1 Capability

The **Virtual Roadside Sites** capability is:

> Expand the deployment, use, and capabilities of virtual/remote sites to increase the effectiveness of enforcement.

Note: the Smart Roadside Working Group decided that "Virtual Roadside Sites" was preferred over "Virtual/Remote Roadside Sites" as the name for this capability.

2 Working Group Recommendations

The Smart Roadside Working Group offers these summary recommendations related to this capability:

- Techniques to identify the carrier, driver, vehicle, and cargo at mainline speed should be explored further.
- Virtual roadside sites are established for a variety of purposes depending on the priorities and needs of each jurisdiction. Federal Motor Carrier Safety Administration (FMCSA) support is appropriate for the activities listed below.
- The working group supports all three options described in this report:
  - Identify best practices and develop design and deployment templates
  - Take the lead in developing and adopting identification standards
  - Research and test of emerging or immature technologies
- Three activities related to this capability are proposed for near-term funding:
  - Best Practices and Lessons Learned
  - Standards for Identification
  - Ongoing Technology Research and Test.

3 Concept of Operations

The term concept of operations (ConOps) means operational attributes of the system from the operators' and users' views. The ConOps allows for the use of a variety of technologies. There may be potential benefits to be gained by using some sophisticated technologies, but only if the technologies are part of a well-conceived and vetted set of practices, are thoroughly understood and tested, and are implemented and used correctly. This chapter summarizes the proposed concept of operations.

Existing systems contain much of the information needed to achieve the goals of the Expanded Commercial Vehicle Information Systems and Networks (CVISN) initiative. To increase

information sharing, expand, merge, establish interfaces between, or enhance existing **information management systems** [e.g., Motor Carrier Management Information System (MCMIS), Commercial Driver's License Information System (CDLIS), Safety and Fitness Electronic Records (SAFER), Commercial Vehicle Information Exchange Window (CVIEW), Performance and Registration Information Systems Management (PRISM), International Registration Plan (IRP) and International Fuel Tax Agreement (IFTA) clearinghouses] to include:

- Open standards for information sharing
- Improved and flexible user interfaces (e.g., provide default look and feel based on user's role; allow user to tailor)
- Standardization around a small number of standards. This gives each state the flexibility to work within its overall statewide architecture, but still encourages commonality among states' systems and approaches.
- Collection of data once and frequent reuse (e.g., collect census data from a carrier and re-use that data from a single source whenever it's needed)
- Consistent level of service regardless of time-of-day or day-of-year
- Improved access to data about all commercial drivers
- More timely and complete IRP and IFTA data in snapshots
- Consistent identification of carrier, driver, vehicle, and cargo
- Association of entities that are related during a trip (e.g., John Driver working for Carrier XYZ driving vehicle with plate 1234567 registered in Maryland hauling trailer with plate 8901234 registered in Delaware)
- Electronic security device event data (to track the status of and activities related to a security device attached to the container and/or trailer)
- Integrate with or link to asset tracking, arrival scheduling, and other vehicle, port and freight information systems [e.g., Freight Information Real-Time Systems for Transport (FIRST), electronic freight manifest, State On-Line Enforcement System (STOLEN)].
- Access to up-to-date credentialing information [e.g., oversize/overweight (OS/OW) permits].

To improve the quality of information and to improve access, develop, expand, merge, or enhance **data collection and reporting systems** used in the field [e.g., ASPEN, Carrier Automated Performance Review Information (CAPRI)] to include:

- Open standards for data collection and reporting
- Access to driver snapshots
- Out-of-service (OOS) processing
- Uniform citation reporting

- Uniform crash reporting
- Hours of service compliance evaluation
- Vehicle and cargo security checks
- Heavy duty diesel (HDD) emissions inspections
- Interface with electronic on-board systems
- Wireless technology
- Cargo theft management.

Look for successes within innovative programs and build on or adapt their business models for broader use. Categories of programs/systems to review include:

- Electronic toll collection systems (e.g., E-ZPass)
- Electronic credentialing systems for multiple credentials [e.g., One-Stop Credentialing and Registration (OSCAR)]
- Regional data-sharing systems [e.g., Extensible CVIEW (xCVIEW)]
- Roadside information reporting systems (e.g., ASPEN)
- Port scheduling/access programs (e.g., PierPass)
- Freight security improvement programs [e.g., Operation Safe Commerce (OSC)]
- Cross-program technical interchange (e.g., CVISN/PRISM)
- Border-crossing improvement programs [e.g., Free and Secure Trade (FAST)]
- Data challenge and correction (e.g., DataQs)
- Theft deterrence (e.g., Cargo Theft Management System).

Review and build on technology lessons learned. Categories of programs/initiatives to review include:

- Recent operational tests [e.g., FMCSA's Hazardous Materials (HazMat) Op Test]
- Intelligent Transportation Systems (ITS) initiatives [e.g., Vehicle Infrastructure Integration (VII)]
- Applications and uses of standards [e.g., Dedicated Short Range Communication (DSRC) standards]
- Technology transfer opportunities [e.g., Federal Rail Administration's (FRA's) railroad track status reporting]
- Commercial Vehicle Operations (CVO) infrastructure deployments (e.g., e-screening)
- Broader transportation infrastructure deployments (e.g., e-toll collection)
- Data sharing models (e.g., CDLIS)

- Virtual roadside site prototypes (e.g., Kentucky, Indiana)
- Container security device tests (e.g., Smart Box program).

4 Requirements

Discussions with the members of the Smart Roadside Working Group established by FMCSA via the ITS/CVO 2005 Deployment Showcase seeded the requirements stated in this chapter. Subsequent review by members of the Smart Roadside Working Group finalized the requirements.

Virtual roadside sites are established for a variety of purposes depending on the priorities and needs of each jurisdiction. Typical purposes include:

- Safety enforcement
- Data collection
- Security (e.g., homeland security, theft deterrence)
- Size and weight enforcement
- To help target enforcement activities
- To spread the enforcement net.

These factors motivate states to establish virtual roadside sites:

- Lower cost
- Scarcity of real estate for fixed weigh stations
- Force multiplier/effective use of resources
- Able to monitor commercial traffic in areas where fixed, manned sites are not practical (urban areas, remote locations, and bypass routes)
- Efficient collection of data (traffic patterns, weight statistics, driver behavior patterns, etc.).

Virtual roadside sites typically should have these characteristics:

- Unmanned
- Components installed in or adjacent to the right-of-way [e.g., weigh-in-motion (WIM) scale, over-height detector, closed circuit television (CCTV) camera, communications hub]
- Data collected and processed on-site and/or forwarded to central location (e.g., weight enforcement and inspection station) for processing

- Capable of flagging vehicle (e.g., for potential violations, matches with hot lists, or other readings of interest), identifying vehicle, and forwarding relevant information to enforcement personnel for immediate response
- Data needed by enforcement or security activities are collected.
  - Identity (vehicle, carrier, transponder, driver, trailer, electronic cargo seal)
  - Image data (e.g., vehicle, driver, trailer)
  - Weight
  - Size
  - Data from on-board sensors (e.g., condition of vehicle systems, container status, driver log)
  - Data from roadside sensors (e.g., radiation, chemical) once the sensors are capable of detection when the vehicle is traveling at its normal speed
- Data needed by planners are collected.
  - Number of vehicles
  - Characteristics of vehicles
  - Time/volume data (e.g., number of commercial vehicles that pass site between 9:00am and 10:00am)
- The site may or may not be readily identifiable by commercial vehicle operators.
- Commercial vehicle operators cannot necessarily determine whether or not site is "active."
- Enforcement is watching the data collected and considers the effort to be tied to real-time enforcement activities.

States should customize sites to meet the state's needs and conditions. Real value should be predicted and measured to ensure an adequate return on investment. The intent is to improve safety by modifying motor carriers' unsafe behaviors.

The working group noted that both FMCSA and Federal Highway Administration (FHWA) play a role in virtual roadside sites. FHWA interests focus on size and weight enforcement. FMCSA is concerned with safety, security, and productivity issues. The group identified these areas where FMCSA and FHWA support is required:

- Identify success stories/best practices and share information quickly
  - Central repository (electronic library)
  - Peer to Peer program
  - Workshops
- Develop and share design and deployment templates and options
  - Request for Proposal/Request for Information (RFP/RFI) templates
  - Basic configuration options that states could tailor
- Take the lead in developing and adopting standards
  - Vehicle, driver, cargo, carrier IDs (uniform)
  - Vehicle-Roadside communication protocols

  - How to automatically identify the vehicle, potentially via standard license plates and markings
  - How to automatically identify the carrier
  - How to automatically identify the driver
  - How to automatically identify the cargo

- Research and test emerging or immature technologies
  - Roadside sensors
  - Collecting data from on-board sensors
  - Sensor technology used at virtual weigh stations and the relationship to safety improvement

- Assist jurisdictions in deploying communications between virtual sites and manned units/sites.

5 Potential Solution Alternatives

Based on technology available today or expected in the near term, potential solutions for the **Virtual Roadside Sites** capability may include one or more of these approaches:

- Data collection
  - Image capture (e.g., whole vehicle, license plate, door, driver)
  - Weight measurement
  - Size measurement
  - Identity via Radio Frequency Identification (RFID) (e.g., vehicle, carrier, driver)
  - Identity via interpretation of image information [e.g., Optical Character Recognition (OCR)]
  - Roadside sensor data capture (e.g., radiation)
  - On-board data readout (e.g., brake status, container status)

- Communications
  - Use existing infrastructure
  - Install/use new equipment (wireless or wired)
  - Store and retrieve later

- Screening
  - Manual screening of data collected
  - Automated screening of data collected

- Enforcement
  - Safety
  - Security.

States would choose a solution that incorporates the approaches that make sense for a particular site.

In the Requirements section, above, several areas for FMCSA support were identified. In this section each major category of FMCSA support has been translated into a potential solution alternative. What is now called Option 1 started as two separate options: one focused on collecting best practices and lessons learned, and a second option on developing templates for design and deployment alternatives. In the April working group telecon, the group asked that those two options be combined.

- Recommended Option 1: Identify best practices and develop design and deployment templates
- Recommended Option 2: Take the lead in developing and adopting identification standards
- Recommended Option 3: Research and test of emerging or immature technologies.

When asked to set priorities among the options, the group was evenly divided. Therefore, all three options are recommended.

5.1 Recommended Option 1: Capture best practices and develop design and deployment templates

States are currently wrestling with many of the same issues, but are analyzing them and seeking solutions independently. While these disparate efforts can lead to creative new solutions, they can also result in states spending much time reinventing the wheel. Under this option, best practices would be collected, lessons learned would be shared, templates and options for design and deployment would be developed for states to tailor, and the information would be made available online for ongoing update and review.

The earliest use of the term “virtual weigh station” referred to the use of existing WIM installations [typically installed for data collection, and often referred to as Strategic Highway Research Program (SHRP) sites] to direct enforcement resources where they would be most effective. There were two methods of doing this:

- Data from the WIM site would be collected and used to determine when overweight trucks were traveling the roadway (i.e., the day of the week and the time of day). Enforcement resources would then be deployed at those times to catch the overweight trucks.
- In some cases, enforcement personnel would actually tap into the WIM data so that they could watch the weights in real time. The officer could be at the site or located some distance downstream. When an overweight truck was detected, the officer would stop the truck.

For these earliest concepts, there was no camera equipment involved, so the only way a specific truck could be identified as overweight was if an officer was on-site or waiting just downstream of the WIM.

Since the early virtual weigh station concepts, a few variations for virtual roadside sites have emerged. These offer basic alternatives to states considering implementation of one or more virtual roadside sites.

The “Indiana model” places an emphasis on weight enforcement and includes a photo of the truck. In 2001, the Indiana Department of Transportation (DOT) installed a virtual weigh station in southeastern Indiana, just west of Cincinnati. That system includes a highly accurate WIM installation and a roadside camera. The intent is to detect overweight trucks and to provide the weight data and a photo to enforcement personnel via the Web. Enforcement personnel can then stop the truck.

Kentucky’s entry into the “virtual enforcement” arena was the Remote Monitoring System (RMS). This system was installed in 2001 on a two-lane roadway in northern Kentucky, which served as a convenient bypass route for the Kenton County weigh station on I-75. The focus of the RMS was on capturing the identifying information (e.g., USDOT number) from the side of the power unit. A roadside camera captured a series of images for each truck that passed, and those images were transmitted to a computer at the Kenton County weigh station. Officers at the station could review the images, read the identifying information, check the company’s status with regard to credentials, taxes, and safety, and, if appropriate, dispatch an officer to intercept the truck. The success of the RMS prompted officials in Kentucky to install a second system in southern Kentucky and to add WIM technology to the system. This is Kentucky’s first virtual weigh station, and it was installed in December of 2002. An inexpensive quartz-piezo WIM system was used.

Florida has considered two different concepts. At Punta Gorda they are planning a system that will weigh vehicles on exit ramps before and after with a WIM type system. This site will utilize an overview camera and an LPR (License Plate Reader) to collect and then transmit the information back to the weigh station and officer's laptop for identification purposes. Florida also plans to install mainline load cell/bending plate WIM in Escambia County on US 29 with a camera system and similar wireless notification to officers in the area.

Delaware takes the position that virtual weigh stations provide Departments of Transportation and Highway Patrols with a cost-effective tool to monitor and enforce truck weights and dimensions on the bypass and secondary routes. Virtual weigh stations utilize and transmit advanced WIM and video image enforcement information downstream to highway patrols. Based on the information police receive, vehicles suspected of being overweight can be either stopped and weighed using portable scales, or can be directed to the nearest weigh station for weighing while allowing vehicles in compliance to continue on their way.

Using technology available today, Delaware plans to use this approach for virtual weigh stations:

- Vehicles cross over loops to initiate the WIM system set up on a bypass route.
- Vehicles then cross WIM scales, and weight limits (thresholds) are checked. The thresholds usually checked are as follows:
  - Gross weight

- Single axle weight
- Tandem axle weight
- Inner bridge
- Federal bridge formula
- Speed
- Length

- If the vehicle does not exceed the above thresholds, a vehicle record is stored per Federal Highway requirements. If the threshold is exceeded, the vehicle record is stored, and the camera takes a picture. The weight threshold information is superimposed in the digital picture.
- The digital picture is then transmitted via wireless to a laptop in a patrol car downstream for enforcement purposes.
- The offending vehicle is pulled over to an area for inspection and static weighing.

This option could also include summarizing costs and benefits from various deployments of virtual roadside sites, and could contrast those costs/benefits with deployment of fixed, manned sites.

Implementation of some best practices will be a state-by-state, site-by-site process rather than a national initiative, given that deployment requires incorporation into state-specific systems and processes. However, exploration of best practices could be an ongoing effort of the Smart Roadside Working Group or an undertaking funded by FMCSA.

Potential sources for best practices and lessons learned include:

- Experiences in Indiana, Kentucky, Florida, Delaware, and other states
- Corridor projects [Gary – Chicago – Milwaukee (GCM), I-95]
- Transportation research results.

Under this option, templates and options for design and deployment would then be developed for states to tailor. Successful implementers would provide their design and procurement documentation. Generic “template” materials would be developed from the actual designs and deployment documents, folding in best practice information. The templates would be made available to other states and coalitions. Please see the **Roadside Access to Data** capability report (reference 1) for potentially related efforts.

5.2 Recommended Option 2: Take the lead in developing and adopting identification standards

For virtual roadside sites to accomplish their enforcement and security missions, it must be possible to identify the carrier, vehicle, driver, and cargo. In this option, effort would focus on establishing and adopting common identifiers, the means to automatically identify entities at normal speeds, and protocols for vehicle-roadside communications. This option is related to

common identifiers requirements identified in the **Safety Data Quality** capability report (reference 2), but is focused on identification operations at virtual roadside sites.

One goal of this option would be to link real-time identification of entities on the road to information extracted from information systems about those entities. In that sense, this effort is tied to the standardization of identifiers used in information systems for carrier, vehicle, driver, and cargo. This option would also encourage states, manufacturers, and the motor carrier industry to find common ground for marking vehicles so that they can be identified at normal speed. The effort would include shippers, carriers, brokers, and enforcement in establishing standards for identifying cargo. The standards should be established to handle interstate, intrastate, and international operations. Different methods for identifying on-the-road entities could be explored, including image capture and identification, attaching an electronic identifying device to the vehicle and reading it at mainline speeds, and using existing on-board equipment (e.g., 802.11 devices) to identify the vehicle.

5.3 Recommended Option 3: Research and test of emerging or immature technologies

Under this option, FMCSA would continue to support research of technologies that offer promise for improving safety, security, and productivity when used at virtual roadside sites. Likely technologies include wireless and wired communications devices and protocols for vehicle-to-roadside and roadside-to-other-site communications; weight and size sensors; chemical, radiation, and biological sensors; image capture; automatic identification; on-board system and performance monitors; electronic logs; electronic identification devices; and tools to automatically process and make decisions about the data captured. The research and test team would select technologies that might meet the requirements identified in this report and would engage stakeholders from within the CVO community to participate in the process. The team would also coordinate activities with other researchers supported by states, industry associations, US DOT, and the Department of Homeland Security who are investigating similar technologies for transportation operations.

6 Cost-Benefit Analysis

The following table provides a high-level cost-benefit analysis for each solution option identified in the previous chapter. Those options are **not** mutually exclusive. The cost figures are rough estimates provided by working group members. The costs are related to the studies proposed in the options, not the associated deployment once the study has been completed.

- Low means less than $100K
- High means more than $1M
- Medium is everything in between.

Option	Pro	Con	Cost
1 (Capture best practices)	All: Common understanding of best practices for virtual roadside sites. Resource center for capturing and researching lessons learned. Simplify and shorten the process of designing and deploying virtual roadside sites Federal: --- State: Gain the information needed to consider deployment. Industry: ---	All: --- Federal: --- State: --- Industry: ---	Federal: Low Medium (~$250K). State: Low. Industry: No significant cost expected.
2 (Identifi-cation standards)	All: Standards would enable automating activities that are now manual. Could also make processes more uniform and more successful. Potentially lower cost for installation and maintenance, if additional vendors offer products that are applicable. Federal: --- State: --- Industry: ---	All: Potential for prohibitive costs associated with deploying standards. Federal: Might require rulemaking and regulations. State: Legislation might be required. Some sites might require changes to adhere to standards. Industry: If marking requirements are changed, significant impact.	Federal: Medium to High State: Low to Medium Industry: Low
3 (Research and test of technolo-gies)	All: Able to capitalize on advances in technology. Federal: --- State: --- Industry: ---	All: Hard to keep up with rapid changes. Federal: --- State: Could involve lane closure during testing. Industry: Could involve lane closure during testing.	Federal: High State: Medium Industry: High

7 Business Case

Currently, inspection resources are stretched thin due to increasing traffic volumes, staffing cuts, and expansion of roles. Environmental and cost restrictions sometimes prohibit the installation of fixed, manned sites at critical points.

Benefits from using virtual weigh stations include:

- Implementation of effective weight and enforcement strategies

- Reduced cost
- Determination of enforcement times
- Profiling habitual offenders
- Truck route and bypass monitoring
- Data collection for statistical analysis.

Virtual roadside sites are intended to provide an increased roadside enforcement presence at a lower cost. Emerging benefits versus costs studies suggest a 5:1 or 7:1 ratio, making a strong case for implementing virtual roadside sites to reduce OS/OW vehicles on the road and improving safety. Virtual sites can be used in locations that may not need a fixed, manned site, but where violators are likely to travel. Virtual sites could be based where risks are high. For example, two-lane roads are often the sites where commercial vehicle fatalities occur. Virtual sites could be located in urban areas more readily than fixed, manned sites that require more real estate. Monitoring commercial vehicles on more roads levels the playing field between compliant and noncompliant carriers and increases the opportunity for enforcement. If the original virtual site does not detect a large number of problem vehicles, the site can sometimes be relocated at less cost than adding a fixed weigh station. If the drivers are unable to discern whether the site is being actively used or not, it is a deterrent to bad behavior all the time.

To help offset costs associated with virtual roadside sites, it is sometimes advisable to obtain funding from nontraditional commercial vehicle monitoring sources. According to a national survey, jurisdictions have indicated willingness and a desire to share data collected from virtual roadside sites with their partner agencies responsible for collecting maintenance traffic data. This type of collaboration involves coordination for virtual site locations as well as shared costs for deployment and/or ongoing maintenance. Other jurisdictions have successfully collaborated with the Department of Homeland Security to secure funding for virtual roadside sites that increase commercial vehicle enforcement capabilities as well as provide efficient monitoring of strategic corridors.

The options listed for this capability do not involve development or deployment of extensive resources. Each option focuses on an area where modest investment by FMCSA would result in significant benefits to states considering virtual roadside sites, the opportunity for improved safety, and a more level playing field for compliant industry stakeholders. Collecting and maintaining information on best practices and lessons learned will leverage past expenditures for future planning. Federal leadership in defining standards has been successful in other areas of ITS and is necessary to advance the ability of roadside sites to automatically identify carriers, vehicles, drivers, and cargo at mainline speeds. Emerging technologies offer promise for virtual roadside sites, but with limited resources, states are ill-equipped to evaluate and test them alone. Ongoing federal support for technology evaluation is required to realize the potential benefits of advances in technology.

All of the options recommended to support virtual roadside sites will also benefit traditional roadside enforcement activities. So, a modest investment in this area will multiply the returned value on that investment.

8 Issues

8.1 Institutional Issues

Privacy issues will need to be addressed in some jurisdictions, since virtual roadside sites may involve capturing images, vehicle event data, or other information that is currently protected. For virtual roadside sites to be effective for enforcement, officers must be available and authorized to take enforcement action based on the information collected. There must be a place to put or send an OOS vehicle; space may be an issue at a virtual roadside site. Standard common identifiers must be used to automate and streamline processing of data collected at virtual roadside sites. Existing issues regarding sharing data about transponders must be overcome if transponders are to offer a means for identifying roadside entities. Using the transponder to identify the vehicle at a virtual site may focus inordinate attention on transponder-equipped vehicles. Enforcement use of 802.11 devices to identify a commercial vehicle may not be in step with ongoing standards efforts. Vehicles are difficult to identify at mainline speed due, at least in part, to variations in license plates and how they are marked. Adding an electronic device to a license plate or elsewhere on the vehicle for automatic identification may raise concerns with industry and add cost to the plates. There is controversy about ubiquitous electronic identification. Today the use of a transponder is voluntary. If identification through an electronic device becomes mandatory, “big brother” concerns may be significant.

8.2 Technical Issues

Techniques to identify the carrier, driver, vehicle, and cargo at mainline speed should be explored further. The wide variety of license plate styles (e.g., colors, materials, fonts) makes it very difficult to use image capture techniques. LPR technology is still not reliable enough to achieve close to 100-percent success at correctly reading the license plate jurisdiction and identifier. Environmental factors (e.g., weather, mud, lighting) and variability in placement of the license plate on the vehicle also make it difficult to automate the process of identifying the vehicle based on LPR inputs. Communications capabilities vary widely across states and within specific areas of a state. On-board vehicle technology continues to evolve. Those technologies may be useful to identify entities on the road (driver, cargo, etc.) and support other roadside activities. Once roadside entities are identified, the next challenge will be to link them to information stored in the infrastructure.

9 Deployment Strategy

In deploying the **Virtual Roadside Sites** capability, several aspects should be considered.

Improve data quality and integrity:

- Establish a consistent set of data elements that are common across information systems and analysis applications.
- Expand the use of standard identifiers for entities visible at the roadside (carrier, vehicle, driver, cargo, chassis) to link related information.
- Make information collection, access, and use consistent across interstate, foreign, and intrastate operations.
- Capture data electronically as close to the source as possible; once information is available electronically, it should be re-used instead of re-entered manually.
- Control access to sensitive information.

Work together and share lessons learned:

- Work with stakeholders to define and deploy common data elements and interoperable business processes for all areas of CVISN expansion.
- Establish standardized terminology and common requirements for data collection, access, quality checks, and making corrections.
- Coordinate standards-related activities with appropriate standards development organizations.
- Actively solicit lessons learned from “early adopters” of CVISN and expanded CVISN concepts, and determine how to apply those lessons more broadly.
- Actively engage stakeholders in identifying priorities, proposing solutions, and participating in prototype projects.
- Proactively reach out to stakeholders who may be affected by changes to systems or processes that are under discussion.
- Learn from other ITS activities about solutions applicable to CVO.

Deploy targeted solutions incrementally:

- Select information-sharing options based on users’ needs and available technology (e.g., proactive data-provider “data push” versus user-initiated “data query”).
- Prototype proposed solutions and link to existing capabilities.
- Consider small-scale solutions that can be expanded or serve as models for national deployment.
- Build in metrics to assess real improvements.
- Provide access to on-line analysis tools.

- Provide an approach that allows states to improve the quality of data sent to aggregation sources while continuing to maintain interaction with other state systems that may insist upon "lower quality" or "nonstandard" data.

Use appropriate technology to improve operations:

- Equip commercial vehicles with standard DSRC and other technologies, enabling a multitude of safety, security and productivity applications.
- Deploy interoperable technologies to support CVISN and other related CVO activities.
- As products become available, consider 5.9 GHz DSRC as an enabling technology for roadside-to-vehicle, vehicle-to-roadside, and vehicle-to-vehicle data exchange.
- Equip cargo containers and trailers with standard electronic security devices (ESDs).
- Expand the use and capabilities of portable and remote sensors to monitor environmental, facility, road and vehicle conditions and provide data to interested stakeholders.
- Apply new and emerging wireless capabilities [e.g., Bluetooth, Wireless Fidelity (Wi-Fi), Global Systems for Mobile Communications (GSM)] and on-board technologies to improve on-road and roadside operations and reduce costs.

The working group recommends three activities related to the Virtual Roadside Sites capability. The first activity involves gathering best practices and lessons learned. The second activity focuses on developing standards for identification of entities at the roadside. The third activity continues ongoing research and test of technologies.

9.1 Best Practices and Lessons Learned

Several states have prototyped virtual roadside sites, as described in Option 1, Section 5.1. Some of those experiences have been reported in documents easily accessible by other states, but others have not. The working group recommends that a concerted effort be made to collect lessons learned and document best practices for virtual roadside sites. The effort should include identifying existing materials, reviewing those materials and checking with authors for updates, identifying successes that are not yet documented, documenting lessons learned as needed, documenting best practices as needed, and organizing all the material into an on-line compendium of tips, approaches, and recommended designs for virtual roadside sites. The effort should also include outreach to make the existence of the site known across the stakeholder spectrum and maintenance support to allow for regular updates. Please see the description of Option 1 in Section 5.1 for a few specific examples of projects that should be reviewed in this effort. Kentucky, Idaho, Alaska, Utah, Battelle, and the Commercial Vehicle Safety Alliance (CVSA) expressed interest in participating in this activity.

9.2 Standards for Identification

This activity addresses standard means for identifying the carrier, vehicle, driver, and cargo on the road. A diverse group of stakeholders, including states, manufacturers, motor carriers,

shippers, brokers, enforcement, and standards developers should work on this problem. This effort should build on the best practices activity described above and focus on the most promising approaches. The goal is to move quickly towards standards that can be used in the near term, while keeping in mind longer-term solutions that are consistent with other broader programs (e.g., Smart Box, VII). Kentucky, Idaho, Alaska, Utah, and CVSA expressed interest in participating in this activity.

9.3 Ongoing Technology Research and Test

As part of this activity, FMCSA would continue to support research of technologies that offer promise for improving safety, security, and productivity when used at virtual roadside sites. Initial research and testing might focus on emerging technologies proposed in the best practices and identification standards activities. The research and test team should work with stakeholders from within the CVO community to participate in the process and coordinate activities with other researchers supported by states, industry associations, US DOT, and the Department of Homeland Security who are investigating similar technologies for transportation operations. Kentucky, Idaho, Alaska, Utah, and CVSA expressed interest in participating in this activity.

10 References

1. JHU/APL, *Expanded CVISN Smart Roadside Capability Report: Roadside Access to Data*, SSD-PL-05-0198, June 2005.

2. JHU/APL, *Expanded CVISN Enhanced Safety Information Sharing Capability Report: Safety Data Quality*, SSD-PL-05-0196, June 2005.