Truck Size and Weight Enforcement Technologies

Implementation Plan






U.S. Department of Transportation
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Implementation Plan

Truck Size and Weight Enforcement Technologies

prepared for

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prepared by

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1.0 Introduction

1.1 VISION

In response to growing demands placed on truck enforcement programs, the Federal Highway Administration (FHWA) and Federal Motor Carrier Safety Administration (FMCSA) have partnered in support of the Smart Roadside Initiative, an undertaking designed, in part, to extend truck inspection capabilities away from the traditional fixed site environment to the roadside. 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 in order to improve motor carrier safety, operational efficiency, and freight mobility. This vision will be achieved through the application of interoperable technology and information sharing between in-vehicle, on-the-road, and freight facility systems.

An array of benefits has been associated with adding automated tools to current truck inspection activities, including:

- Less infrastructure damage caused by overloading;
- Safer highway operations;
- Lower overall highway-based vehicle emissions;
- Reduced transport costs and enhanced global competitiveness; and
- Substantially decreased time between inspections.

Development, testing, and deployment of advanced technologies that accurately measure commercial vehicles while they are in motion; determine a motor carrier's or commercial vehicle's compliance with Federal and State size and weight, safety, and credentialing regulations; and target enforcement at noncompliant/high-risk motor carriers and commercial vehicles are key elements of the Smart Roadside. Two essential components of these elements of the Smart Roadside initiative are wireless roadside inspections and virtual weigh stations, both of which facilitate dramatic improvements in the scope and effectiveness of roadside enforcement. The wireless roadside inspection increases the frequency of roadside safety inspections through the use of on-board systems and roadside and communication technologies. Virtual weigh stations increase the frequency of roadside size and weight measurements through the expanded monitoring of bypass, secondary, remote, and urban routes and targeting of enforcement action on high-risk carriers and vehicles. Depending on their configuration, virtual weigh stations also have the potential

to increase the frequency with which a motor carrier's/commercial vehicle's compliance with Federal and State safety and credential regulations is verified.

1.2 PURPOSE OF PLAN

The purpose of this Implementation Plan is to recommend strategies to encourage the deployment of roadside technologies to improve truck size and weight enforcement in the United States. The plan includes strategies that State practitioners can use to overcome typical challenges confronting the deployment of virtual weigh stations and other roadside enforcement operations (Section 3.0) and overall program support that FHWA needs to provide to jurisdictions looking to deploy virtual weigh stations and other operations (Section 4.0). The plan is the final deliverable in FHWA's Truck Size and Weight Enforcement Technology project conducted by Cambridge Systematics. The goal of the project was to encourage and facilitate states' technology deployments as a means to improve the efficiency and effectiveness of roadside enforcement.

The Truck Size and Weight Enforcement Technology project consisted of seven interrelated tasks. The results of each task were described in a series of memoranda. Task 7 incorporates the task results into the Implementation Plan. The preceding tasks were:

- **Task 1 –** Produce a diagram that illustrates how roadside technologies could be combined to improve the efficiency and effectiveness of various elements of the roadside enforcement process in the United States;
- **Task 2 –** Evaluate the state of the practice for using roadside technologies in enforcement activities. Develop a concept of operations for the virtual weigh station, describing the goals, functions, key concepts, architecture, operational scenarios, operational policies, and impacts of virtual weigh stations;
- **Task 3 –** Identify and describe institutional, technical, regulatory, legal, and other issues that can be expected to hinder the development or deployment of roadside technologies for enforcement;
- **Task 4 –** Produce guidelines on the use of weigh-in-motion technology in roadside enforcement;
- **Task 5 –** Determine the feasibility of sharing data collected from roadside enforcement systems with motor carriers, in order to improve private sector operations; and
- **Task 6 –** Determine how other Federal agencies could improve their programs and operations by leveraging data generated from roadside size and weight enforcement technologies.

Task 1 produced the "American Lego diagram," a tool that was adapted from the Netherlands and applied to the roadside environment of the United States.

Technologies are depicted as building blocks that can be added to a truck weight enforcement program to realize greater enforcement efforts using fewer human resources. As building blocks, the technologies can be combined into different solution sets in order to serve multiple purposes at the roadside and to meet a jurisdiction's unique needs and operational objectives. From this model virtual weigh stations and other roadside systems are constructed from individual technologies and used for enforcement purposes. Coordination and integration of technologies is, in fact, the core "mission" of the Smart Roadside Initiative.

New data was collected for this project during Tasks 2 and 5. Task 2 was supported by an expanded data collection effort designed to capture the "best practices" of states with differing approaches to utilizing technologies. Emphasis was placed on weigh-in-motion (WIM) activities during State site visits and phone interviews. Information about other technologies used by states for enforcement, especially technologies used in association with WIM, also was captured. Task 5 featured interviews conducted with representatives from electronic roadside programs, motor carrier industry associations, and individual motor carriers.

The focus of this Implementation Plan is enforcement applications of WIM technology, including other technologies associated with WIM at the roadside.

1.3 ORGANIZATION OF PLAN

This document contains four sections. The sections are the following:

1. **Section 1.0, Introduction –** Provides the context for developing an implementation strategy and describes the purpose of this plan.
2. **Section 2.0, Summary of Benefits and Challenges –** Presents an overview of the benefits and challenges of deploying roadside technologies.
3. **Section 3.0, Strategies –** Recommends strategies that can be used by states to mitigate challenges and facilitate deployment of roadside technologies.
4. **Section 4.0, Program Implementation –** Describes the program support that needs to be offered by FHWA to help states overcome the challenges.

Two appendices also are included in this document. **Appendix A** is a list of acronyms. **Appendix B** is a "Reference Guide to Deploying Roadside Technologies" that summarizes the important steps that can be taken by states in order to incorporate new roadside technologies into their enforcement programs. States are encouraged to tailor or modify the guide to suit their particular circumstances and needs.

2.0 Summary of Benefits and Challenges

2.1 BACKGROUND

In Task 2 of this project, FHWA and Cambridge Systematics interviewed stakeholders from nine states that are at the forefront of the deployment of roadside enforcement systems. Site visits were conducted in four of these states. During the course of these interviews and visits, several standard applications of roadside technologies were identified. These standard deployments include:

- **Traffic monitoring WIM systems** support pavement research, facility design, infrastructure maintenance, infrastructure planning, and evaluation of congestion trends. Data used for traffic monitoring, pavement monitoring, etc., also can be used to help determine where new WIM systems should be installed to better target enforcement of overweight trucks. Some states use the WIM information to assign enforcement resources. Although these activities have enforcement-related impacts, they are primarily planning activities.
- **Mobile screening at WIM sites** consists of an enforcement officer at the roadside physically monitoring real-time WIM data on a laptop computer and visually sorting out trucks suspected of being overweight, which will be intercepted for inspection. Patrol vehicles are located within sight distance of the WIM cabinet, often at the WIM site, in order to facilitate the visual matching of a commercial motor vehicle (CMV) with its WIM data. WIM sites used for mobile screening operations are not continuously monitored. Enforcement personnel may conduct screening operations at a site according to a schedule or on a day-to-day basis, often as resources permit.
- **Virtual weigh stations** are roadside enforcement facilities that are not continuously staffed and are monitored from another location. A "basic" virtual weigh station (VWS) includes mainline WIM, a camera system, and high-speed communications, for use in real-time truck screening. An enhanced VWS may include one or more optional technologies, including automatic vehicle identification (AVI) capabilities in the form of optical character recognition (OCR) technologies such as a license plate reader (LPR) and United States Department of Transportation (USDOT) number reader, overheight detection sensors, augmented screening software (e.g., information from safety and vehicle databases integrated with WIM and image data), and enhanced communication infrastructure.
- **Fixed site-based mainline weight screening** utilizes WIM on the mainline to screen vehicles traveling at highway speeds for weight compliance as they

approach a weigh station, signaling vehicles either to bypass or pull-in to the station for further inspection. When used as part of an electronic screening or bypass system such as PrePass or NORPASS, WIM provides real-time weight verification concurrent with safety and credentials verification for bypass eligibility. Vehicles cleared for bypass are not generally directed to pull into the weigh station.

- **Ramp sorting** employs WIM on weigh station ramps to weigh and sort vehicles traveling at slow speeds, signaling vehicles either to use the bypass lane to return to the highway or proceed to the static scale for weighing. Compared to mainline WIM systems, ramp WIM systems weigh vehicles moving at lower speeds and provide a more accurate measure of a vehicle's weight. Ramp sorting combined with a bypass lane can process more vehicles than could be supported by static weighing alone.

2.2 BENEFITS

Previous project tasks have described the benefits associated with deploying roadside technologies. Roadside technologies and their key benefits are summarized below.

Traffic Monitoring WIM Systems

Mainline WIM systems are commonly used to collect traffic characteristics information for analysis of travel and weight trends, pavement and bridge monitoring and management, pavement design, and development of emissions models; this information is used by the State transportation or highway agency. Additionally, some states' enforcement agencies use the WIM information to make more effective use of enforcement resources, assigning personnel based on occurrences of recorded weight violations. Historical data from WIM systems can be used to focus inspections at locations where noncompliant and overweight trucks are known to travel. Factors such as levels of truck traffic and frequency of overweight trucks at a site broken down by day and time of day are used to determine the most productive locations, days, and times for scheduling mobile enforcement teams.

Data on CMV travel patterns could be used to determine the most commonly traveled freight corridors, for example, to support Federal and State freight planning initiatives. Vehicle dimension data could be used by FHWA to identify the highways that carry the largest number of commercial vehicles, as well as the heaviest annual loads. This data could be integrated with existing pavement and bridge management processes, in order to target maintenance funding at high-traffic/high-weight/high-risk corridors.

Mobile Screening at WIM Sites

In a typical mobile screening environment, an enforcement officer at the roadside with a laptop computer receives individual axle weights and gross vehicle weights that are wirelessly transmitted from the WIM device on the mainline to the mobile officer's laptop. The officer physically monitors the real-time WIM data on the laptop and visually identifies the trucks that are overweight according to the data received. The potentially overweight trucks are then intercepted for inspection after traveling past the WIM site. Mobile screening makes it much easier to identify overweight trucks. In fact, having quantifiable performance measurements (i.e., individual axle weights and gross vehicle weights) avoids stopping vehicles that are legal according to weight thresholds established by the State. Moreover, screening keeps the industry moving by not weighing trucks that are legally loaded.

Mobile screening at WIM sites provides increased opportunity for enforcement by providing added capacity for resources, allowing for enforcement that is not disruptive to the travel stream, and guaranteeing more efficient delivery of enforcement actions through targeted intervention. In many cases, WIM systems chiefly used for data collection can be upgraded to contain mobile screening capabilities at relatively low cost. Traffic monitoring functions (e.g., availability of data for State and Federal planning purposes) have remained intact, while the addition of screening capabilities is attractive to the State's enforcement agency and optimizes the utility of the WIM equipment. These WIM sites may be located in areas currently not monitored by fixed or mobile enforcement resources, or new WIM systems may be installed for the same reasons – to expand the geographic scope of the State's truck size and weight enforcement program and remove illegally operating, overweight trucks from the roadways. As a result, mobile screening operations help to protect and preserve the roadway infrastructure, improve safety, and level the playing field for safe and legal carriers.

Virtual Weigh Stations

A virtual weigh station is similar to a mobile screening site, but a VWS includes the addition of a camera system, at minimum, and possibly additional technologies, such as a LPR or USDOT number reader. While in use for enforcement purposes, both a mobile screening site and a VWS require human monitoring of the real-time data generated by the WIM installation. A VWS deployment, compared to mobile screening, does not require the monitoring officer to be positioned at or near the WIM site. The addition of a camera allows an officer to be located at a much greater distance from the site, affording lower visibility of enforcement activities. The same data and images viewed by an officer located downstream of the WIM site may be viewed by enforcement personnel in a fixed facility. Instead of an officer located downstream performing monitoring and weighing functions, personnel viewing the WIM data and images at another location such as a central office or weigh station

could dispatch nearby enforcement units to intercept and weigh suspect vehicles identified on the monitor.

Flexibility in the positioning of the patrol vehicle was mentioned by several states participating in the project as a key advantage of digital imaging deployment at a VWS. Furthermore, in areas with high truck volumes, a suspect vehicle can be identified by its photo integrated with its WIM record. A LPR or USDOT number reader can be deployed to provide the VWS with digital image capture and identification through a digital camera or cameras augmented with specialized OCR software to isolate and identify specific characters and numbers making up a license plate number and/or USDOT number. LPRs and USDOT number readers are forms of AVI. AVI relieves the need for any kind of manual visual recognition, whether it is based on direct observation of the vehicle itself or examining a photo of the vehicle. AVI deployment allows screening on safety, credentials, and criminal justice information as well as weight by associating WIM readings and can considerably reduce the time required to retrieve additional information about a suspect vehicle.

Benefits that accrue to stakeholders from VWS deployment are described below. These benefits are similar to the benefits associated with mobile screening.

- **Targeted enforcement focused on high-risk carriers and vehicles –** Trucks that exceed weight thresholds established by the State are identified by the WIM system and screening software; in expanded VWS deployments, a vehicle can be automatically identified and screened for weight, safety, and credentials. The screening software will assign weights to the various factors and determine if the vehicle will be targeted for closer inspection.
- **More effective use of roadside enforcement resources –** The State's enforcement agency is able to focus its limited human enforcement assets on commercial vehicles that are known to be overweight or have other increased risk factors.
- **Improved monitoring of bypass, secondary, remote, and urban routes –** VWS can be located where a fixed weigh station would not be feasible for environmental or cost reasons. For example, virtual sites can be located in urban areas more readily than fixed, staffed weigh stations. They also may be located where a fixed, staffed site is not needed, but where violators are likely to travel. This expansion of the enforcement network removes additional violators from the system and helps to level the playing field for safe and legal carriers.
- **Increased protection and preservation of the roadway infrastructure –** By expanding the geographic scope of the truck size and weight enforcement program and deploying enforcement assets into areas currently not monitored by fixed or mobile enforcement resources, VWS deployments have the potential to dramatically reduce the damage done to the roadways by

overweight vehicles operating illegally (i.e., without a valid oversize and overweight [OS/OW] permit).

- **Improved air quality –** The targeting of noncompliant CMVs decreases the number of trucks that are stopped for roadside inspections. The reduction in stopped and idling trucks has the potential to reduce greenhouse gas (GHG) emissions and improve air quality.
- **Reduced delays for safe and legal carriers and vehicles –** Vehicles identified by the VWS as operating within legal weight limits (and at expanded VWS sites, screened for and found to not have additional risk factors) are allowed to proceed at highway speed without being subject to roadside enforcement action.
- **Improved asset tracking –** Expanded VWS deployments can generate the requisite data (e.g., vehicle identification, date, time, location) to allow a motor carrier to track its commercial vehicles' movements.
- **Improved freight data for planning –** Virtual sites can provide data on the movement of commercial vehicles across the State's transportation system, which is critical to freight planning. These data can be used to identify corridors that support CMV traffic, as well as to provide inputs to travel demand models that forecast the impact of a change to a region's infrastructure.
- **Improved vehicle identification, location, dimension, and performance data –** These data have a number of existing and potential uses as described in the Task 6 deliverable (describing Federal agencies' potential uses of data generated from roadside size and weight enforcement technologies). For example, vehicle identification and location data generated by VWS technologies could be used by State and Federal agencies for tracking hazardous materials or imported plants, and performance data could be used to monitor compliance with emissions standards in real-time. FMCSA's wireless roadside inspection (WRI) program could integrate data from the roadside size and weight enforcement technologies with the on-board WRI systems to provide a more comprehensive package of data for analysis. Vehicle identification, dimension data, and carrier history of compliance/noncompliance with Federal or State truck size and weight regulations will be particularly important to WRI.

Fixed Site-Based Mainline Weight Screening

WIM systems are used to screen vehicles on the mainline (ML) for weight compliance as they approach a weigh station. Trucks that exceed the threshold are directed into the weigh station to be weighed on more accurate static scales used to write citations. Mainline weight screening produces a number of benefits. Weigh-in-motion significantly increases the capacity of weigh stations. In the absence of mainline WIM, queues may form and cause closure of weigh stations; as a result, compliance checks are not performed on the bypassed

vehicles. WIM also reduces congestion within the fixed weigh station facility; focuses enforcement on high-risk operators, thereby increasing enforcement personnel's effectiveness; and provides time savings for safe and legal carriers, supporting more efficient movement of freight. The reduced number of trucks that idle and stop as they enter the weigh station queue to be weighed on the static scale also improves air quality.

When used as part of an electronic screening or bypass system such as PrePass or NORPASS, WIM provides real-time weight verification concurrent with safety and credentials verification for bypass eligibility. Data (e.g., vehicle identification, date, time, location) are generated by these deployments that can allow a motor carrier to track its vehicles' movements. Additional benefits of mainline weight screening deployments include the availability of WIM data for freight planning and other State and Federal monitoring, tracking, and screening purposes.

Ramp Sorting

WIM scales are also installed on weigh station ramps to weigh and sort vehicles at low speeds. Vehicles that have left the main highway move to the approach ramp where they are weighed by a ramp, or sorter, WIM. The ramp WIM sorts the arriving trucks based on a weight threshold set by weigh station personnel. Axle spacing, vehicle height, and vehicle classification also may be determined. Vehicles that do not exceed the threshold are signaled by a message sign to move to the bypass lane for return to the main highway. Remaining vehicles are directed to the static scale for weighing.

Ramp sorting combined with a bypass lane can process more vehicles than could be supported by static weighing alone. Several states participating in the project reported that they plan to install additional sorter WIM systems in order to increase throughput at the weigh station. While not as effective as mainline WIM in reducing delays for safe and legal carriers and vehicles, ramp systems provide a much quicker alternative to static scale processing.

Table 2.1 summarizes the benefits of the various roadside technologies and identifies the stakeholder groups that accrue the benefits.

Table 2.1 Benefits of Roadside Technologies

Benefit	Benefit Applies to				Benefit Derived from					
	Enforce-ment	**DOT**	**Motor Carrier**	**Federal**	**WIM – Traffic Data**	**WIM – Mobile Screen-ing**	**VWS With Camera**	**VWS With OCR**	**WIM – ML Screen-ing**	**WIM – Ramp Sorting**
Targeted enforcement focused on high-risk carriers and vehicles	●		●	●		●	●	●	●	●
More effective use of roadside enforcement resources	●				●	●	●	●	●	●
Reduced weigh station congestion/mainline backups	●	●	●						●	●
Improved monitoring of bypass/ secondary/remote/urban routes	●	●	●			●	●	●		
Increased protection/preservation of roadway infrastructure		●		●		●	●	●	●	●
Improved air quality	●	●	●	●		●	●	●	●	●
Reduced delays for safe and legal carriers and vehicles	●		●			●	●	●	●	●
Improved asset tracking			●				●	●	●	
Improved freight data for planning		●			●	●	●	●	●	
Improved vehicle identification, location, dimension, and performance data	●	●		●	●	●	●	●	●	

2.3 CHALLENGES

Despite the potential of advanced technologies to dramatically improve the effectiveness and efficiency of roadside enforcement operations, a number of challenges commonly confront states that attempt to deploy these systems. These challenges include:

- Cost;
- Manpower requirements;
- Interagency cooperation;
- Data issues;
- Technology performance;
- Funding; and
- Lack of standards/architecture.

These challenges are described below. Strategies that have been employed successfully by states to overcome these challenges are presented in Section 3.0. Program support that needs to be offered by FHWA to help states overcome these challenges are presented in Section 4.0.

Cost

WIM systems vary considerably in cost. An example of a low-cost WIM device that has been deployed in the United States, especially for traffic monitoring purposes, is the piezoelectric sensor. Recently, several states have begun including quartz piezo WIM systems in their programs because of their usefulness in truck enforcement activities. Quartz piezo WIM devices, like electric piezos, are relatively inexpensive and not difficult to install. One State participating in the project reported the cost per lane of piezoelectric WIM as $16,000, the cost of quartz piezo WIM as $29,000, and the cost of bending plate WIM as $40,000. Another State reported the cost per lane of a single load cell system as $87,500. Comparatively expensive systems like load cell and bending plate also are significantly more intrusive to the pavement structure. However, the expected service life of the WIM instrument is greater with higher cost. The accuracy of weight estimates reported for quartz piezo, bending plate, and single load cell systems is about 95 percent; piezoelectric accuracy rate is lower, at about 85 percent.

When WIM systems are used for screening purposes, additional cost elements are required that can substantially raise deployment costs. Most costly is construction of a new weigh station with mainline WIM screening and/or ramp sorting capabilities. Construction, equipment, and operations and maintenance (O&M) costs were identified by participating states as a primary reason states are not building new weigh stations. A "typical" weigh station can cost $12 million

to build. If land must be purchased, the cost of a new weigh station can approach $300 million. In comparison, adding a mainline WIM system to an existing weigh station is a fraction of the cost.

Virtual weigh stations are a low-cost alternative to a new weigh station. Costs associated with VWS deployments vary by the scope of the VWS being deployed, the amount of existing infrastructure that can be leveraged by a State, as well as the type of technology being deployed. Based on requests to FMCSA for Federal Commercial Vehicle Information Systems and Networks (CVISN) Deployment funds, estimated costs of recent VWS deployments are between $300,000 and $1,400,000.[1] Even the high-end costs are much lower than the costs associated with building a new fixed weigh station. At the lower cost range, a basic VWS consists of WIM (which may be new or existing, thereby affecting the cost), a camera system, and high-speed communications. At the upper cost range, an expanded VWS includes WIM, AVI (such as a license plate reader or USDOT number reader), multiple database linkages, enhanced screening algorithm, and additional technologies.

Deployment of mobile screening at a WIM site is less costly than a virtual weigh station. "Limited incremental costs" were reported by one State for upgrading a WIM site from traffic monitoring data collection only to enforcement (screening). A more robust WIM site with four lanes of new quartz sensors, WIM controller, roadside cabinet, radio frequency transmitter and receiver, and utilities was reported to cost $160,000.

Owing to the very high cost of constructing, operating, and maintaining a weigh station, many states are turning to mobile screening and virtual weigh stations to increase the scope of enforcement activities at less cost and staff than are required by weigh station operations. As states deployed these non-traditional forms of enforcement, they found considerable benefits, to the point where several states reported that better results in identifying overweight trucks were obtained by using WIM sites, either through mobile screening or virtual weigh stations, because of the greater coverage afforded by these WIM applications.

Manpower Requirements

Arguably the most labor intensive roadside operations are weigh stations, which must support a complement of size, weight, and safety specialists on a continuous basis when the weigh stations are open. Mainline weight screening and ramp sorting using WIM systems automate much of the process of weighing vehicles approaching or entering weigh stations, but staff still are needed to interact with vehicles that must be weighed on the static scale. For a new weigh station, personnel previously assigned to other duties will be needed to operate

[1] Data is from State applications for Federal CVISN Deployment Grant applications, Fiscal Years 2006-2008.

the new facility, drawing officers away from existing operations, including mobile patrols.

Inasmuch as virtual weigh stations today serve only as screening tools for roadside enforcement personnel, VWS deployments require that a human weigh a truck and issue a citation for any overweight or compliance issue that may be detected. As such, despite the presence of VWS technology a State's enforcement capacity remains limited to the number of enforcement personnel that are on duty at one time in a given region. These enforcement resources can be easily overwhelmed by the number of noncompliant vehicles operating in a region thereby reducing the overall utility and effectiveness of the technology.

States participating in the project emphasized that sufficient staffing is critical in any enforcement operation, whether the operations take place at weigh stations, where staffing tends to be continuous, or at WIM sites (as mobile screening) or virtual weigh stations, which do not require continuous staffing, but where resources are necessary to monitor, intercept, and take enforcement action on commercial vehicles.

Interagency Cooperation

Benefits from deploying roadside technologies accrue most noticeably when technologies are combined. In fact, the Task 1 deliverable ("American Lego diagram") illustrated how roadside technologies could be combined to improve the efficiency and effectiveness of various elements of the roadside enforcement process in the United States. The experiences of the states participating in the project provided real-world examples of improving enforcement operations through the integration of technologies.

Many states support weigh stations equipped with mainline and/or ramp WIM, as well as traffic monitoring WIM systems. In a relatively simple enhancement, traffic monitoring WIM sites are upgraded or retrofitted with Wi-Fi (wireless fidelity) connectivity, a transmitter/receiver, a laptop capable of handling data, and software that can display the WIM data, to support real-time weight screening. A camera system and enhanced communication capability and computer software can be added to the WIM site to allow a vehicle to be identified by its photo integrated with its WIM record, as part of a virtual weigh station. Further, virtual weigh stations can be enhanced with automatic vehicle identification that can provide an automated screening decision based on linkages with vehicle, safety, and security databases and screening algorithms.

The challenges facing a State that seeks to deploy systems with multiple technologies, whether by adding on to existing systems or building complex systems anew, are technical and institutional. Virtual weigh stations that support digital imaging, AVI, automatic access to commercial vehicle data, and advanced screening algorithms, for example, rely on a well-designed architecture with documented systems interfaces, data flows, and communications networks. More often than not, it will be a challenge to integrate the technologies into one

system. It also is a challenge to deploy the system with one user interface. As additional technologies (e.g., radiation detection, infrared brake sensing) are added, there is a tendency to add user interfaces (computer screens) to the mix of operations. According to one participating State, any project with multiple technologies will have this problem. Regardless, the goal is to minimize the number of interfaces that enforcement personnel have to monitor.

Interagency cooperation is crucial to the success of non-traditional enforcement applications such as mobile screening and virtual weigh stations. The importance of interagency teamwork was expressed by several states as an essential requirement for deploying virtual weigh stations because of the need to involve the State's transportation or highway agency, chief enforcement agency, and motor vehicle agency in designing the deployment. The multiple technologies associated with the virtual weigh station rely on a team concept for successful deployment, according to one of the participating states. Interagency cooperation also is essential to ensure multiple objectives are met when deploying a new mainline WIM application in the vicinity of a weigh station. Enforcement needs as well as data collection needs should be coordinated during planning and design. Mobile screening often utilizes existing traffic monitoring WIM systems that have been upgraded to enable real-time weight screening. The new enforcement needs, as well as new equipment (e.g., communication capability), must be integrated with the existing data collection functions. In many cases, the interests of multiple agencies are involved and these agencies must work together to establish an effective and mutually beneficial WIM application.

Data Issues

Motor carriers expressed concerns about the data generated from roadside enforcement technologies in interviews conducted in Task 5. These concerns involve data retention, usage, and privacy. The issues are described briefly below.

- Data should not be retained for "extended" periods of time. It was suggested that data should be retained for no longer than 30 to 90 days. The concern about retaining data beyond 30 to 90 days relates to a general concern that some interviewees expressed about data being subpoenaed and used against them.
- All of the data collected at the roadside should be used to accomplish specific safety goals or other tangible goals that are in the public's interest. Data should not be collected merely for the sake of collecting data. It also was pointed out that using roadside technologies for purposes beyond specific safety or public interest goals could impact carrier participation in roadside programs.
- Data privacy is a major concern of industry. In particular, motor carriers do not want operational data or data about their customers to fall into the hands

of their competitors. On a related note, several representatives indicated that to the extent that data generated by roadside systems will be used for planning purposes by the states or the Federal government, the data should be cleansed of unique identifiers so that it cannot be attributed to individual carriers.

Technology Performance

Performance issues with AVI technologies commonly used in advanced virtual weigh stations can jeopardize the widespread deployment of virtual weigh stations as a means to identify and screen all commercial vehicles. The only identifiers that currently are common to all CMVs are license plates, vehicle identification numbers, and USDOT numbers (for interstate motor carriers, as well as intrastate motor carriers in states participating in the Performance and Registration Information Systems Management [PRISM] program). These identifiers were designed to be read by a human and not by a machine or automated system. Because of this limitation, and operational and environmental factors related to these OCR technologies frequently used in virtual weigh stations, LPRs and USDOT number readers are not currently able to accurately identify 100 percent of CMVs that are screened.

While in-cab transponders are commonly used for AVI at fixed sites in association with electronic screening with excellent results, they have not been deployed at virtual weigh stations because system operators want to screen all CMVs, not only the modest number of vehicles with transponders. As most experts believe that accuracy will never approach 100 percent because license plates and displayed USDOT numbers are not standardized and not optimized for automated reading, it may be necessary for the stakeholder community to establish a universal, electronically readable identifier for commercial vehicles. It is within this context that the Federal Highway Administration is undertaking a universal truck identification project that will encourage the implementation of a technology that can accurately identify all CMVs at the roadside.

WIM technologies in use today for screening provide 85 to 95 percent accuracy of highway speed weight estimates. States that have deployed virtual weigh stations report the performance of WIM systems as excellent for screening purposes. However, inasmuch as greater accuracy will result in fewer trucks that require static weighing, which will conserve resources and eliminate delays for more trucks, higher performing WIM systems will be a considerable benefit to states. For direct weight enforcement to be adopted in the United States, 100 percent accuracy in determining a vehicle's weight will be necessary. As such, current WIM technology cannot support direct enforcement in the United States.

Funding

Lack of funding is a major impediment to the deployment of virtual weigh stations and other roadside technologies. Federal CVISN funds currently are the primary source of funding that states are pursuing to support the deployment of

virtual weigh stations. To date, 14 states have applied for CVISN funds for this purpose. While this is an effective source of funds with favorable rules regarding the State/private sector match that is required, several factors may impact its utility.

First, the CVISN Deployment Grant program is only authorized through Federal Fiscal Year (FY) 2009, which concludes on September 30, 2009. While FMCSA has requested an extension of this program, the future of the funding program will not be determined until Congress completes the highway bill reauthorization. Second, states can only receive a combined $3.5 million in Federal funding to support its CVISN program under TEA-21 and SAFETEA-LU. A handful of states already have reached this limit and therefore are ineligible to receive additional Federal funding to support their CVISN programs. Even if the CVISN program is reauthorized as part of the new highway legislation, this $3.5 million ceiling could limit the utility of the funding source for some states. Finally, states are required to deploy basic (i.e., Core) functionality as part of the CVISN program. This Core CVISN functionality (e.g., electronic credentialing, safety information exchange, and electronic screening) may require all of a State's available CVISN funding and therefore not leave sufficient funding to support the deployment of additional functionality (i.e., virtual weigh stations).

Lack of Standards/Architecture

The CVISN Architecture "identifies the general vehicle, general driver, and CVO-unique aspects of the National ITS Architecture."[2] While states have a great deal of flexibility in determining how to deploy CVISN functionality, the National CVISN Architecture with its pre-defined interface standards and data models ensures that data can be shared effectively and accurately across jurisdictional boundaries. An architecture has the following high-level benefits:

- It provides a common framework against which systems are developed, modified, or refined;
- Using this common framework makes it easier for stakeholders to communicate with other stakeholders to exchange information; and
- It identifies where standard interfaces are needed to support interoperability between systems and jurisdictions.

Relatively new roadside operations such as virtual weigh stations do not have an established architecture. This makes it difficult for various jurisdictions to achieve consistency in designing and deploying technologies, communications,

[2] *Commercial Vehicle Information Systems and Networks (CVISN) System Design Description*, The Johns Hopkins University Applied Physics Laboratory, June 2009, page 10. "ITS" refers to Intelligent Transportation Systems.

software, interfaces, and user services. Communication about a "virtual weigh station" frequently causes confusion as different jurisdictions conceptualize VWS differently.

In view of the increasing number of virtual weigh station deployments without a common framework, FHWA in Task 2 of this project directed the development of a concept of operations (ConOps), including a high-level architecture, for the virtual weigh station. The ConOps will be available in June 2009.

3.0 Strategies

3.1 OVERVIEW

Deployment of roadside technologies can provide numerous benefits to State, Federal, and motor carrier stakeholders. Deployment is associated with several significant challenges that pose potential obstacles that should be addressed during the planning process.

The goal of the project is to encourage and facilitate the deployment of roadside technologies to improve truck size and weight enforcement in the United States. In support of this goal, strategies are recommended to assist states in mitigating the challenges and realizing successful deployment. These strategies have been employed successfully by states to overcome deployment challenges.

Table 3.1 summarizes how these strategies address the challenges associated with the deployment of roadside enforcement technologies. Descriptions of the strategies follow the table.

Table 3.1 State Strategies to Address Deployment Challenges

Challenges	Develop Business Case	Seek Best Practices	Develop Technology Roadmap	Identify Champions	Build Partner-ships	Maximize Funding
Cost	●	●	●		●	●
Manpower Requirements	●		●	●		●
Interagency Cooperation	●	●		●	●	
Data Issues	●	●		●	●	
Technology Performance		●	●			
Funding	●	●	●	●	●	●
Lack of Standards/ Architecture		●	●			

3.2 DEVELOP BUSINESS CASE

In order to ensure a coordinated and strategic deployment of roadside technologies, it is recommended that states develop a business case and/or program plan to guide their deployments. A business case enables a State to obtain management commitment and approval for investments in technologies and provides a framework for planning and managing the "business" changes that will occur when new technologies are introduced.

Each State's business case for technology deployments should be based on their particular environment and needs. A typical business case will include a description of needs and/or problems, proposed solutions, assumptions and constraints, alternatives, and benefits and costs. For deployment of roadside technologies, the following questions should be part of the business case:

- Where on the highway system do size, weight, and safety problems exist?
- What technologies are available, through procurement or development, to address the problems?
- What resources are available in the State (e.g., human, existing technologies/systems, access to Federal grants) to apply to the problems?
- What other agencies, organizations, or parties in the State (or region) have a potential interest or stake in solving the identified problems?
- What issues/obstacles have to be dealt with in order to move forward (e.g., lack of staff, lack of funding, lack of expertise)?
- How can the State obtain the best return on investing in technology? For example, a State may combine near- and long-term objectives into an incremental plan:
  - Invest initially in "low hanging fruit" (i.e., quick, inexpensive "wins");
  - Leverage and enhance existing deployments; and
  - Follow with more expensive technologies that will be integrated with operating systems.

The business case may reflect the adoption of new or modified size and weight enforcement strategies that support non-traditional enforcement operations in order to alleviate the high costs of weigh station construction and attendant manpower requirements.

3.3 SEEK BEST PRACTICES

The data collection approach of the project was to capture the "best practices" of states with differing approaches to utilizing technologies. Best practices, and the related "lessons learned," consist of guidance and instruction on practices and

planning, policy, technical, or funding issues from experienced peers. Because states deploying roadside technologies face the same problems and struggle with the same issues, transferring information and lessons learned from states experienced in particular technologies to relative newcomers provides benefits of prior work and reduces costs and risks.

Task 2 of this project evaluated the state of the practice for using roadside technologies in enforcement activities. The task deliverable described how roadside technologies are deployed, and how they work with other technologies, to support roadside enforcement. Contact information is given in the deliverable for all states that provided detailed interviews or hosted site visits of their deployments. These states can be contacted for additional information and to answer specific questions about their deployment experiences.

The Roadside Identification Ad Hoc Team draws its 50 to 60 members from various commercial vehicle-related regulatory agencies in different jurisdictions throughout the United States. The ad hoc team meets on a monthly basis via teleconference to discuss current and evolving technologies that capture information about commercial vehicles at the roadside. Jurisdictions share their experiences with a variety of roadside technologies and systems, provide evaluation results, seek information from other jurisdictions, and discuss how the technologies can be used in new ways to facilitate roadside enforcement as well as produce efficiencies for motor carriers. The team is part of the Federal Motor Carrier Safety Administration's Expanded CVISN program. Section 4.0 also documents how FHWA will make these best practices available to stakeholders.

3.4 DEVELOP TECHNOLOGY ROADMAP

Many states have supported an incremental approach to deploying a suite of systems and technologies. Budget constraints and the need to sequence information technology projects make an incremental approach attractive. Sequential, integrated investments can be expected to lead to optimal program build out and successful delivery of full program capabilities.

A general recommended approach for building a Smart Roadside consists of the following sequence:

- Use of traffic monitoring data (vehicle classification count, continuous classification counts, WIM) to understand where the heavy loadings are occurring on the network;
- Informed placement of enhanced monitoring capabilities supporting effective enforcement resource deployment;
- Installation of automated inspection technologies supporting screening of CMVs for targeted inspections;

- Intervention targeting persistent illegal loading practices observed through effective surveillance; and
- Possibility for direct enforcement (which is NOT a current goal of the Smart Roadside).

A technology "roadmap" must be developed according to the State's particular circumstances, as well as its business case, regardless of whether one was developed formally (in a structured document) or informally (e.g., memorandum, verbal argument). The roadmap will build on the business case by specifying technology solutions, with defined timelines, to help meet established goals. Overall, the roadmap will help plan and coordinate technology deployments.

The roadmap should consist of answers to the following questions:

- What technologies already exist/are used today?
- What technologies can be leveraged? What changes will be needed?
- What technologies need to be replaced? When will they be replaced?
- What technologies need to be procured? When will they be procured?
- What technologies will be operating in the next three to five years?
- What costs will be associated with these decisions? How will the costs be borne (e.g., most of the costs at the outset, or spread out over time)?

3.5 IDENTIFY CHAMPIONS

A champion is a special stakeholder who is effective at promoting a program or initiative. States may find that inertia will hinder the deployment of new technologies. With respect to roadside technologies, inertia may come from the State's enforcement agency that is resistant to moving from traditional practices such as weigh stations and mobile patrols to virtual weigh stations; or it may come from the State's highway agency that prefers doing "business" the old fashioned way with weigh stations and mobile patrols. Change may be very difficult given conditions such as these, but a champion (or champions) can provide the focused leadership that can "turn the tide" toward new technology deployments.

An effective champion for new roadside technologies can mobilize support within the dissenting agency to obtain buy-in. This individual can communicate the benefits of deployments to all stakeholders, and address the challenges and issues that have the potential to prevent technologies from being deployed. The business case and technology roadmap may be tools that the champion uses to counter resistance. The champion also may lead efforts to identify and secure funding and may coordinate policy and funding decisions.

It is likely that the champion will emerge from the agency that has the most to gain from the technologies. This provides an incentive to work hard to implement the technologies. If the champion is not an agency executive, executive-level support from all affected agencies will be essential for ongoing support in the form of labor and monetary resources.

3.6 BUILD AND NURTURE PARTNERSHIPS

Some states have successfully deployed roadside technologies by forging partnerships between the State's enforcement and highway agencies. A team approach helped several of the states participating in the project install new WIM systems to support mobile screening and virtual weigh stations. Almost all states commented on the need to involve more than one agency to deploy mobile screening and virtual weigh stations. Historically, WIM systems were used by State transportation/highway agencies for statistics collection and planning. In many states, existing traffic monitoring WIM sites were upgraded (or retrofitted) for screening purposes, with new communication capability, computer operating system, and data processing applications. In order for this to occur, the highway agency and the enforcement agency must agree on the mutual benefits to be derived from "double duty" WIM installations.

Similar to the multi-agency teams that support State CVISN programs, these partnerships will provide ongoing interagency communication and ensure that the appropriate stakeholders and decision makers are involved in key decisions throughout the process. One enforcement agency said that becoming partners with the State DOT allowed it to deploy the components needed for mobile screening/virtual weigh station operations. The agencies formed a Commercial Vehicle Strategy Team and embarked on a series of meetings that were specifically designed to improve commercial motor vehicle enforcement. Today, the agencies jointly issue a "Call for Projects and Guidance" related to CMV enforcement and work together to jointly decide where to locate mobile screening locations.

3.7 MAXIMIZE FUNDING

The costs of technologies are a challenge for many states intent on deployment. Various funding sources are available to support deployment. It is important to make use of as many eligible funding sources as possible and to maximize funding sources by pairing technology purchases with sources that may be limited to certain uses.

For example, Federal-Aid Highway Program (FAHP) funding eligibility is determined by the primary intended purpose and use of the WIM system that will be deployed. Construction of WIM systems "that directly facilitate an effective vehicle weight enforcement program" are eligible for FAHP funding as defined under "construction" in Section 101 of Title 23, United States Code

(USC).[3] Therefore, deployment of WIM systems in conjunction with a VWS deployment may be an eligible FAHP expense. WIM systems that are built to primarily support the statewide traffic monitoring program for uses including analysis of travel and weight trends, pavement and bridge monitoring and management, and pavement design, qualify for funding through the State Planning and Research (SP&R) program. These WIM sites can be used secondarily by enforcement personnel for resource planning and commercial vehicle weight screening.

In the past few years, over a dozen states have used Federal CVISN Deployment Grant funds to implement virtual weigh stations. Among components of the virtual weigh station that are eligible expenses for CVISN funding are WIM scales, cameras, OCR technology, system electronics, screening software, and system integration. A State's Commercial Vehicle Information Exchange Window (CVIEW) system, which is an eligible CVISN expense, also can serve as a key data repository in support of VWS deployments (e.g., serve as a database of motor carrier and commercial vehicle safety and credentials data that can be queried by the VWS screening system, serve as a repository for data collected from the VWS). CVISN funds also can be used to support expanded communication networks to support the timely and secure transmission of virtual weigh station data to users, as well as integration of safety data/screening algorithms into roadside operations.

[3] 23 USC Section 101(a)(3)(H).

4.0 Program Implementation

4.1 OVERVIEW

Deployment of roadside technologies to improve truck size and weight enforcement in the United States is an important goal of the Federal Highway Administration. This goal will be supported by the Smart Roadside Initiative. As stated in Section 1.0, the Smart Roadside will support information sharing among commercial vehicles, motor carriers, enforcement resources, highway facilities, intermodal facilities, toll facilities, and other nodes on the transportation system in order to improve motor carrier safety, operational efficiency, and freight mobility. Interoperable technologies and systems will accomplish the data sharing.

The Smart Roadside Initiative is a partnership of FHWA and the Federal Motor Carrier Safety Administration. It includes a number of mechanisms to support states' technology deployments that will be available to states on an as-needed basis, at the customer's request. Other mechanisms are generally available to any interested stakeholders.

The objectives of the Smart Roadside program implementation are to:

- Provide **training** to practitioners to allow them to plan, design, deploy, and operate roadside technologies and systems. Training can take a variety of forms, including courses, conferences, workshops, and hands-on instruction;
- Guide practitioners through the planning and design processes through more **customized technical assistance**;
- Offer **outreach** to executive-level decision makers to promote goals, key concepts, and deployment benefits, and to keep them abreast of deployments in other jurisdictions;
- Identify and/or provide **sources of funding** to support states' technology deployments. This could include funds for states to procure and install technologies, obtain design and integration services from vendors, and participate in tours or visits of deployment sites;
- Support the development of **technical architectures** and/or concepts of operations to support key components of the Smart Roadside, such as the wireless roadside inspection and virtual weigh station; and
- **Promote roadside technologies** at stakeholder activities and events.

The remainder of this section will detail key elements of the program implementation. Table 4.1 summarizes how these program elements address the

challenges associated with the deployment of roadside enforcement technologies.

Table 4.1 Federal Program Elements to Address Deployment Challenges

Challenges	Training	Funding	Architecture
Cost		●	
Manpower Requirements		●	
Interagency Cooperation	●		●
Data Issues	●		●
Technology Performance	●		●
Funding	●	●	
Lack of Standards/ Architecture	●		●

4.2 TRAINING

The goal of training is to produce a level of expertise that an individual can apply to his or her job, and also share with co-workers and associates. The key Smart Roadside-related topics are likely to be:

- Deciding on a technology, including what technologies are available for particular needs or functions, operational scenarios, technology limitations, historical performance, benefits, start-up and O&M costs, changes (e.g., legislative, regulatory) required, and examples of deployment locations;
- Financing technology deployments, including seeking Federal grants and State appropriations;
- Marketing new technologies to agency executives and motor carriers;
- Procurement, contracting, and grants management related to technologies;
- Managing technology projects, including managing vendors and working with multiple agencies;
- Integration of technologies, systems, and other architectural elements; and
- Planning, coordinating, and integrating projects.

States may identify additional training topics that will be entertained by FHWA and FMCSA at the customer's request.

Delivery mechanisms for Smart Roadside training will be varied, reflecting the range of State, as well as Federal and industry, stakeholders who will benefit from training. The Federal partners are committed to providing a variety of mechanisms because of time, cost, and distance considerations; the proliferation of distance learning methods; and the differential ability of delivery mechanisms to address specific training needs and audiences. Peer interaction in some manner also is a key element of several of the delivery mechanisms.

Delivery mechanisms that will be available for Smart Roadside training include the following:

- **On-site customized technical assistance –** An experienced professional can be assigned to work on-site with a State's team through presentations, small group work sessions, questions-and-answers sessions, and other tools. Products of technical assistance may include a business case, technology roadmap, project plan, procurement plan, and/or implementation plan. The assistance, and the products, will be customized for the individual State. A similar approach has been implemented successfully by FMCSA in support of the CVISN program.
- **On-site executive briefings –** Concise and focused education for State agency executives can be provided to help them better understand the Smart Roadside Initiative and its benefits. Briefings also involve executives in planning and deployment activities that will foster a sense of ownership that is critical to secure commitment of staff and resources for the program. They may be delivered by a State program manager, by the Intelligent Transportation Systems (ITS) or Smart Roadside "champion," or by other personnel with influence and credibility among both public and private stakeholders. Federal personnel (e.g., headquarters, division) may also participate in delivering executive briefings.
- **Peer-to-peer –** Peer-to-peer support consists of technical assistance provided to a State typically on a specific subject (e.g., financing, preparing for O&M) by a representative from another State. Participating peers are professionals experienced in ITS, CVISN, advanced technologies, and other related areas, who are matched to the requestor's needs. The training can take various forms, including on-site visits, telephone conferences, and review and comment on documents and materials. Peer-to-peer is a unique means to talk to peers about common experiences, including processes and challenges about to be faced.
- **Technology showcases –** One or more deployment sites will be selected to highlight the integration of different technologies, systems, and services in one place or region. A showcase is a means to illustrate progress and successes, and solidify and expand support for the deployments. In addition,

it offers a distinct opportunity to "see what's out there" in the way of operational technologies and systems.

- **Deployment site visits –** Locations other than the "featured presentation" model of the technology showcase may be attractive to states because of particular technologies that are deployed. A State may have an unusual or unique deployment or program that is of interest to another State. Self-arranged site visits (which may be coordinated through FHWA or FMCSA) differ from scanning tours that are sponsored and organized by a Federal agency and typically include personnel from multiple jurisdictions.
- **Webinars –** Web meetings will be scheduled periodically to disseminate information on topics of interest to stakeholders. Topics may include technical subjects such as WRI and VWS, as well as how to build effective partnerships or how to finance technology deployments. Participation in webinars can be extremely valuable, and because they can be attended without travel, they provide a lot of "bang for the buck."
- **Web sites –** FHWA and FMCSA have web sites where documents and presentations of interest to the Smart Roadside community are posted for general viewing. The web sites also announce dates for webinars, conferences, workshops, and other meetings of interest. The CVISN Collaboration SharePoint Site currently provides this functionality for the Roadside Identification Ad Hoc Team.
- **Roadside Identification Ad Hoc Team meetings –** The Roadside Identification team meets on a monthly basis via teleconference to discuss current and evolving technologies that capture information about commercial vehicles at the roadside. Jurisdictions share their experiences with a variety of roadside technologies and systems, provide evaluation results, seek information from other jurisdictions, and discuss how the technologies can be used in new ways to facilitate roadside enforcement as well as produce efficiencies for motor carriers.
- **Workshops –** FMCSA and FHWA sponsored the Smart Roadside Workshop in 2008 to advance the planning of the Smart Roadside Initiative. The primary objectives were to educate stakeholders about the initiative, explore opportunities for additional ITS applications, identify key issues and concerns related to implementation of Smart Roadside functionality, and build partnerships to support follow-on planning and implementation. FMCSA sponsored the CVISN Deployment Workshop in 2008 entitled "Collaborating to Advance CVISN." Roadside technology was one of the featured topics at the workshop; VWS, WRI, and universal truck identification were covered by practitioners who described current projects. Future Smart Roadside and CVISN Deployment Workshops are planned.

4.3 FUNDING

Funding to support Smart Roadside activities and technology deployments continues to be a tangible obstacle to advancement. As described in Section 2.3, the cost of technologies is one of the biggest challenges facing a State that wishes to improve its roadside enforcement program. States require funds to procure and install technologies, obtain outside design and integration services, and participate in visits of deployment sites and workshops.

FHWA and FMCSA continue to seek funding to help them deliver the Smart Roadside program. At minimum, Federal representatives are available to advise stakeholders on potential funding sources and how to maximize funding by matching technology purchases with sources that may be limited to certain uses. Given the potential challenges associated with the CVISN funding program, FHWA and FMCSA will seek alternate sources of funding and/or improvements to the current program (e.g., increasing the per State ceiling for CVISN funding, extending the CVISN program beyond FY 2009).

4.4 ARCHITECTURE

FMCSA sponsored the development and maintenance of the National CVISN Architecture to serve as a framework to guide stakeholders in the commercial vehicle operations (CVO) community as they develop information systems, standards, interfaces, and subsystems to support identified user services based on stakeholder needs and requirements. Interoperability is one of the hallmarks of the CVISN Architecture. Computers, sensors, communications and networks, software, system services, and security equipment must support the exchange and use of information in order to be interoperable. Similarly, the Smart Roadside is supported by interoperable technology and information sharing between in-vehicle, on-the-road, and freight facility systems.

As a result of the findings of the Smart Roadside Workshop, FHWA identified the need to construct an architecture for the many different systems included in an increasingly complex roadside enforcement operations environment. Development of this architecture is the primary purpose and goal of the agency's new "Electronic Permitting/Virtual Weigh Station" Architecture project, which is scheduled to start in 2009. The architecture will depict various technology-based enforcement and inspection tools and data elements and provide a summary discussion of data interrelationships and data flow characteristics included in the architecture.

Appendix A – Acronyms

AVI	Automatic Vehicle Identification
CMV	Commercial Motor Vehicle
ConOps	Concept of Operations
CVIEW	Commercial Vehicle Information Exchange Window
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
FAHP	Federal-Aid Highway Program
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FY	Fiscal Year
GHG	Greenhouse Gas
ITS	Intelligent Transportation Systems
LPR	License Plate Reader
ML	Mainline
O&M	Operations and Maintenance
OCR	Optical Character Recognition
OS/OW	Oversize and Overweight
PRISM	Performance and Registration Information Systems Management
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SP&R	State Planning and Research
TEA-21	Transportation Equity Act for the 21st Century
USC	United States Code
USDOT	United States Department of Transportation
VWS	Virtual Weigh Station
Wi-FI	Wireless Fidelity
WIM	Weigh-in-Motion
WRI	Wireless Roadside Inspection

Appendix B – Reference Guide for Deploying Roadside Technologies

STEP 1

Develop Business Case

Document needs and problems

Describe potential solutions

Identify issues and obstacles

Identify benefits and costs

STEP 2

Seek Best Practices

Learn from the deployment experiences of other jurisdictions

- Technologies
- Planning
- Funding
- Contracting

Pursue training opportunities

- Peer-to-Peer
- Site Visits
- Webinars
- Workshops and Conferences

STEP 3

Develop Technology Roadmap

Consider an incremental approach in order to accommodate budget constraints and the availability of information technology resources

Identify technologies in use today that can be leveraged for new functions and new technologies that should be procured to meet needs and solve problems defined in the business case

Account for system and process changes necessary to accommodate new technology solutions, and draw timelines for the deployments

STEP 4

Identify Champions

Seek an agency executive, manager, or leader who will effectively:

- Mobilize support from all key stakeholders, especially stakeholders who hesitate to buy in to new technologies
- Lead efforts to secure funding
- Communicate benefits and lead resolution of issues and obstacles

STEP 5

Build Partnerships

Build a team comprising the State's enforcement agency and transportation/highway agency

Focus on the mutual benefits of deploying roadside technologies

Nurture the partnership through regular/frequent team meetings, sponsorship of joint projects, and reciprocal input in technology-related decisions

STEP 6

Maximize Funding

Use as many eligible funding sources as possible

Seek Federal-Aid Highway Program (FAHP) funding to deploy WIM systems as part of virtual weigh stations

Seek Federal Commercial Vehicle Information Systems and Networks (CVISN) funding to implement complete virtual weigh stations

FHWA and FMCSA will seek to increase funding provided through the CVISN program (e.g., raising the per State ceiling, extending the program beyond Fiscal Year 2009)

STEP 7

Deploy Technologies

Deploy sequential, integrated investments that contribute to an optimal program. Add to existing roadside enforcement operations new capabilities, for example:

- Deploy traffic monitoring weigh-in-motion (WIM) systems to locate heavy loadings on the network
- Upgrade or build WIM systems for real-time screening
- Install automatic identification technologies to support targeted inspections at fixed weigh stations and virtual weigh stations. In the absence of universal truck identification, it is postulated that license plate readers are the preferable technology
- Adopt progressive intervention methods/tools (e.g., warning letters, company visits, inspections) to target persistent illegal loading or unsafe practices observed through surveillance
- Develop data management systems that support enforcement action (i.e., intervention methods) on noncompliant carriers that cannot be addressed in real-time because of "data overload"

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16. Abstract

The purpose of this Implementation Plan is to recommend strategies to encourage the deployment of roadside technologies to improve truck size and weight enforcement in the United States. The plan includes strategies that State practitioners can use to overcome typical challenges confronting the deployment of virtual weigh stations and other roadside enforcement operations (Section 3.0) and overall program support that FHWA needs to provide to jurisdictions looking to deploy virtual weigh stations and other operations (Section 4.0). The plan is the final deliverable in FHWA's Truck Size and Weight Enforcement Technology project. The goal of the project was to encourage and facilitate states' technology deployments as a means to improve the efficiency and effectiveness of roadside enforcement.

The Implementation Plan includes a two-page "Reference Guide to Deploying Roadside Technologies" that summarizes the important steps that can be taken by states in order to incorporate new roadside technologies into their enforcement programs. States are encouraged to tailor or modify the guide to suit their particular circumstances and needs.

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