PROVIDING CARRIER- , DRIVER- , AND VEHICLE-SPECIFIC INFORMATION TO THE ROADSIDE

Report to the United States Congress
from the Administrator of the
Federal Highway Administration
pursuant to Senate Report 103-310,
Department of Transportation and
Related Agencies Appropriations Bill, 1995

FEDERAL HIGHWAY ADMINISTRATION

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Table of Contents

Executive Summary

Senate Report 103-310, accompanying the Department of Transportation and Related Agencies Appropriations Bill, 1995, requested the FHWA Administrator to submit a report to the House and Senate Committees on Appropriations specifying how and when the FHWA will design, maintain, and help deploy an advanced information system that will provide on-line and real-time carrier- , driver- , and vehicle-specific information to enforcement officers.

This report describes progress by the FHWA in planning for the design, deployment, and maintenance of an integrated collection of commercial vehicle information systems to provide needed carrier- , driver- , and vehicle-specific information to enforcement officers and other users in the motor carrier community. From the enforcement officer's perspective, these information systems are necessary to maintain and improve highway safety as the volume of motor carrier activity increases throughout North America. In this environment, enforcement officers need to:

- focus on high-risk carriers and drivers,
- increase the efficiency and effectiveness of their enforcement activities,
- reduce redundant non-essential inspections, and
- redirect enforcement resources to where they yield the greatest benefit.

The FHWA, working with other stakeholders including the Intelligent Transportation Society of America and the Commercial Vehicle Safety Alliance, has identified the need for a fully integrated collection of commercial vehicle information systems operated by the states, the FHWA, carriers, and other stakeholders to support safe and seamless commercial vehicle transportation throughout North America. These systems will provide high-quality, timely, and easily accessible information to all users. The FHWA calls this collection of systems the Commercial Vehicle Information Systems Network (CVISN - pronounced C-Vision).

- CVISN will provide required carrier, driver, and vehicle information to enforcement officers. CVISN users will have immediate access to information stored locally and timely access to information stored remotely in state, regional, or national systems.

- CVISN will be deployed in a series of steps. Assuming adequate funding, carrier-specific information will be provided to enforcement officers in participating states in the 1997 timeframe and driver- and vehicle-specific information will be provided in the 1999 timeframe.

- CVISN will be operated and maintained by the states, the FHWA, and third parties. The FHWA is working with its public and private partners to determine an equitable and workable approach to cost sharing.

Section 1 of this report, Introduction, provides the authority for this report and describes the report approach.

Section 2, Summary of Relevant Ongoing FHWA Projects, sets the stage for the later sections which focus on the specific issue of what information to provide to the roadside enforcement officer. These projects include:

- Commercial Vehicle Information Systems Network (CVISN) Architecture Project
- 100/200 Motor Carrier Safety Assistance Program (MCSAP) Site Project
    - Roadside Data Technology Project (RDTP)
    - Inspection Selection System (ISS)
    - Safety and Fitness Electronic Records (SAFER) System
- Commercial Vehicle Information System (CVIS) feasibility study

Section 3, How CVISN Supports MCSAP, discusses how these systems will improve the effectiveness and efficiency of the activities that comprise a comprehensive MCSAP. These activities include verification of out-of-service repairs, compatible safety rules, roadside inspections, compliance reviews, traffic enforcement, hazardous materials training, drug and alcohol enforcement, and data collection.

Section 4, Developing and Deploying CVISN, summarizes objectives and milestones for CVISN. The section also discusses how the FHWA will continue to work with other stakeholders to address and resolve the technical, financial, and institutional issues in order to accelerate progress toward successful deployment of CVISN.

This report drew heavily on the material produced during the projects mentioned above and discussions with other stakeholders, including members of the ITS America Commercial Vehicle Operations (CVO) Technical Committee. The major findings from this report are listed below with references to the sections in the report that address each finding. This report was developed in consultation with the Commercial Vehicle Safety Alliance (CVSA), which concurs with the report's findings.

- The next three to five years will see increased deployment of the roadside electronic verification system components of CVISN, such as HELP Pre-Pass and the Advantage I-75 Mainline Automated Clearance System. These systems will be used at fixed and mobile checkpoints to achieve the ITS objective of verifying the safety and legality of carriers, drivers, and vehicles without requiring them to stop. Wherever these systems are deployed, transponder-equipped commercial vehicles (and their current carrier and, eventually, the driver) will be electronically identified at mainline speeds. Other vehicles will be electronically identified at lower speeds using license plate readers. Based on the information readily available at the checkpoint, these systems will be used to make a decision in a matter of seconds on whether to allow a vehicle to proceed past a checkpoint. (See Section 3.1, Changes in the Roadside Environment)

- So that officers can continue to focus inspections on high-risk carriers and drivers, CVISN will provide enforcement officers with critical pieces of information. Most of the information will be carrier-specific, though some will be driver- and vehicle-specific, as shown below. (See Section 3.2, Providing Information to Enforcement Officers and Appendix D)

- For the <u>carrier</u> currently responsible for the vehicle:
  - Identification information
  - Date/time and reason for out-of-service order (if applicable)
  - Carrier status
  - Carrier safety risk rating
  - CVIS Motor Carrier Safety Improvement Process (MCSIP) level
  - Carrier census information
  - Inspection summary for past 24 months
  - Accident summary for past 24 months
  - Summary of most recent compliance review (if any)

- For the current <u>driver</u> of the vehicle:
  - Identification information
  - Date/time and reason for out-of-service order (if applicable)
  - Date/time out-of-service repair/condition was verified (if applicable)
  - Status of commercial driver's license
  - Date and location of most recent inspection
  - Flags for violations of critical items from most recent inspection

- For the <u>vehicle</u>, including the power unit and all trailers as appropriate:
  - Identification information
  - Date/time and reason for out-of-service order (if applicable)
  - Date/time out-of-service repair/condition was verified (if applicable)
  - Date CVSA decal expires (if applicable)
  - Date and location of most recent inspection
  - Flags for violations of critical items from most recent inspection

- To use the information listed above, officers will need a way to reliably and accurately identify the carrier, driver, and vehicle. (See Section 3.2.1, Identifying the Carrier, Driver, and Vehicle)

- To make use of this information, officers will have "on-line" access to local computers and information systems that present the needed information in a way familiar and useful to the officer. The information will be accessed automatically using the electronic carrier, vehicle, and driver IDs. To support the exchange of information, these local computers and information systems will have the capability to connect to a nationwide network, when necessary (e.g., to upload one or more inspection reports or to download updated information from other sources). (See Section 3.2.2, "On-line" Access to Information)

- The information will need to move from where it is collected to where it is needed in a timely manner. However, this report finds the need for timely access to current information as opposed to a need for "real-time" information in the same sense as a traffic control system or airline reservation system needs "real-time" information. (See Section 3.2.3, Timely versus "Real-time" Access to Information)

- Most of this information will have been collected and reported by fellow officers and FHWA personnel at other locations as a result of compliance reviews, roadside inspections, accident reports, or traffic stops. Some of the information, such as the carrier safety risk rating, will result from analysis of the collected data. The importance of the information to the carrier rating process and the inspection selection process will increase the need for accurate and timely data collection. This need will be met by more widespread use of pen-based computers and similar technology to speed the process of collecting, reporting, and sharing information. (See Section 3.4, Accuracy of Safety Ratings)

- Providing the above information to the roadside will also give enforcement officers another means for identifying vehicles and drivers that were previously placed out-of-service so that they can verify compliance with out-of-service orders. (See Section 3.5, Compliance with Out-of-Service Orders)

- Improvements in the technology used by mobile inspection teams to support electronic identification and the retrieval of critical information will make it easier for enforcement officers to establish the temporary checkpoints needed to detect chronic violators. (See Section 3.7, Effective Targeting of MCSAP Inspections)

- The CVO Program Plan being developed by the FHWA describes how the FHWA will help design, deploy, and initially maintain all elements of the CVO program, including CVISN. This planned approach will allow adequate time to resolve technical, financial, and institutional issues. In particular, the CVO Program Plan will describe the approach to resolving issues connected with sharing the costs of deployment, operations, and maintenance. (See Section 4.4, Technical Issues and Section 4.5, Financial and Institutional Issues)

- Deployment will begin in pilot states using data on all interstate carriers and their vehicles. The system will expand to include data on intrastate carriers and out-of-service drivers and their vehicles for the pilot states as they connect their systems to the nationwide network. (See Section 4.5.1, Interstate and Intrastate Carriers)

- The FHWA and the carrier community agree that participation in ITS should remain voluntary for safe and legal carriers. The system will not require that all commercial vehicles and drivers be equipped with transponders or smart cards for identification or other purposes. However, since compliance with safety regulations is not voluntary, the FHWA is evaluating alternatives means for identifying unsafe carriers or out-of-service vehicles, including equipping them with transponders. (See Section 4.5.2, Should Transponders Be Required?)

- In the long term, CVISN will be expanded to include access to, and by, Canadian and Mexican systems and users. (See Section 4.5.3, Foreign Vehicles and Drivers Entering the United States)

Use of the technology described throughout this report will promote consistency and uniformity in enforcement activities and help ensure enforcement resources focus on high-risk carriers and drivers. This technology will provide enforcement officers with better information and tools to support and carry out their responsibilities, thereby improving highway safety while improving the efficiency and effectiveness of the Motor Carrier Safety Assistance Program.

The FHWA will continue to refine the development of CVISN with the help of those groups participating in the ITS America CVO Technical Subcommittee, including CVSA, the National Private Truck Council, the American Trucking Associations, the American Bus Association, the Independent Truckers and Drivers Association, the Owner-Operators Independent Drivers Association, the National Governors' Association, the American Association of State Highway and Transportation Officials, the American Association of Motor Vehicle Administrators, the International Association of Chiefs of Police, and representatives of Canada.

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1 Introduction

1.1 Authority for the Report

Senate Report 103-310, accompanying the Department of Transportation and Related Agencies Appropriations Bill, 1995, stated on pages 107-108:

"... the Committee, together with many other organizations involved with the MCSAP and the commercial vehicle information system (CVIS), believes it is essential that initial work should be undertaken toward the next step -- a nationwide, accurate, and uniform carrier- and vehicle-specific information and identification system. Such an advanced system goes considerably beyond the evolving motor carrier safety fitness system and would be of critical importance to enabling or promoting: (1) the targeting of specific vehicles for inspection, (2) accuracy of safety ratings that are based in part on roadside performance data, (3) identification of specific vehicles and drivers that were previously found to be out-of-service in order that compliance with repair orders can be verified,
(4) effective enforcement of registration denials based on information provided by the CVIS, and (5) even more effective targeting of MCSAP inspections, thus further promoting the cost efficiency of this activity. Such a system should, to the maximum extent practicable, identify the motor carrier that has responsibility for the safety compliance of a particular driver and vehicle under different leasing arrangements at a specified time. The advanced system would provide safety and past inspection data on specific vehicles and drivers, safety ratings, crash information, and other information relevant to determining inspection priorities."

"Consistent with these objectives, the FHWA Administrator shall submit, before May 1, 1995, a report to the House and Senate Committees on Appropriations specifying how and when FHWA will design, maintain, and help deploy this advanced information system that will provide on-line and real time carrier- , driver- , and vehicle-specific information to enforcement officers. The report will: (1) outline objectives and milestones for the development and implementation of such a system, (2) indicate the technical, financial, and institutional constraints to such a system and how FHWA is addressing these constraints, (3) be developed in consultation with the Commercial Vehicle Safety Alliance and other relevant organizations, (4) address how data on both interstate and intrastate vehicles and drivers will be incorporated into this system, and (5) include an analysis of whether FHWA will need to require all commercial vehicles to eventually be equipped with transponders that can be used for vehicle identification or other purposes. Plans should also be developed to eventually expand the system to include data on foreign vehicles and drivers entering the United States."

1.2 Report Approach

This report focuses attention three to five years into the future, hereafter referred to as the "mid-term." This report describes steps that are being taken now, or that could be taken in the near term, to reach the mid-term vision.

Section 2, Summary of Relevant Ongoing FHWA Projects, sets the stage for the later sections which focus on the specific issue of what information to provide to the roadside enforcement officer. These projects include:

- Commercial Vehicle Information Systems Network (CVISN) Architecture Project
- 100/200 Motor Carrier Safety Assistance Program (MCSAP) Site Project
  - Roadside Data Technology Project (RDTP)
  - Inspection Selection System (ISS)
  - Safety and Fitness Electronic Records (SAFER) System
- Commercial Vehicle Information System (CVIS) feasibility study

Section 3, How CVISN Supports MCSAP, discusses how these systems will improve the effectiveness and efficiency of the activities that comprise a comprehensive MCSAP. These activities include verification of out-of-service repairs, compatible safety rules, roadside inspections, compliance reviews, traffic enforcement, hazardous materials training, drug and alcohol enforcement, and data collection. This section of the report addresses the operational objectives raised by the House and Senate Committees on Appropriations listed in the following table.

Congressional Objective	Report Section
The targeting of specific vehicles for inspection	See Section 3.3, Inspection Selection Process
Accuracy of safety ratings that are based in part on roadside performance data	See Section 3.4, Accuracy of Safety Ratings
Identification of specific vehicles and drivers that were previously found to be out-of-service in order that compliance with repair orders can be verified	See Section 3.5, Compliance With Out-of-Service Orders
Effective enforcement of registration denials based on information provided by the CVIS	See Section 3.6, Enforcement of Registration Denials
More effective targeting of MCSAP inspections	See Section 3.7, Effective Targeting of MCSAP Inspections

Section 4, Developing and Deploying CVISN, summarizes objectives and milestones for CVISN. This section discusses how the FHWA will continue to work with other stakeholders to address and resolve technical, financial, and institutional issues in order to accelerate progress toward successful deployment of CVISN. This section of the report addresses the issues raised by the House and Senate Committees on Appropriations listed in the following table.

Congressional Issue	Report Section
Outline objectives and milestones for the development and implementation of such a system	See Section 4.1, CVISN Objectives and Guiding Principles, and Section 4.2, CVISN Milestones
Indicate the technical, financial, and institutional constraints to such a system and how FHWA is addressing these constraints	See Section 4.3, Stakeholder Roles, Section 4.4, Technical Issues, and Section 4.5, Financial and Institutional Issues
Address how data on both interstate and intrastate vehicles and drivers will be incorporated into this system	See Section 4.5.1, Interstate and Intrastate Carriers
Include an analysis of whether FHWA will need to require all commercial vehicles to eventually be equipped with transponders that can be used for vehicle identification or other purposes	See Section 4.5.2, Should Transponders Be Required?
Plans should also be developed to eventually expand the system to include data on foreign vehicles and drivers entering the United States.	See Section 4.5.3, Foreign Vehicles and Drivers Entering the United States

Appendix A lists references used in this report. Appendix B lists acronyms used in this report. Appendix C contains the Executive Summary from the CVISN Operational Concept Document (Reference [2]). Appendix D lists the data items in the carrier, driver, and vehicle snapshot of interest to the enforcement officer. Appendix E contains the guiding principles for safety assurance adopted at the 14 December 1994 meeting of the ITS America Commercial Vehicle Operations (CVO) Program Subcommittee. Appendix F presents analysis of inspection data from 1992 and 1993 for interstate carriers.

This report drew heavily on the material produced during the projects mentioned above and discussions with other stakeholders, including members of the ITS America CVO Technical Committee. The major findings from this report are listed in the Executive Summary. This report was developed in consultation with the Commercial Vehicle Safety Alliance (CVSA), which concurs with the report's findings.

2 Summary of Relevant Ongoing FHWA Projects

This section summarizes some of the ongoing FHWA projects related to developing and deploying the Commercial Vehicle Information Systems Network (CVISN). The FHWA is working actively to coordinate the efforts of the projects described in the following subsections to ensure they each meet their individual objectives within the framework of the evolving CVISN architecture.

- Commercial Vehicle Information Systems Network Architecture Project
- 100/200 Motor Carrier Safety Assistance Program (MCSAP) Site Project
  - Roadside Data Technology Project (RDTP)
  - Inspection Selection System (ISS)
  - Safety and Fitness Electronic Records (SAFER) System
- Commercial Vehicle Information System (CVIS) feasibility study

CVISN is defined in Reference [3] as:

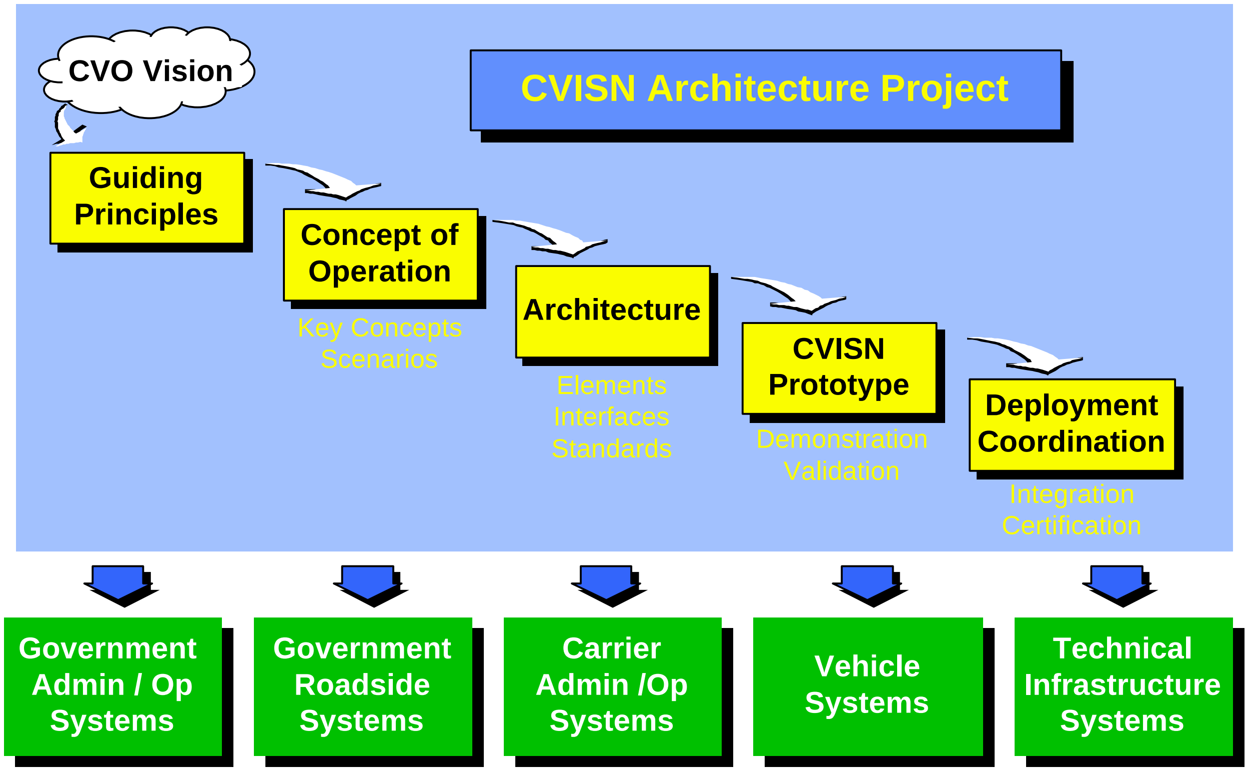
> "The collection of information systems and communication networks that provide support to CVO. CVISN includes systems owned and operated by governments, carriers, and other stakeholders."

Figure 1 illustrates the preliminary CVISN application architecture as described in the CVISN Operational Concept Document (see Appendix C and Reference [2]). CVISN's scope encompasses all commercial vehicle operations (CVO) information systems, including any systems that provide carrier- , driver- , or vehicle-specific information to roadside enforcement officers.

CVISN will ensure the timely and accurate exchange of commercial vehicle-related information among states, carriers, and the federal government. The objectives and milestones for this integrated system have been developed in conjunction with key public and private stakeholders, including members of the Intelligent Transportation Society of America (ITS America) and CVSA. At each stage of CVISN's deployment, the enhanced flow of information will improve the safety of the nation's highways while also increasing efficiency in both government and motor carrier operations.

2.1 CVISN Architecture Project

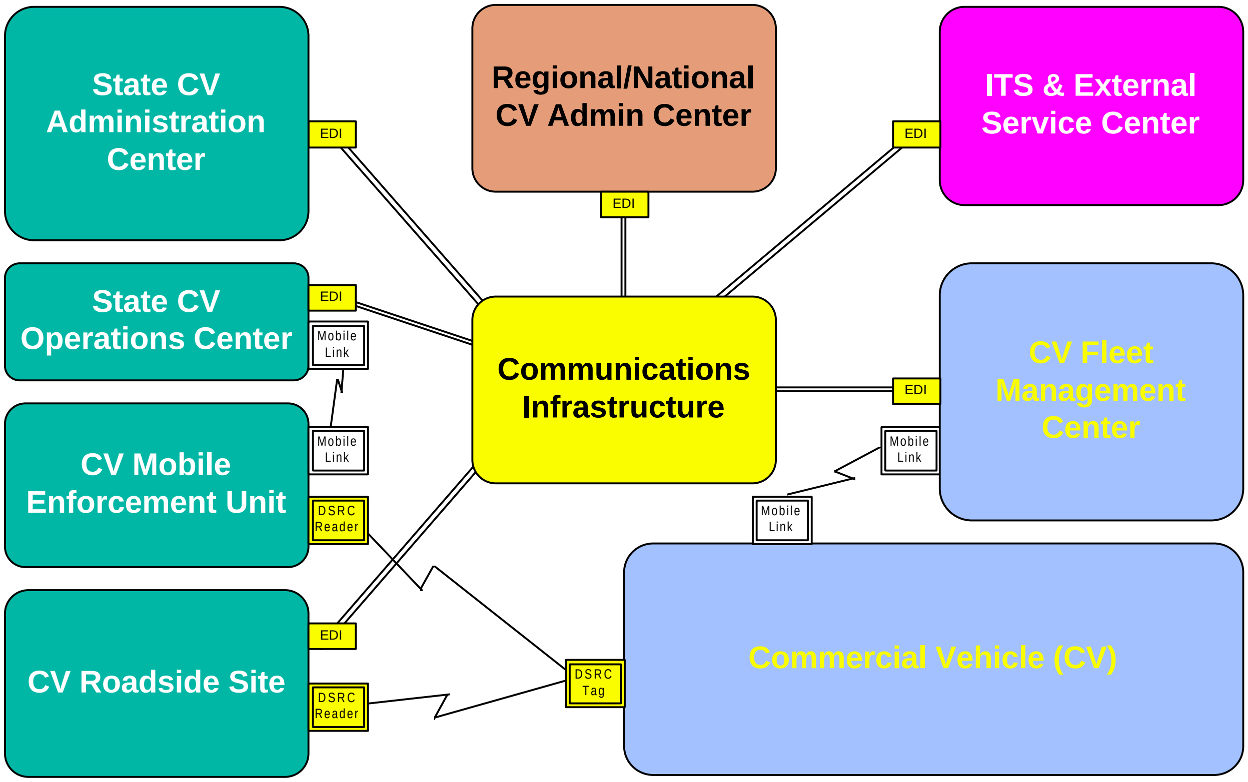
CVISN will provide a mechanism for the cost-effective exchange of information on motor carriers, commercial vehicles, and commercial drivers in support of the CVO user services identified in the National Program Plan for Intelligent Transportation Systems (ITS). The CVISN architecture project is intended to provide a technical framework for implementing future CVO information systems. The project began with the basic vision outlined in the National Program Plan for ITS (Reference [1]). Existing CVO plans, projects, and systems were analyzed to form a baseline for further work (see Figure 1).



. CVISN Architecture: A Framework for System Development

Guiding principles were developed by consensus among stakeholders. This process was facilitated by the ITS America CVO Program Subcommittee, whose members include representatives of CVSA, the National Private Truck Council, the American Trucking Associations, the American Bus Association, the Independent Truckers and Drivers Association, the Owner-Operators Independent Drivers Association, the National Governors' Association, the American Association of State Highway and Transportation Officials, the American Association of Motor Vehicle Administrators, the International Association of Chiefs of Police, and representatives of Canada. Guiding principles provide a concise statement of core values that are supported by representatives of various stakeholders. They form a foundation on which to build. Appendix E contains the guiding principles for safety assurance adopted by the full membership of the CVO Program Subcommittee.

The vision and guiding principles are expanded into a concept of operation. The CVISN Operational Concept Document (OCD) (Reference [2]) defines how the envisioned system will work in user-oriented terms. It assists in clarifying system concepts, building consensus among project stakeholders, and defining project priorities. The CVO Program Subcommittee also reviews, recommends changes to, and ultimately endorses the OCD. Appendix C contains the Executive Summary from the CVISN Operational Concept Document.



. Preliminary CVISN Application Architecture

As CVISN architect, The Johns Hopkins University Applied Physics Laboratory (JHU/APL) is working with appropriate public and private organizations to consolidate and define the requirements for a national CVISN architecture. JHU/APL has developed and evaluated alternate CVISN architectures that provide the system functions necessary to meet the requirements. A preliminary CVISN architecture has been selected and is currently being documented. Subsequently, it will be refined through an iterative process. This iterative process will include numerous presentations to the user community to obtain feedback. JHU/APL is working with the Loral and Rockwell teams designing the National ITS Architecture to ensure consistency between that architecture and CVISN. The CVISN architecture will be modified and updated to address deficiencies identified by the user community.

Once the final architecture is refined and accepted by consensus in the CVO community, it will provide a technical framework for CVISN development. A CVISN Development and Deployment Plan will be developed by the FHWA to describe the plan for moving from current systems to the envisioned architecture.

The architecture is intended to be useful to all stakeholders that are developing information systems. This includes state, local, and federal governments, large and small carriers, and service and technology providers. It is intended to provide a framework of standards and guidelines that allow stakeholders to independently develop their systems with the assurance that they will be compatible with interfacing systems being developed by other stakeholders.

The preliminary CVISN architecture (see Figure 2) developed by the CVISN Architecture Project includes:

- Authoritative sources - the information systems that collect and store carrier- , driver- , and vehicle-specific data. This includes federal and state systems relevant to this report, such as the Commercial Drivers License Information System (CDLIS), the Motor Carrier Management Information System (MCMIS), and SAFETYNET.

- Snapshots - a set of key identification, census, and status attributes pertaining to a carrier, driver, or vehicle. A snapshot is primarily used by automated systems, such as inspection selection systems and roadside electronic verification systems (e.g., HELP, Advantage I-75).

- Profiles - a brief synopsis of the full set of information for a specific carrier, driver, or vehicle. A profile is primarily used by people in cases where the snapshot does not provide sufficient information and the full set of information is not needed.

- Information Exchange Network (IEN) - a wide area network provided by a commercial service provider to support the exchange of information between authoritative sources and users.

- Information Exchange System (IES) - a system to provide users with a directory for routing queries and a repository (database) of commonly required information.

The following subsections describe the primary elements of CVISN that involve and affect the roadside enforcement officer.

2.2 100/200 MCSAP Site Project

The FHWA and the states are in the process of implementing improvements in the information technology used at the roadside to select vehicles for inspection and report inspection results. This project has come to be known as the "100/200 MCSAP Site Project" as a result of a request from a Congressional Committee that advanced technology be deployed at 100 MCSAP sites by 1996 and no fewer than 200 MCSAP sites by the middle of 1997. The 100 site requirement will be met by the deployment of pen-based inspection systems as part of the Roadside Data Technology Project. These systems will support the Inspection Selection System and access to CDLIS. The 200 site requirement will be met in conjunction with the deployment of the Safety and Fitness Electronic Records (SAFER) System.

2.2.1 Roadside Data Technology Project

The FHWA initiated the Roadside Data Technology Project (RDTP) to bring together, under one umbrella, efforts in several states aimed at improving the roadside inspection process through the use of pen-based computers. This technology will improve the accuracy of inspection data and reduce the delay in getting the data from the inspection site into other information systems.

The inspection software developed as part of the RDTP (known as ASPEN) includes selection lists of information needed during an inspection, such as violation codes. Having this information available from a selection list both speeds the inspection process and reduces errors in recording the appropriate code for a particular violation.

ASPEN also includes the capability to upload vehicle and driver inspection results to SAFETYNET. This information will include such data as whether a CVSA decal was issued and whether the vehicle or driver was placed out-of-service. How this data would be made available to other enforcement officers in a timely manner and used by them in the inspection selection process is addressed later in this report.

ASPEN also includes the capability for the roadside inspector to access the CDLIS. This technology will allow the inspector to check the status of the driver's license and to request details from the state of record when necessary.

As currently envisioned, the pen-based system will use a dial-up connection capability to support CDLIS access and the uploading of inspection results, once a driver has been stopped for an inspection.

In the next three to five years, the pen-based system will be tied into other systems at the roadside, including, for example automated brake testing systems and information systems supporting the roadside electronic verification process. These other systems will feed additional information to the inspector to improve the efficiency and effectiveness of the inspection selection process and inspection reporting.

The capability to store, access, and display the driver- and vehicle-specific information to be provided to the enforcement officer at the roadside will be integrated into the pen-based system.

2.2.2 Inspection Selection System

The RDTP is also developing the capability to use historical carrier safety data in an inspection selection system (ISS) as required by the "100/200 MCSAP Site" project. This technology will improve the selection process by providing inspectors with additional information about the carrier responsible for the vehicle being considered for inspection.

To carry out this objective, the ISS needs access to a small subset of the historical carrier safety information. The carrier data items used in the ISS algorithm or displayed to the enforcement officer include:

- Carrier identification information
- Carrier status
- Carrier census information

- Carrier inspection summary for past 24 months
- Carrier accident summary for past 24 months
- Summary of most recent carrier compliance review (if any)
- Carrier safety fitness rating from most recent carrier compliance review (if any)
- CVIS Motor Carrier Safety Improvement Process (MCSIP) level (if it exists)

The algorithm incorporated in the ISS, under development by North Dakota State University, considers both the safety history of the carrier responsible for the vehicle and the amount of performance data available for this carrier. For example, given two similar carriers, the ISS will recommend the inspection of a vehicle operated by the carrier with the higher risk rating. Likewise, given two carriers with similar risk ratings, the ISS will recommend an inspection of the carrier with the least information. Definition of the algorithm and the required data is being coordinated with a technical working group including representatives of the enforcement community from the states participating in the RDTP. The ISS also includes an expert system that recommends particular areas to focus on during the inspection based on the carrier's safety record. For example, the ISS may recommend a Level 3 (driver only) inspection if the carrier has a history of problems in the critical inspection items for drivers.

As currently envisioned, this information will initially be physically downloaded into the pen-based system (or another local computer system) on a periodic basis so that the system can be used in the field without needing to be connected to an external network. Providing the capability to download this data electronically and more frequently is addressed in the next section.

The ISS will provide the enforcement officer with carrier information, and a tool to use that information, to support their inspection selection decision. In the near term, when most vehicles must continue to slow down or stop at checkpoints, the officers will be able to use visual clues along with the ISS to make their selection decision. As more and more of the decisions are made while the vehicle travels at mainline speeds, officers will need to rely more frequently on the ISS.

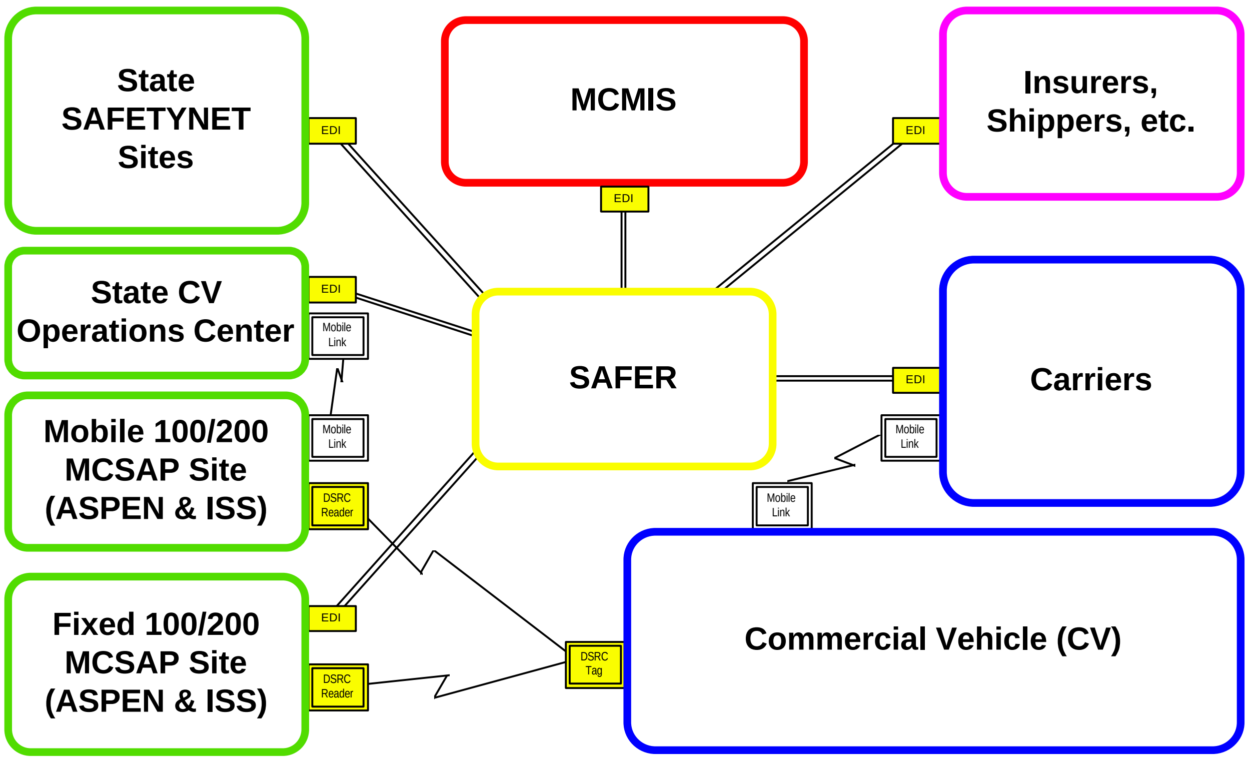
Driver- and vehicle-specific information provided to the enforcement officer at the roadside should be included with the carrier-specific information in the ISS algorithm. For example,

- When a vehicle or its driver is under an active out-of-service order, then the vehicle should be brought into the checkpoint irrespective of the carrier's safety history.

- When a vehicle has an active CVSA decal, then current policy would suggest that this particular vehicle should not be selected for a vehicle inspection unless there is an obvious violation. Note, however, that it may be reasonable to select the vehicle for a driver inspection if this carrier has a history of driver-related problems.

2.2.3 Safety and Fitness Electronic Records (SAFER) System

The second phase of the 100/200 MCSAP Site Project entails developing and deploying the Safety and Fitness Electronic Records (SAFER) System. This system will replace the periodic, physical download of the information needed for the ISS and the pen-based systems with a more frequent electronic transmittal. This will improve the timeliness of the information available at the roadside and improve the efficiency of the download process. As envisioned, most roadside sites will continue to load their pen-based systems with the needed information so they can be used in the field without connection to an external network. However, when necessary, SAFER will provide information within seconds on a motor carrier's safety risk rating, roadside inspection history, and accident record.



. Safety and Fitness Electronic Records (SAFER) System

SAFER will also provide other systems and users with electronic access to carrier data. The system will provide insurers and shippers with electronic access to the safety information they need to support their business operations. The system will also be designed so that it can eventually support other Intelligent Transportation System (ITS) applications, such as roadside electronic verification systems, checking safety credentials at the time of vehicle registration via the Commercial Vehicle Information System (CVIS), and other commercial vehicle administrative processes. Figure 3 illustrates the eventual connection between SAFER and other components of the 100/200 MCSAP Site Project and CVISN.

SAFER will provide users with either a summary of a carrier's safety record ("snapshot") or a more detailed report ("profile"). Definition of the contents of the snapshot and profile is being coordinated with a technical steering committee including representatives of the enforcement community, CVSA, and other stakeholders.

SAFER will be both re-active (i.e., responding to specific requests) and pro-active (i.e., allowing users to request that they be informed when the snapshot changes substantially). Users will be able to request information for specific carriers, or for carriers meeting certain selection criteria. Users will specify the desired response time and delivery mechanism.

Initially, information will be available for interstate carriers only. The system will be expanded to provide access to state information systems and intrastate carriers. Expanded system functions will also include allowing users to request industry-wide safety statistics, and provisions for providing larger user sites with change-only updates rather than complete updates.

To carry out its functions, SAFER will need access to motor carrier identification information for both interstate and intrastate carriers. Over time, SAFER will become the authoritative source for motor carrier identification information.

As noted above, SAFER is being designed with the long term in mind. In particular, it is envisioned that SAFER will form the foundation for the CVISN Information Exchange System (IES). The two systems share the same functionality and SAFER's scope is a subset of the IES scope. Where SAFER is concerned primarily with carrier safety information, the IES is concerned with safety and non-safety related information for carriers, drivers, and vehicles. Once a site is equipped with the technology needed to access and use the information provided by SAFER, the necessary basic infrastructure will be in place to exchange data with other stakeholders through the CVISN IES.

2.3 Commercial Vehicle Information System (CVIS) Feasibility Study

As envisioned, the Commercial Vehicle Information System (CVIS) would allow the states, when issuing a license plate for a commercial motor vehicle, to determine the safety fitness of the motor carrier to which the registered vehicle will be assigned and ensure the safety fitness of the motor carrier through sanctions or limitations on operations. Iowa is leading the CVIS feasibility study in conjunction with Colorado, Indiana, Minnesota, and Oregon. An interim report on the study was provided to Congress in January 1995.

If implemented, CVIS will extend the value of the information collected by enforcement officers at the roadside by using that information in the vehicle registration process. The CVIS operational concept requires evaluating the performance of all carriers. Carriers with substandard performance would enter into a Motor Carrier Safety Improvement Process (MCSIP). As envisioned, most carriers in the MCSIP would heed warning letters about declines in their performance, make appropriate changes to their management programs, and eventually graduate from the MCSIP as their performance improved. A subset of carriers in the MCSIP would actually proceed to the point of suspending or revoking their vehicle registration privilege.

CVIS is mentioned in this report because of its potential impact on the roadside enforcement officer. First, the evaluation of carrier performance will be based in part on inspection data collected at the roadside. This increases the importance of the enforcement officer having a reliable and accurate means for identifying the carrier responsible for the vehicle and driver at the time of the inspection. Second, when a carrier enters the MCSIP, its performance on subsequent inspections will help determine whether the carrier is making effective management program improvements. This increases the importance of focusing inspection resources on carriers in the MCSIP. Third, if a carrier progresses to the point where it has been denied vehicle registrations, roadside enforcement officers will become involved in enforcing that order.

3 How CVISN Supports MCSAP

This section discusses how CVISN will facilitate the improvement of the effectiveness and efficiency of the activities that comprise a comprehensive MCSAP. These activities include verification of out-of-service repairs, compatible safety rules, roadside inspections, compliance reviews, traffic enforcement, hazardous materials training, drug and alcohol enforcement, and data collection. In particular, these subsections address how CVISN would enable or promote: "(1) the targeting of specific vehicles for inspection, (2) accuracy of safety ratings that are based in part on roadside performance data, (3) identification of specific vehicles and drivers that were previously found to be out-of-service in order that compliance with repair orders can be verified, (4) effective enforcement of registration denials based on information provided by the CVIS, and (5) even more effective targeting of MCSAP inspections, thus further promoting the cost efficiency of this activity," as called for in the authority for this report.

3.1 Changes in the Roadside Environment

This report assumes that the next 3 to 5 years will see increased deployment of the roadside electronic verification system components of CVISN, such as HELP Pre-Pass and the Advantage I-75 Mainline Automated Clearance System. These systems will be used at fixed and mobile checkpoints to achieve the ITS objective of verifying the safety and legality of carriers, drivers, and vehicles without requiring them to stop. Wherever these systems are deployed, transponder-equipped commercial vehicles (and their current carrier and, eventually, the driver) will be electronically identified at mainline speeds. Other vehicles will be electronically identified at lower speeds using license plate readers. Based on the information readily available at the checkpoint, these systems will be used to make a decision in a matter of seconds on whether to allow a vehicle to proceed past a checkpoint.

As noted in Section 2, the next three to five years will also see a dramatic increase in the use of technology to support the roadside inspection process. As the capabilities developed during the 100/200 MCSAP Site Project are deployed to other sites, more enforcement officers will use information systems to assist them in making their inspection selection decision. These same systems will improve the accuracy of inspection reports and provide summaries of the reports to enforcement officers at other sites in a timely manner. In this timeframe, there will also be an increase in the use of automated systems to support the inspection itself (e.g., brake testing systems).

The deployment of this technology will radically alter the environment for the roadside enforcement officer. Today, most officers rely on visual clues to assist them in determining where to focus their limited resources. In this environment, the officers will have access to electronic information to support their decision making process. Enforcement officers equipped with a roadside electronic verification system to electronically identify carriers, drivers, and vehicles and the systems to improve the roadside inspection process will be well positioned to achieve the objective of focusing their limited resources on high-risk carriers and drivers.

3.2 Providing Information to Enforcement Officers

So that officers can continue to focus inspections on high-risk carriers and drivers, as called for in the safety assurance guiding principles, the components of CVISN mentioned in Section 2 will provide enforcement officers with critical pieces of information. Most of the information will be carrier-specific, though some will be driver- and vehicle-specific. The information of interest is listed below and described in more detail in Appendix D:

- For the carrier currently responsible for the vehicle:
  - Identification information
  - Date/time and reason for out-of-service order (if applicable)
  - Carrier status
  - Carrier safety risk rating
  - CVIS Motor Carrier Safety Improvement Process (MCSIP) level
  - Carrier census information
  - Inspection summary for past 24 months
  - Accident summary for past 24 months
  - Summary of most recent compliance review (if any)

- For the current driver of the vehicle:
  - Identification information
  - Date/time and reason for out-of-service order (if applicable)
  - Date/time out-of-service repair/condition was verified (if applicable)
  - Status of commercial driver's license
  - Date and location of most recent inspection
  - Flags for violations of critical items from most recent inspection

- For the vehicle, including the power unit and all trailers as appropriate:
  - Identification information
  - Date/time and reason for out-of-service order (if applicable)
  - Date/time out-of-service repair/condition was verified (if applicable)
  - Date CVSA decal expires (if applicable)
  - Date and location of most recent inspection
  - Flags for violations of critical items from most recent inspection

To make use of this information, officers will need:

- a way, preferably electronic, to reliably and accurately identify the carrier, driver, and vehicle,

- "on-line" access to computers and information systems that present the needed information in a way familiar and useful to the officer, and

- timely access to current information, as opposed to "real-time" access.

These points are described in more detail in the following subsections.

3.2.1 Identifying the Carrier, Driver, and Vehicle

To use the information listed in Section 3.2, officers will need a way to reliably and accurately identify the carrier, driver, and vehicle.

The means by which enforcement officers identify carriers, vehicles, and drivers will vary by carrier. Some carriers may choose to fully automate their vehicles while other carriers will forgo all automation. For this report, the many options related to the degree to which carriers equip their vehicles with transponders capable of dedicated short-range communications with state systems are divided into three categories:

- no transponder,
- simple transponders that transmit only a unique transponder number that can then be used with a separate data base to determine the vehicle on which the transponder is (or was) installed (approximate cost of $25-$50), and
- advanced transponders that transmit a unique identifying number for the vehicle, the carrier currently responsible for the vehicle, and (eventually) the current driver, as well as pertinent information such as data from previous checkpoints (approximate cost of $50-$100).

Carriers will decide what technology to equip their vehicles with based on the overall benefit and cost of installation and support. The benefits to safe and legal carriers will increase as more states implement the technology that uses information from transponders to identify unsafe or illegal carriers.

As noted in the CVISN Operational Concept Document (Reference [2]), states will choose from among many options for how their checkpoints will identify carriers, drivers, and vehicles. For this report, the many options are divided into three categories:

- manual techniques - includes entering an identification number (e.g., the carrier number displayed on the side of the vehicle, the vehicle license plate number, the driver's CDL number) or other identifying information (e.g., carrier name, driver's name) into a system that searches a data base for a match.
- electronic video techniques - includes license plate readers and similar devices. These systems relieve the officer from manual data entry, but still require searching a data base for a match to the vehicle license plate. The vehicle information is then used to search a data base tieing the vehicle to a carrier or driver, if such a data base exists.
- transponder reader/writers - vehicles equipped with transponders capable of dedicated short-range communications will send identifying information directly to roadside readers -- no searching of a data base for a match is required. In some cases, the transponders may provide additional information and the checkpoint may write information on the transponder for use at subsequent checkpoints.

States will decide what technology to deploy at their checkpoints based on the overall benefit and cost of installing, supporting, and using the equipment. Deployment will proceed in phases and will vary by state. Some states may use a combination of the options mentioned here. Once a checkpoint has the ability to identify carriers, drivers, and vehicles, it will need information systems to use that identifying information to retrieve additional information of value to the enforcement officer.

3.2.2 "On-line" Access to Information

To make use of this information, officers will need "on-line" access to computers and information systems that present the needed information in a way familiar and useful to the officers. The CVISN architecture assumes that for the most part these computers and systems will be local to the roadside and the enforcement officer will perform the needed functions without being connected to remote systems.

The information will be accessed automatically using the available electronic carrier, vehicle, and driver IDs.

To support the exchange of information with remote systems, these local computers and information systems will have the capability to connect to a nationwide network, when necessary (e.g., to upload one or more inspection reports or to download updated information from other sources).

A wide variety of computers and systems exist today at the roadside, with some states far ahead of others in implementing the infrastructure required to take advantage of this technology. The CVISN architecture focuses on standards for sharing information among these systems, as opposed to imposing standards for the roadside systems.

States will decide what information systems to deploy at their checkpoints based on the overall benefit and cost of installing, supporting, and using the equipment. Systems that provide carrier information will be deployed first (e.g., ASPEN, ISS, SAFER), followed by systems that provide vehicle and driver information.

3.2.3 Timely versus "Real-time" Access to Information

The information of interest to the enforcement officer will need to move from where it is collected to where it is needed in a timely manner. However, this report finds the need for timely access to current information as opposed to a need for "real-time" information in the same sense as a traffic control system or airline reservation system needs "real-time" information.

"Real-time" is generally used to refer to a requirement to receive or access data immediately after it is available. In the CVO context, the electronic roadside verification system has a need for "real-time" information from weigh-in-motion systems (WIM) so that the WIM measurements can be used when making the decision whether to bring the vehicle into the weigh station.

The information that is of interest to enforcement officers is primarily carrier-specific. Trends in this carrier data are the main interest. Since the information focuses on summaries of carrier data (e.g., ratings, out-of-service rates), significant changes in the data will occur infrequently over time. When a change does occur, it is certainly reasonable to allow time for the changed information to get to the roadside enforcement officer. For example, if it takes days to perform and analyze a compliance review, it certainly is not necessary to send the results of that review to all enforcement officers in "real-time"; hence the finding that information needs to be shared in a timely manner.

The driver- and vehicle-specific information of interest to enforcement officers changes whenever a vehicle or driver is inspected. Multiple inspections of particular vehicles and drivers in one year occur very infrequently. Therefore, this information will be infrequently updated. When updated, the information needs to flow to other roadside sites in a timely manner. Again, there is not a "real-time" requirement because it takes time for the vehicle and driver to travel from the inspection site to any subsequent checkpoint.

The most time critical situation occurs when a vehicle or driver is placed out-of-service and the enforcement officer cannot monitor the situation to ensure compliance with the order. This is the reason to include the date, time, and reason for an out-of-service order in the information of interest. When provided with this information, an officer at a subsequent site can take appropriate action to ensure compliance with the order. The CVISN Architecture Project is assessing the options for how the information is to be provided to the officer at the subsequent site. Options include storing the information in the transponder, sending the information through the IES at a high priority, or a combination of these two options. See Section 3.5, Compliance with Out-of-Service Orders, for further discussion of this topic.

3.3 Inspection Selection Process

Most of the activities in the comprehensive MCSAP focus on the carrier. This focus recognizes the fact that: (1) a carrier's safety management policies strongly influence the behavior of its drivers and the quality of vehicle maintenance, (2) more information is available on carriers than on specific vehicles or drivers, and (3) carriers are held accountable for the drivers and vehicles they employ and use.

The roadside inspection program is an important element of the safety assurance program, but it is not designed to inspect all vehicles. Instead, the inspection program serves multiple purposes, including providing measurements of a carrier's level of compliance with safety regulations, providing poor performing carriers with incentives to improve, and removing imminently dangerous vehicles and drivers from the roadway.

This focus on the carrier is reflected in the information listed in Section 3.2. Although inspections will usually be targeted by carrier rather than by vehicle or driver, there are a few instances where the inspection selection process should be influenced by driver- or vehicle-specific information.

- When a vehicle or its driver is under an active out-of-service order, then the vehicle should be brought into the checkpoint irrespective of the carrier's safety history.

- When a vehicle has an active CVSA decal, then current policy would suggest that this particular vehicle should not be selected for a vehicle inspection unless there is an obvious violation. Note, however, that it may be reasonable to select the vehicle for a driver inspection if this carrier has a history of driver-related problems.

Appendix F presents analysis of inspection data from 1992 and 1993 for interstate carriers. As noted in the analysis, a small percentage of all vehicles and drivers have a recent inspection and the above conditions (active out-of-service order or active CVSA decal) will exist for an even smaller percentage. Still, there seems to be general agreement that this information is of great interest to the roadside enforcement officer. The issues connected with how to cost effectively deliver this information to the roadside are addressed later in this report.

It is important to note that if the information made available to inspectors via the Inspection Selection System (ISS) allows them to better target their inspections, use of the ISS may result in an increase in the percentage of inspected vehicles and drivers that are placed out-of-service. This result will need to be carefully explained to the public so that they do not interpret the data as an indication that highway safety has declined. Periodic random inspections without the benefit of the ISS will be necessary to establish a measure of the out-of-service violation rate for the entire motor carrier population.

3.4 Accuracy of Safety Ratings

Most of the information listed in Section 3.2 will have been collected and reported by fellow officers and FHWA personnel at other locations as a result of compliance reviews, roadside inspections, accident reports, or traffic stops. Some of the information, such as the carrier safety risk rating, will result from analysis of the collected data. The FHWA intends to continue basing the carrier's safety risk rating on the management performance of the carrier and the on-road performance of vehicles or drivers under the carrier's control.

The importance of the information to the carrier rating process and the inspection selection process will increase the need for accurate and timely data collection. By using pen-based computers to access carrier identification information, inspectors will ensure the carrier is correctly identified when the inspection report is filed. In those cases where the vehicle is operating under different leasing arrangements, the inspector will use the information systems to ensure the results of the inspection are credited to the responsible carrier. Filing the report electronically will significantly reduce data entry delays, errors, and costs.

The proactive exchange of the safety rating via SAFER will improve the rating's accuracy. Since the rating will be an important component in the systems supporting ITS user services (e.g., roadside electronic verification systems such as HELP and Advantage I-75), both the carrier and the provider of the ITS user service will have a strong interest in having an accurate rating.

This increased interest in the accuracy of the rating will result in increased pressure to correct data entry errors, or to make changes resulting from appeals. Carriers will most likely want an electronic means to inform the authoritative source whenever performance data is incorrectly assigned.

3.5 Compliance With Out-of-Service Orders

As noted in the previous sections, providing the information listed in Section 3.2 to the roadside will give enforcement officers another means for identifying vehicles and drivers that were previously placed out-of-service so that they can verify compliance with out-of-service orders.

It is critical that when an inspection results in a vehicle or driver being placed out-of-service, the vehicle or driver does not enter back into service without repairing or correcting the out-of-service condition. Enforcing and verifying compliance with out-of-service orders are necessary both to ensure that chronic poor performers either improve their performance or cease to operate, and to protect the public from imminent danger. The FHWA has two operational tests underway in the area of out-of-service verification. These tests are exploring methods for improved covert monitoring and approaches to passing information to subsequent inspection sites. The FHWA is also exploring the feasibility of putting transponders on vehicles placed out-of-service. The concepts presented here may be modified as a result of those tests and as a result of the peer review of out-of-service verification (Reference [4]).

The following discussion addresses three distinct ways the information system can be used in support of the verification of out-of-service orders:

- by an enforcement officer at the site where the vehicle or driver was originally placed out-of-service,
- by an enforcement officer at a subsequent inspection site, and
- by a non-enforcement officer (e.g., a repair facility, the driver, or the carrier's facility).

In those cases where an enforcement officer at the original inspection site performs the verification, the inspector will update the information system to indicate that the out-of-service repair has been verified. The fact that the return to service has been verified can then be taken into account when the vehicle or driver passes a subsequent inspection site.

In those cases where the inspector at the original site will not be available to verify the repair (e.g., the site is closing), the inspector will first update the information system to show this vehicle or driver as having an unverified out-of-service order. Any vehicle or driver with an active out-of-service order that encounters a subsequent inspection site will be pulled in for a verification inspection focusing on the condition that originally placed the vehicle or driver out-of-service. Some states are testing this concept on a limited level by sending faxes between sites listing the vehicles and drivers that are under out-of-service orders at the time a site closes.

In many cases, a vehicle placed out-of-service will be towed to a repair facility or repaired after the inspection site has closed. Similarly, a driver placed out-of-service for an hours-of-service violation may return to service after getting the necessary rest. In these cases, there should be a means for non-enforcement officers to inform the appropriate authorities that the vehicle or driver is legally back in service.

Given the seriousness of an out-of-service order, there also needs to be a way to check the information system for unverified out-of-service orders. In this case, an enforcement officer can contact the carrier of record at the carrier's place of business. Failure to verify repairs should increase the likelihood of a carrier compliance review and potentially raise a carrier's safety risk rating.

3.6 Enforcement of Registration Denials

The Commercial Vehicle Information System (CVIS) feasibility study being led by Iowa has defined a Motor Carrier Safety Improvement Process (MCSIP) aimed at encouraging carriers with poor safety records to improve their performance or risk losing their vehicle registrations.

The Volpe National Transportation Systems Center is developing the SafeStat algorithm to support the CVIS feasibility study. This algorithm will take available information about the carrier and determine a single, composite SafeStat score. Carriers with scores above a specified number will enter the MCSIP. There are several levels in the MCSIP with ample opportunity for the carrier to improve its performance before moving to a more severe level. Only carriers that reach the final level will be denied registrations.

Like the ISS, the MCSIP requires accurate and timely collection of performance data and updating of the SafeStat score. Once a carrier enters the MCSIP, there will be an increase in the number of inspections of that carrier in order to provide data to indicate whether performance is improving (in which case, the carrier would move to a less severe level or entirely out of the MCSIP) or declining (in which case, the carrier would move to a more severe level).

A carrier's SafeStat score and MCSIP level are included in the information provided to enforcement officers so that they can take appropriate action to enforce the denial of vehicle registrations.

3.7 Effective Targeting of MCSAP Inspections

The efforts mentioned in the previous subsections will result in more effective targeting of MCSAP inspections.

Closing the loop on out-of-service orders will increase the pressure on carriers to correct problems identified during inspections. Failure to take corrective action and to report the action taken will adversely affect the carrier's safety risk rating.

A higher risk rating will lead the ISS to increase the probability of selecting this carrier for an inspection. A higher risk rating will also eventually result in the carrier entering the MCSIP, which will bring increased focus on the carrier's operations.

To make these improvements in the inspection process, the accuracy and timeliness of the inspection data collection process must be improved. Several states have already demonstrated the advantages of using pen-based systems to address this issue. Use of these systems also improves inspection consistency from state to state and from inspector to inspector.

To make these improvements, the exchange of the critical elements of safety data must be improved. Since it is very likely that the improved targeting of inspections will lead some high-risk carriers and drivers to take further actions to avoid encounters with enforcement officers, access to safety data must be provided to mobile inspection teams, in addition to fixed inspection sites. Improvements in the technology used by mobile inspection teams to support electronic identification and the retrieval of critical information will make it easier for enforcement officers to establish the temporary checkpoints needed to detect chronic violators.

Use of the technology described throughout this report will promote consistency and uniformity in enforcement activities and help ensure enforcement resources focus on high-risk carriers and drivers. This technology will provide enforcement officers with better information and tools to support and carry out their responsibilities, thereby improving highway safety while improving the efficiency and effectiveness of the Motor Carrier Safety Assistance Program.

4 Developing and Deploying CVISN

The CVO Program Plan being developed by the FHWA (Reference [6]) describes how the FHWA will help design, deploy, and initially maintain all elements of the CVO program, including CVISN. The CVO Program Plan is an expansion of the CVO components of the National ITS Program Plan (Reference [1]), and includes the CVO Program Roadmap (see Section 4.2, CVISN Milestones). The CVO Program Plan emphasizes the interrelationship between CVISN and the other public and private elements of the program. The following subsections summarize pertinent information from the CVO Program Plan.

4.1 CVISN Objectives and Guiding Principles

CVISN is designed to achieve the following objectives:

- **Implement the ITS CVO user services**: The National Program Plan for ITS documents a carefully obtained consensus on what user services are to be developed. These are considered as fundamental direction to the CVISN architecture project.

- **Improve CVO efficiency and effectiveness**: Information technology is the key to improvement of CVO processes. Many current bottlenecks can be alleviated with technology.

- **Promote consistency among processes and data**: Inconsistency makes compliance for carriers more complex and expensive. Consistency reduces costs and improves productivity.

- **Improve availability of timely, accurate information**: People make better decisions when they have the best available information. Likewise, automated processes are most effective when they operate with the most complete and accurate set of information available.

CVISN will be developed in accordance with the following guiding principles:

- **The priorities for CVISN deployment are determined by stakeholder consensus.** - The ITS CVO program is emphasizing a focus on stakeholders and consensus building. ITS America committees are actively involved in working with the federal government to determine program priorities and direction.

- **Participation in CVO programs is voluntary. Any carrier can participate in CVO programs with a modest investment.** - The programs must be voluntary for both carriers and state governments. There must be clear and compelling benefits to joining programs to encourage participation.

- **The federal government expedites the deployment of CVISN by providing technical, managerial, and funding support.** - Expediting deployment of CVISN has been a topic of considerable discussion during meetings of the ITS America CVO

Technical Committee and its subcommittees. Stakeholders have indicated they want strong national leadership that builds on existing regional and state efforts such as HELP, Advantage I-75, I-95, etc. The FHWA is working actively with stakeholders to identify and resolve technical issues and to provide management coordination among the numerous projects. Based on experience with CDLIS and SAFETYNET, the FHWA also recognizes that in order to rapidly deploy CVISN and achieve the goals of interoperable systems and increased uniformity among states, the federal government must provide funding to expedite research, development, evaluation, and prototype and pilot deployment of ITS technology. This funding will be used in part to create incentives for participation. The FHWA and its public and private partners recognize that no single stakeholder should support the full costs of ongoing operation and maintenance. The FHWA is working with other stakeholders to determine an equitable and workable approach to cost sharing.

- **Measures of effectiveness (MOEs) are used to assess CVISN applications and guide investment decisions.** - An MOE is a quantitative expression of the success of a system in achieving a specified objective. These will be used to evaluate plans and assess results to assure that ITS CVO projects and investments are focused on producing measurable benefits.

- **CVO programs treat stakeholders equitably.** - ITS technology must be available to any stakeholder willing to make the necessary investments and process improvements. Willing participants whose performance drops below some standard should be encouraged to improve their performance, rather than removed from the program.

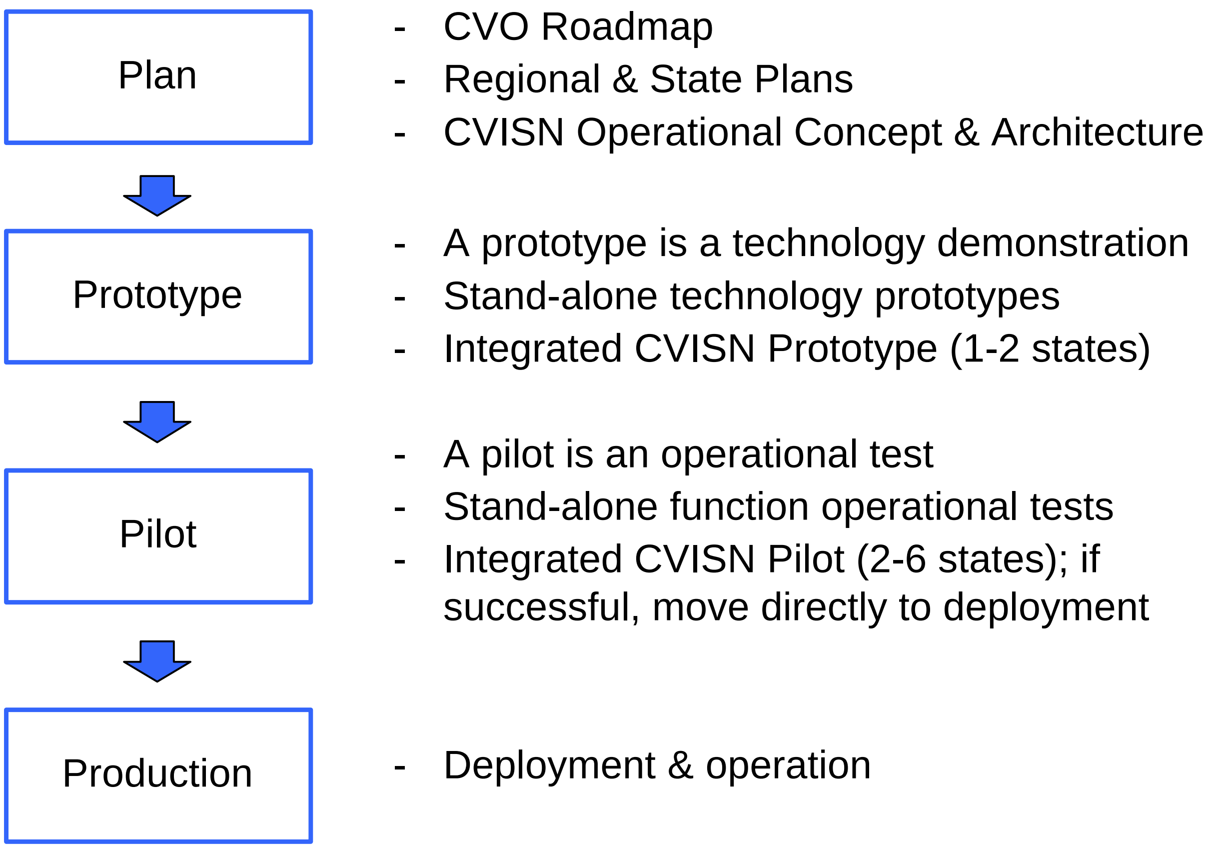
- **Governmental CVO policies and practices are structured to primarily benefit safe and legal carriers.** - The benefits should accrue primarily to safe and legal carriers. There is no requirement for equitable treatment of unsafe or illegal carriers relative to safe and legal carriers.

- **Information technology is used to facilitate continuous process improvement and/or process re-engineering.** - Technology is not an end in itself. It is to be applied to improve the efficiency and effectiveness of processes. This may be done gradually (continuous process improvement) or more radically (business process re-engineering).

- **The United States works with Canada and Mexico to implement compatible policies and interoperable systems.** - The focus of the United States ITS effort is naturally on deployment within the U.S. However, it is recognized that it is critically important to implement compatible polices and interoperable systems with Canada and Mexico to achieve all ITS goals and support the North American Free Trade Agreement (NAFTA).

4.2 CVISN Milestones

The FHWA has developed a preliminary CVO Program Roadmap that includes the milestones connected with the development and deployment of CVISN. The CVO Program Roadmap uses a four-phase strategy to technology development and deployment as shown in Figure 4.



. CVO Program Roadmap Technology Development Strategy

The major CVISN milestones are listed in Table 1 and summarized here.

Preliminary Architecture - completion of the preliminary CVISN Architecture Specification.

CVISN Prototype - completion in one or two states of prototype components of CVISN based on the preliminary architecture. The focus will be on the exchange of information necessary to support roadside electronic verification systems and roadside inspection systems.

100 MCSAP Sites - deployment of the ASPEN pen-based inspection system, the Inspection Selection System (ISS), and access to the Commercial Drivers License Information System

(CDLIS) at no fewer than 100 MCSAP sites in accordance with Congressional direction. These sites will have access to information on all interstate carriers and drivers.

Table 1. Major CVISN Milestones

Milestone	Date
Preliminary Architecture	July 1995
CVISN Prototype (1-2 states)	December 1995
100 MCSAP Sites	December 1995
National ITS Architecture	June 1996
CVISN Pilot (2-6 states)	December 1996
Start National Deployment	January 1997
200 MCSAP Sites	June 1997
Full IES/IEN Deployment	December 1998
Complete National Deployment	December 2000

National ITS Architecture - completion of the integration of the CVISN architecture with the National ITS Architecture Project that addresses all 29 ITS user services.

CVISN Pilot - experience gained in the prototypes states will be used during deployment of the CVISN architecture in from two to six pilot states. These states will have the full CVISN functional capabilities within and between pilot states.

Start National Deployment - experience gained in the pilot states will be used to start national deployment. States will be encouraged to form regional consortia to reduce deployment costs and improve program effectiveness.

200 MCSAP Sites - deployment of the Safety and Fitness Electronic Records (SAFER) System and updates to ASPEN and the ISS at no fewer than 200 MCSAP sites in accordance with Congressional direction. These sites will have access to information on all interstate carriers and drivers. Sites in pilot states will also have access to information on intrastate carriers.

Full IES/IEN Deployment - experience gained in the pilot states and with SAFER will be used to complete the expansion of the Information Exchange System (IES) and Information Exchange Network (IEN) components of CVISN. The IEN will provide connectivity for all participating states. The IES will contain information on all carriers, vehicles and drivers for participating states.

Complete National Deployment - assuming continued federal and state funding, national deployment should be completed by the end of the year 2000.

4.3 Stakeholder Roles

The FHWA is committed to working with other stakeholders in developing and deploying CVISN. The following material on stakeholder roles was extracted from the CVISN Operational Concept Document.

The ITS CVO program is a voluntary effort. Its success is totally dependent on the cooperation of all stakeholders. Stakeholders must have a willingness to honestly represent their point-of-view, to understand other stakeholder's requirements, and to collaborate to achieve mutually beneficial policies, plans, and processes. The FHWA is working with other stakeholders to define the extent to which each stakeholder funds or pays for the development, deployment, operation, and maintenance of the components of CVISN. Discussion of the approach to cost sharing will be included in the CVO Program Plan.

States - Participating states must make an investment in information systems and other ITS technology. They must enhance their systems for licensing, credential and tax administration, and safety assurance to be compatible with the national architecture. This primarily means supporting standard electronic data interchange (EDI) transactions. They must establish an information infrastructure to provide data necessary for electronic verification to fixed sites and to mobile police units. They must provide the data necessary to support electronic verification to other states.

Carriers - For a carrier to get the full benefit of ITS programs, it must make some level of investment in technology. The minimum level is to install a standard transponder on their vehicles. This allows participation in paperless truck and electronic verification programs. Depending on their own cost/benefit analysis, they may also choose to make further investments in fleet management software, on-board computers, mobile communications, office automation, electronic data interchange, and other technologies that improve their internal processes.

Drivers - Drivers need to participate in CVO projects as a partner in developing and evaluating innovative technology applications. Participating drivers can support CVO initiatives through trade associations and unions.

Service Providers & Manufacturers - The ITS program has an overall goal to develop an ITS industry in the United States. The CVISN development and deployment approach relies heavily on private industry to provide computer, software, and communication technology and services to meet the architecture. It relies on vehicle manufacturers to incorporate on-board technologies first as add-on equipment and, eventually, as an integral part of commercial vehicle manufacturing.

Professional & Trade Associations - Professional and trade associations can organize their memberships to participate collectively in ITS efforts. They can provide a channel for outreach and feedback. They can prioritize issues and help build consensus for national programs. **Particularly relevant to this report is the work by CVSA and ITS America to ensure that every enforcement officer recognizes the benefits and costs of this system.**

Operational Tests & Consortiums - Test efforts and consortiums can modify their systems to demonstrate CVISN concepts and standards. Regional efforts such as HELP, Advantage I-75, I-95, and others that evolve over time will serve as important test beds for deployment of the integrated and interrelated components of CVISN.

Federal government - The federal government will expedite the deployment of ITS technology by providing technical, managerial, and funding support. The CVISN architecture effort is a key element of technical support which provides a technical framework for states to implement their systems. The CVISN Development and Deployment Plan provides a management framework for all stakeholder projects. Funding will be provided for key research projects, operational tests, and deployment efforts. The level of federal funding will depend on Congressional action.

4.4 Technical Issues

Based on the analysis to date as part of the CVISN Architecture Project, key technical issues have been identified that will need to be addressed as part of completing the architecture definition. The issues relevant to providing information to enforcement officers are discussed below.

Standards for EDI and EFT - The architecture is designed to be flexible and easily evolve with new technology, regulations, and business practices. It uses a minimalist approach, leaving most of the aspects of design open to definition and customization by states and carriers. It provides well defined, managed interfaces for information exchange but does not constrain the internal design of state and carrier systems.

Systems will be developed by states, the federal government, and carriers which must all share data to achieve the CVO vision. This requires agreement on detailed standards for electronic data interchange (EDI) and electronic funds transfer (EFT). Data elements which must be exchanged among systems must be identified. The authoritative source and unique identifiers must be designated for each element. There should be a single common data element dictionary for CVO to ensure consistency of data definitions. (See Reference [3] for a first draft of such a dictionary.) The data element dictionary should be based on a data model, rather than just listing elements. The data model provides a framework for analysis and it helps clarify the relationships among elements.

Information Exchange System and Information Exchange Network - The CVISN architecture includes the Information Exchange System (IES) and Information Exchange Network (IEN) as elements in facilitating data exchange. Since these elements are key to establishing interfaces, their detailed design must be completed to validate the architecture and reduce the risk of unforeseen problems. This includes selecting the location of communication points-of-presence and protocols for the IEN. It also includes specifying the number and location of IES servers and the database design.

Vehicle to roadside communication standard - The vehicle to roadside communication standard is a key architectural decision. A number of projects are currently underway which utilize vehicle-mounted transponders for toll collection and automatic vehicle identification. In the long term, a single standard may be adopted for transponders that can support the requirements of all applications. Since a single transponder standard may be a several years away, a mid-term solution is to pick a few acceptable transponders and design a reader that works with all of them. Note that the transponder standard will describe in detail both what information flows from the vehicle to the roadside and how the information will flow.

Data integrity and privacy - Data integrity and privacy are key issues. Detailed designs for the use of passwords and encryption must be developed to ensure that the architecture provides adequate data protection. Carriers are concerned that competitors not be able to read the data from transponders to determine where vehicles have travelled and whether they are full or empty. Drivers are concerned that the use of smart cards and electronic identification will eventually lead to systems that track a driver's location. Both of these concerns, and the other data integrity and privacy concerns, can be addressed cost effectively by today's information technology.

User interface standards - Multiple systems may ultimately be developed within the CVISN architecture framework by different suppliers at different times for use by enforcement officers, administrators and drivers. In order for these systems to be compatible from a user interface perspective and thereby reduce training time and improve user efficiency and effectiveness, it may be desirable to adopt some form of user interface standards.

Prototype design and cost benefit analysis - Finally, to evaluate the architecture, a specific design must be chosen. This is not necessarily the final design, or a complete design. The CVISN Architecture Project will develop a top-level design for the IES, IEN, and the roadside and administrative systems of a few representative states. This will help to identify problems with the architecture, validate that it is complete, and provide a basis for cost benefit analysis of the architecture.

4.5 Financial and Institutional Issues

The stakeholders participating in the CVISN Architecture Project and related efforts have identified key fiscal and institutional issues and barriers, some of which are mentioned here. Many of the institutional issues have a basis in whole or in part in fiscal issues. Because carrier and state participation in these systems is voluntary, each stakeholder will work through these issues and barriers when they see a direct benefit to them that exceeds their costs.

The complex institutional challenges hindering deployment, each with a variety of causes and solutions, can be grouped into three broad categories: mandate, organization, and resources.

Mandate barriers relate to legal and political conditions and requirements. Mandates significantly affect the way public and private agencies operate. An analysis of the FHWA's institutional issue studies identified some primary mandate barriers as:

- lack of support from the top management of state agencies involved in CVO,
- lack of support from the motor carrier industry,
- lack of a national CVO plan, and
- need for statutory, administrative, and regulatory changes.

Organization barriers involve an organization's structure, administration, and ability to change. The barriers stem from interagency, interstate, or public-private relationships. Examples of primary organizational barriers include:

- lack of coordination among agencies involved in motor carrier administration and enforcement,
- lack of uniform regulations and policies across states, and
- lack of cooperation and trust among state agencies and motor carriers.

Resource barriers relate to personnel levels, funding, expertise, and technology. These barriers, though obvious, point to critical areas which need to be resolved. Examples of primary resource barriers include:

- high anticipated public and private implementation costs,
- lack of technical expertise among current personnel of many agencies involved in CVO,
- lack of public sector data processing capabilities and incompatibility of existing systems among and within states, and
- lack of national technical standards.

In general, these issues cannot be resolved quickly or unilaterally. As has been demonstrated by the work of the ITS America CVO Program Subcommittee, time and resources must be devoted to allow stakeholders to (1) state and discuss their issues and concerns, (2) consider alternatives, and (3) reach consensus. This is particularly true for issues that affect the legal or regulatory environment or that have cost impacts. The FHWA agrees with the approach being taken by the CVO Program Subcommittee to document and resolve these issues in parallel with addressing the technical and program management issues.

The first three subsections address the following issues raised by the House and Senate Committees on Appropriations:

- address how data on both interstate and intrastate vehicles and drivers will be incorporated into this system,

- include an analysis of whether FHWA will need to require all commercial vehicles to eventually be equipped with transponders that can be used for vehicle identification or other purposes, and

- plans should also be developed to eventually expand the system to include data on foreign vehicles and drivers entering the United States.

4.5.1 Interstate and Intrastate Carriers

Data on interstate carriers and drivers will be integrated into CVISN as a natural consequence of the deployment in pilot states and then on a national level.

With the initial release of the CVISN Information Exchange System (IES), CVISN will provide for the exchange of interstate carrier safety information and commercial driver information between the authoritative sources (MCMIS, SAFETYNET, CDLIS) and at least 200 MCSAP sites via the IES and IEN. CVISN will also provide for the exchange of non-safety data for interstate carriers and safety and non-safety data for intrastate carriers based within the few pilot states.

In the following years, CVISN will expand to include other states and thereby other intrastate carriers. The timeframe for when CVISN will deploy into a particular state depends to a large extent on the state's level of fiscal and institutional commitment. In the long term, the effectiveness of the system will increase as more states connect to the network.

4.5.2 Should Transponders Be Required?

The FHWA and the carrier community agree that participation in ITS, including outfitting vehicles with transponders, should remain voluntary for safe and legal carriers. As noted in Section 3.2.1, carriers will need to see a direct benefit of outfitting their vehicles with transponders. States will need to see a direct benefit of outfitting their checkpoints with the equipment necessary to read and write to transponders.

For carriers, transponders provide a way to electronically identify the carrier, vehicle, and driver to suitably equipped checkpoints at mainline speeds. Assuming all checks pass, the vehicles will then be allowed to proceed on their way without entering the checkpoint. Carriers and shippers recognize the benefit this has in reduced (and more predictable) transit times. Many carriers will equip their vehicles with transponders to support electronic toll collection. Others will buy the equipment to support their own fleet management programs. As mentioned in Section 4.4, the key issue for carriers is being able to buy one transponder that supports these multiple functions.

For states, the ability to electronically identify and check transponder-equipped vehicles will reduce traffic congestion at checkpoints. This will have a positive effect on safety in the immediate vicinity of the checkpoint. Transponders with in-cab displays and signals also provide states with an inexpensive and reliable means for communicating with specific vehicles. As mentioned in Section 4.4, reaching consensus on a transponder standard or, in the interim, agreement on a single reader will simplify the process of outfitting checkpoints with the equipment needed for electronic identification.

Significant benefit can be realized from the implementation of the architecture even if some carriers and vehicles are not equipped with transponders. As noted in Reference [5], states will realize long-term savings in the cost of their programs even with as few as ten percent of vehicles equipped with transponders. Also, other technologies (e.g., license plate readers) can be used to identify vehicles electronically at lower speeds so long as a data base relating license plate numbers to vehicles exists and is kept up to date. Though the greatest benefit will be realized when all vehicles are equipped with the minimum transponder capability, requiring transponders would be inconsistent with the guiding principle that carriers can make their own decision of what systems to implement. When making their business decision, carriers will know that states will be able to perform the necessary checks of transponder-equipped vehicles at mainline speeds, whereas non-transponder-equipped vehicles will need to continue to pull into checkpoints.

A transponder coupled with a smart card, or another method of electronically identifying drivers, will be needed to support electronic verification of driver credentials at roadside checkpoints. In the long term, "paperless" vehicles may be possible as states implement the capability to issue electronic credentials to carriers with vehicles equipped with transponders.

In summary, CVISN will not require that all commercial vehicles and drivers be equipped with transponders or smart cards for identification or other purposes. States equipped with license plate readers will be able to use the system to gather information on vehicles that are not equipped with transponders. However, the effectiveness and efficiency of the system will increase as more carriers and states are outfitted with the equipment necessary to perform electronic identification at mainline speeds. Furthermore, since compliance with safety regulations is not voluntary, the FHWA is evaluating alternative means of identifying unsafe carriers or out-of-service vehicles, including equipping them with transponders.

4.5.3 Foreign Vehicles and Drivers Entering the United States

Today, MCMIS includes data collected in the United States on foreign carriers entering the U.S. In the long term, CVISN will be expanded to include access to, and access by, Canadian and Mexican systems and users.

One issue to consider for the long term is whether the information on foreign carriers, vehicles, and drivers accessible through CVISN would reflect only their performance while in the United States or throughout North America.

There are several other issues connected with exchanging information on foreign motor carriers, drivers, and vehicles related to NAFTA, the US Customs Service, and the Immigration and Naturalization Service (INS). Discussion of NAFTA, Customs, and INS is beyond the scope of this report. The FHWA is working with its counterparts in these organizations to ensure consistency in the approach to information exchange. It is also worth noting that Canadian representatives have been involved in the stakeholder meetings conducted as part of the CVISN Architecture Project.

4.5.4 Other Financial and Institutional Issues

The FHWA is working with other stakeholders to resolve other issues connected with the development and deployment of CVISN, some of which are mentioned here.

Building on legacy systems - The CVISN architecture deployment will evolve incrementally, starting with legacy systems and proceeding in manageable steps. Funding is not available for a quick, massive deployment. Even if it were, the organizational infrastructure doesn't exist to make a quick deployment possible. ITS technology must be adopted gradually as consensus develops among the hundreds of state agencies and hundreds of thousands of carriers that could participate.

Funding after initial deployment - Major financial constraints come from the lack of funding for full-scale deployment and for on-going training, operations, and maintenance. The CVO Program Plan will address this and other cost-sharing issues.

Internal competition for limited funding - Major institutional constraints come from the variability in commitment in each state to improvements in the safety information systems. In some states, considerable funding has been available to make improvements and the momentum is significant enough that progress will be made with or without a national deployment plan. But, in most states, the competition for funds has resulted in little effort to develop or implement a state-wide strategic plan. The first phase of the institutional issue studies has made commendable progress in identifying the problems. The FHWA believes the second phase of the institutional issues studies underway in many states will bring states closer to formulating strategic plans for resolving these difficult issues and plans for deploying this technology.

Competitive marketplace will develop software applications - The impact of these fiscal constraints will be reduced by the competitive forces of the marketplace. Competition provides the best environment for the development of most CVO software applications to be used by carriers and states. The architecture deployment effort will not attempt to develop standard applications and impose them on states and/or carriers. The architecture and associated standards will be published and made readily available to interested parties. Stakeholders can then use these as guidance in developing or acquiring their own applications.

Electronic verification standards - The CVISN Development and Deployment Plan assumes that multiple electronic verification systems will exist, including HELP, Advantage I-75 and possibly others. Carriers want to be able to participate in multiple programs without duplication of effort, equipment or software and without separate procedures. How should these standards be administered? Is an electronic verification base state agreement of some type required?

Operational problems to paperless vehicles - As we move from verification based on decals and on-board paperwork to electronic verification, there are many issues that must be addressed. Some of these are legal issues regarding current laws that require paper documents. Others are transitional issues related to the fact the states and carriers will implement the transition on different schedules. For example, how can compatibility of states and carriers be maintained during these transitions, e.g., when a "paperless" vehicle goes into a "paper" state?

Cost sharing - The costs of electronic verification systems and other ITS services should be shared among the beneficiaries (primarily states and carriers). Numerous funding sources have been cited, including the taxes carriers already pay and additional user fees. For example, the HELP, Inc. operational concept includes charging each vehicle on a per clearance basis for mainline clearance (note that doing so creates a requirement for bookkeeping, billing, and payment tracking). The FHWA will continue to work with those groups studying the costs and benefits of these systems, including the American Trucking Associations, the National Private Truck Council, the American Association of State Highway and Transportation Officials, the American Bus Association, and other key stakeholders to resolve the issue of sharing costs.

Unique identifiers - The envisioned system depends on reliably storing and retrieving information on carriers, drivers, and vehicles via a nationwide network. In order for this to work, everyone must agree to a method of uniquely identifying key entities (e.g., the USDOT or state-assigned carrier number, the commercial driver's license number, and the vehicle identification number).

Ownership of Information Exchange System & Network - The IES and IEN are key elements of the envisioned architecture. It is not clear whether the IES and IEN should be owned, operated and maintained by the federal government, a consortium of states, or some type of public/private partnership.

Appendix A. References

[1] DOT/FHWA, *National Program Plan for Intelligent Vehicle-Highway Systems (IVHS)* (Draft), May 1994.

[2] JHU/APL, *Commercial Vehicle Information Systems Network (CVISN) Operational Concept Document*, (Preliminary Draft) PDI-95-006, January 31, 1995.

[3] JHU/APL, *Commercial Vehicle Operations (CVO) Information Systems Data Element Dictionary*, (Working Draft) PDI-94-207, December 30, 1994.

[4] South Carolina Department of Public Safety, *Peer Review of Out of Service Verification*, (Final Report), March 1995.

[5] Oregon Department of Transportation and Oregon Public Utility Commission, *Strategic Plan IVHS/CVO in Oregon*, July 1993.

[6] DOT/FHWA, *CVO Program Plan* (under development).

Appendix B. Acronyms

ASPEN	Pen-based inspection support software being developed for the RDTP
CDLIS	Commercial Driver's License Information System
CVIS	Commercial Vehicle Information System
CVISN	Commercial Vehicle Information Systems Network
CVO	Commercial Vehicle Operations
CVSA	Commercial Vehicle Safety Alliance
EDI	Electronic Data Interchange
EFT	Electronic Funds Transfer
FHWA	Federal Highway Administration
GVWR	Gross Vehicle Weight Rating
HELP	Heavy Vehicle Electronic License Plate Program
IEN	Information Exchange Network
IES	Information Exchange System
INS	Immigration and Naturalization Service
ISS	Inspection Selection System
ITS	Intelligent Transportation Systems (formerly IVHS)
ITSA	Intelligent Transportation Society of America
JHU/APL	The Johns Hopkins University Applied Physics Laboratory
MCMIS	Motor Carrier Management Information System
MCSAP	Motor Carrier Safety Assistance Program
MCSIP	Motor Carrier Safety Improvement Process
NAFTA	North American Free Trade Agreement
OCD	Operational Concept Document
RDTP	Roadside Data Technology Project
SAFER	Safety and Fitness Electronic Records System

Appendix C. Executive Summary from CVISN Operational Concept Document

The following material was extracted from the Executive Summary of the CVISN Operational Concept Document (OCD) (Reference [2]), with slight modifications to reflect comments received since the reference was issued.

This executive summary provides a brief overview of the Commercial Vehicle Information Systems Network (CVISN) operational concept and architecture. First, the fundamental principles used to guide the definition of the operational concept and architecture are summarized. Next, key operational concepts for the envisioned CVO situation are summarized. These are organized into two major groups:

- use of electronic business transactions, and

- improvements in safety and efficiency.

Then, an overview of the envisioned CVISN architecture is provided. The architecture focuses on defining the interfaces among systems by specifying electronic data exchange (EDI) standards. Finally, the role of each stakeholder in achieving the envisioned situation is discussed. Cooperation among stakeholders is critical to achieving the vision.

A Summary of Guiding Principles

The CVISN Architecture Project is using statements of principle to define essential concepts and guidelines for the CVISN architecture. Principles are derived by considering the CVO environment as well as government, business, and technology trends. They are intended to provide a concise vision of the CVO information technology environment to enable multiple projects to proceed independently and still lead to an integrated environment. Guiding principles are discussed in each section of the CVISN OCD and a complete list is provided in Appendix B to that document.

Several guidelines are used in formulating architectural principles. Principles must:

- require defense (i.e. they are not simply obvious statements of facts, automatically accepted by all),
- be stated in present terms,
- be specific enough to guide decision making,
- tie to a benefit,
- be endorsed by the CVO program leadership,
- be few in number, and
- be supported by a consensus.

The principles listed in Figure C-1 summarize the complete list of CVISN Guiding Principles.

- CVISN treats stakeholders equitably and responds to their needs.
- Information technology is used to improve CVO administrative efficiency for carriers and government.
- Electronic verification ensures effective regulatory compliance without unnecessary vehicle delay.
- Safety assurance activities focus resources on higher risks.
- The CVISN architecture enables electronic information exchange.
- The CVISN deployment approach mitigates risk & proceeds in manageable steps, starting with legacy systems.
- The CVISN architecture leads to available & maintainable systems.

Figure C-1. Summary of CVISN Guiding Principles

Equitable and Responsive - ITS technology must be available to any stakeholder willing to make the necessary investments and process improvements. It must be responsive to the real needs of stakeholders. The architecture must offer clear and compelling benefits to win stakeholder voluntary support and participation.

Efficient Credential and Tax Administration - Information technology will be applied to improve the productivity of carrier and government administration.

Electronic Verification - The use of vehicle transponders, roadside readers, and databases of CVO status information will allow electronic verification of the safety and legality of carriers, drivers, and vehicles. It will allow for the "paperless vehicle."

Focus on Higher Safety Risks - Providing timely, accurate information to enforcement personnel where they work will enable them to focus on carriers and drivers which have a higher risk of safety problems.

Electronic Information Exchange - The focus of the architecture is to allow information exchange by defining standard electronic data interchange (EDI) transactions among carrier and government systems.

Manageable Deployment Steps - CVISN deployment must start with legacy (existing) systems and proceed in small steps. Each step must provide a clear benefit and build toward the final vision.

Available and Maintainable Systems - The CVISN deployment effort must plan for operational support from the outset. Fielding unreliable systems will destroy stakeholder support.

B Vision: Electronic Business Transactions

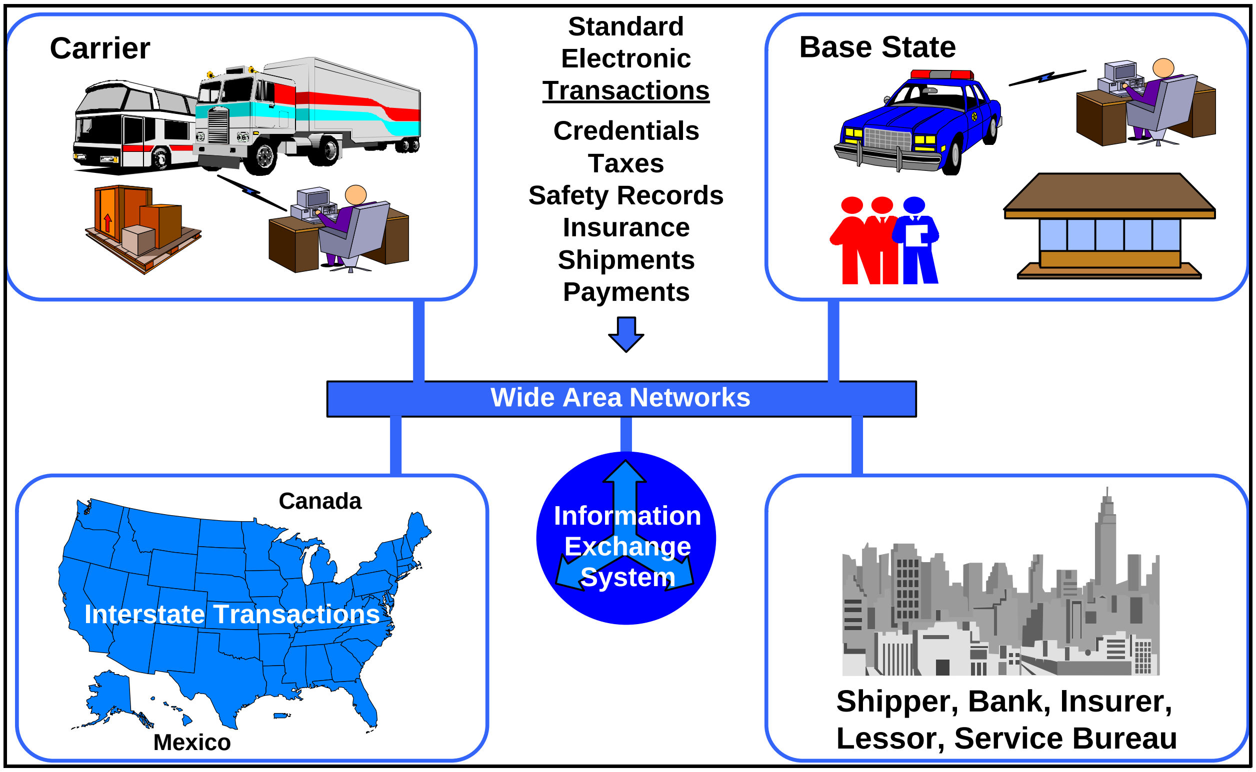


Figure C-2. Vision: Electronic Business Transactions

It is envisioned that in the year 2005, the vast majority of CVO business transactions are being conducted electronically (see Figure C-2). This includes transactions among carriers, shippers, government agencies, and insurance companies.

In 2005, most carriers apply and pay for credentials electronically, including operating authority, registration, and permits. They file and pay taxes electronically. Carriers deal with a base state for all business transactions, including registration, permits, taxes, and clearance. The base state handles any allocation of fees or taxes to other states, simplifying carrier administration. Credentials are distributed electronically. No bingo cards, stamps, decals, or paper permits are required for participating carriers.

Information from one process (e.g., registrations) is available to other processes (e.g., fuel tax) in a timely manner. This avoids redundant data entry, improves data accuracy, and provides data to support better decision making. It permits cross checks such as denying registration to a carrier with a poor safety history.

Some aspects of audits are conducted electronically with participating carriers. State systems send queries to carrier systems. The responses are compared to state records and often the audit is completed with little or no manual intervention.

States deal with carriers electronically, but they also deal with each other electronically. They routinely interchange electronic information about operating authority, registration, tax, clearance, and safety transactions.

Shipping transactions are primarily electronic. Shippers place orders, track freight movement, receive invoices, and make payments electronically.

State highway planning and enforcement operations are planned and managed based on comprehensive, timely information. The information is gathered as a byproduct of the administrative processes and roadside processes. It is anonymous; in other words, carrier and driver identifiers are removed and only the overall statistics are used.

Data privacy and integrity are assured via encryption and password techniques.

C Vision: Efficient & Safe Shipping Operations

It is envisioned that in the year 2005, trucking operations have become much more efficient, largely due to the availability of accurate information in electronic form (see Figure C-3).

In 2005, the vast majority of trucks are equipped with ITS toll and traffic management transponders which transmit messages to and receive messages from the roadside. A clearance message transmits vehicle, carrier, driver, and specially regulated load type identifiers to roadside readers. The identifiers are used to access status information stored in government information systems. Credential, tax, permit, and safety status are checked and compliance verified at mainline speeds. Carriers which participate in clearance programs can operate trucks with no paper credentials on-board.

Trucks can be equipped with a variety of equipment to improve productivity and safety. These include mobile communications systems, navigation and tracking systems, on-board vehicle monitors, collision avoidance devices, crash restraints, and vision enhancement equipment. Vehicle owners decide what to buy based on the specific costs and benefits to them.

Carriers use fleet management systems to optimize schedules, routing, and maintenance. A wide range of accurate and timely information is available to support this processing: freight data, vehicle data, highway data, and traffic data. When warranted, carriers can choose to track vehicles throughout North America. Intermodal transfers are supported by electronic data interchange. Many carriers maintain databases of the location of each shipment. Standards are available to support cross carrier queries and tracking, so a shipper can find the location of its shipment via an electronic query.

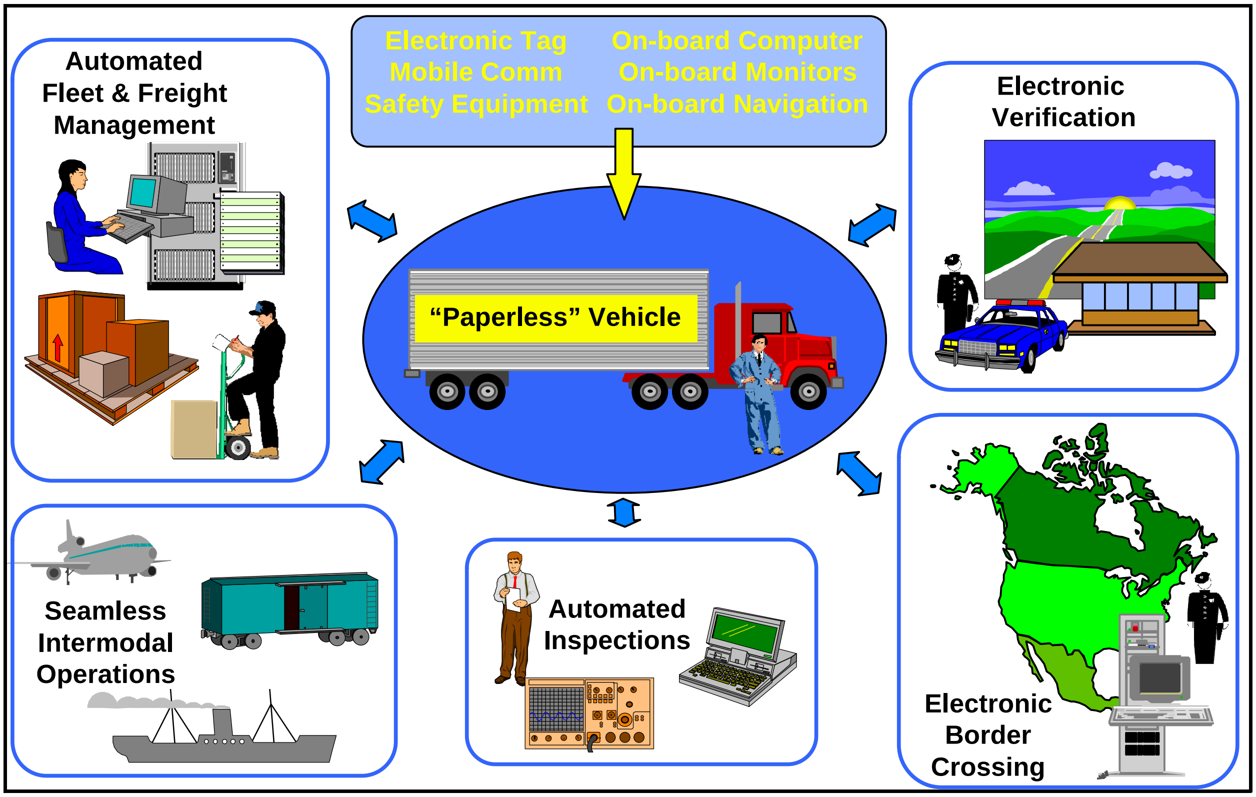


Figure C-3. Vision: Efficient & Safe Shipping Operations

En-route delays have been virtually eliminated. Electronic verification is used to check the vast majority of vehicles at mainline speeds. Support for just-in-time manufacturing is improved with the elimination of unpredictable delays.

When inspections occur, they are conducted quickly with the aid of automated safety inspection equipment. Many vehicles are equipped with on-board monitoring equipment. Results from this equipment can be voluntarily provided to the roadside at mainline speeds and can be used as a direct input to the automated inspection equipment.

International border crossings occur with little or no delay. Routine shipments are often cleared as the vehicle passes at mainline speeds. Immigration and Naturalization (INS) and customs checks are aided by the exchange of electronic transactions and proceed with limited manual intervention.

Electronic transactions support intermodal interchange among trucks, railroads, ships, and air freight lines. All trailers and containers are equipped with a standard intermodal tag. This tag can be read on highways, on rail lines, at truck and rail terminals, and at shipyards.

Carriers which voluntarily adopt driver alertness management programs and equipment are exempted from maintaining trip logs. Other carriers maintain trip logs electronically.

D Application Architecture - Major Architectural Elements

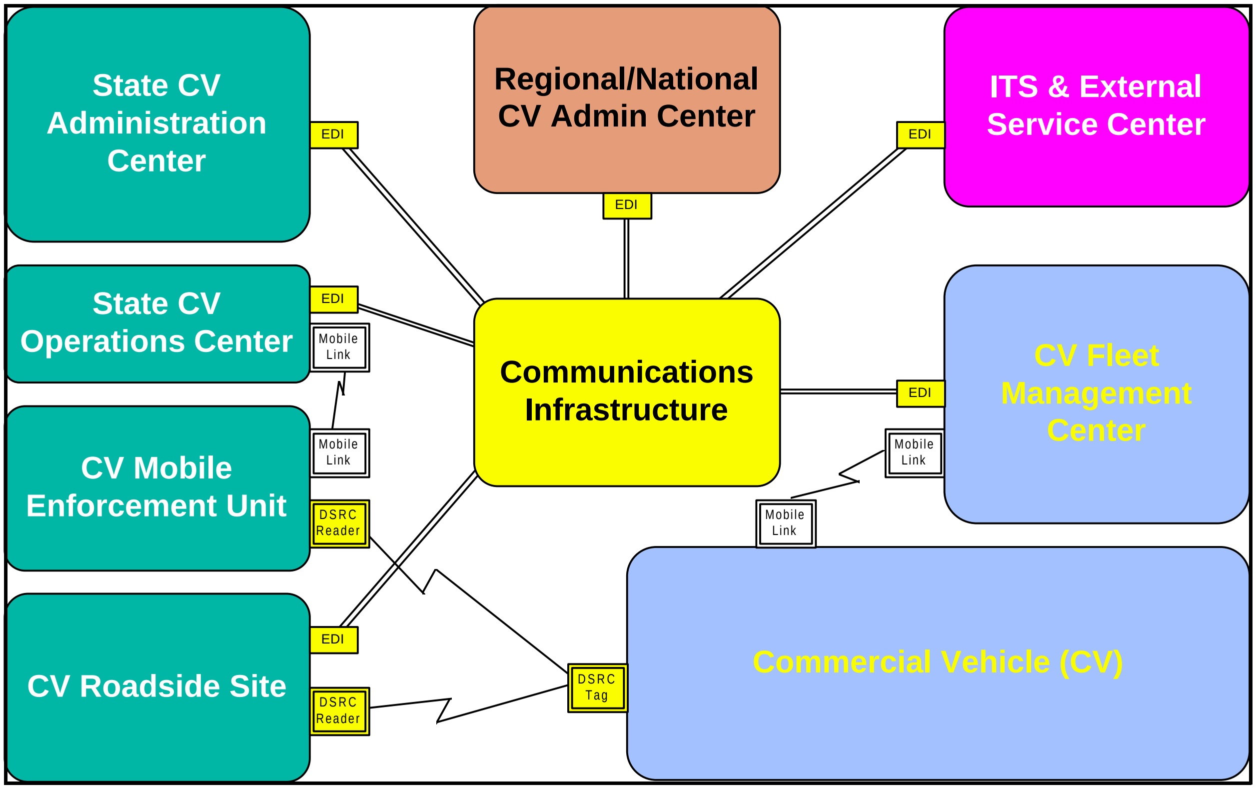


Figure C-4. Application Architecture - Major Architectural Elements

The application architecture defines the major applications needed to support CVO (see Figure C-4). The applications architecture is not a design for systems, nor is it a detailed requirements specification. It is a definition of the major functions to be performed and the top-level requirements to be met by each application, the interfaces to other applications, and the distribution of data among shared databases and applications. The application architecture was developed through an iterative approach using informal trade studies to select one of a number of various alternatives.

The application architecture is defined in multiple levels:

- Segment: The top level elements (components) of the architecture.
- System: A computer system within a segment. This may include hardware, software, procedures, and people.
- Subsystem: A system which is part of a larger system.
- Application: A software subsystem. An integrated software package which supports a specific, well defined process (e.g., a vehicle registration application).

There are nine major segments in the CVISN application architecture:

- State CV Administration Center
- State CV Operations Center
- CV Mobile Enforcement Unit
- CV Roadside Site
- Regional/National CV Administration Center
- ITS & External Service Center
- CV Fleet Management Center
- Commercial Vehicle
- Communications Infrastructure

The segments exchange information primarily via electronic data interchange (EDI) transactions. An exception to this is the vehicle-to-roadside communication system which uses dedicated short-range communication system (DSRC) messages. These are conceptually the same as EDI transactions but technically different and governed by very different protocols and standards.

The complete architecture consists of a definition of these segments, a list of the functions allocated to these segments, a definition of the interfaces among segments (especially EDI transactions and DSRC messages), and any design constraints on the segments. These items are described in detail in a separate CVISN architecture specification.

E Application Architecture - Functions Are Allocated to Major Elements

A requirements specification has been prepared which lists the functions that must be carried out by CVO information systems. These detailed requirements are allocated to the segments, i.e., each segment is assigned specific functions it must perform and capabilities it must have. This allocation is summarized at a very high level in Figure C-5.

State CV Administration Center: This segment performs administrative functions related to credentials, taxes, and safety regulations. In most states, there are multiple centers and multiple systems, applications, and databases within each center.

State CV Operations Center: This segment performs operational functions related to enforcement and clearance operations. In most states, there will be multiple centers and multiple systems, applications and databases within each center.

CV Mobile Enforcement Unit: This segment performs the function of verifying tax, credential, size, weight, and safety regulatory compliance using mobile units. This segment is either a police car or mobile clearance/inspection unit.

CV Roadside Site: This segment performs the function of verifying tax, credential, size, weight, and safety regulatory compliance at a fixed roadside site. It may be a fixed clearance and/or any inspection site. It may be attended or unattended.

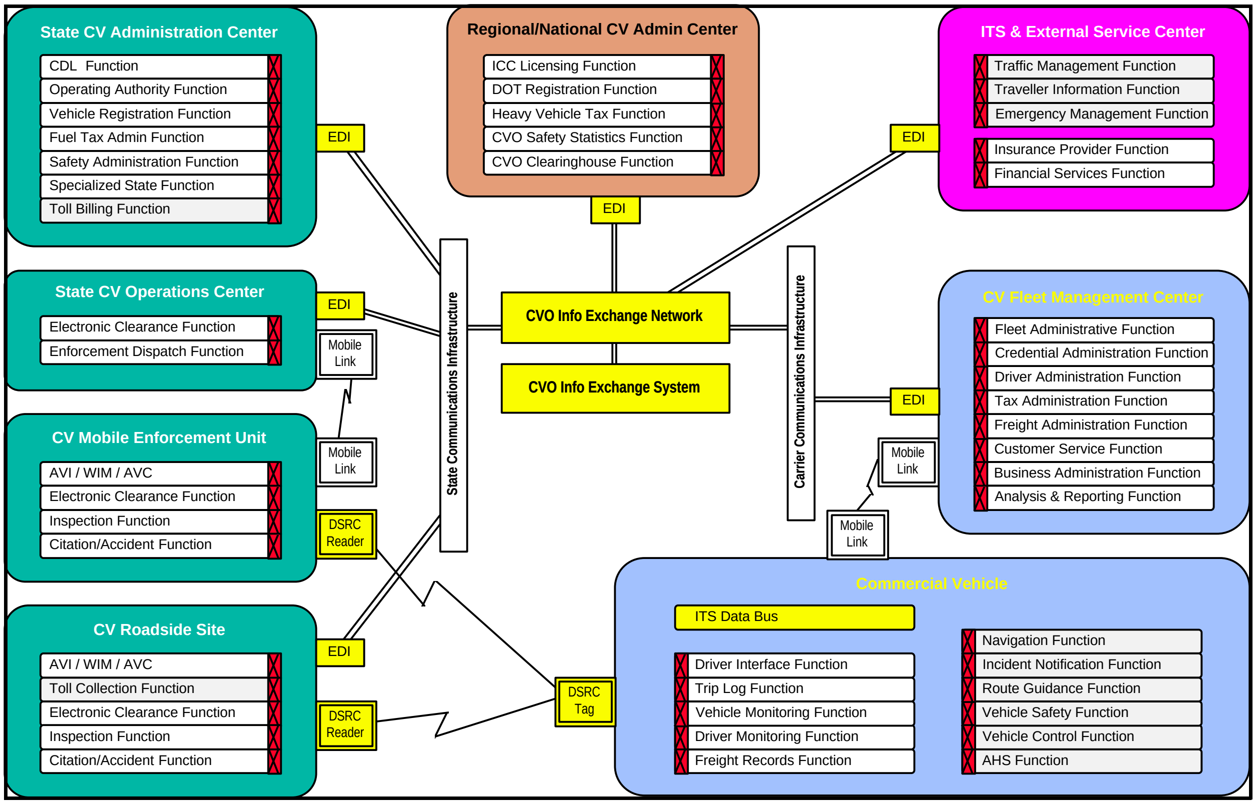


Figure C-5. Application Architecture - Functions Are Allocated to Major Elements

Regional/National CV Administration Center: This segment performs administrative functions related to credentials, tax, and safety regulations that span multiple states. It consists of multiple, dissimilar, geographically distributed systems. The IRP Clearinghouse, the HELP, Inc. regional center, and the I-75 Gateway System are examples of systems of this type.

ITS & External Service Center: This segment performs service functions that are not unique to CVO but are important enough to the CVO operational concept to mention explicitly.

CV Fleet Management Center: This segment performs all the administrative and operational functions necessary to operate a commercial vehicle fleet. This may range from a telephone and manual records to a national network of offices and terminals with extensive information system support.

Commercial Vehicle: This segment includes the vehicle and driver. Its function is to move freight. It may include options such as a DSRC transponder, mobile communications terminal, on-board sensors, data bus, and on-board computers.

Communications Infrastructure: This segment provides data communication among the segments. It includes national, state, carrier, and other private communications facilities.

F Key Architectural Features

The single largest problem with current CVO information systems is the difficulty of data exchange. The architecture effort focuses on addressing this problem. It will establish a common data dictionary of key data elements. An authoritative source for each element will be defined; these will primarily be state administrative systems. Electronic data interchange (EDI) formats will be defined for common transactions among states and carriers. This will allow paperless exchange of credentials, tax, and safety information. It will eliminate the need for carrying paper credentials and decals on tagged commercial vehicles.

- State systems are the authoritative source of **electronic CVO credential, tax, & safety data.**
- **Electronic Data Interchange (EDI)** standards provide common transaction formats for all CVO systems.
- The **CVISN Information Exchange System (IES)** distributes commonly required data to the roadside and deskside.
- The **CVISN Information Exchange Network (IEN)** provides the physical communication path to interconnect CVO systems.
- A **standard transponder** supports clearance & toll collection throughout North America.
- Encryption & password technology ensure **data privacy**.
- Architecture supports **customized & evolving capabilities**.

Figure C-6. Summary of Key Architectural Features: Improved Data Availability

An Information Exchange System (IES) will be established which allows user applications to get snapshot information on key entities in tens of seconds. A national network of information servers will be established with nodes located in each region. These will be of common design and able to exchange data easily. Systems within a given state will communicate to other states via this system. It will be owned and operated by either the federal government or a consortium of states.

The communication system architecture includes a wide area network, a vehicle-to-roadside link, and a mobile link. An Information Exchange Network provides a common method for linking state, regional, national, carrier, and other private networks.

A standard transponder is a key architectural feature. The standard must support multiple ITS functions, including toll collection, CVO electronic clearance, and possibly others, depending on the final National ITS Architecture. The standard transponder, coupled with the information systems, will allow vehicles and drivers to be checked for proper credentials, tax, size, weight, and safety at mainline speeds.

Encryption and password technology are used to ensure data integrity and privacy. Each data element is available only to authorized users. For example, there will be some carrier data maintained by the government that can be viewed only by that carrier or the government. There will be other data that is publicly available to everyone, such as shippers and insurance companies. The design of security rules for each data element is critical to gaining stakeholder confidence and willingness to participate.

The architecture is designed to be flexible and to easily evolve with new technology, regulations, and business practices. It uses a minimalist approach, leaving most of the aspects of design open to definition and customization by states and carriers. It provides well defined, managed interfaces for information exchange but does not constrain the internal design of state and carrier systems.

G CVO Stakeholder Roles

The ITS CVO program is a voluntary effort. Its success is totally dependent on the cooperation of all stakeholders (see Figure C-7). Stakeholders must have a willingness to honestly represent their point-of-view, to understand other stakeholders' requirements, and to collaborate to achieve mutually beneficial policies, plans, and processes.

Carriers - For carriers to get the full benefit of ITS programs, they must make some level of investment in technology. The minimum level is to install a standard transponder on their vehicles. This allows participation in paperless truck and electronic verification programs. Depending on their own cost/benefit analysis, they may also choose to make further investments in fleet management software, on-board computers, mobile communications, office automation, electronic data interchange, and other technologies that improve their internal processes.

Drivers - Drivers need to participate in CVO projects as a partner in developing and evaluating innovative technology applications. Participating drivers can support CVO initiatives through trade associations and unions.

Service Providers & Manufacturers - The ITS program has an overall goal to develop an ITS industry in the United States. The CVO program development and deployment approach relies heavily on private industry to provide computer, software, and communication technology and services to meet the architecture. It relies on vehicle manufacturers to incorporate on-board technologies first as add-on equipment and, eventually, as an integral part of commercial vehicle manufacturing.

- **Carriers**
  - Participate in CVISN projects
  - Install vehicle transponders
  - Invest in other technology when benefit justifies investment
- **Drivers**
  - Participate in CVISN projects
- **Service Providers/Manufacturers**
  - Develop technologies
  - Provide products & services
- **Professional/Trade Associations**
  - Organize membership to participate in ITS CVISN activities
  - Help to build consensus
- **Operational Tests/Consortiums**
  - Demonstrate CVISN concepts
  - Prototype/adopt CVISN standards
- **State & Local Governments**
  - Invest in ITS technology
  - Provide data to each other
  - Establish CVO information infrastructure
  - Change processes to allow paperless vehicles
- **Federal Government**
  - Provide leadership
  - Expedite ITS CVO deployment
  - Develop architecture
  - Develop deployment plan
  - Provide funding when possible
- **Shippers & Public**
  - Support CVISN initiatives

Figure C-7. CVO Stakeholder Roles

Professional & Trade Associations - Professional and trade associations can organize their memberships to participate collectively in ITS efforts. They can provide a channel for outreach and feedback. They can prioritize issues and help build consensus for national programs.

Operational Tests & Consortiums - Test efforts and consortiums can modify their systems to demonstrate CVISN concepts and standards.

States - Participating states must make an investment in information systems and other ITS technology. They must enhance their systems for licensing, credential and tax administration, and safety assurance to be compatible with the national architecture. This primarily means supporting standard electronic data interchange (EDI) transactions. They must establish an information infrastructure to provide data necessary for electronic verification to fixed sites and to mobile police units. They must provide the data necessary to support electronic verification to other states.

Federal Government - The Federal Government will expedite the deployment of ITS technology by providing technical, managerial, and funding support. The CVISN architecture effort is a key element of technical support which provides a technical framework for states to implement their systems. The CVISN Development and Deployment Plan provides a management framework for all stakeholder projects. Funding will be provided for key research projects, operational tests, and deployment efforts. The level of funding will depend on Congressional action. In the past, Congress has provided funds for Intelligent Transportation Systems/Commercial Vehicle Operations activities in the amount of $10 million in FY 1994, and $10.7 million in FY 1995. For FY 1996, the amount requested by the Administration totals $10.7 million. The House of Representatives has recommended $12.7 million stating "Within the amount recommended, sufficient funds are available to improve and operate the SAFER and supporting systems, to equip at least 50 additional sites across the country by mid-1998 with the SAFER/inspection module that will provide on-line vehicle- and driver-specific inspection information ...".

Appendix D. Data Items in the Carrier, Driver, and Vehicle Snapshot of Interest to the Enforcement Officer

The information presented below provides further detail on the data items under consideration for inclusion in the carrier, driver, and vehicle snapshot. These definitions are preliminary and will be reviewed and modified by stakeholders during the process of refining the CVISN architecture. The data items will be provided by the appropriate authoritative sources systems to the CVISN Information Exchange System (IES) for inclusion in the appropriate snapshot. The IES will then make the snapshot available to all authorized users.

For the carrier:

- Identification information - including the unique identifying number for this carrier, legal name, doing-business-as (DBA) name, address, etc.

- Date/time and reason for out-of-service order (if applicable)

- Carrier status - active, inactive, suspended, etc.

- Carrier safety risk rating - this is a single, composite safety rating number on an absolute scale using a well defined set of performance data. This rating will be one component of the algorithms used to select carriers for compliance reviews, inspections, entry into the Motor Carrier Safety Improvement Process, etc.

- CVIS Motor Carrier Safety Improvement Process (MCSIP) level - If the CVIS feasibility study demonstrates the usefulness of the MCSIP, then the MCSIP level will be included in the carrier snapshot. Once in the MCSIP, a carrier's level and step will vary as the carrier responds to warning letters, etc.

- Carrier census information - number of power units, etc.

- Inspection summary for past 24 months - including number of inspections, number of violations in key areas, number of out-of-service orders, etc.

- Accident summary for past 24 months - from SAFETYNET

- Summary of most recent compliance review (if any) - including safety fitness rating, rating factors, etc.

For the driver:

- Identification information - same as current CDLIS identification information, includes proper endorsements and age
- Date/time and reason for out-of-service order (if applicable)
- Date/time out-of-service repair/condition was verified (if applicable)
- Status of commercial driver's license
- Date and location of most recent inspection - used as pointer to inspection record and to reduce number of redundant non-essential inspections
- Flags for violations of critical items from most recent inspection - indicates whether there was one or more violations in each critical item area (e.g., license, medical certificate, hours of service, etc.)

For the vehicle, including the power unit and all trailers as appropriate:

- Identification information - including VIN when available, license plate and issuing state, etc.
- Date/time and reason for out-of-service order (if applicable)
- Date/time out-of-service repair/condition was verified (if applicable)
- Date CVSA decal expires (if applicable)
- Date and location of most recent inspection - used as pointer to inspection record and to reduce number of redundant non-essential inspections
- Flags for violations of critical items from most recent inspection - indicates whether there was one or more violations in each critical item area (e.g., brakes, tires, steering mechanism, etc.)

Appendix E. Safety Assurance Guiding Principles

Statements of principle are used to define essential concepts and guidelines for the development of the CVISN architecture. Principles are derived by considering the CVO environment as well as government and industry trends. They are intended to provide a concise vision of the CVO information technology environment to enable multiple projects to proceed independently and still lead to an integrated environment. The following principles associated with safety assurance are stated as they were adopted by the undersigned members of the ITS America CVO Program Subcommittee on 14 December 1994.

- Carriers and drivers are responsible for the safe and legal operation of commercial vehicles.
- Governments develop and implement uniform standards, practices, procedures, and education programs to improve safety. These activities leverage market forces that encourage safety.
- Governments focus safety enforcement resources on high risk carriers and drivers. They remove chronic poor performers from operation and help cooperative marginal performers to improve.
- Governments conduct inspections and audits to provide incentives to improve poor performance and to collect information for assessing carrier and driver performance.
- Governments develop a safety risk rating for every carrier and driver based on timely and accurate performance data.
- Safety program benefits exceed costs. Benefits and costs are determined using accepted measures of effectiveness that include economic and non-economic factors.

Gene Bergoffen (Chairman)
J. Glen Beaton
Rita Bontz
Rick Craig
Carmen Daecher
Greg Fulton
Kirk Harralson
Don Hartman
Paul Henry
Gilbert Holmes
Gary Hughes
Brian Kinsey
Richard Landis
Dennis Lebo
Steve Lesser
Stuart McDaniel
Marygrace Parker
Susan Perry
Robert Pitcher
Angel Ramirez
David Rich
Thom Rubel
Otto Sonefeld
Jack Williams
Michael Winfrey
Robert Young

Appendix F. Analysis of Inspection Data for 1992 and 1993

Motor carrier inspection data has been effectively used for some time to assess the safety performance of individual motor carriers. This analysis looks at inspection data for interstate carriers from 1992 and 1993 to determine the probability of finding data on a specific vehicle or driver.

Data

The following tables use data from a total of 2,260,271 inspections of interstate motor carriers reported to the Motor Carrier Management Information System (MCMIS) for calendar years 1992 and 1993. About 98 percent of those inspections included the license plate number of the power unit. About 55 percent of those inspections included the driver license number. The following tables include data only for inspections where the vehicle or driver was identified. The analysis that follows assumes that in the near term all inspections will record the vehicle and driver identifying information.

There were 1,288,103 different power units among the 2,209,558 inspections with a recorded vehicle license plate number. Table F-1 shows how many power units had the indicated number of inspections over the two-year period.

Table F-1. Number of power units with given number of inspections

Inspections	Power Units	Frequency	Total	Frequency
1	811,826	63.02%	811,826	36.74%
2	249,951	19.40%	499,902	22.62%
3	115,537	8.97%	346,611	15.69%
4	56,011	4.35%	224,044	10.14%
5	27,745	2.15%	138,725	6.28%
6	13,456	1.04%	80,736	3.65%
7	6,639	0.52%	46,473	2.10%
8	3,267	0.25%	26,136	1.18%
9	1,605	0.12%	14,445	0.65%
>9	2,066	0.16%	20,660	0.94%
	1,288,103	100.00%	2,209,558	100.00%

There were 820,553 different drivers among the 1,239,557 inspections with a recorded driver license number. Table F-2 shows how many drivers had the indicated number of inspections over the two-year period.

Table F-2. Number of drivers with given number of inspections

Inspections	Drivers	Frequency	Total	Frequency
1	573,388	69.88%	573,388	46.26%
2	147,707	18.00%	295,414	23.83%
3	57,998	7.07%	173,994	14.04%
4	23,825	2.90%	95,300	7.69%
5	10,107	1.23%	50,535	4.08%
6	4,262	0.52%	25,572	2.06%
7	1,823	0.22%	12,761	1.03%
8	755	0.09%	6,040	0.49%
9	327	0.04%	2,943	0.24%
>9	361	0.04%	3,610	0.29%
	820,553	100.00%	1,239,557	100.00%

Analysis

This analysis makes the following assumptions on the number of inspections in 12 months, the population of vehicles and drivers eligible for inspection, and the results of the inspections:

- total of 2,000,000 inspections per year (this equates to approximately 5,500 inspections per day or 165,000 inspections per month)
- 5,500,000 commercial vehicles over 10,000 GVWR, including both interstate and intrastate carriers.
- 10,000,000 commercial drivers including those in CDLIS and drivers of vehicles with GVWR between 10,000 and 26,000.
- approximately 25 percent of the inspections result in the vehicle being issued a CVSA decal (equates to 41,500 decals per month)
- approximately 30 percent of the inspections result in the vehicle being placed out-of-service (equates to 1,700 per day) and approximately 8 percent of the inspections result in the driver being placed out-of-service (equates to 450 per day)

This analysis assumes vehicle and driver identifying information will be recorded for all inspections. This analysis also assumes that the distribution of drivers and vehicles by number of inspections as shown in the data for interstate carrier inspections would be approximately the same for intrastate carrier inspections.

Under these assumptions, 2 million inspections of 5.5 million vehicles would result in inspections of approximately 1.16 million different vehicles - or about 21 percent of all vehicles in one year. Even if all 2 million inspections were done for different vehicles, only 36 percent of all vehicles would have inspection data in the past year. Therefore, this analysis finds that if an enforcement officer were to request inspection data from the last year for a particular vehicle, the chances would be somewhere between one in three and one in five that data would be available.

Under these assumptions, 2 million inspections of 10 million commercial drivers would result in inspections of approximately 1.32 million different drivers - or about 13 percent of all drivers in one year. Even if all 2 million inspections were done for different drivers, only 20 percent of all drivers would have inspection data in the past year. Therefore, this analysis finds that if an enforcement officer were to request inspection data from the last year for a particular driver, the chances would be somewhere between one in five and one in eight that data would be available.

The sparseness of inspection information for a particular vehicle or driver supports the concept that the inspection selection decision should focus primarily on carrier-specific information. However, this analysis finds that there are three situations where driver- or vehicle-specific inspection information could be valuable.

Under these assumptions, approximately 1700 vehicles and 450 drivers are placed out-of-service each day. This number is likely to increase as inspections are better focused on high-risk carriers and drivers. Providing identifying information about the vehicles and drivers that should be out-of-service to enforcement officers will most likely result in increased compliance with out-of-service orders.

Under these assumptions, approximately 125,000 vehicles have CVSA decals issued in the preceding three months. Providing this information electronically to the systems used to select vehicles for inspection is consistent with the policy of not re-inspecting a vehicle with an active CVSA decal.

As a final point, the data indicates that some vehicles and drivers are inspected much more frequently than others. The available data was not specific enough to indicate whether some of these multiple inspections occurred close together in time (e.g., inspections within a two-week time period at two different sites or by two different officers) or whether they were distributed roughly uniformly over the two-year period. There was also insufficient data to determine if there might have been a valid reason for re-inspections such as a carrier failing to correct problems noted on previous inspections. Anecdotal evidence suggests that there are instances where a particular vehicle or driver is inspected multiple times on one trip. Providing information to enforcement officers that a vehicle or driver was recently inspected could reduce the instances of unnecessary multiple inspections.