV Driver	<ul style="list-style-type: none"> <li>• Modification of responsibilities – change in how duty hours are recorded, additional information on vehicle performance places new emphasis on driver for vehicle maintenance.</li> <li>• Training in SRI applications.</li> </ul>
Motor Carrier	<ul style="list-style-type: none"> <li>• Training in SRI applications.</li> <li>• Modification of responsibilities – decision to participate in SRI program and assurances for data privacy and security, development of capabilities to respond to SRI messages – “yellow light” vehicle performance, enhanced scrutiny of driver performance, hours on duty in particular.</li> </ul>
CMV Enforcement Supervisor	<ul style="list-style-type: none"> <li>• Additional training in use of SRI applications.</li> <li>• Enhanced skill levels – access to additional motor carrier, driver, and vehicle performance and safety information will result in more targeted enforcement activities</li> </ul>
Third Party Providers	<ul style="list-style-type: none"> <li>• Potential for expansion of service providers and service offerings.</li> </ul>
<b>Tier II Users</b>	
MCSAP Lead Agency Manager	<ul style="list-style-type: none"> <li>• Modification of responsibilities – improved data for use in planning and monitoring operations.</li> </ul>
Motor Carrier Safety Program	<ul style="list-style-type: none"> <li>• Modification of responsibilities – improved data for use in planning and</li> </ul>

User Designation	Description
Personnel	monitoring operations.
FMCSA Personnel	<ul style="list-style-type: none"> <li>Modification of responsibilities – improved data for use in planning and monitoring operations.</li> </ul>
FHWA Size & Weight Personnel	<ul style="list-style-type: none"> <li>Modification of responsibilities – improved data for use in planning and monitoring operations.</li> </ul>
NHTSA Personnel	<ul style="list-style-type: none"> <li>Modification of responsibilities – improved data for use in planning and monitoring operations.</li> </ul>
Other State Agency Personnel	<ul style="list-style-type: none"> <li>Modification of responsibilities – installation and maintenance of SRI hardware, equipment, and software.</li> <li>Training in operations and maintenance of new hardware, equipment, and software.</li> <li>Development of additional skills to support operations and maintenance.</li> </ul>
CMV and Equipment Manufacturers and other equipment providers	<ul style="list-style-type: none"> <li>Potential for expanding equipment and infrastructure sales to support SRI operations.</li> </ul>

### 7.3 Impacts During Development

This section addresses the impacts the SRI system user community will experience while the system is being developed and deployed. During the prototype development phase there will be a need for continuous user testing and feedback due to the concurrent design and development approach. Demonstrations and test activities will need to be conducted using real roadside facilities and existing user forums. The CVSA spring and fall conferences, Technology Maintenance Council (TMC), and other forums provide an excellent venue for reaching a representative cross-section of the user communities. The information will be limited to the results of the prototype test, but a continuing dialogue with the user communities will be important to ensuring that potential issues and concerns are identified.

The actual quantity of data that will be generated through the prototype test may be limited. However, to demonstrate the potential benefits of SRI and to ensure the ongoing support of the motor carrier and enforcement communities, data integrity and quality performance measurements will need to be collected, analyzed, and disseminated during the development phases. Demonstrating data integrity and quality performance will help build the level of confidence that enforcement and motor carrier communities will need to continue with SRI once the prototype is completed.

The expected impacts for both Tier I and Tier II users are summarized in Table 16 below.

**Table 16. Users Impacts during Development**

User Designation	Description
<b>Tier I Users</b>	
CMV Enforcement Officer	<ul style="list-style-type: none"> <li>Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>User interface design and testing, including customization.</li> </ul>

User Designation	Description
	<ul style="list-style-type: none"> <li>• Developing business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing</li> <li>• Involvement in documentation development and required training.</li> </ul>
CMV Driver	<ul style="list-style-type: none"> <li>• User interface design and testing, including customization.</li> </ul>
Motor Carrier	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• User interface design and testing, including customization.</li> <li>• Development of business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> <li>• Involvement in documentation development and required training.</li> </ul>
CMV Enforcement Supervisor	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• User interface design and testing including customization.</li> <li>• Development of business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> <li>• Involvement in documentation development and required training.</li> </ul>
Third Party Providers	<ul style="list-style-type: none"> <li>• User interface design and testing, including customization.</li> <li>• Development of business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> <li>• Involvement in documentation development and required training.</li> </ul>
<b>Tier II Users</b>	
MCSAP Lead Agency Manager	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• User interface design and testing, including customization.</li> <li>• Development of business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> <li>• Involvement in documentation development and required training.</li> </ul>
Motor Carrier Safety Program Personnel	<ul style="list-style-type: none"> <li>• User interface design and testing including customization</li> <li>• Development of business rules and controls for field operations</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing</li> <li>• Involvement in documentation development and required training</li> </ul>
FMCSA Personnel	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• User interface design and testing, including customization.</li> <li>• Development of business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> <li>• Involvement in documentation development and required training.</li> </ul>

User Designation	Description
FHWA Size & Weight Personnel	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• User interface design and testing, including customization.</li> <li>• Development of business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> <li>• Involvement in documentation development and required training.</li> </ul>
NHTSA Personnel	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> </ul>
Other State Agency Personnel	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• User interface design and testing, including customization.</li> <li>• Development of business rules and controls for field operations.</li> <li>• Involvement in reviews and demonstrations, evaluation of modifications, and acceptance testing.</li> <li>• Involvement in documentation development and required training.</li> </ul>
CMV and Equipment Manufacturers	<ul style="list-style-type: none"> <li>• Involvement in studies, meetings, and discussions prior to design and programming.</li> <li>• Provide equipment and hardware .</li> </ul>

# 8 Analysis of the Proposed System

USDOT's goals for SRI that are the motivation for the development of this system identify several intended outcomes from its implementation in the form of systems. This section offers some analysis of how systems developed under this conceptual framework might benefit potential users.

## 8.1 Summary of Improvements

At its core, the SRI program is intended to provide benefits that span a broad range of areas. The system described in this concept of operations, in conjunction with complementary efforts under the V2X cooperative systems program, has the potential to result in significant advancements in information exchange and processing, which will:

- Enhance safety by better enabling the enforcement community to identify and take enforcement action against non-compliant motor carriers and drivers;
- Enhance size and weight enforcement on secondary roads and fixed facility by-pass routes as well as enhance mainline enforcement, with the end result of reducing damage to the highway infrastructure; and
- Enhance mobility in meeting freight delivery requirements for safe and compliant carriers through ES/VWS and WRI, thus reducing redundancy in enforcement actions and promoting safe and compliant operations.

### 8.1.1 New Capabilities

New capabilities to be tested through the SRI Prototype Test include:

- Enhanced exchange of information at roadside (via vehicle-to-vehicle and vehicle-to-infrastructure communication) at mainline speeds to support such activities as mobile enforcement compliance checks;
- Assignment of unique identifiers to drivers, vehicles, and motor carriers that can be exchanged at mainline speeds;
- Common protocols and communications standards for the exchange of information;
- Interoperable applications;
- Temporal targets for measuring the speed of data exchanges occurring between the vehicle and roadside equipment; and
- Supplying information to motor carriers and drivers about motor carrier services in real-time (e.g., truck parking).

## 8.1.2 Enhanced Capabilities

The integration of multiple systems through the proposed SRI enterprise-level application will significantly enhance the exchange of data between the roadside and external systems. As a result of this integration through SRI, the enforcement community will be able to exchange information on motor carrier, driver, and vehicle safety conditions, company and vehicle safety history, and compliance with credentialing requirements using external systems on a near real-time basis.

Another enhanced capability will be the additional sources of data that can be used to support FMCSA's CSA program, calculating a motor carrier's safety rating in particular. The additional data sources will also provide substantially enhanced data on driver and vehicle performance and will significantly expand the total number of data points included in State and Federal motor carrier safety history and credential databases.

Finally, the use of SRI applications on secondary roads and fixed facility by-pass routes will enhance size and weight enforcement and reduce damage to road systems.

## 8.1.3 Deleted Capabilities

The SRI prototype application is intended to enhance and expand current operations. To this end, the Research Team did not identify any capabilities that will be deleted as a result of a successful SRI prototype test.

## 8.1.4 Improved Performance

The most significant improvements that will result from SRI include:

- Enhancing the ability of enforcement personnel to identify non-compliant load movements and focus enforcement resources on those vehicles requiring a closer look;
- Removing compliant vehicles from enforcement queues, thereby improving productivity in the transportation sector;
- Exchanging data between vehicles and between vehicles and the roadside in near real-time.
- Providing additional sources of data for the enforcement community to use in making enforcement and inspection decisions (near real-time data on driver and vehicle performance as examples);
- Using ES/VWS and WRI on road systems not currently monitored on a regular basis by the enforcement community; and
- Enabling service providers to supply the motor carrier community with near-real-time access to information on services (e.g., truck parking).

## 8.2 Disadvantages and Limitations

The primary disadvantage facing the SRI prototype test is that only one vehicle will be provided with complete instrumentation. While this will enable the Research Team to test SRI applications and

supporting communications and roadside infrastructure, using only one vehicle is more in line with a proof of concept rather than a full prototype test.

A second limitation of the SRI prototype test is that the project scope and budget limits the number of sites at which to execute the test. The Research Team has identified two potential sites that can be used to support the prototype test, but these are both located in the same geographic region, at the Connected Vehicle Test Bed in Michigan and the North Dakota State University Test Facility in Fargo, North Dakota. Identifying a test site in a different region would enable prototype applications testing under different weather conditions and different approaches to enforcement operations.

### **8.3 Alternatives and Trade-Offs Considered**

The Research Team has done an extensive review of existing systems and applications that are currently deployed to promote CMV operations in the areas of both enforcement and services. This included the Task 2 and 3 reviews of existing deployments and current research and site visits to two States (New Mexico and Missouri) that are currently deploying SRI applications provided by a private sector vendor.

The key element that the Research Team noted in reviewing the current state of the systems/environment is that while these systems do support specific SRI applications, no system offered an integrated solution. Further, the SRI prototype that will be developed will be tested to assure its compatibility with all other aspects of the USDOT connected vehicle initiative.

The Research Team determined that the best approach for conducting the SRI prototype test was to develop an application that offers such an integrated solution, as discussed in section 5 and summarized as having:

- A customized user interfaces designed to meet the unique requirements of user groups;
- An enterprise-level application with full systems integration; and
- A data buffer that enables the temporary storage of data needed by users for quick access.

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