Introduction to Commercial Vehicle Information Systems and Networks (CVISN)

DRAFT REVISION

POR-956982 P.2

February 1997

Prepared for:

Federal Highway Administration

US Department of Transportation

Prepared by:

The Johns Hopkins University
Applied Physics Laboratory

Please note that this is a Working Document

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Introduction to CVISN
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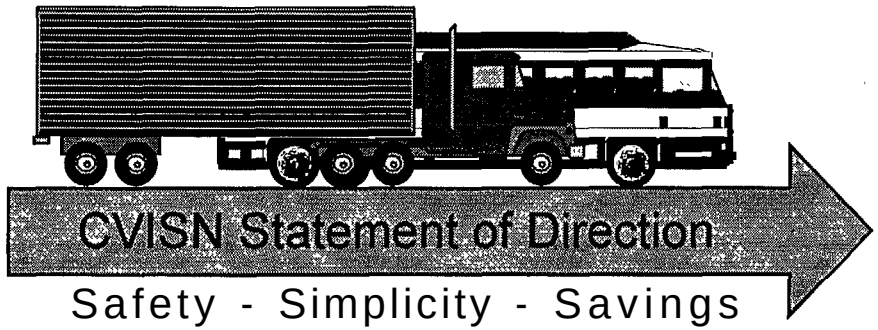


Safety - Simplicity - Savings

Intelligent Transportation Systems (ITS) are transportation systems which utilize information, communication, sensor, and control technologies to achieve improved levels of performance, The US DOT has developed a National ITS Program Plan for ITS which provides a new vision for surface transportation in America. The ITS Program includes seven major elements:

- Travel & Transportation Management
- Travel Demand Management
- Public Transportation Management
- Electronic Payment
- Commercial Vehicle Operations (ITS/CVO)
- Emergency Management
- Advanced Vehicle Control & Safety Systems

The ITS/CVO element includes the ITS technologies which uniquely support Commercial Vehicle Operations (CVO). The scope of CVO includes the operations associated with moving goods and passengers via commercial vehicles over the North American highway system and the activities necessary to regulate these operations. It includes activities related to safety assurance, commercial vehicle credentials and tax administration, roadside operations, freight & fleet management, and vehicle operation.

The term commercial vehicle information systems and networks (CVISN, pronounced "see'vision") refers to the ITS information system elements that support CVO. CVISN includes information systems owned and operated by governments, carriers, and other stakeholders. It excludes the sensor and control elements of ITS/CVO

The DOT has sponsored the development of a National ITS Architecture to provide a technical framework which describes how ITS elements fit together into an overall system. The CVISN Architecture is the ITS/CVO information systems portion of the National ITS Architecture.

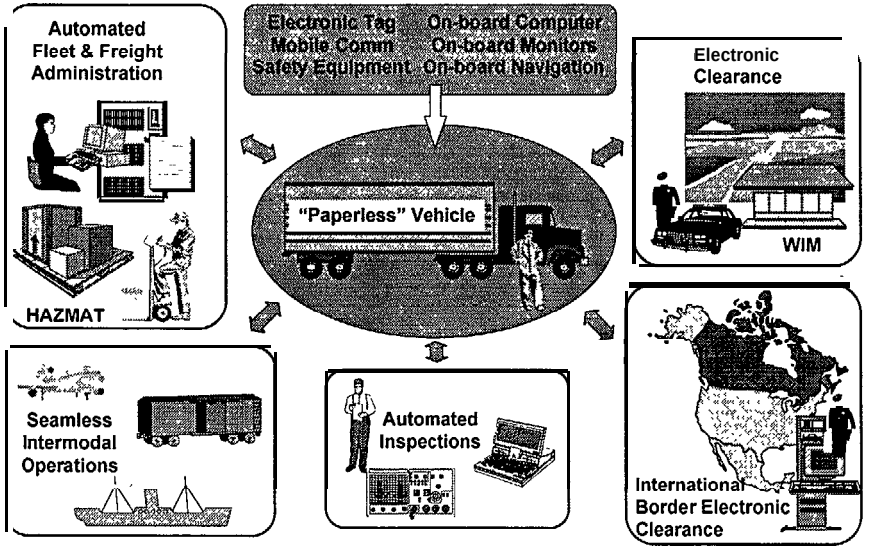
The CVISN Architecture was baselined in 1996. It is being used to develop open standards and provide a technical framework for implementing the CVISN Prototype and Pilot. These are an initial deployment of selected CVISN elements in ten states to demonstrate the operational feasibility and effectiveness of CVISN prior to full scale national deployment. These include systems in the prototype and pilot states, carrier systems, and the CVISN Core Infrastructure. The CVISN Core infrastructure is a selected group of key CVO information systems that provide a mechanism for exchange of safety information, registration, fuel tax, HAZMAT, and commercial driver license information among states.

The ITS/CVO Program is being organized to develop and deploy eight primary capabilities. Some of these are undergoing operational test or are in use now. Others will be developed over the next five to ten years.

ITS/CVO Capabilities

- Safety Information
- Administrative Processes
- Electronic Clearance
- International Clearance
- Automated Inspection
- On-Board Safety
- HM Incident Response
- Fleet & Freight Admin

Vision: Safe and Efficient Shipping Operations



It is envisioned that in the year 2005, trucking operations will have become much more efficient, largely due to the availability of accurate information in electronic form.

In 2005, carriers are able to equip their vehicles with a variety of productivity and safety improvements: mobile communications systems, navigation and tracking systems, on-board vehicle monitors, collision avoidance devices, crash restraints, and vision enhancement equipment.

Most trucks are equipped with ITS dedicated short range communications (DSRC) transponders which transmit messages to and receive messages from the roadside.

En-route delays at weigh stations have been virtually eliminated. Electronic screening is used to check the vast majority of vehicles at mainline speeds. A screening 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. Safety, credential, tax, and permit information are checked at mainline speeds. Carriers which participate in clearance programs can operate trucks with no paper credentials on-board.

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

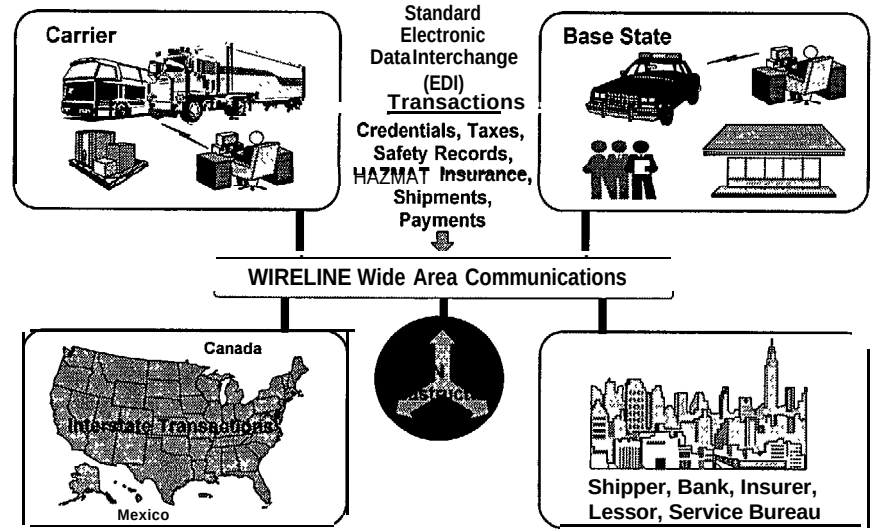
International border crossing clearances occur with little or no delay. Routine shipments are cleared by use of ED1 well in advance of the vehicle approaching the border, and more often than not, the vehicle passes with less than a minute delay.

When inspections occur, they are conducted quickly with the aid of automated safety inspection equipment.

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 use fleet management systems to optimize schedules, routing, and maintenance. Accurate highway and traffic data is available to support routing. Carriers can choose to track vehicles throughout North America. 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 their shipment via an electronic query. HAZMAT handling data required to respond to HAZMAT incidents is available on-line to emergency personnel.

Vision: Electronic Business Transactions



It is envisioned that in the year 2005, the vast majority of CVO business transactions are being conducted electronically. This includes transactions among carriers, shippers, government agencies, insurance companies, and other CVO stakeholders.

In 2005, carriers apply and pay for credentials electronically, including registration, HAZMAT permits, and oversize/overweight permits. They file and pay fuel 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 his tory.

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, and states also deal with each other electronically. They routinely interchange electronic information about business transactions relating to safety, registration, tax, and clearance.

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 by-product 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.

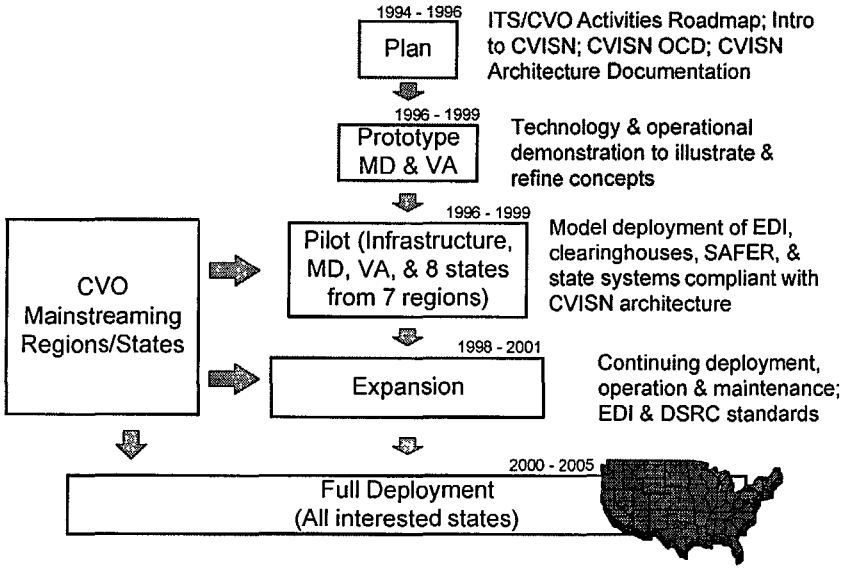
Data privacy and integrity are assured via encryption and password techniques.

The FHWA ITS/CVO Management Approach

The FHWA has established several related ITS/CVO Programs and Projects to carry out the CVO portion of ITS and achieve the vision summarized above and described in the National ITS Program Plan. The program management approach is summarized below.

- The **FHWA ITS Joint Program Office (JPO)** is providing the focal point for Federal leadership in the development of ITS/CVO systems.
- The FHWA ITS JPO has set a **high priority** on the development and deployment of ITS/CVO user services. The JPO views CVO as one of the first, areas that is sufficiently well defined to support relatively quick development and deployment.
- The **ITS America CVO Technical Committee** and its subcommittees are providing an interactive stakeholder forum relating to ITS/CVO Program planning activities.
- This Statement of Direction (SOD) is one of a series of documents that will be used to **fully inform CVO stakeholders** of FHWA concepts and plans.
- The FHWA is using the **CVISN Architecture as a technical framework** for the development of interoperable information systems which support ITS/CVO services.
- The FHWA is sponsoring **studies & operational tests** to validate concepts and develop benefit/cost information.

- The FHWA is conducting **mainstreaming** activities to expedite the widespread deployment of ITS/CVO concepts and systems. These will include support for state business planning, regional and national forums, and outreach.
- The FHWA is sponsoring a CVISN **Prototype Program** to demonstrate the operational feasibility and effectiveness of CVISN concepts and systems in two states, Maryland and Virginia.
- The FHWA is sponsoring a CVISN **Pilot Program** to demonstrate selected ITS/CVO services in **eight additional states** from seven regions (a.k.a. "trucksheds"). The pilot will run from 1996 through 1999. Pilot states were selected based on their endorsement of CVISN objectives, institutional readiness, participation in regional programs, technical experience, and intent to support inter-agency data sharing.
- The FHWA is providing funding and technical support to critical **multi-state data sharing** projects (e.g., the IRP Clearinghouse) to connect to pilot project states via standard interfaces. These projects are collectively referred to as the CVISN **Core Infrastructure.**
- The FHWA will provide the results of the CVISN Pilot to other states in the form of a ***CVISN Deployment Tool Kit.*** This will include computer-based management and technical documentation and planning tools to facilitate deployment of CVISN in other states.
- The FHWA will **foster the national deployment** of CVISN after the pilot to the extent that funding allows.
- It is anticipated that CVISN Pilot & deployment tasks will stimulate **process improvement & reengineering** efforts in CVO that will provide significant benefits beyond those obtained through automation alone.



The CVISN Program is proceeding in five major steps. The first step develops the management (plans) and technical (architecture) frameworks necessary to coordinate the subsequent phases. The second step is to prototype the technology in an integrated way in two states to demonstrate operational concepts and validate requirements. The third step is to pilot the approach in eight additional states. This allows testing and evaluating in a project of manageable size before proceeding to widespread deployment. The fourth step, expansion, will expand from the pilot states to a number of partner states. This should be a smooth expansion, since each partner state will be coordinating with a pilot state in the same region throughout the pilot. The final step allows for deployment to all interested states. By this time the technology, concepts, costs, and benefits should be well understood and documented. Deployment should be straightforward with little risk.

Mainstreaming

Throughout this process, FHWA is focusing on mainstreaming, which means the organizational aspects of moving ITS/CVO services beyond the concept development phase and into operation. As part of mainstreaming, certain organizational strategies will be required to support the technical activities. The ITS/CVO Program will develop policies, plans, programs, and projects at the state, regional, and national levels: at the state level because the states have the power and responsibility for building and maintaining highways and for taxing and regulating the motor carriers that use them; at the regional level because most trucks operate at the regional level; and at the national level because of the need to ensure uniformity of services for interregional and international motor carriers.

Planned mainstreaming activities include:

State CVO Business Plans: Fund states to develop CVO business plans to prepare for eventual deployment of CVISN technology.

Regional CVO Champions & Planning Forums: Support a regional program director who can lead planning forums and policy development and otherwise "champion" ITS/CVO service deployment in each region.

National Clearinghouse Agreements: Fund national working groups as required to develop policy agreements and expedite clearinghouse deployment.

Benefit / Cost Studies: Fund benefit / cost studies to synthesize the evaluations of individual CVO projects.

CVISN Guiding Principles

Statements of principle are being used to document fundamental concepts and guidelines supported by the CVO community. These are summarized here and listed below.

Summary

- A balanced approach involving ITS/CVO technology as well as institutional changes will be used to achieve measurable improvements in efficiency and effectiveness for carriers, drivers governments, and other CVO stakeholders. Specific technology and process choices will be largely market-driven.
- The CVISN architecture will enable electronic information exchange among authorized stakeholders via open standards.
- The architecture deployment will evolve incrementally, starting with legacy systems where practical and proceeding in manageable steps with heavy end-user involvement.
- Safety assurance activities will focus resources on high risks, and be structured so as to reduce the compliance costs of low-risk carriers and drivers.
- Information technology will support improved practices and procedures to enhance CVO credential and tax administration efficiency for carriers and government.
- Roadside operations will focus on eliminating unsafe and illegal operations by carriers, drivers, and vehicles without undue hindrance to productivity and efficiency of safe and legal carriers and drivers.

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Status of CVISN Guiding Principles

These principles were developed by the ITSA CVO Program Subcommittee. They will be updated as required to reflect the consensus of the CVO community. (2/25/97)

General CVO

- To the extent possible, ITS/CVO technology development and deployment will be market-driven. The federal role in ITS deployment will be limited to instances in which a government role is indispensable and in which the technology is proven and reliable.
- Investment and participation in ITS/CVO technology will be voluntary.
- The relative benefits of various ITS/CVO technology applications and investments will be assessed quantitatively using measures of effectiveness and established methods of quality control.
- Potential ITS/CVO technology applications will be evaluated against regulatory choices involving low-technology and non-technological options to ensure applications are cost-effective for both government and industry.
- Government CVO policies and regulatory practices will permit safe and legal carriers and drivers to operate without unnecessary regulatory and administrative burdens.
- Stakeholders will use technology and institutional reform to implement continuous process improvement and cost-effective process re-engineering.
- The confidentiality of proprietary and other sensitive stakeholder information will be preserved.
- The United States CVO community will work to implement compatible policies and architecture and interoperable systems in all states.
- The United States CVO community will work with those in Canada, Mexico, and other nations to encourage compatible policies and architecture and to implement interoperable systems throughout North America and, when possible, worldwide.

CVISN Architecture

- The CVISN architecture will be open, modular, and adaptable.
- The architecture will enable data exchange among systems, a key to reaching CVO objectives. Methods used to exchange data will ensure data integrity and prevent unauthorized access.
- Data exchange will be achieved primarily via common data definitions, message formats, and communication protocols. These enable development of interoperable systems by independent parties.
- A jurisdiction shall have and maintain ownership of any data collected by any agent on its behalf.
- The architecture will accommodate existing and near-term communications technologies.
- The architecture will accommodate proven technologies and legacy systems whenever possible.
- The CVISN architecture will allow government and industry a broad range of options, open to competitive markets, in CVO technologies.

CVISN Deployment

- The feasibility of the architecture will be demonstrated incrementally and quickly in simulations, prototypes, operational tests, and pilots. There will be heavy end-user involvement in each step of the process.
- After feasibility has been demonstrated, key architectural elements will be incorporated into appropriate national and international standards.
- The architecture deployment will evolve incrementally, starting with legacy systems where practical and proceeding in manageable steps.
- Strong federal leadership will foster voluntary cooperative efforts within government jurisdictions and among groups of other stakeholders to develop systems which are in accord with the architecture.

Safety Assurance

- **Carriers** and **drivers** will be responsible for the safe and legal operation of commercial vehicles.
- Jurisdictions will develop and implement uniform standards, practices, procedures, and education programs to improve safety. These activities will leverage market forces that encourage safety.
- Jurisdictions will focus safety enforcement resources on high risk carriers and drivers. They will remove chronic poor performers from operation and help cooperative marginal performers to improve.
- Jurisdictions will conduct inspections and audits to provide incentives for carriers and drivers to improve poor performance and to collect information for assessing carrier and driver performance.
- Jurisdictions will use a safety risk rating for all carriers based on best available information and common criteria.
- Jurisdictions will identify high risk drivers based on best available information and common criteria.
- Safety programs will provide benefits which exceed costs for carriers and drivers as well as governments.

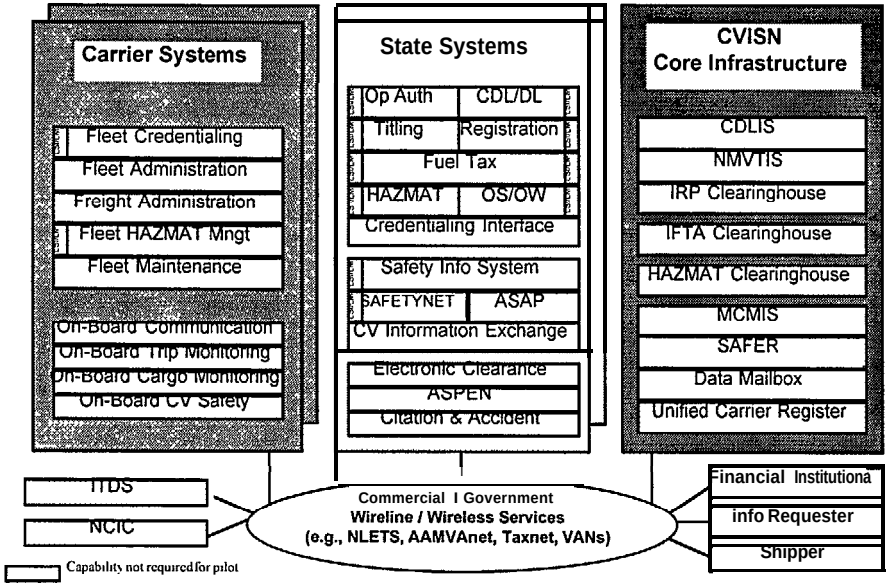
Credential & Tax

- Electronic information will be used in place of paper documents for the administration of CVO credential and tax requirements.
- Authorized users will be able to electronically exchange credential and tax related information and funds via open standards and transmission options.
- The information needed to administer tax and credential programs involving carriers, drivers, and vehicles will be available to authorized officials, on a need-to-know basis.
- Individual jurisdictions, or their designated agent, will be the authoritative source of information on credentials they issue.

Roadside Operations

- Roadside operations will **focus on eliminating unsafe and illegal operations by carriers, drivers, and vehicles** and will be designed and administered to accomplish this in a manner that does not unduly hinder the productivity and efficiency of safe and legal motor carriers and drivers.
- Jurisdictions will support CVO roadside operations programs with **timely, current, accurate, and verifiable electronic information,** making it unnecessary for properly equipped vehicles to carry paper credentials.

CVISN Prototype & Pilot Programs



The CVISN Pilot Program is being initiated by FHWA to move ITS/CVO user services beyond the concept phase and into operation, It is intended to be a cooperative effort of the FHWA, states, government and industry associations (e.g., ITSA, AAMVA, IRP, IFTA), and carriers. The CVISN Pilot Project will provide funding to supplement funds currently being provided by other federal, state, and private sources as required to enhance or modify existing projects and legacy systems to meet the objectives of the CVISN Pilot.

Build the CVISN Core Infrastructure

There are several multi-state data sharing projects currently planned, under development, or operational that are required to support the CVISN pilot. These are collectively referred to as the CVISN Core Infrastructure. The CVISN Pilot will cooperate with these projects to expedite their development.

Establish Eight Pilot States

FHWA selected eight states to participate in the pilot program. Each pilot state committed to enhancing its state information systems in order to implement ITS/CVO user services over a 3 year period in a manner compatible with the CVISN architecture.

Involve Carriers in Pilot States

Each pilot state will establish cooperative agreements with representative carriers based in their state to participate in the pilot. The carriers will participate in all phases of the pilot, from planning through implementation and operation. They must commit to enhancing their information systems to implement ITS/CVO user services in a manner compliant with the CVISN architecture.

Prototype & Establish Formal Standards

The pilot effort is using draft EDI and DSRC standards in its early stages. As the pilot proceeds, the program will support standards development organizations (SDO's) to get formal, open standards developed that incorporate lessons learned. The pilots will incorporate the updated standards into the final releases of the pilot systems.

Demonstrate Three Critical ITS/CVO User Services

An important purpose of the pilot is to demonstrate the synergistic effects of providing multiple user services in an integrated way. The pilots are focusing on safety information distribution, administrative processes (electronic credentialing and clearinghouses), and electronic clearance.

Prepare for Full Scale Deployment

The CVISN Pilot will help prepare for the full deployment of CVISN in four ways. First, it will establish the CVISN Core Infrastructure as an operational set of systems. Future states that wish to implement ITS/CVO services will be able to connect to this infrastructure using documented and proven techniques. Second, the pilot will support the definition of open DSRC and ED1 standards. Third, the pilot effort will produce a CVISN Deployment Tool Kit. This will be a set of work products and lessons learned organized into a personal computer based set of tools that can easily be distributed to and used by other states. Fourth, it results in a number of vendor products that will be available for purchase by other states.

I. Introduction

This document provides an overview of the concepts and plans for the development and deployment of commercial vehicle operations (CVO) information systems and communications networks as currently envisioned by the Federal Highway Administration (FHWA). These systems are collectively referred to as the Commercial Vehicle Information Systems and Networks (CVISN).

The purpose of this document is to describe key plans, concepts, & architectural features for all interested ITS/CVO stakeholders, including states, carriers, vendors, and academia.

For More Information: To obtain more information on CVISN, visit the CVO Program Internet World Wide Web home page provided by the Johns Hopkins University Applied Physics Laboratory (JHU/APL) at ***http=//www.jhuapl.edu/cvisn/***

This includes an on-line copy of the latest version of this document, as well as a file copy that can be downloaded. Other CVISN information and documents are also provided.

If you do not have access to the Internet World Wide Web, you can request additional paper copies of this document or find out more about the CVISN project by contacting:

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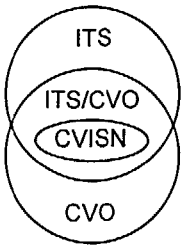
Please Comment on this Document: You can comment by FAXing or e-mailing comments to John Hardy. You can use the Document Comment and Evaluation Form at the end of this document to assist in your evaluation if you prefer.

Definitions of Key Terms



- ITS (Intelligent Transportation Systems) - Transportation systems which utilize information, communication, sensor, and control technologies to achieve improved levels of performance.

- Architecture -The overall structure (elements & interfaces) and unifying design characteristics (principles, concepts, & standards) of a system.
- National ITS Architecture - A technical framework which describes how ITS elements fit together into an overall system.
- CVO (Commercial Vehicle Operations) - The operations associated with moving goods and passengers via commercial vehicles over the North American highway system and the activities necessary to regulate these operations. It includes activities related to commercial vehicle credentials and tax administration, roadside operations, safety assurance, freight & fleet management, & vehicle operation.
- ITS/CVO - The ITS elements which support CVO. Note: This is equivalent to CVISN plus the non- information system elements of ITS which support CVO (e.g., weigh-in-motion devices).
- CVISN (Commercial Vehicle Information Systems and Networks) - The ITS information system elements which support CVO. The collection of information systems and communications networks that provide support to CVO. CVISN includes information systems owned and operated by governments, carriers, and other stakeholders. It excludes the sensor and control elements of ITS/CVO.
- CVISN Operational Concept - The characteristics of a system as seen by a user. Documented in an operational concept document (OCD). The OCD describes the CVO user organizations, processes, and information systems from an integrated user/system point-of-view. The OCD makes use of scenarios.
- CVISN Architecture - The ITS/CVO information systems portion of the National ITS Architecture. The CVISN Architecture documentation begins with the National ITS Architecture and adds more detail in some areas (e.g., the OCD and Electronic Data Interchange (EDI) message requirements) to facilitate further development.
- CVISN Design - A description of specific state, carrier, and national systems, their functions, and standardized interfaces that interconnect them to support the CVISN architecture and operational concepts.
- CVISN Core Infrastructure - A selected group of key CVO information systems that provide a mechanism for exchange of safety information, registration, fuel tax, HAZMAT, and commercial driver license information among states.

Why are new information systems required?

Current CVO processes and systems have evolved over decades. The result is a CVO infrastructure that is often not cost effective and characterized by:

- Redundant data entry
- Lack of timely, accurate information
- Complex, labor intensive procedures
- Obsolete (or no) supporting technology
- Costly operations

Why are new information systems required?

Current CVO practices and systems are the products of decades of evolution. Each practice and system was developed to satisfy a specific need as it existed and was understood at the time of its origin. But the situation continues to change. The regulatory environment, transportation industry, competitive environment, and technology have changed and are continuing to change at a rapid pace. Due to funding limitations and/or institutional barriers to change, the practices and systems do not always meet the current needs. The technology available today makes it possible for CV information system operations to provide the support always desired by the users.

Some of the problems that plague some of the current systems include:

Redundant data entry: In today's systems, the same information must often be manually entered into multiple systems. This is inefficient and results in errors and inconsistencies. Even if one system is fully automated, it is not connected to other systems that need the same information.

Lack of timely information: Even when information is captured in electronic systems, it is often not distributed to all the people and systems that need it. If it is distributed, there may be a delay of weeks.

Complex, labor intensive procedures: Many procedures could be simplified via automation, for example, using common information system features like automated checklists, menus, and help messages.

Obsolete (or no) technology: Some of the software and hardware in current use was designed 10 to 20 years ago. Some functions are yet to be automated.

Costly operations: The labor intensive aspects of current systems operations lead to increased cost. The obsolete technology makes it difficult to incrementally modify computer software to keep it current.

Why is an architecture required?

If we do not have an architecture to guide the development of new systems, they are likely to be characterized by:

- Inconsistent concepts, processes, data definitions, and user interfaces
- Inability to share data
- Inability to cooperate in carrying out a process
- Inability to be developed independently
- Overlapping functions and redundant development
- Inability to evolve with changing practices & technology

Why is an architecture required?

Automation can and will contribute to the solution of the problems with current systems listed on the previous page. However, not just any type of automation will solve all the problems. Some problems can only be addressed by modifying existing systems or building a set of new systems so that they interoperate with each other. To have systems that work efficiently together, a complete architecture is required. The term architecture is used herein to mean a description of the overall structure (i.e., major components and interfaces) and unifying design characteristics (i.e., principles or standards) of a system. A good architecture solves the problems described.

Inconsistent concepts, processes, data definitions, and user interfaces: Often, a single stakeholder will need to use multiple systems. For example, a carrier administrator will have to apply for permits in multiple states and a truck driver will encounter weigh stations in multiple states. Differing systems and practices among states can create confusion for the user. A good design provides a uniform user interface that reduces complexity.

Inability to share data: The agencies within a state may have systems that need common information, such as carrier addresses. An architecture is required to allow these systems to exchange this information so that all the systems can access the information after it is entered once.

Inability to cooperate in carrying out a process: For a carrier to get a credential, such as a vehicle registration, both the carrier and the appropriate state agency must perform some process. The carrier may have all the relevant information in a fleet management system. An architecture will allow the fleet management system to interchange data and cooperate with a state system in carrying out the steps of applying for and granting a vehicle registration.

Inability to be developed independently: In the example above, the developer of the fleet management system and the state registration system could build systems independently using a common interface standard for exchanging and processing information. The architecture provides this standard.

Overlapping functions & redundant development: An architecture describes what functions are performed by each system. It allows one system to access the capabilities of another system (usually through data exchange). For example, if a system is designed to manage carrier census information, a good architecture would allow other systems to access this census data without having to duplicate the census management function.

Evolving practices & technology: Today's business and economic climate virtually guarantee that whatever is done now will be obsolete in five to ten years. Practices and systems must evolve. An architecture enables this. An analogy is the architecture of stereo systems. It makes it possible to replace a turntable with a tape player and then a CD player as technology changed over a period of two decades. Similarly, the CVISN architecture will enable the gradual adoption of new technology and practices.

Vision
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The mission & vision for Commercial Vehicle Operations focus on using information to improve safety and efficiency

CVO Mission:

To provide safe, high quality, efficient, and legal commercial vehicle shipping and busing services throughout North America.

CVO Vision:

Safe and legal trucks and buses travel like cars throughout North America.

CVISN Vision:

A fully integrated set of motor carrier information systems supports safe and seamless commercial transportation throughout North America. This system provides high quality, timely, and easily accessible information to authorized users.

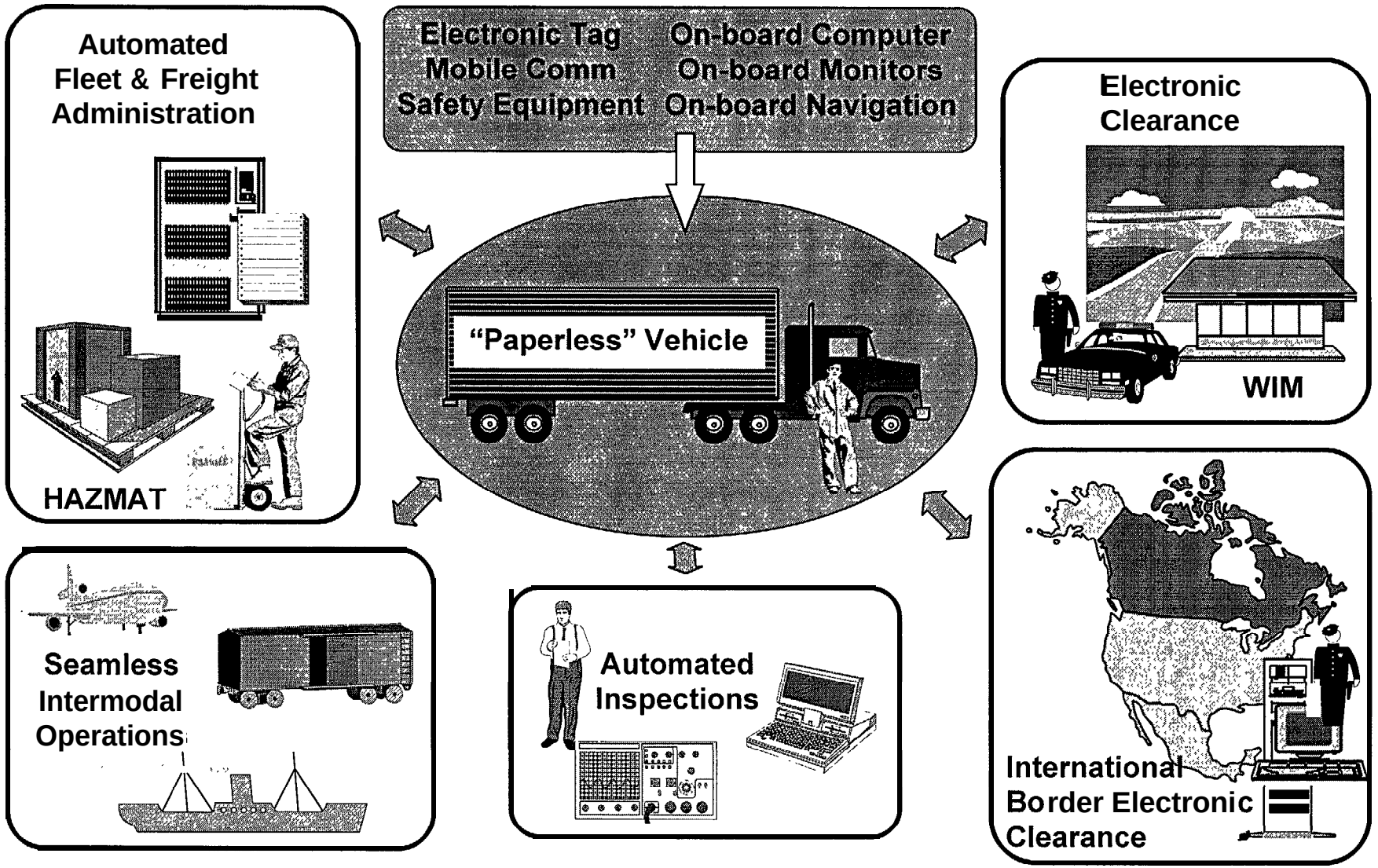
Mission & Vision

A mission statement briefly says why an activity exists. The purpose of commercial vehicle operations is to transport goods and people using trucks and buses on the North American highway system. It provides a service to its customers, shippers and travelers.'

A vision statement briefly says how a mission will be carried out in the future if improvements are implemented successfully. The vision for CVO is that safe and legal trucks and buses travel like cars. In other words, they can move freely from state to state and across North American international borders. They are typically not stopped or slowed down for credential, weight, and size checks. They are not burdened with excessive paperwork related to safety, credentials, and taxes.

To achieve the CVO vision, some existing systems must be modified or new information systems must be developed. These must provide high quality and timely information to CVO stakeholders. Information technology is critical to achieving the vision of efficient and seamless operations. Information must flow quickly and reliably among governments and carriers to enable all stakeholders to perform their tasks effectively and efficiently. Checks that are currently done manually must be done via automated means.

Vision:
Safe and Efficient Shipping Operations



Vision: Safe & Efficient 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.

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. Safety information, credential, tax, and permit 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 safety and productivity. 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 their shipment via an electronic query.

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.

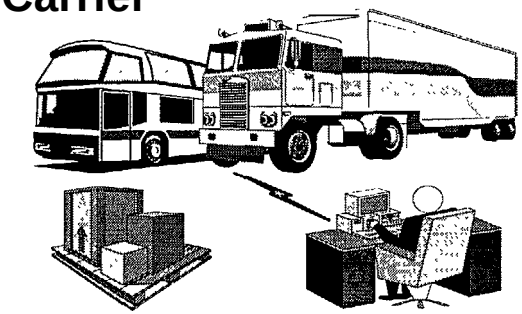
International border crossing clearances occur with little or no delay. Information about the shipment is provided in advance of arrival at the crossing point via EDI, and correlated with the vehicle as it approaches the border check point. Immigration and Naturalization Service (INS) and Customs checks are aided by the exchange of electronic transactions and proceed with limited manual intervention. Safety and credentials checks comparable to those performed at domestic sites are also included.

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.

Vision:
Electronic Business Transactions

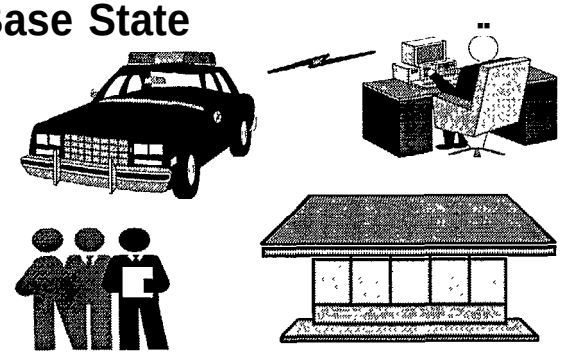
Carrier



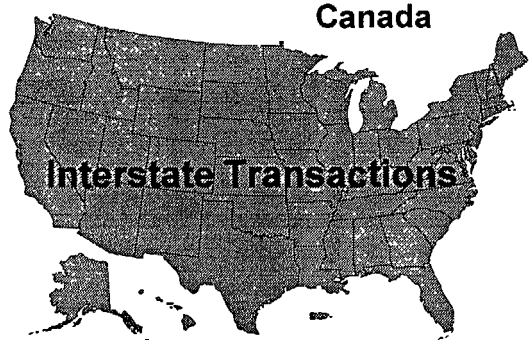
Standard Electronic Data Interchange (EDI) Transactions

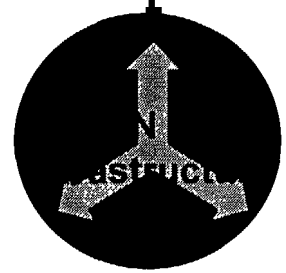
Credentials, Taxes, Safety Records, HAZMAT, Insurance, Shipments, Payments

Base State



WIRELINE Wide Area Communications





Shipper, Bank, Insurer, Lessor, Service Bureau

Vision: Electronic Business Transactions

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

In 2005, carriers and vehicle owner/operators apply and pay for credentials electronically, including registration, tax credentials, 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. For example, compliance reviews may be streamlined using electronic data exchanges between a state or federal system and a fleet management system. Information from the fleet management system may be compared to state or federal records to complete the compliance review more effectively and efficiently.

States deal with carriers electronically, and they also deal with each other electronically. They routinely interchange electronic information about 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. In addition, the legal issues associated with the Privacy Act of 1974 are supported.

CVISN guiding principles drive operational concepts and architecture decisions

- A **balanced approach** involving ITS/CVO technology as well as institutional changes will be used to achieve measurable improvements in efficiency and effectiveness for carriers, governments, and other CVO stakeholders. Specific technology and process choices will be largely **market-driven.**
- Information technology will support modified practices and procedures to **improve CVO credential and tax administration efficiency** for carriers and government.
- Roadside operations will **focus on eliminating unsafe and illegal carriers, drivers, and vehicles from service** without undue hindrance to motor carrier productivity and efficiency.
- Safety assurance activities will **focus resources on high risks,** and be structured so as to reduce the compliance costs of low-risk carriers.
- The CVISN architecture will enable **electronic information exchange** among authorized stakeholders via open standards.
- The architecture **deployment will evolve incrementally,** starting with legacy systems where practical and proceeding in manageable steps with **heavy end-user involvement.**

Summary of CVISN Guiding Principles

We are 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 this 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)

*Define the desired future situation

*Be specific enough to guide decision making

*Tie to a benefit

*Be endorsed by the CVO program leadership

*Be few in number

*Be supported by a consensus.

The principles listed above summarize the complete list which is provided in the Statement of Direction at the start of this document.

The goals for Commercial Vehicle Operations are tailored from the National ITS Program Plan

CVO

- Improve commercial vehicle safety
- Improve shipping efficiency
- Improve freight mobility
- Improve credentials & tax administration
- Ensure regulatory compliance & equitable treatment

CVO Information Svstems

- Implement the CVO user services
- Improve CVO efficiency and effectiveness
- Promote consistency among processes and data
- Improve availability of timely, accurate information

Goals

The goals of the ITS program are stated in the National Program Plan for ITS:

. Improve Safety

Increase Efficiency

. Reduce Energy & Environmental Impact

. Enhance Productivity

· Enhance Mobility

. Create a U.S. ITS Industry

The CVO objectives listed support theoverall ITS goals. In most cases a direct link is obvious. The only one which may not have an obvious link to the goals is the last: to ensure regulatory compliance and equitable treatment. Governments have an obligation and need to establish and enforce regulations related to safety, environment, road use, and taxation. They must enforce these in an equitable manner to ensure fair competition. It is a fundamental principle that fair competition will improve productivity, which ties back to the ITS goals.

The information system objectives are intended to support the achievement of the CVO objectives. Information system projects should not be advanced as technology for its own sake. Such projects should show a clear benefit and connection to CVO objectives.

Implement 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 & effectiveness: Information technology is the key to improvement of CVO processes. Many current bottlenecks can be alleviated with automation.

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 data: 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.

Key Operational Concepts

Improved Processes via Information Technology

- Focus safety enforcement on high risks
- Electronic credentials & paperless vehicle
- Ubiquitous (but secure) electronic data access
- Standard snapshots & profiles for carrier, vehicle, & driver information
- Mainline clearance & automated roadside operations
- Flexible deployment options
- Seamless intermodal operations

Summary of Key Operational Concepts

Many attempts at incorporating new technology and the associated changes in practices and procedures never achieve the original objectives for undertaking the change. This is often because the impact of the technology on operations is not clearly understood by users until the system is nearly completely developed, and then it is often too late to change. We believe that a critical success factor for the CVISN project is that the CVO stakeholder community understand the operational impact of the new technology proposed by CVISN. These operational concepts are briefly summarized here, and discussed more thoroughly in the Operational Concept Document [revised in June 1996] Most stakeholders will be more interested in and concerned about the operational concepts than the details of the architecture.

Focus safety enforcement on high risks: Providing enforcement personnel with current, detailed, accurate information about carriers, drivers, and vehicles allows them to do a better job of selection of vehicles for inspection and allows them to focus on carriers, drivers, and vehicles that have the highest safety risk. Pen-based units will be on-line prior to others.

Electronic credentials & paperless vehicle: The concept is to support the complete credential life cycle electronically: application, fee payment, credential issuance, revenue distribution, modification, renewal, audit, sanctioning, appeals, and inspection, Paper could be produced from the electronic information if and when required.

Ubiquitous (but secure) electronic data access: All information necessary to carry out CVO functions would be captured electronically in the most convenient manner. This data would be made available to authorized users over commercially available wide are communications. Passwords and encryption would be used to protect data from unauthorized access.

Standard snapshots & profiles for carrier, vehicle, & driver information: ITS/CVO involves multiple applications and interfaces among hundreds of state agencies and thousands of carriers. Snapshots and profiles provide a common way of sharing information about carriers, vehicles, and drivers that allows all stakeholders to share a common format for basic data. This avoids a lot of redundant effort of each pair of trading partners defining a specific format to meet their needs.

Mainline clearance & automated roadside operations: Stopping a truck or bus costs time, money, and convenience. The current weigh station screening process and safety inspection process can be greatly expedited through automation with technologies such as weigh-in-motion, hand-held computers, brake testing, and communications networks.

Flexible deployment options: The architecture provides a common technical framework and a basis for developing interface standards. It does not specify a particular design for states or carriers; it allows them to select from a wide range of options to meet their particular needs. It only constrains design options in areas necessary to achieve interoperability and compatible practices.

Benefits of CVISN for State Administrators

- **Data interchange among states, carriers, financial institutions, and insurance companies will be electronic**
- **Administrators & enforcement personnel will have electronic access to required data**
- **Credentials issuance, tax filing, interstate reconciliation, & audits will be automated to proceed more effectively & efficiently**
- **Enforcement resources can be focused on non-compliant carriers & drivers**
- **Better enforcement of registration, licensing, weight, size, & tax regulations**
- **Better customer service to safe & legal motor carriers & drivers**
- **In the long term, policies & practices can be based on measured data & careful analysis**

Benefits of CVISN for Motor Carriers

- **Reduced administrative burden in regulatory compliance**
  - **Electronic Credential Application / Electronic Tax Filing**
  - **Paperless Vehicle**
  - **Electronic access to credential, tax, & safety data**
- **Vehicles of safe & legal carriers will incur less delay**
  - **Mainline clearance**
  - **Automated inspections**
  - **Automated international border crossing**
- **Technology investment can support multiple services**
  - **Tag**
  - **On-board Computer & Sensors**
  - **Fleet Management Software**
- **Uniformity of services across North America**
  - **Clearance - Toll - Traffic Management - Traveler Information**
- **Focus on unsafe carriers will "level the playing field"**

Benefits of CVISN for Shippers

- **Improved motor carrier safety**
- **More efficient & effective motor carriers**
- **Improved shipment tracking**
- **Fewer delays & more predictable schedules**
- **Improved access to motor carrier Safety information**

CVISN Capabilities
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CVISN capabilities correspond to the rows in the ITS/CVO Activities Roadmap

- Safety Information Exchange
- Administrative Processes
- Electronic Clearance

Electronic Credentialing

Clearinghouses

The CVISN Prototype & Pilof Projects are focused on fhe highlighfed items

- International Clearance
- Automated Inspection
- On-Board Safety
- HazMat Incident Response
- Fleet & Freight Admin

These items will be developed further in the CVISN Expansion Phase.

CVISN Capabilities

The capability areas that are the focus for the CVISN Prototype and Pilot Projects include:

Safety Information: Provides carrier, vehicle, and driver safety information to roadside enforcement personnel and other authorized users.

CV Administrative Processes: Provides for electronic application, processing, fee collection, issuance, and distribution of CVO credentials, support of base state agreements, and provides for CVO tax filing/auditing.

Electronic Clearance: Provides for screening vehicles that pass a roadside check station, determining whether further inspection or verification of credentials is required, and taking appropriate actions. Vehicle-to-roadside communications via transponders and readers/writers facilitate the clearance functions at mainline speed. Weigh-In-Motion provides for high speed, mainline weighing. This ITS/CVO capability may be implemented at either fixed or mobile sites.

The other capability areas are planned for development in the CVISN Expansion Phase:

International Clearance: Provides for expedited clearance activities related to commercial vehicle crossings between the United States and Canada or Mexico.

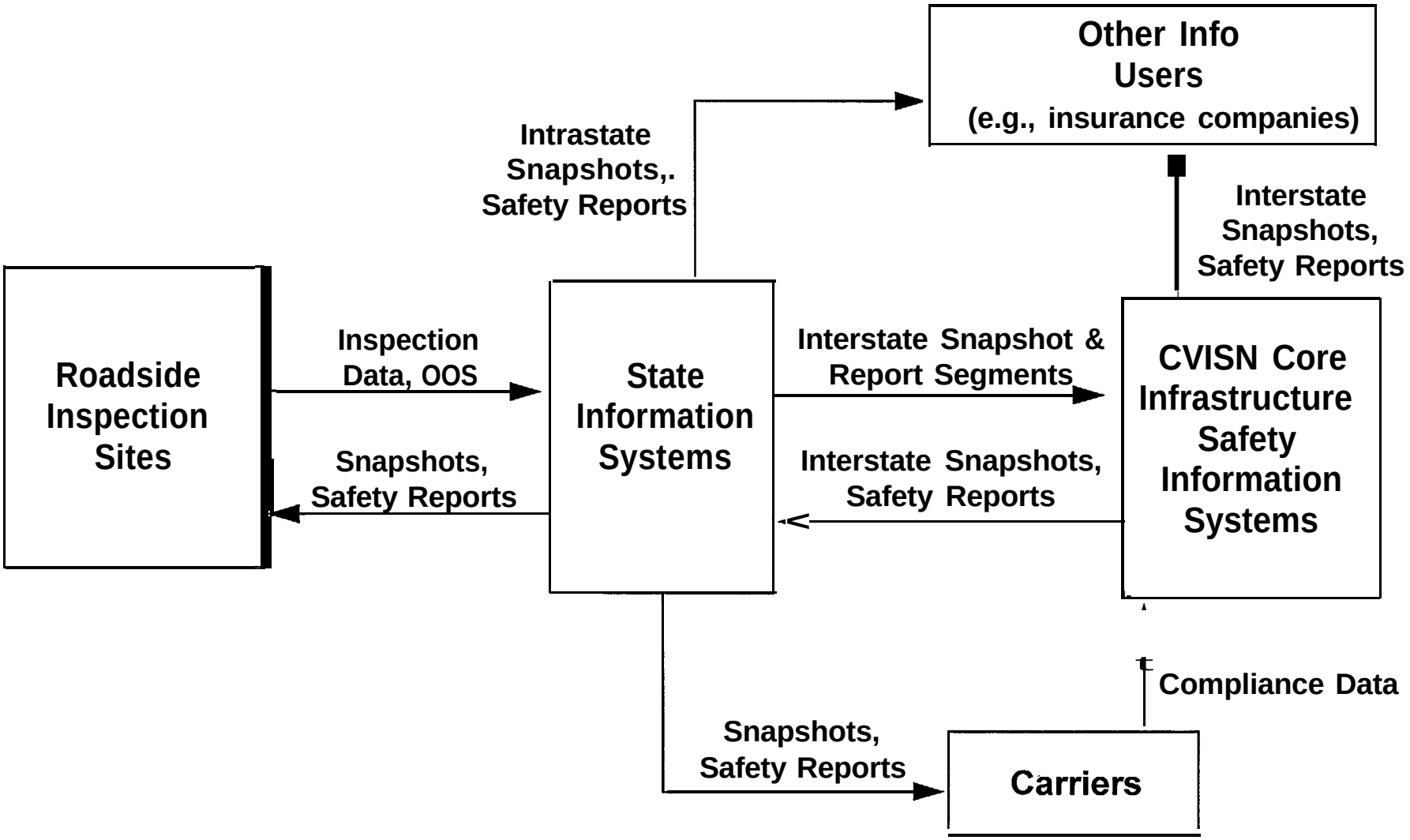
Automated Inspection: Provides for automated roadside safety monitoring, inspection, and reporting.

On-board Safety: Provides for on-board commercial vehicle safety monitoring using sensors, and reading exceptional safety status from the roadside via vehicle-to-roadside or wireless communications.

HazMat Incident Response: Integrates Emergency and Traffic Management Subsystem capabilities with CV tracking and credentials management to assure effective treatment of HazMat incidents.

Fleet & Freight Administration: Keeps track of and provides planning support for vehicle location, itineraries, and fuel usage using communications between the Fleet Management Center and the fleet of commercial vehicles. Tracks cargo and the cargo conditions. Provides for communications interfaces among commercial fleet managers, commercial drivers, and intermodal operators.

Safety information exchange is intended to improve safety performance



Safety Information Exchange

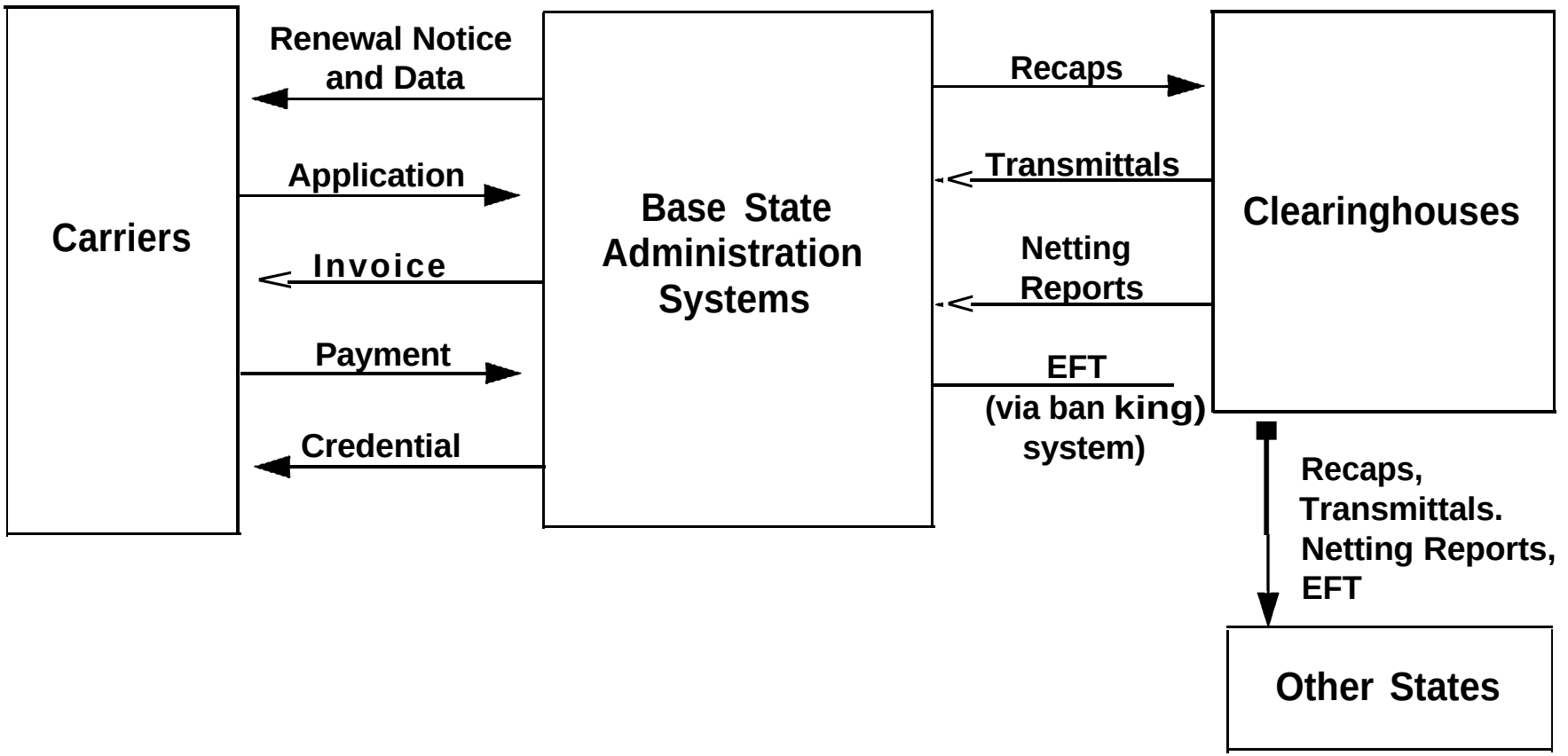
The Safety Information Exchange capability area includes:

- **Automated collection of information about safety performance and credentials status**
- **Improved access to carrier, vehicle, and driver safety and credentials information**
- **Proactive updates of carrier, vehicle, and driver snapshot information**

Expected benefits are:

- **Improved safety performance**
- **Focusing resources on high risk operators**

Improved administrative processes should make government and business more efficient



Administrative Processes

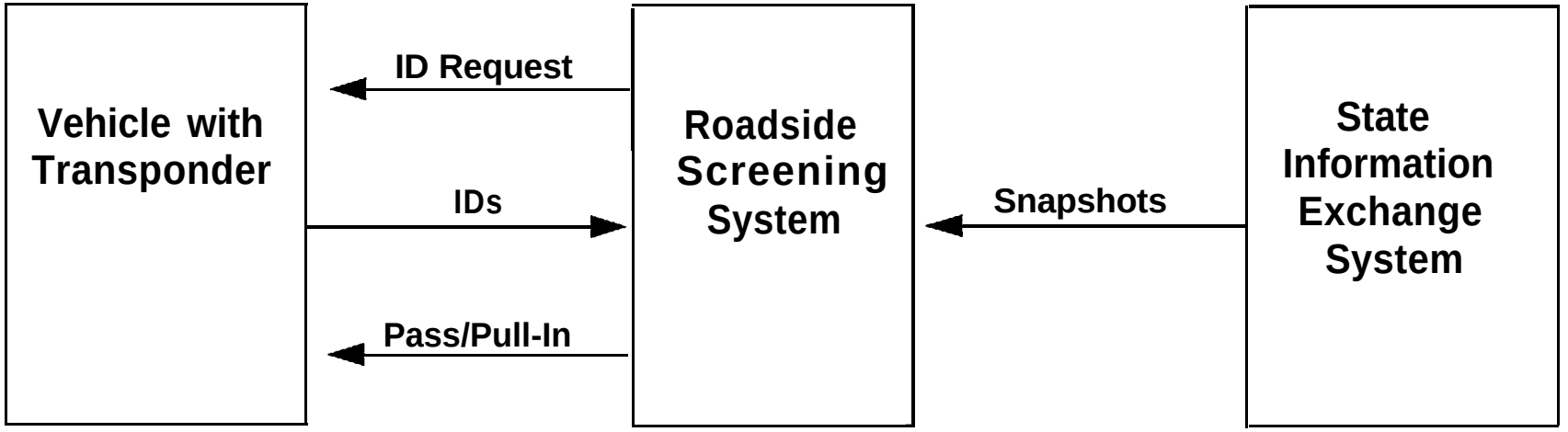
The Commercial Vehicle Administrative Processes ITS/CVO capability area includes:

- **All aspects of applying for, reviewing, and granting CVO credentials (IFTA, IRP, Intrastate Registration, Carrier Registration, CDL/DL,OS/OW Permits, HazMat Permits, etc.)**
- **Filing returns on fuel taxes; paying the associated CVO taxes and fees**
- **Managing information about credentials and tax payment status**
- **Supporting base state agreements and associated fee payment reconciliation**

Expected benefits are:

- **More efficient administrative processes for carriers and government agencies**

Electronic clearance is intended to focus on risky operators and improve freight mobility



Electronic Clearance is supported by Dedicated Short Range Communications (DSRC), Weigh In Motion (WIM), Automated Vehicle Identification (AVI), Automated Vehicle Classification (AVC), License Plate Reader (LPR), and Variable Message Sign (VMS) technologies.

Electronic Clearance

The Electronic Clearance capability area provides for:

- **Screening vehicles that pass a roadside check station based on identifiers read from the transponder, correlated with safety and credentials information from snapshots**
- **Determining whether further inspection or verification of credentials is required,**
- **Taking appropriate actions.**

- **Expected benefits are:**
- **Focusing resources on high risk operators**
- **More efficient movement of freight**

ITS/CVO Programs Overview
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The ITS/CVO goals are being reached via a collection of a number of programs, projects, and operational activities. These are viewed in this chapter as if they were all part of a "super-program".

The shared purpose of all ITS/CVO Programs is to implement the ITS/CVO User Services

The ITS program has defined 29 user services, with the 6 shown here unique to CVO. The fundamental purpose of the ITS/CVO Programs is nationwide implementation of these user services.

- CV Electronic Clearance
- Automated Roadside Safety Inspection
- On-board Safety Monitoring
- CV Administrative Processes
- HAZMAT Incident Response
- Freight Mobility

Implementing these ITS/CVO User Services leads to improved:

- Safety
- Simplicity
- Savings

Purpose: Implement the ITS/CVO User Services

Commercial Vehicle Electronic Clearance - This service provides for screening vehicles that pass a fixed or mobile roadside check station, determining whether further inspection or verification of credentials is required, and taking appropriate actions. Vehicle-to-roadside communications via transponders and readers/writers facilitate the clearance functions at mainline speed. At a state's option, clearance may include weigh-in-motion (WIM) equipment to allow mainline weight checks. At international borders, the clearance function is merged with automated customs and immigration checks to expedite border crossing.

Automated Roadside Safety Inspection - This service allows electronic access at the roadside to the safety performance record of carriers, vehicles, and drivers. Such access will ensure timely correction of previously identified problems. This service would also automate as many items as possible of the manual inspection process. It would, for example, allow for more rapid and accurate inspection of brake performance at the roadside. Through sensors and diagnostics, it would efficiently check vehicle systems and driver requirements and ultimately driver alertness and fitness for duty.

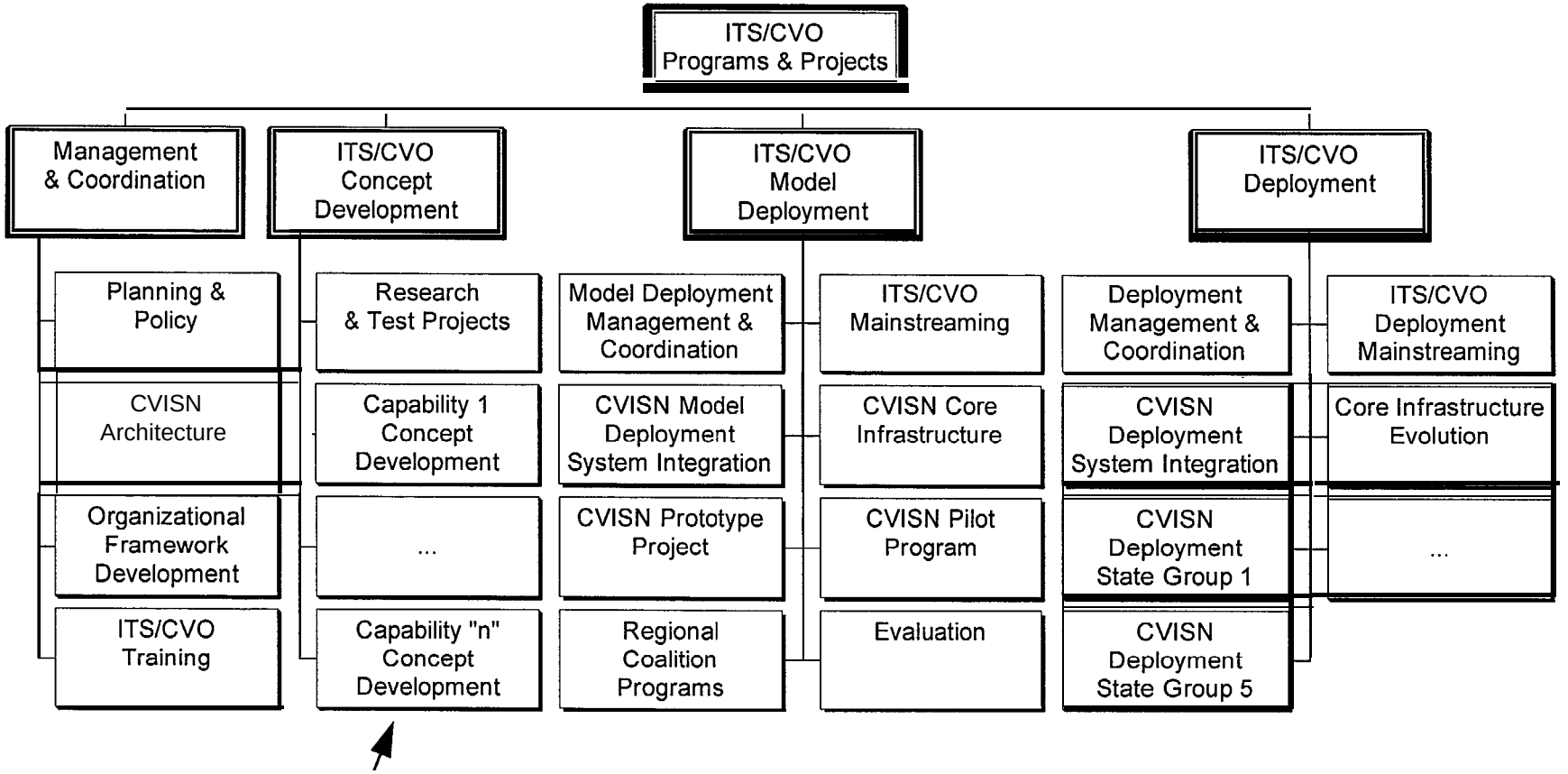
On-Board Safety Monitoring - This service provides for on-board commercial vehicle safety monitoring using sensors, displaying the information to the driver, and optionally providing safety alarms to the carrier or roadside via vehicle-to-roadside or wide area wireless communications.

Commercial Vehicle Administrative Processes - This service provides for electronic application, processing, fee collection, issuance, and distribution of CVO credentials and provides for CVO tax data collection, filing, and auditing. It will reduce burdensome paperwork and processing time for both states and motor carriers. It also includes multi-state sharing and processing of interstate credential and tax data.

Hazardous Material Incident Response - This service provides immediate description of hazardous materials to emergency responders to assure effective treatment of HAZMAT material during traffic accidents or other spill incidents.

Freight Mobility - This service keeps track of and provides planning support for vehicle location & condition, cargo location & condition, itineraries, fuel usage, and fleet maintenance. It uses communications among drivers, dispatchers, intermodal transportation providers, and on-board monitoring equipment. It uses fleet & freight management software to support scheduling and tracking. The benefits from this service would be substantial for those intermodal and time-sensitive fleets which can use ITS technologies to make their operations more efficient and reliable.

The ITS/CVO vision is being realized via a collection of coordinated programs and projects.



ITS/CVO Capabilities

Safety Information	Administrative Processes
Electronic Clearance	International Clearance
Automated Inspections	On-Board Safety
HAZMAT Incident Response	Fleet/Freight Admin

Note: These capabilities correspond to the rows in the ITS/CVO Program Roadmap.

ITS/CVO Programs Work Elements

The ITS/CVO Programs are the collection of programs, projects, and other operational activities sponsored or coordinated by the FHWA that are intended to fulfill the CVO elements of the ITS National Program Plan. The elements of work involved can be organized into a work breakdown structure (WBS) as shown. (Note that this WBS is for illustration only and it does not correspond to a formal FHWA funding or management structure.) The WBS emphasizes technical elements, but also includes non-technical elements such as coordination and organizational development.

The Management & Coordination element includes the planning, policy, and training efforts necessary to establish a vision and management strategy. It also includes an Organizational Framework Development component in recognition that ITS service deployment requires more than simply installing technology. It requires private and public organizations to think, plan, organize, and operate in new ways. Just as the CVISN architecture provides a technical framework, the Organizational Framework Development component must provide a new management framework.

The ITS/CVO Programs will develop policies, plans, programs, and projects at the state, regional, and national levels to support mainstreaming of CVISN. At the state level because the states have the power and responsibility for building and maintaining highways and for taxing and regulating the motor carriers that use them; at the regional level because most trucks operate at the regional level; and at the national level because of the need to ensure uniformity of services for interregional and international motor carriers.

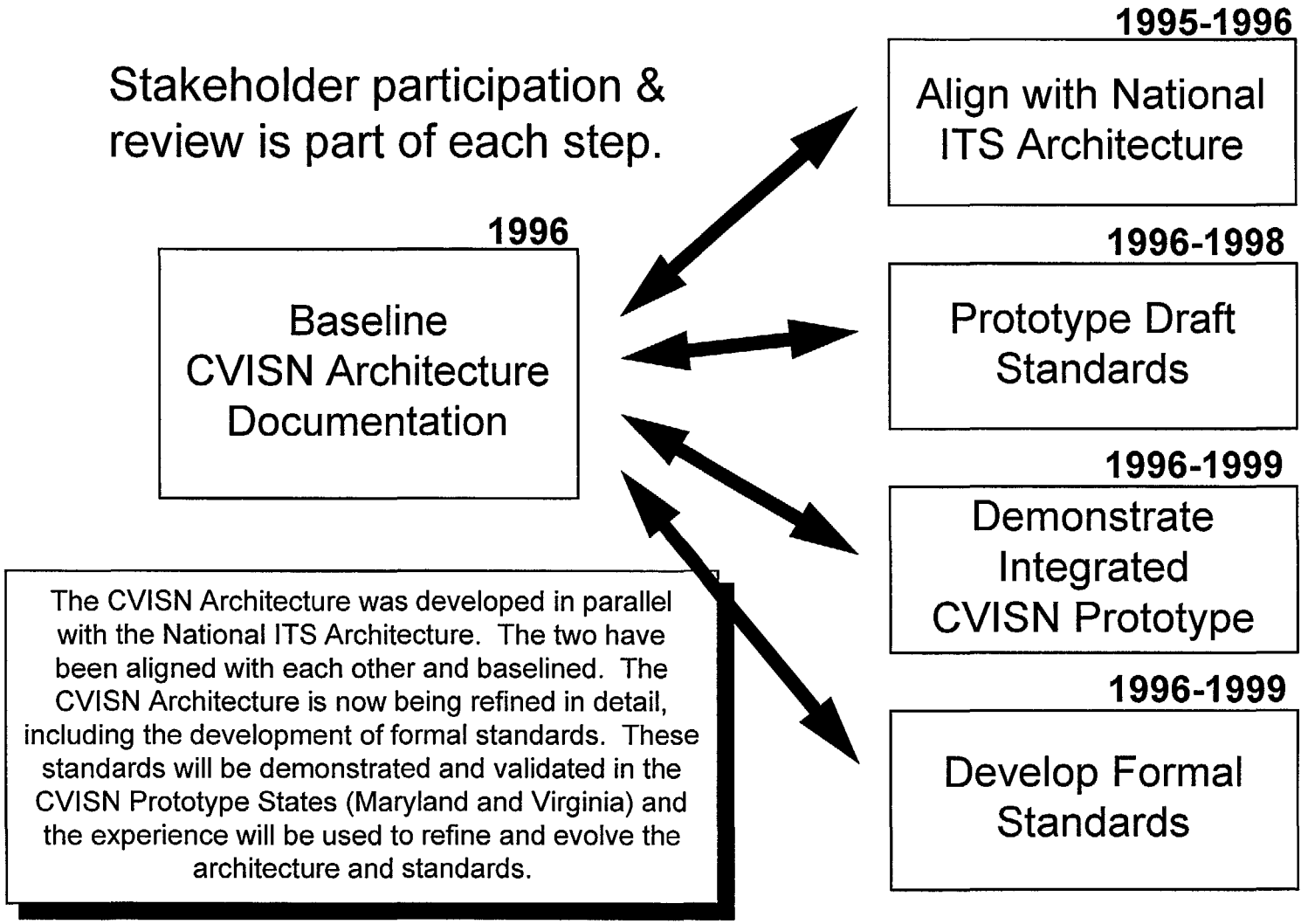
The WBS includes elements to develop and deploy "capabilities". The capabilities are essentially a refinement of the user services that more directly reflect the way that the FHWA and CVO community are developing, testing, integrating, and deploying systems. [These capabilities correspond to the rows in the ITS/CVO Program Roadmap.]

The **ITS/CVO Concept Development** element refers to the FHWA research efforts, operational tests, state efforts, multi-state efforts, and private efforts (e.g., HELP, individual carriers) that are developing the first (often experimental) versions of systems to implement services.

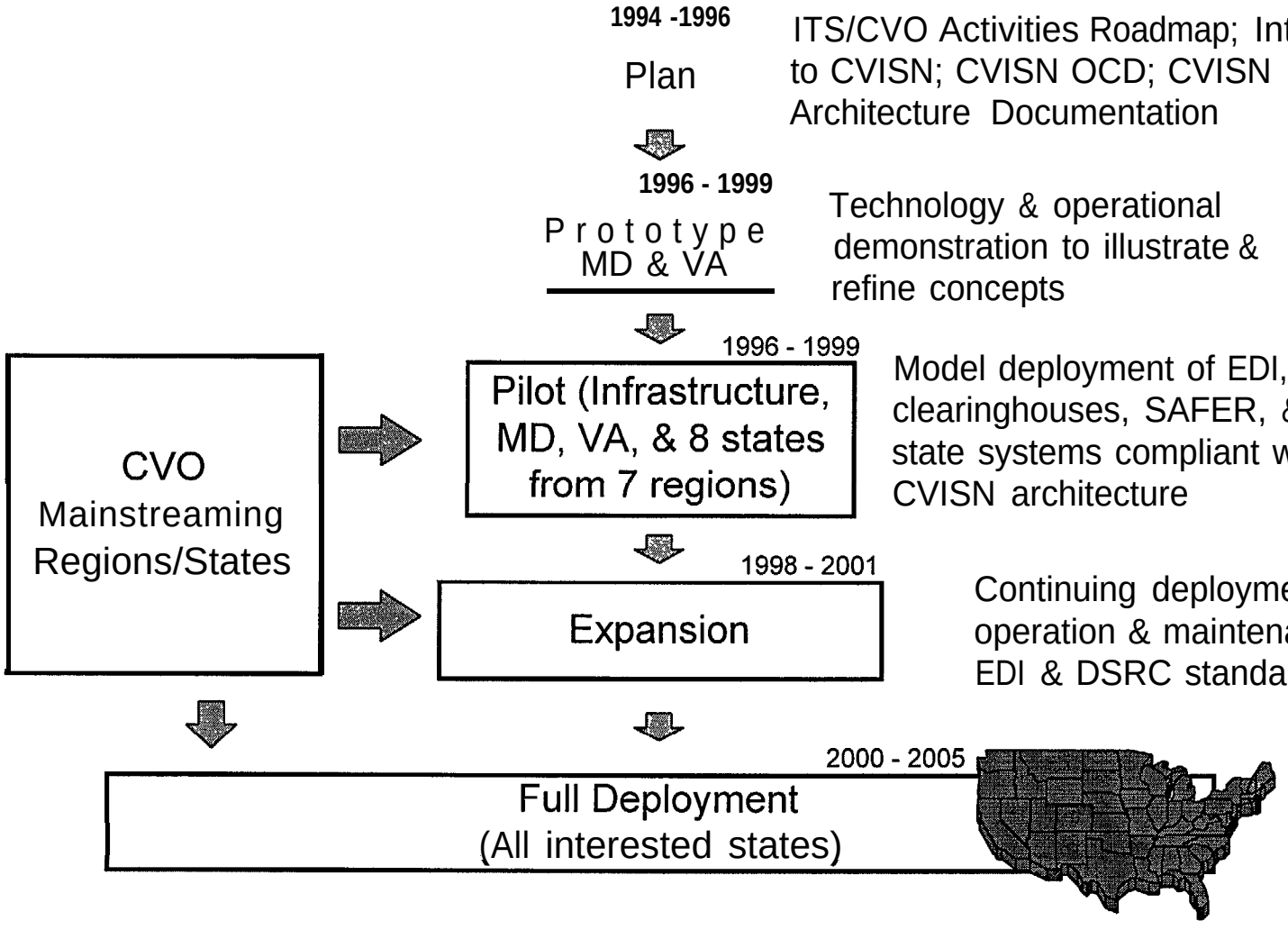
The **CVISN Model Deployment** element is primarily an FHWA Program which will develop the necessary core infrastructure and demonstrate a key subset of CVISN capabilities (those ready for model deployment) in 2 prototype states and 8 pilot states, with both state agency and carrier participation. It is intended to show how all the services are integrated within a state and among multiple states and how this leads to a synergy which multiplies benefits. It is the final step before full scale deployment on a national basis.

The **ITS/CVO Deployment** element refers to implementing ITS User Services in any interested state or carrier. The concepts, standards, systems, and processes validated in the CVISN Model Deployment would be deployed on a national basis. The plans and technical documentation developed for the pilot states would be used as models for other states.

The CVISN Architecture has been baselined and is now being refined based on model deployment experience.



CVISN is being deployed nationwide using an incremental strategy to minimize risk.



ITS/CVO Programs are actively involving hundreds of people from dozens of participating organizations

- FHWA JPO: The U.S. DOT Manager for ITS
- ITSA: Congressionally Chartered Advisor to FHWA for ITS
- JPL/Mitre: ITS National Architecture Technical Management Support
- Loral/Rockwell: ITS National Architecture Development Team
- FHWA OMC: ITS/CVO Program Management
- FHWA R&D: ITS/CVO Research & Development
- JHU/APL: CVISN Architecture Development, Prototype Development, & Pilot Coordination
- IDT, RSIS, others: CVISN Component Prototyping Subcontractors
- CSI: Mainstreaming Support
- Associations: AAMVA, ATA, CVSA, NPTC, HELP, Inc., Advantage CVO, IRP, Inc., IFTA, Inc., others
- Op Test States & Contractors
- CVISN Prototype & Pilot States & Carriers
- Equipment & Software Vendors

The development and complete deployment of CVISN will ultimately require the involvement of hundreds of state agencies, hundreds of vendors, and thousands of carriers. The organization cannot be represented as a simple hierarchy. It is a complex network of relationships. Funding is not provided from a single source, but rather from multiple public and private sources.

ITS/CVO programs are continuing to make progress according to planned milestones.

✓	Dec 95	100 MCSAP Sites Operational
✓	Oct 96	MD/VA CVISN Prototype Showcase 1 Demonstration
✓	Jun 96	Finalize National ITS Architecture
✓	Oct 96	Initiate CVISN Pilot Program
✓	Dec 96	Baseline CVISN Architecture
✓	Feb 97	SAFER/Carrier Initial Operating Capability
	Jun 97	200 MCSAP Sites Operational
	Dec 97	Interim CVISN Prototype Demonstrations
	Jun 98	All Critical DSRC & EDI Standards Available
	Sep 98	Interim CVISN Prototype & Pilot Demonstrations
	Sep 99	Complete CVISN Prototype & Pilot

A variety of stakeholders must perform specific roles for the overall success of ITS/CVO programs.

- 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 CVISN information infrastructure
  - Change processes to allow electronic commerce & paperless vehicles
- Federal Government
  - Provide leadership
  - Expedite ITS CVO deployment
  - Develop architecture
  - Develop deployment plan
  - Support system integration
  - Provide funding when possible
- Shippers & Public
  - Support CVISN initiatives

Stakeholder Roles

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 stakeholders' requirements, and to collaborate to achieve mutually beneficial policies, plans, and processes.

Carriers - For a carrier to get the full benefit of ITS programs, it must make some level of investment in transponder and ED1 technology. This allows participation in paperless truck and electronic verification programs. These investments in transponders, fleet management software, on-board computers, mobile communications, office automation, electronic data interchange, and other technologies will improve their internal processes and roadside operations.

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.

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. They must also provide electronic screening equipment at roadside sites.

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. Funding will be provided for key research projects, operational tests, and deployment efforts. The level of funding will depend on Congressional action.

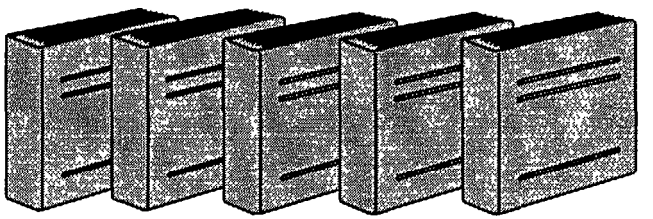
A variety of outreach, feedback, & consensus mechanisms are being used to ensure the CVO community is informed & involved.

- Timely, broad distribution of documentation
- E-mail
- World Wide Web Site: www.jhuapl.edu/cvisn/
- Committee Participation
  - BSWG, CVSA, ITSA Program Subcommittee, ITSA Architecture & Standards, Standard Development Organizations (SDO's), . . .
- Conferences & Workshops
  - ATA, CVSA, ITSA, ITS National Architecture, NPTC, SAE, . . .
- CVISN Prototype
- CVISN Pilot
- ITS/CVO Mainstreaming

A dedicated effort is being made in the CVISN development to involve stakeholders in each step of the process. The mechanisms being used are listed above.

A comprehensive set of ITS/CVO & CVISN documentation is being developed as ITS/CVO programs proceed.

- ITS/CVO Activities Roadmap
- CVISN Statement of Direction
- Introduction to CVISN
- Operational Concept Document
- Architecture Specification
- Data Element Dictionary
- CVISN Operational & Architectural Compatibility Handbook (COACH)
- Standards Requirements & Selected Draft Standards
  - Dedicated Short Range Communications (DSRC)
  - CVO Electronic Data Interchange (EDI) Transactions



There is an extensive effort underway to document management and technical information related to CVO and CVISN. Some significant documents are listed here.

A world wide web home page (www.jhuapl.edu/cvisn/) has been set up to provide on-line documents and information on how to obtain paper copies.

The ITS/CVO Activities Roadmap is a management tool being used by the FHWA to describe the 5 year "big picture".

Several Critical Success Factors have been identified to focus management attention where it is most needed.

Critical success factors are those things that must be done right in order for an endeavor to succeed. The items below are critical for the success of CVISN. Each is discussed in the body of the document.

- Comprehensive CVO Program Planning & Coordination
- Clear Operational Concepts - Supported by Stakeholders
- Electronic Data Interchange (EDI) Standards
- Multi-state Information Exchange Capability
- Dedicated Short Range Communication (DSRC) Standards
- CVISN Prototype Project & CVISN Pilot Program
- Assessment via widely accepted Measures of Effectiveness

Critical Success Factors

Comprehensive CVO Planning & Coordination - ITS/CVO programs are collectively a very complex endeavor involving hundreds of government agencies and thousands of carriers and other private stakeholders. The organizational structure is not a simple hierarchy, it is a complex network of (mostly voluntary) relationships. Funding comes from multiple public and private sources and CVO funding requests must compete with other good projects for funding. For all of these reasons, the success of ITS/CVO programs is critically dependent on having good, stable, documented plans and effective coordination mechanisms to allow partnerships and teamwork to develop in the CVO community.

Clear Operational Concepts - The ITS technology can often be implemented in multiple ways, not all of which lead to the desired level of benefits and interoperability. For the ITS/CVO Program to succeed, stakeholders must reach consensus on and implement common operational concepts (i.e., common ways to use the technology). For example, if each state implements electronic clearance according to different concepts, drivers will be faced with confusing variations in operations as they travel from state to state.

ED1 Standards - The central theme of CVISN is sharing information. ED1 is the way business transactions are exchanged today in a wide range of industries including shipping, warehousing, manufacturing, and retailing. It provides the technical and institutional framework to achieve open interface standards for exchanging business and regulatory information among states and carriers, and other stakeholders.

Multi-State Information Exchange Capability - Information users in one state agency often could benefit greatly by having access to information created by other agencies in the same or different states. For example, an enforcement office can benefit from inspection reports and credential status information generated by other states. CVISN must provide an affordable, timely mechanism for supporting this information exchange.

DSRC Standards - A standard is needed to ensure that a single, affordable DSRC tag can support all applicable ITS user services in all North American jurisdictions. Without this standard, carriers would need to get multiple tags to participate in multiple services in different geographic regions. This would be a large barrier to deployment.

CVISN Prototype & Pilot - Documentation of concepts and architectures is a good beginning, but the only real test of CVISN benefits is to implement it in an operational environment in a limited number of settings. The CVISN Prototype & Pilot affords this opportunity. It moves CVISN from the laboratory to the "real world".

Measures of Effectiveness - If CVISN concepts and technology are to be widely adopted and improved over time, it must be possible to measure the effect of implementing each service. If a new service is intended to improve safety, this result must be demonstrated through quantified measurements of key parameters (e.g., fatal accident rate) referred to as MOE's. The community must agree on the importance of these MOE's and must collect data to track trends over the years.

ITS National Architecture
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ITS National Architecture
Project Overview

Fiscal 94Q1	94Q2	94Q3	94Q4	95Q1	95Q2	95Q3	95Q4	96QI	96Q2	96Q3	96Q4	97Q1	97Q2	9783 ++

Phase I

4 Independent teams developed 4 alternative architectures for delivering the 29 ITS User Services. 2 contractor teams, Loral & Rockwell are selected to continue into Phase II.

Phase II

Loral (now Lockheed Martin) & Rockwell merge best features of 4 architecture products of phase I into a architecture. Architectural details are developed. Workshops are used to elicit feedback & build consensus for a final architecture. Highway-Rail Intersection (HRI) added as 30th user service in 1996.

Maintenance/Support

Architecture maintenance, standards development, and outreach.

ITS National Program Goals

- Improve Safety
- Increase Efficiency
- Reduce Energy & Environmental Impact
- Enhance Productivity
- Enhance Mobility
- Create a United States ITS Industry

ITS National Architecture Milestones

Jun 95: IPR1 - 1st Merged Architecture
Oct 95: IPR2 - Updated Merged Architecture
Feb 96: CVISN Documentation Aligned to NA
May 96: FPR - Final program review
June 96: NAR - National Architecture Review
Jan 97: HRI Update

ITS National Architecture Documentation

Executive Summary
Mission Definition, Vision
Theory of Operation
Logical Architecture
Physical Architecture
Traceability Matrix
Communications Document
Evaluatory System Design
Risk Analysis, Performance & Benefits Study
Cost Analysis, Evaluation Summary
Standards Requirements Document
Standards Development Plan
Implementation Strategy

The ITS National Architecture (NA) Project

The ITS National Architecture (NA) effort is being sponsored by the FHWA to provide a technical framework for the development and deployment of the 30 ITS User Services defined in the National ITS Program Plan. This effort has used multiple contractor teams, with each team including 5- 10 member organizations that represent a vast expertise in transportation and information technology. The architecture is defined using constructs described below:

ITS User Services: The ITS National Program Plan defines 30 specific User Services that ITS would deliver; these serve as the fundamental requirements for the ITS NA. Six of these are related to CVO.

Subsystems: A subsystem is an implementable system that performs specific functions that have been allocated to it by the ITS NA project. Subsystems are the heart of ITS NA definition.

Equipment Packages: An equipment package is an element of a subsystem which would typically be purchased as a unit. It may include both hardware and software components.

Market Packages: Market packages are a tool to discuss and analyze the deployment of the NA. The ITS NA defines approximately.56 "market packages". Each implements a cohesive set of user requirements that satisfy a market need and are likely to be deployed as a group or market bundle. These packages are intended to support analysis of deployment strategies and do not necessarily prescribe a specific approach to deployment.

When completed, the architecture will provide an integrated framework for independent public and private organizations to develop ITS applications which will be geographically and functionally interoperable. The architecture should lead to open standards which will expedite ITS deployment.

ITS User Services

Travel & Transportation Management

En Route Driver Information
Route Guidance
Traveler Services Information
Traffic Control
Incident Management
Emission Testing & Mitigation
Travel Demand Management
Pre-Trip Travel Information
Ride Matching & Reservation
Highway-Rail Intersection

Public Transportation Operations

Public Transportation Management
En Route Transit Information
Personalized Public Transit
Public Travel Security

Electronic Payment Services

Commercial Vehicle Operations

Commercial Vehicle Electronic Clearance
Automated Roadside Safety Inspection
On-Board Safety Monitoring
Commercial Vehicle Administrative Processes
Hazardous Materials Incident Response
Freight Mobility

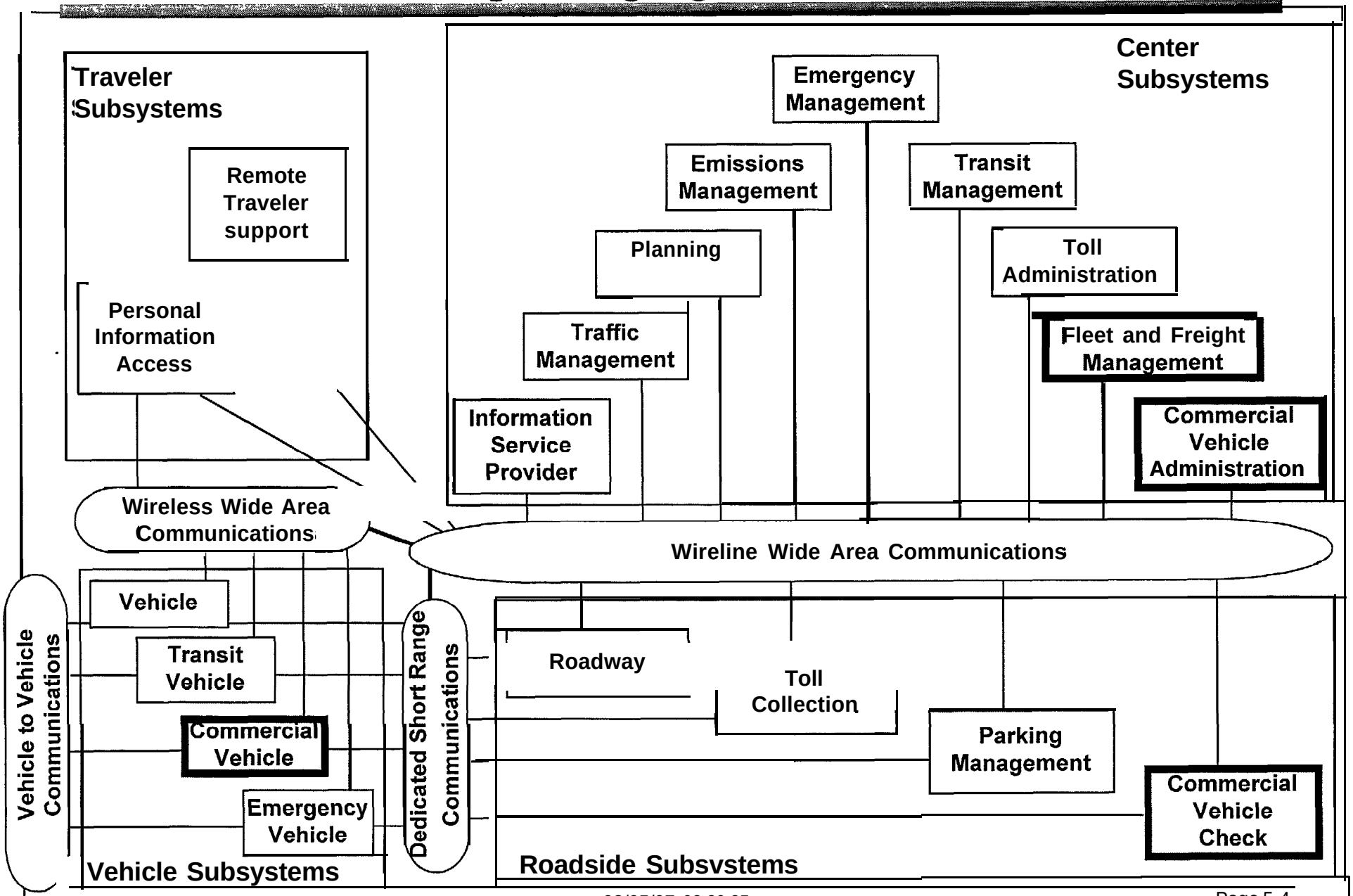
Emergency Management

Emergency Notification & Personal Security
Emergency Vehicle Management

Advanced Vehicle Control & Safety

Longitudinal Collision Avoidance
Lateral Collision Avoidance
Intersection Collision Avoidance
Vision Enhancement for Crash Avoidance
Safety Readiness
Pre-Crash Restraint Deployment
Automated Highway System

This version of the ITS National Architecture Subsystems Interconnect Diagram highlights the CVO subsystems



ITS National Architecture: Subsystems Interconnect Diagram

The ITS subsystems communicate with each other using the communication elements and architecture interconnect channels shown in the ITS Architecture Interconnect Diagram. The subsystems are shown as boxes, the communications channels are shown as lines, and the communication elements are shown as "sausages." In this version of the drawing, elements unique to Commercial Vehicle Operations are shaded and those which interface with the CVO-unique elements are shown as pale white.

The subsystems shown as single entities are **representative of multiple instances** of the specific subsystems. For example, several Commercial Vehicle Administration subsystems in a region, each with their own jurisdiction, may communicate with each other.

The ITS architecture **subsystems are grouped by classes** where the subsystems may share common communication elements, deployment, and institutional characteristics. The classes of subsystems are **Traveler Subsystems, Center Subsystems, Roadside Subsystems, and Vehicle Subsystems.**

Traveler Subsystems provide the "personal" and portable platform for ITS functions of interest to a traveler for support of multimodal travel. No unique requirements are imposed by CVO on these subsystems.

Center Subsystems are typically located at fixed sites. These subsystems provide management, administration, and support functions for the transportation system. These subsystems communicate with other centers to enable coordination with other agencies, between modes, and across jurisdictions. Center Subsystems provide electronic credentialing services for Commercial Vehicle Operations, support the roadside in screening and inspecting Commercial Vehicles, enable safe HAZMAT operations, support freight mobility, and provide services in common with other modes of transportation.

Roadside Subsystems include some functions that require convenient access to a roadside location for deployment of sensors, signals, programmable signs, or some other interface with travelers, vehicles, or freight. Roadside subsystems generally need wireline communications for messages to/from one or more Center Subsystems. For Commercial Vehicles, vehicle-to-roadside communications via a transponder mounted on the vehicle and a roadside reader will facilitate roadside check and inspection operations.

Vehicle Subsystems are installed in a vehicle. There will be considerable subsystem commonality across the various vehicle types in some areas such as navigation and Mayday functions. In addition to vehicle-to-roadside communications equipment, some Commercial Vehicles may be equipped with wireless wide area network communications to facilitate data communications with Center Subsystems such as Fleet and Freight Management.

Several ITS/CVO Market Packages support the CVO user services

ITS/CVO User Services	ITS/CVO Market Packages
- On-board Safety Monitoring	- On-board CVO Safety
- CV Electronic Clearance	- Electronic Clearance
	- Weigh-In-Motion
	- International Border Electronic Clearance
- Automated Roadside Safety Inspection	- Roadside CVO Safety
- CV Administrative Processes	- CV Administrative Processes
- HAZMAT Incident Response	- HAZMAT Management
- Freight Mobility	- Freight Administration
	- Fleet Administration
	- CVO Fleet Maintenance

ITS/CVO Market Packages

Market packages are a tool used by the National Architecture project to discuss and analyze the deployment of the ITS NA. Each implements a cohesive set of user requirements that satisfy a market need and are likely to be deployed as a group or market. bundle. They can be thought of as a refinement of the user services as shown above.

The **On-board CVO Safety** ITS market package provides for on-board commercial vehicle safety monitoring using sensors, and reading exceptional safety status from the roadside via dedicated short range communications.

The **Fleet Administration** ITS market package keeps track of and provides planning support for vehicle location, itineraries, and fuel usage using communications between the Fleet Management Center and the fleet of commercial vehicles.

The **Freight Administration** ITS market package tracks cargo location and cargo conditions. This service provides for communications interfaces among commercial fleet managers, commercial drivers, and intermodal operators.

The **Electronic Clearance** ITS market package provides for screening vehicles that pass a roadside check station, determining whether further inspection or verification of credentials is required, and taking appropriate actions. Dedicated short range communications via transponders and readers/writers facilitate the clearance functions at mainline speed.

The **International Border Electronic Clearance** ITS market package provides for expedited clearance activities related to commercial vehicle crossings between the United States and Canada or Mexico.

The **Weigh-In-Motion** ITS market package provides for high speed weigh-in-motion with or without automatic vehicle identification. Primarily, this ITS service provides the roadside with additional equipment,, either fixed or mobile.

The **Roadside CVO Safety** ITS market package provides for automated roadside safety monitoring, inspection, and reporting.

The **CVO Fleet Maintenance** ITS market package supports maintenance planning and scheduling of CVO fleet vehicles through interfaces with on-board monitoring equipment and automated vehicle location support capabilities within the Fleet and Freight Management Center.

The **HAZMAT Management** ITS market package integrates incident management capabilities with CV location and cargo tracking to assure effective treatment of HAZMAT material and incidents.

The**CVO Administrative Processes** ITS market package provides for electronic application, processing, fee collection, issuance, and distribution of CVO credentials and provides for CVO tax filing/auditing.

CVISN Architecture
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The CVISN Architecture Project started with defining the architecture and continues through nationwide deployment

94	95	96	97	98	99	00	01

Preliminary Architecture Definition

- Operational Concept
- Align with ITS NA
- Baseline Architecture
- EDI Interface Rqmts
- DSRC Interface Rqmts
- CVISN Prototype
- Roadmap & Plan

CVISN Refinement & Piloting

- CVISN System Design
- CVISN Pilot
- Core Infrastructure
- DSRC Standard
- EDI Standards
- Deployment Tool Kit
- System Integration

CVISN Deployment & Evolution

- Deployment to all Interested Stakeholders
- Operation & Maintenance
- Evolving Technology
- Evolving Services
- Process Improvement & Reengineering Based on Data & Analysis

CVISN Architecture Project Overview

The CVISN Architecture Project was initiated at the beginning of 1994. This was in parallel to the ITS National Architecture effort that was initiated in late 1993. The CVISN effort was initiated because the FHWA Office of Motor Carriers and Research Divisions wanted to ensure that the requirements of the CVO community were addressed in detail. From the outset, it was intended that the CVISN Architecture be in alignment with the ITS NA. It would contain more detail than the National Architecture in some areas. The CVISN Architecture Project team would give more attention to the details of legacy systems. It would also provide additional effort in defining standards, outreach to the CVO community, and assisting the CVO community to implement a specific design and deployment plan compliant with the architecture.

The CVISN architecture has being aligned with the ITS NA. The NA and CVISN teams incorporated the changes required for alignment in their architecture and operational concepts documentation. The CVISN documentation reflects the ITS NA definitions of subsystems, equipment packages, and market packages.

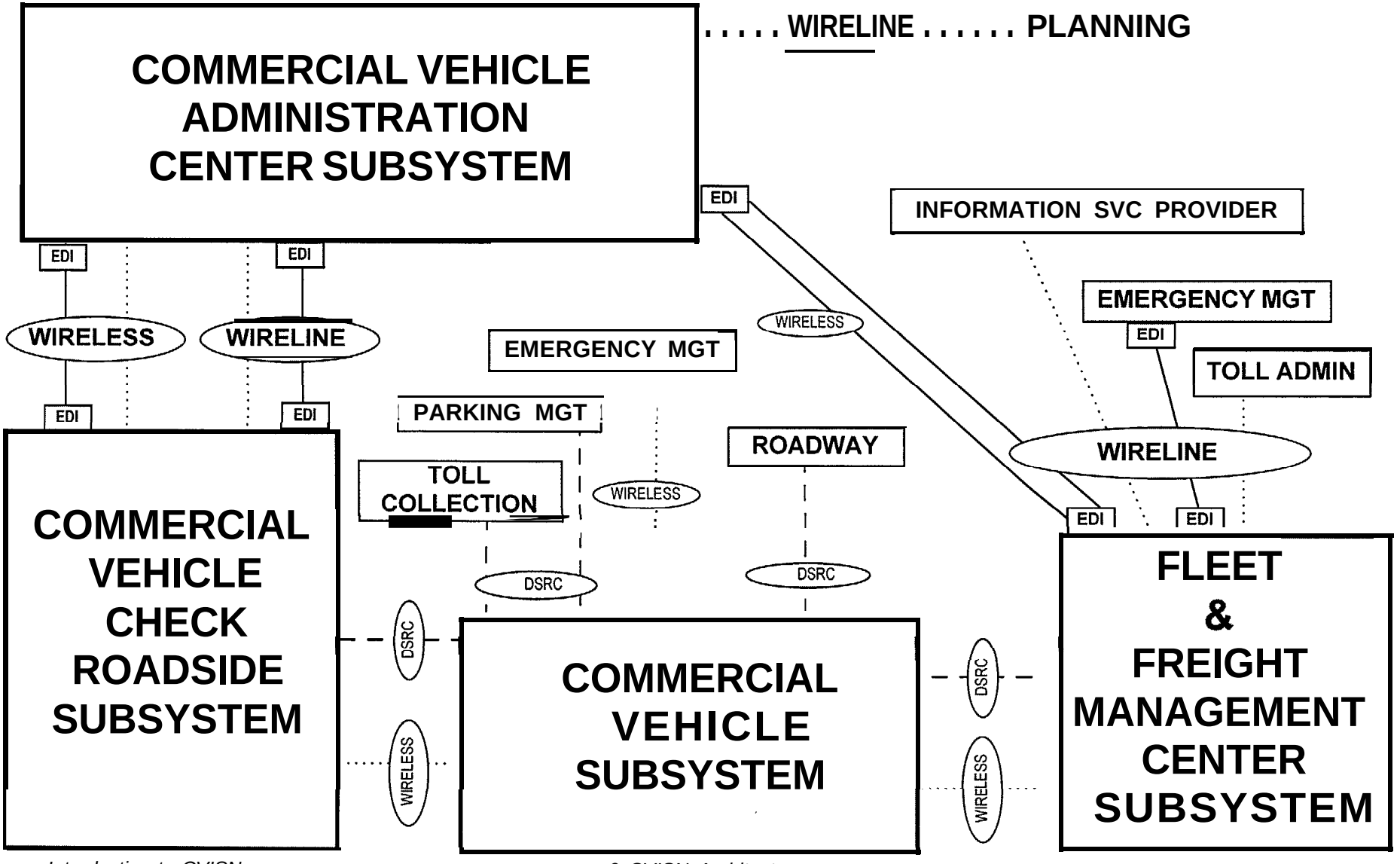
The CVISN Architecture Project will proceed through three phases. The first phase delivered a baseline architecture. This provides a technical framework for subsequent CVISN planning, development, and deployment. It is a fully developed architecture, with complete documentation, but it should not be thought of as "final' or "cast in concrete". Subsequent stages will refine it through use.

The Refinement & Piloting phase is fielding the CVISN Core Infrastructure and systems in pilot states. These will be fed-back to the architecture to adjust it before widespread deployment. Guidelines for system development and integration will be developed.

The final stage of the architecture project reflects the need to view the architecture as a dynamic tool that evolves with experience, technology changes, environment changes, service changes, policy changes, etc. The end of the pilot should not be viewed as the end of the architecture development. New technologies may make radically new concepts and approaches possible and affordable in the future. CVISN will provide for the collection of computerized data related to measures of effectiveness. These data are collected as a by-product of normal operations. The process will support future architecture evolution based on careful analysis of real data and knowledge, reducing risk and easing the process of change for future generations of CVISN.

The following pages provide more definition of the ITS/CVO equipment packages and subsystems.

The CVISN architecture connects subsystems via a combination of EDI and DSRC interface standards



CVISN Architecture Subsystems

This figure depicts the ITS subsystems that support Commercial Vehicle Operations (CVO). The subsystems shown as large boxes are unique to CVO. Smaller boxes contain functions that support CVO and as well as other transportation elements. The small dark gray box shows the common subsystem that contains HAZMAT incident response functions unique to CVO. Lines represent communication channels; the line types indicate the kind of standardization recommended. "Sausages" represent communication elements of the architectural framework.

The diagram shows two **interface types critical to the CVO** portion of ITS: DSRC (Dedicated Short Range Communications) and ED1 (Electronic Data Interchange).

DSRC will occur via a transponder (tag) on the vehicle that is read from and written to by a roadside reader. The tag supplies screening data, safety data, and HAZMAT flags unique to CVO.

EDI transactions, as defined by ANSI Accredited Standards Committee (ASC) X12, will be used to communicate CVO-related business information among trading partners using pre-defined formats so that computers can process information such as credential applications, safety data, etc. ED1 transactions are used for CVO data interfaces that must be standardized across jurisdictions.

The four **subsystems unique to CVO** are:

- **Commercial Vehicle Administration**
- **Commercial Vehicle Check**
- **Fleet and Freight Management**
- **Commercial Vehicle.**

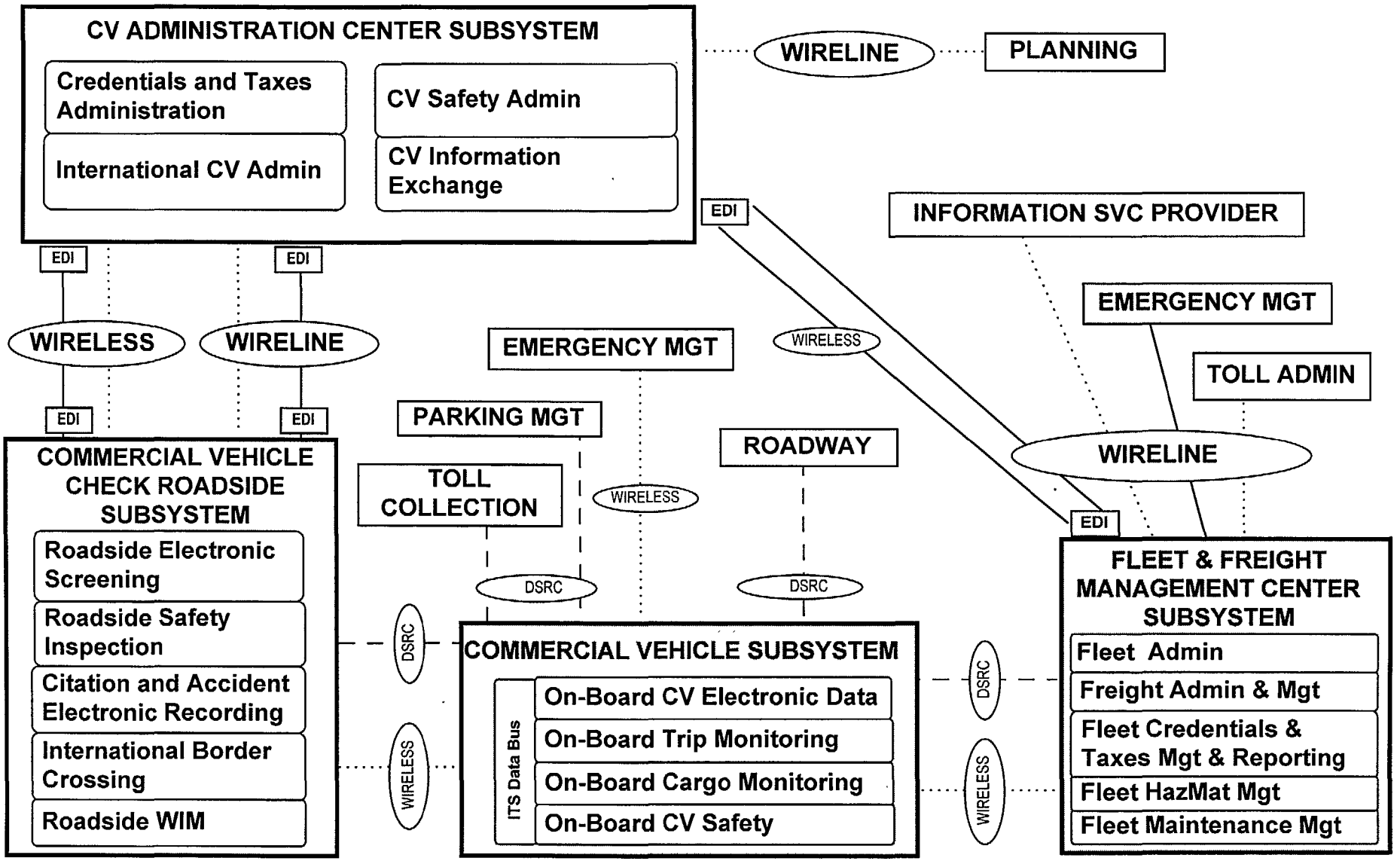
The **Commercial Vehicle Administration Center Subsystem** will operate at one or more fixed locations within a region. This subsystem performs administrative functions supporting credentials, tax, and safety regulations. The subsystem coordinates with other Commercial Vehicle Administration Subsystems (in other states/regions) to support nationwide access to credentials and safety information for administrative and enforcement functions.

The **Commercial Vehicle Check Roadside Subsystem** supports automated carrier, vehicle, and driver identification at mainline speeds for credential checking, supports roadside safety inspections, and conducts weigh-in-motion. The subsystem enhances current capabilities by supporting expedited brake inspections, the use of operator hand-held devices, on-board safety data access, and rapid access to safety history information.

The **Fleet and Freight Management Center Subsystem** provides the capability for commercial drivers, dispatchers, and intermodal operators to receive real-time routing information and track vehicle and cargo locations. The communications capabilities of the subsystem support electronic credentialing and expedited hazardous material incident response.

The **Commercial Vehicle Subsystem** resides in a commercial vehicle and provides the sensory, processing, storage, and communication functions necessary to support safe and efficient commercial vehicle operations.

In the CVISN architecture, CVO functions are allocated to subsystems and equipment packages consistent with the National ITS Architecture



CVO Functions Are Allocated to Equipment Packages

The figure above shows how **CVO functions are allocated to subsystems and equipment packages.**

The **Commercial Vehicle Administration Center Subsystem** consists of four equipment packages:

Credentials and Taxes Administration, supporting the processing, update, and issuance of CVO credentials; collection, processing, and review of CVO fees and taxes

International Commercial Vehicle Administration, supporting administrative functions associated with commercial vehicles crossing international borders

Commercial Vehicle Safety Administration, supporting the collection and review of CV safety data

Commercial Vehicle Information Exchange, facilitating the exchange of snapshots and reports containing safety and credentials information for drivers, carriers, and vehicles.

The **Commercial Vehicle Check Roadside Subsystem,** consists of five equipment packages:

Roadside Electronic Vehicle Screening, supporting the screening and electronic clearance of vehicles

Roadside Safety Inspections, supporting automated safety inspections

Roadside Weigh-In-Motion, which weighs commercial vehicles at mainline speeds.

Citation/Accident Electronic Recording, supporting the recording of information related to citations or accidents

International Border Crossing, supporting customs and Imagination services for CVO

The **Fleet and Freight Management Center Subsystem** consists of five equipment packages:

Fleet Administration, supporting fleet tracking, dispatch, making and distributing route plans

Freight Administration and Management, supporting cargo tracking and trading partner interfaces

Fleet Credentials and Taxes Management and Reporting, supporting CV credential application, fee payment, and tax filing

Freight HazMat Management, communicating information about the location and handling of HAZMAT for incident response

Fleet Maintenance Management, providing the capability to use vehicle mileage and safety data to automatically generate maintenance schedules.

The **Commercial Vehicle Subsystem** consists of four equipment packages:

On-Board Commercial Vehicle Electronic Data, supporting the communication of IDS and other status and messages from/to the vehicle and driver through DSRC and wireless communications

On-Board Trip Monitoring, providing for the determination and communication of the vehicle's location and recording trip events

On-Board Cargo Monitoring, supporting assessment and reporting of cargo status

On-Board Commercial Vehicle Safety, supporting gathering and communicating safety sensor information.

Summary of Key CVISN Architectural Features

- 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
- State systems provide **snapshot data proactively**
- The **information exchange capability** distributes commonly required snapshot data to the roadside and deskside
- **Commercial wireline & wireless** wide area communications are used to provide data connectivity among all stakeholders
- **Vehicle-based and roadside-based equipment compliant with dedicated short range communications standards (DSRC)** support clearance, toll, traffic, fleet applications, and border clearance processes throughout North America
- Encryption & password technology ensure data privacy
- Architecture supports customized & evolving capabilities

Key CVISN 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 safety, credentials, and tax information. It will eliminate the need for carrying paper credentials and decals on tagged commercial vehicles.

An information exchange capability will be established which allows applications to get a "snapshot" of current status information on carriers, vehicles, and drivers in tens of seconds. Systems within a given state will communicate to other states via this capability. A combination of state-based systems and a single centralized system (to handle data about interstate operators) will assemble the snapshots from multiple sources and provide it to multiple users, serving as an "information hub". This will avoid redundant and costly development, computer processing, and communications. It will make the architecture more flexible because new applications can easily come on-line and obtain snapshot data using documented, open interface standards.

The communication system architecture includes a wide area network, a vehicle to roadside link, and a mobile link. Commercial wireline and wireless service companies will be used to provide connectivity for linking state, regional, national, carrier, and other private information systems. Only the dedicated short-range communication element will be a special purpose deployed just to meet ITS needs.

A standard transponder is a key architectural feature. The standard must support multiple ITS functions, including toll collection, CVO electronic clearance, fleet and freight management, HazMat incident response, automated safety inspection, in-vehicle signing, and traffic management. 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 only be viewed 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 evolve easily as changes occur in 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.

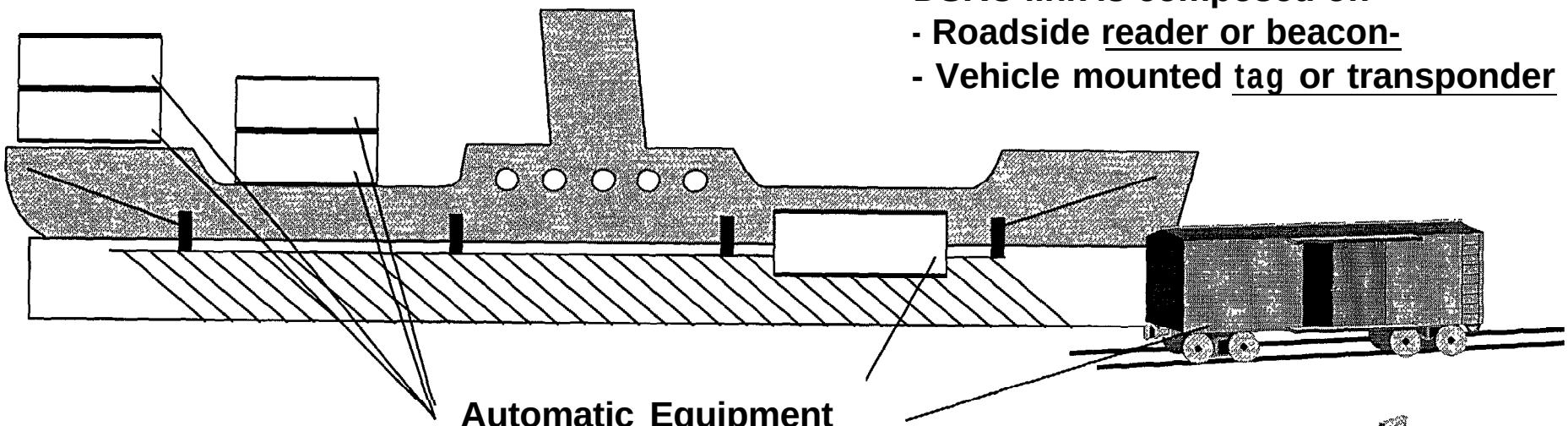
Standard data interfaces enable the exchange and use of information among CVISN elements

- **Two types of data interfaces have been identified for standardization:**
  - **Between the roadside or fleet management center and the commercial vehicle, Dedicated Short Range Communications (DSRC)**
  - **Between trading partners for computer-to-computer interchange, Electronic Data Interchange (EDI)**

- **Standard identifiers for Carrier, Vehicle, Driver, Shipment, and Trip will enable cross referencing**

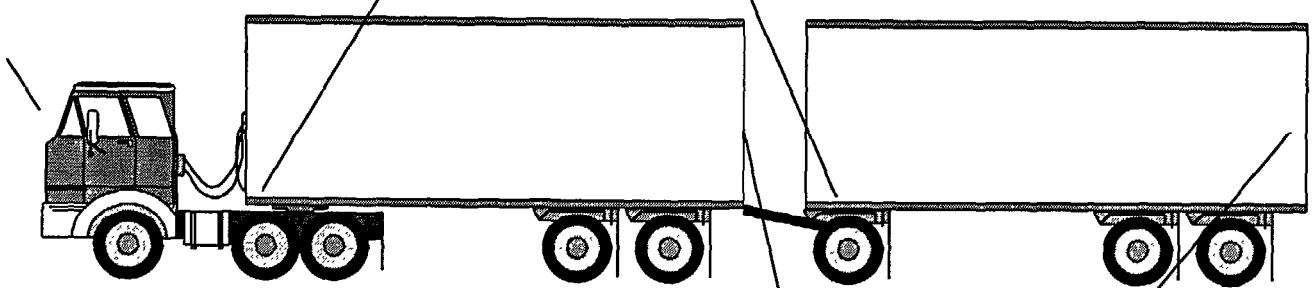
Dedicated Short Range Communications (DSRC) are recommended for vehicle-to-roadside information exchanges

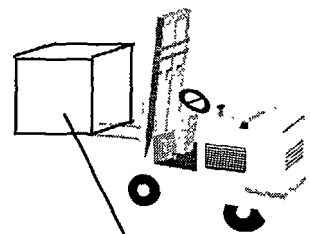
DSRC link is composed of:
- **Roadside reader or beacon-**
- **Vehicle mounted tag or transponder**



Automatic Equipment Identification (AEI) Tag

Power Unit Tag

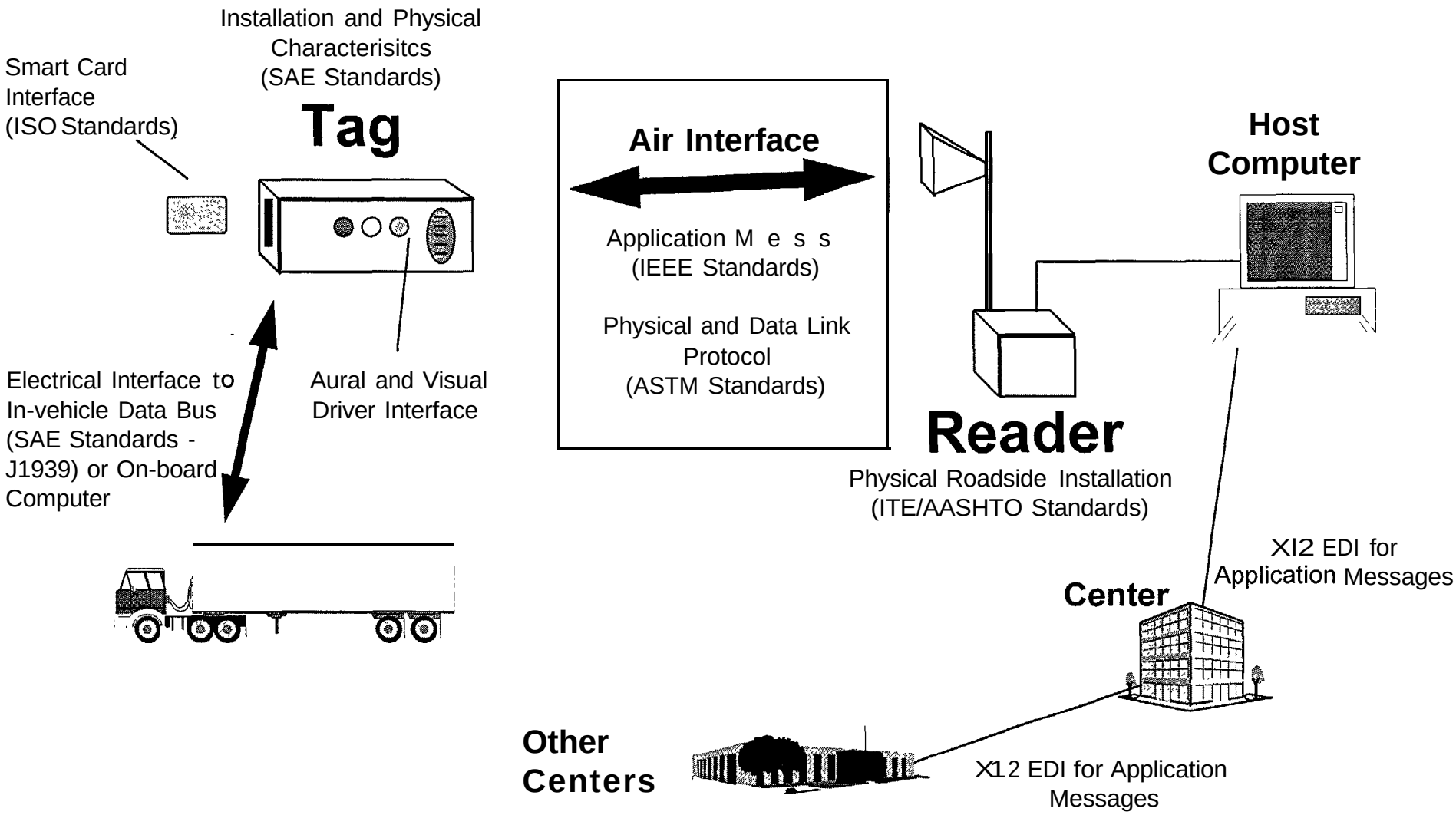




Cargo Tag

Electronic Lock Tag

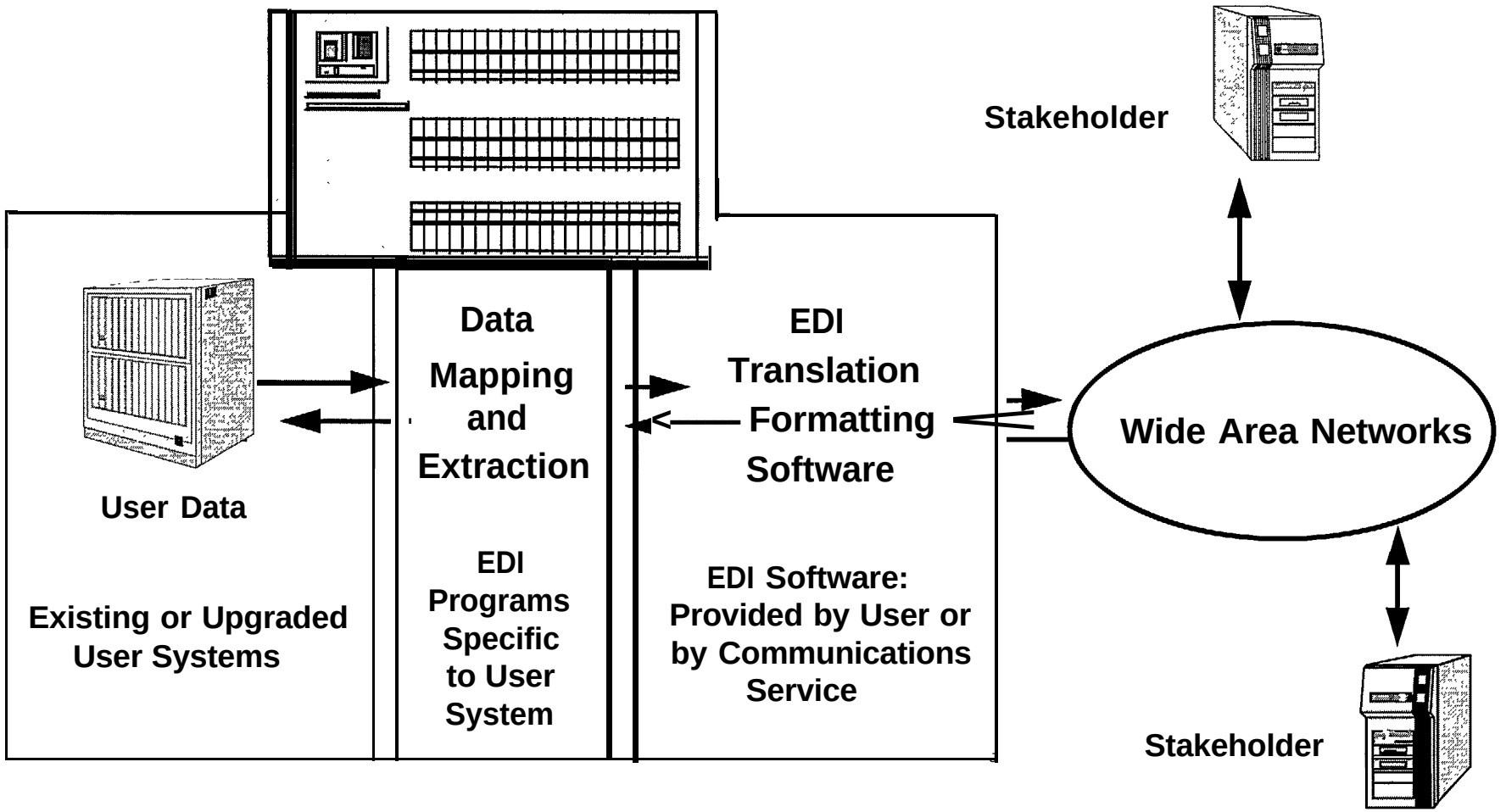
The two primary components of DSRC are the vehicle-mounted transponder (AKA "tag") and the roadside reader



DSRC Standard Requirements

- Tag must be geographically interoperable
- A family of tag capabilities must be available
  - Type III for power units and electronic locks
  - Type I for vehicle components (e.g. trailers, containers)
- An open standard for air interface and in-vehicle equipment must exist
- Air interface must be divided into independent layers (corresponding to the ISO OSI layers 1, 2 and 7)
- For Type III tags - Layer 7 (application layer) must support nationwide message standards (for toll collection, CVO screening) as well as user defined business proprietary message sets
- Tag need not be issued nor pre-programmed by any specific toll, parking, or other government or private agency in order to obtain their services
- Tag must support anonymous fee payment
- A process to rapidly add new message sets must be available

Electronic Data Interchange (EDI) standards are recommended for computer-to-computer information exchanges



EDI enables computer processing of messages using commercial translators

What is EDI?

- Electronic Data Interchange (EDI) is the electronic exchange of business information in a format that permits *computer generation and processing* of the message
  - Reduces or eliminates paper transactions
  - Promotes AUTOMATED processing & storing of data
- EDI is transmitted as text data files, and so can be exchanged using almost any communications network and protocol.
- EDI *standards* and user *implementation guides* define the structure and meaning of messages passed between trading partners
- A common implementation is to couple existing systems to an EDI *translator* software package & a commercial network

Why Use EDI?

- Allows *automatic* message generation, processing and response. Thus, *end user* system can preprocess and filter messages according to that user's particular requirements.
- Largely system independent.
- Already has considerable support and use in the transportation industry.
- Supported by readily available commercial products.
- Multiple communication options.
- The American National Standards Institute (ANSI) provides an infrastructure for defining & maintaining open EDI standards

CVISN Design
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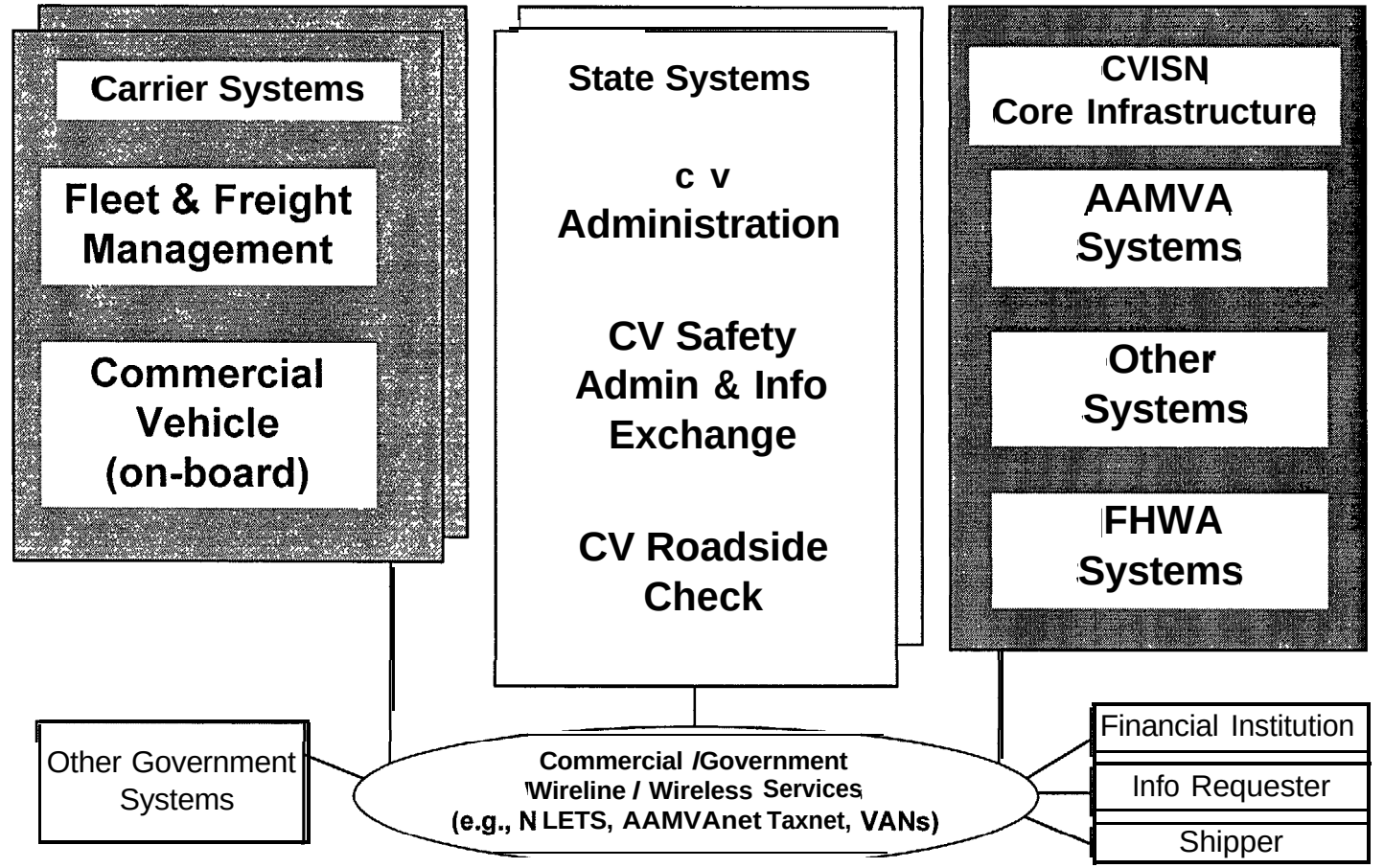
The CVISN architecture and model system design provide a technical framework for all stakeholders to develop interoperable systems.

CVISN System Design - Simplified Stakeholder View

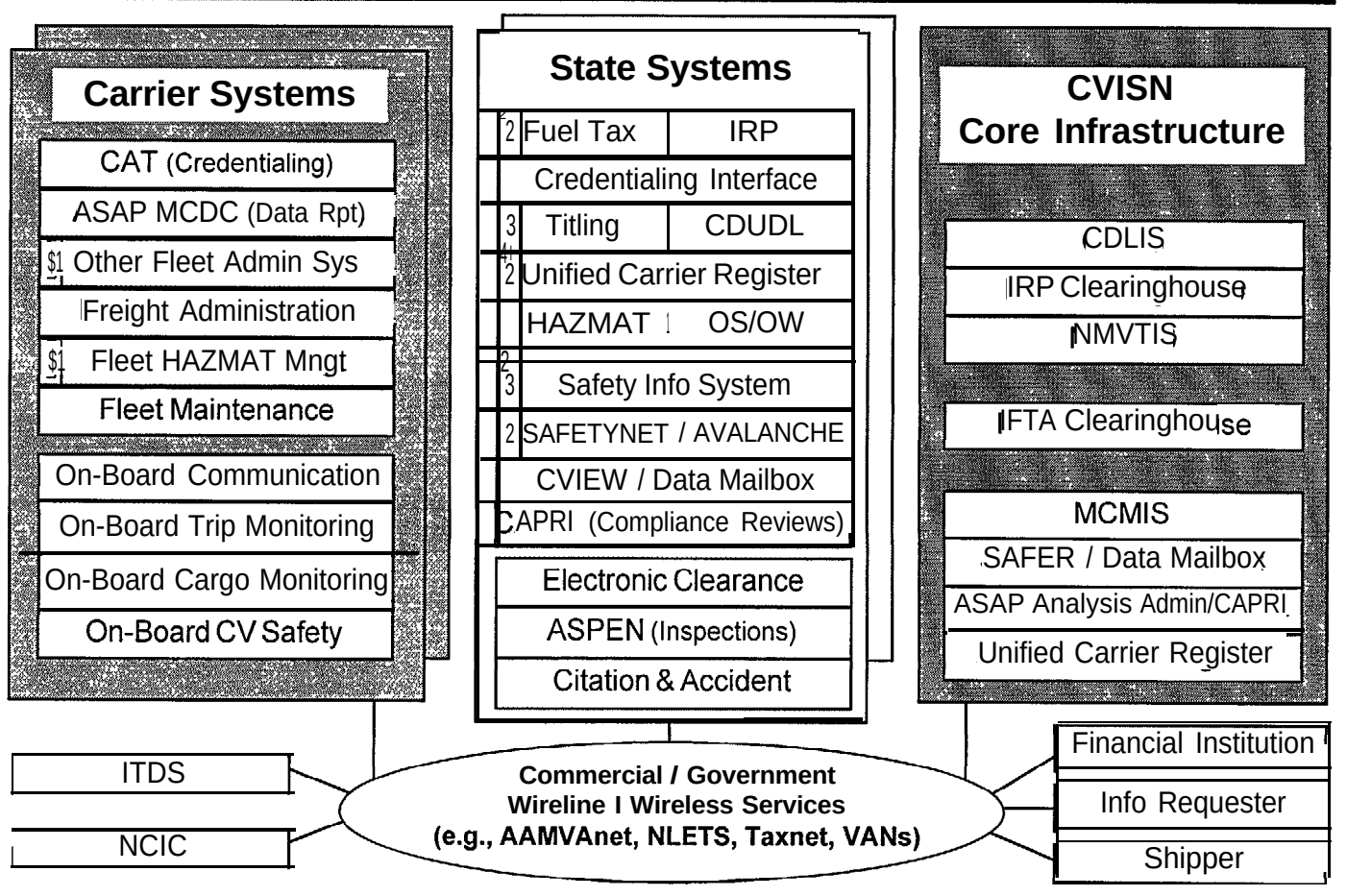
This view of the CVISN System Design groups systems according to major stakeholder groups, functions, and operators. It illustrates how many subsystems owned by different stakeholders can be viewed as parts of one large system, i.e., CVISN. Each subsystem must be designed with a view toward how it fits into the whole system if in teroperability is to be attained.



The actual system names for each stakeholder will differ, but functions are fairly common with the names shown here.

CVISN System Design Stakeholder View

This view of the CVISN System Design shows individual systems in the stakeholder categories. Unshaded system boxes are those which are most closely associated with the objectives for the CVISN prototype and pilot phases.



Key CVISN Design Elements

- Standard Identifiers
- DSRC and EDI open standards for information exchange
- Snapshots for carrier, vehicle, and driver safety and credentials information exchange
- State Systems equivalent to
  - Credentialing Interface (CI) - single interface between carriers and legacy credentialing systems for electronic credential applications and responses
  - CV Information Exchange Window (CVIEW) - manage snapshots within the state and interface with national SAFER system
- Carrier System equivalent to
  - Carrier Automated Transaction (CAT) - apply for and receive credentials electronically
- SAFER (CVISN Core Infrastructure system) to manage interstate snapshots

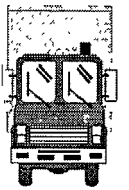
Recommended Standard Identifiers

Standard identifiers are intended to **facilitate the process of exchanging information** about carriers, vehicles, drivers, shipments, and international trips.

- USDOT number is recommended for the basis of the carrier ID.
- VIN is recommended as the basis for the vehicle ID.
- Driver's license "number" is recommended as the basis for the driver ID. Each state may establish a slightly different format for the driver's license "number," as long as it fits within the prescribed length.
- Shipment numbers should be set by carriers/shippers.
- Trip/load number is defined by ITDS to be based on the carrier DUNS number.

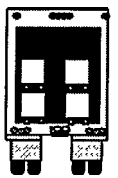
Major Entities

Carrier
US241 23456A890B9AT01

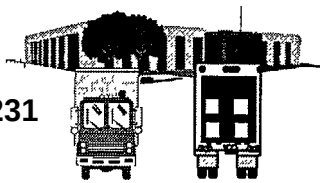


Vehicle
IFDKE30F8SHB33184

Driver
US24AB9999-999-9999A

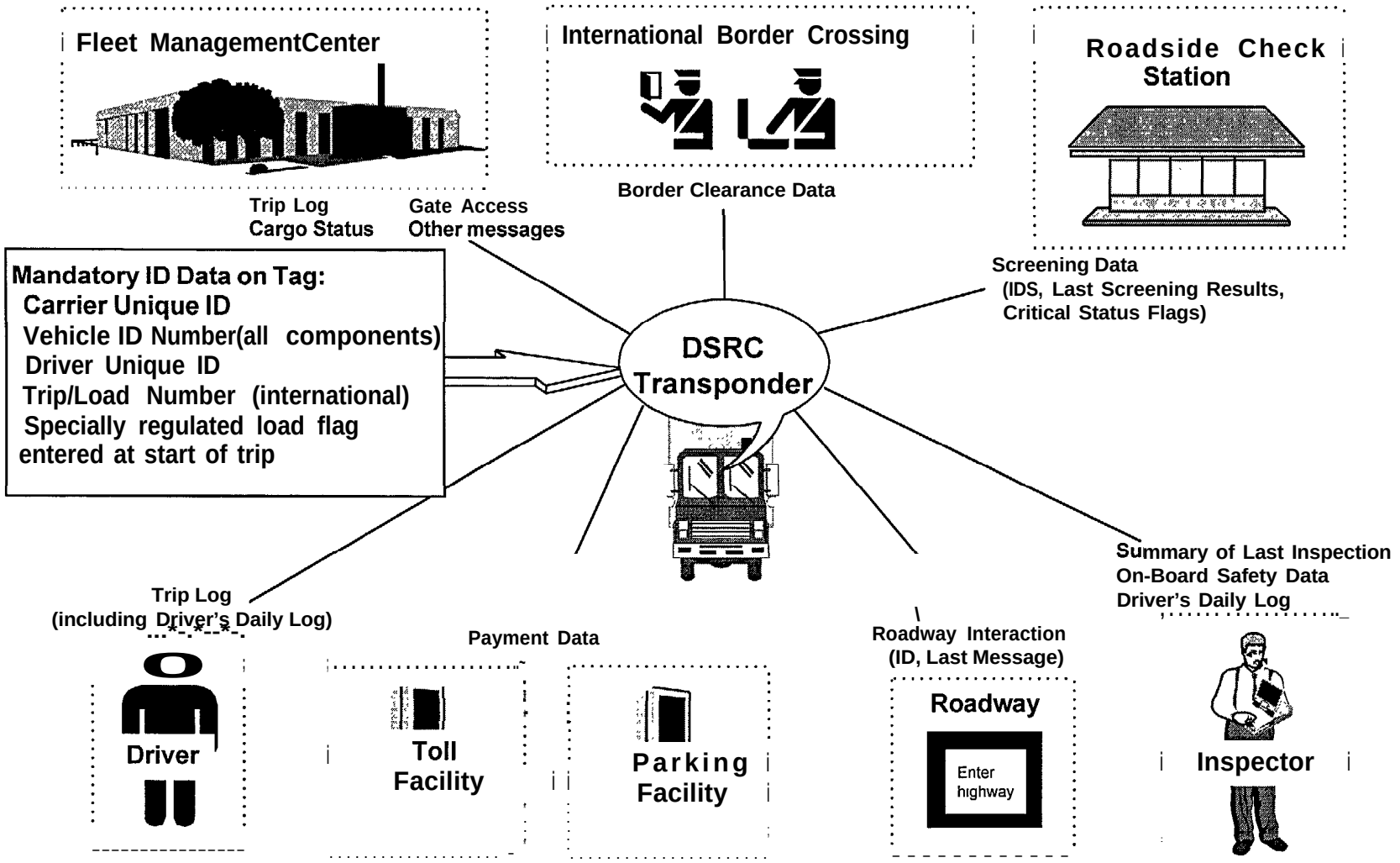


Shipment
776655443322



TripLoad
123456789761231

DSRC standards are used to read information from a vehicle-mounted transponder while the vehicle is in motion.



Standard EDI transaction sets support computer-to-computer exchange without the need to negotiate unique interface agreements

Transaction Set Subject	Description	Status
CVO Safety & Credentials Information Exchange (TS 285)	Request and send snapshots, profiles, other reports	Approved for Publication as DSTU
Commercial Vehicle Credentials (TS 286)	Submit electronic application for credentials Return credential data to applicants Exchange application data among jurisdictions	In Xl2 Review Process
Quarterly Fuel Tax Filing	File fuel tax returns with taxing authorities	TS 813
Interstate Fuel Tax	Send data on fuel tax filings among jurisdictions.	TS 826
Compliance Review Report	Send review results, OOS notifications, and carrier warnings/notifications.	Planned
Inspection Report Data	Inspection results, OOS notifications, and carrier warnings/notifications.	Planned
Citation	Used to transmit notice of legal violations	Planned
Accident Report	Used to transmit data on accidents	Planned
Internat. Border Clearance	Import / Export & related data	Existing ED I FACT Messages
HAZMAT Information Request	Request Information on HAZMAT Shipments	Planned
Financial Exchanges	Invoices, remittance advice, rate info., etc	Appr 10 existing stds
Shipping & Routing	Shipping Papers & Route Information	Appr 12 existing stds

Snapshots are assembled & stored to facilitate the exchange of safety & credentials information among systems

1 There are 3 kinds of snapshots: carrier, vehicle, and driver.

2 Use of common identifiers allows agencies and jurisdictions to exchange information

3 DMV data is primarily provided to SAFER in response to a query. Exceptions:

(a) Apportionment data are provided proactively upon change by the DMV

(b) Authoritative source may request SAFER to store DMV check flags sent proactively

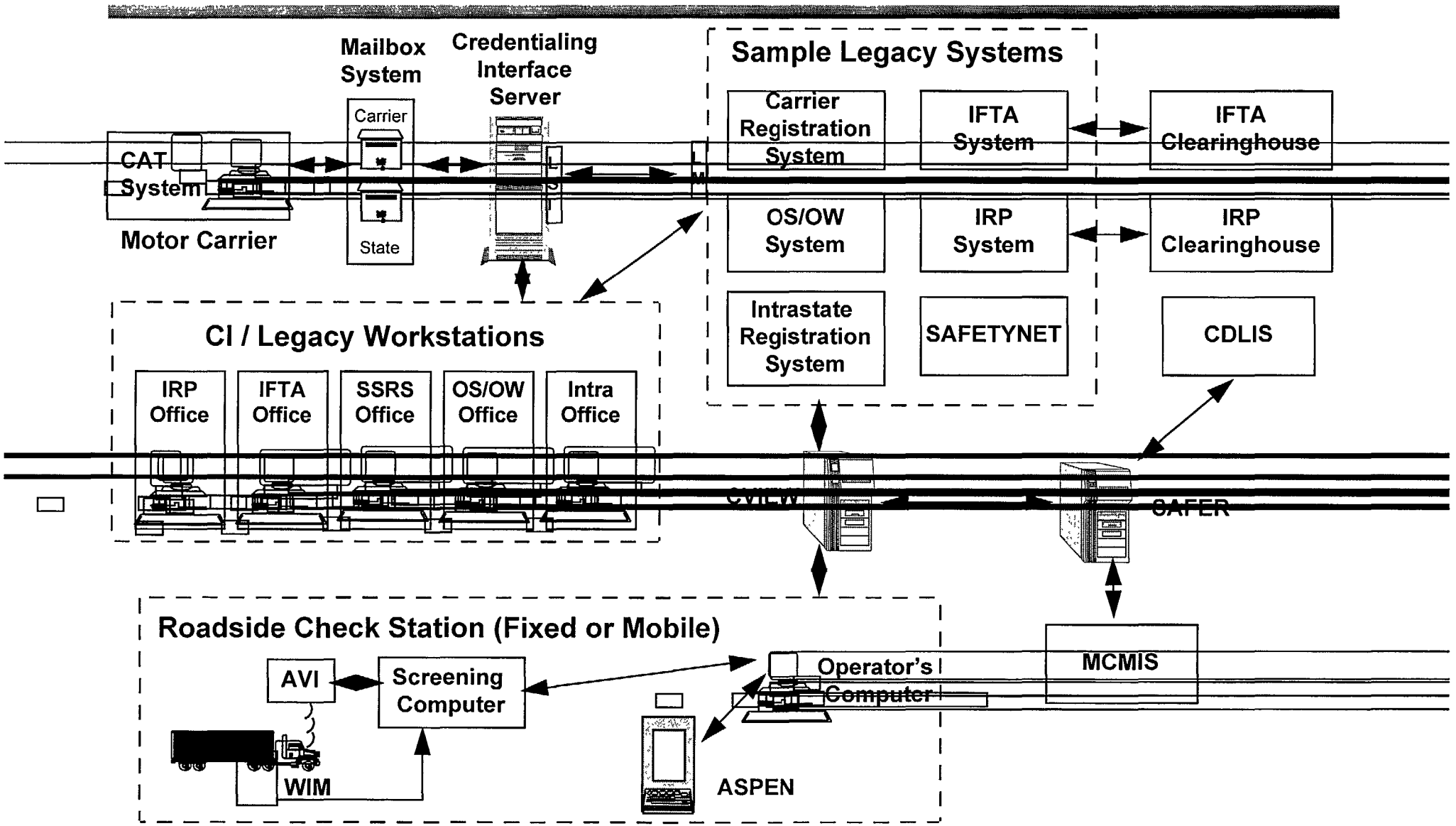
4 Each state may set and store check flags in its CVIEW to alert roadside officers

5 Safety information shows the performance history and latest out-of-service status

Data —> v Snapshot	Identifier/ Census Data	Safety Information	Credential Information
Carrier	2	5	3 4
Vehicle	2	5	3 4
Driver	2	5	3 4

Snapshot Data Stored in SAFER/CVIEW

This Typical State Configuration shows how a state might implement new functions and build on existing systems



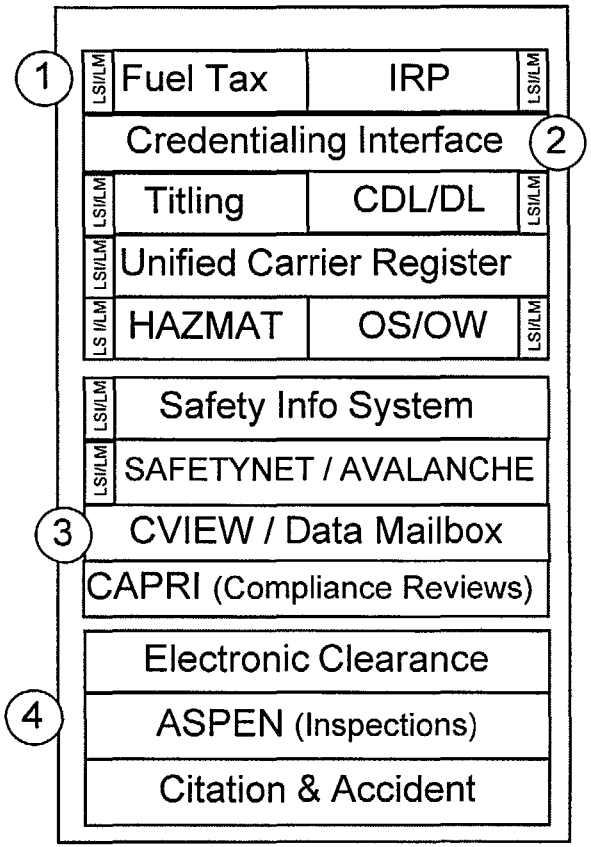
Legacy systems in the state will be leveraged to improve commercial vehicle operations and adopt CVISN principles.

Administrative systems will be updated to
(1) support electronic credentialing and automation of safety assurance functions.

New systems may be added to support key CVISN concepts
(2) Credentialing Interface for one stop shopping
(3) CV Information Exchange Window for creation of intrastate carrier & vehicle snapshots and to provide a single point of contact within the state for all snapshots and report queries

Roadside systems will be updated to support use
(4) of safety & credentials data for electronic clearance, to report inspections, and to report citations and accidents.

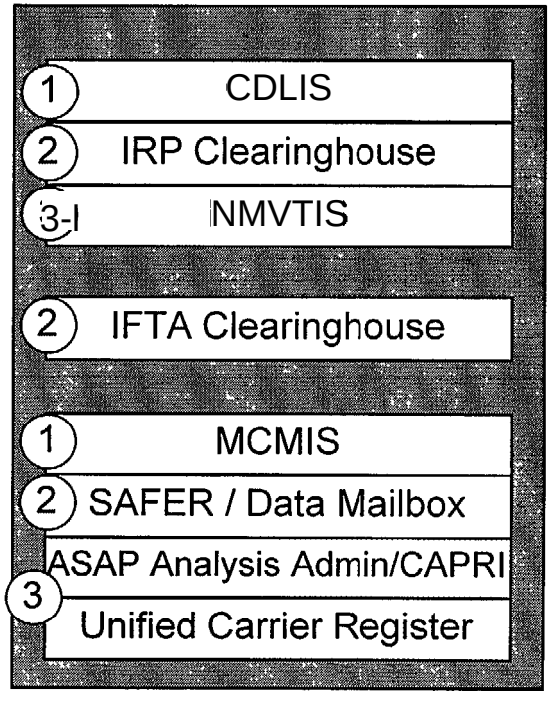
State Systems



New CVISN Core Infrastructure systems support information exchange

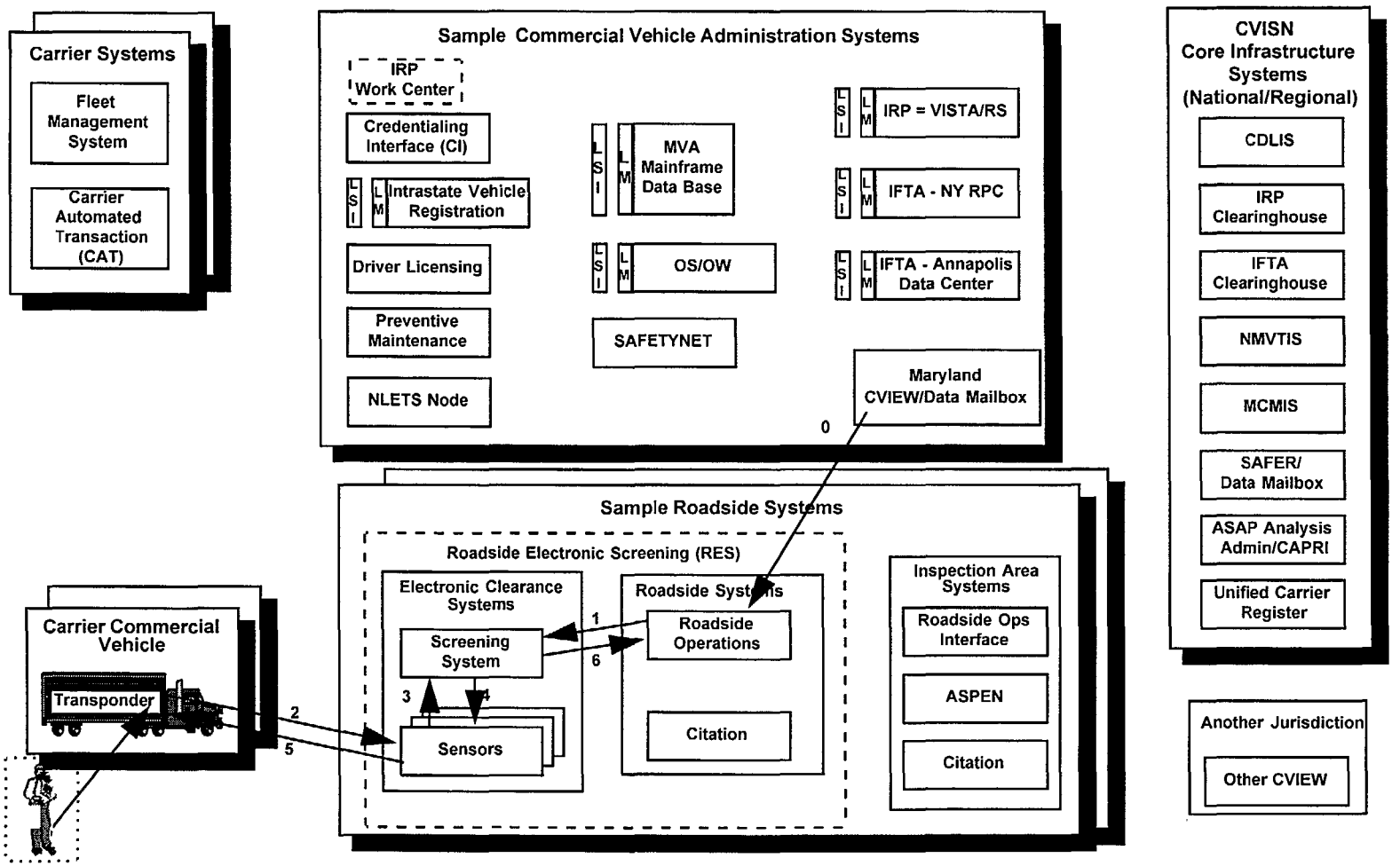
1. *Existing systems may be updated to support enhanced information exchange.*
2. *New systems are being developed to support key CVISN concepts:*
   - *IRP Clearinghouse for administration of IRP base state agreement*
   - *IFTA Clearinghouse for administration of IFTA base state agreement*
   - *SAFER for creation of interstate carrier, vehicle, and driver snapshots and to provide a single point of contact within the core infrastructure for all snapshots and report queries*
3. *Other systems are being considered for development or are underway as a result of non-CVISN activities:*
   - *NMVTIS development is underway to improve access to titling information for all types of vehicles*
   - *ASAP (under development) and CAPRI (operational) support compliance reviews*
   - *A Unified Carrier Register is being considered for centralizing and simplifying carrier registration and permitting*

CVISN Core Infrastructure



Functional thread diagrams are used to illustrate process and data flow among systems. Lines with arrows and numbers are overlaid onto a common design template showing all CVO systems.

Sample State CVISN System Design Showing a Functional Thread : Roadside Electronic Clearance for a Tagged Vehicle



CVISN Prototype
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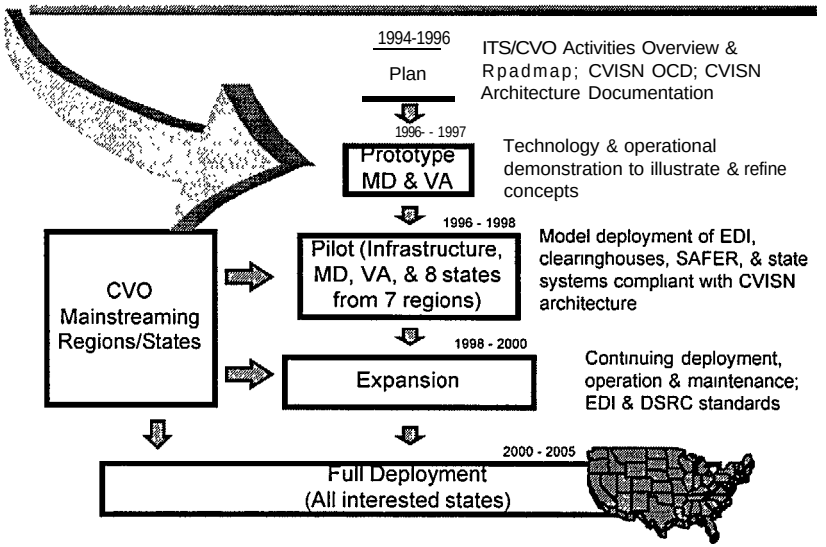
The CVISN Prototype tests key CVISN concepts, architecture and system design features in Maryland and Virginia

The CVISN Prototype Project is to

- **Integrate information systems and networks to improve:**
  - **Safety**
  - **Effectiveness and efficiency of deskside activities**
  - **Effectiveness and efficiency of roadside activities**
- **Provide feedback on CVISN Architecture and System Design.**
- **Provide inputs to CVISN Pilot**

CVISN Nationwide Deployment Strategy



The CVISN Prototype forms a partnership among MD, VA, industry, and FHWA

- **Maryland**
  - **State agencies**
  - **University consortium (Morgan State, MIT, Johns Hopkins University Applied Physics Laboratory)**
- **Virginia**
  - **State agencies**
- **Industry**
  - **Maryland Motor Truck Association**
  - **Independent Truckers and Drivers Association**
  - **Maryland Bus Association**
  - **Virginia Trucking Association**
- **FHWA**
  - **-**
  - **RS Information Systems**
  - **IDT**

CVISN Prototype - Major Activity Areas

- Safety Information
  - State CV Information Exchange
  - ASPEN & ISS
  - SAFER
- Electronic Clearance
  - Roving Verification (ROVER) Van
  - Fixed Site
  - Toll Facility
- Electronic Credentialing
  - Carrier Automated Transactions
  - IRP, IFTA, OS/OW Credentials & Permits
  - IFTA Tax Filing
  - Motor Carriers' Home Page
- Clearinghouses
  - IRP
  - IFTA

Products of the CVISN Prototype

- A working system for Maryland & Virginia
- A "showcase" for other states, demonstrating primary ITS/CVO user services integrated in a comprehensive, regional system
- Working CVIEW, Clearinghouses, & SAFER
- EDI Standards
- DSRC Standard? (or progress towards one)
- Example technical & management documentation

- Overall result:

Facilitate states & carriers in deployment of ITS/CVO.

CVISN Prototype Project Approach

Maryland CVISN Prototype

- Develop System Design Document
- Roadside Electronic Screening
  - coordinating with DSRC Project
  - specifying & integrating RES for a Fixed site at West friendship
  - specifying & integrating RES for a Mobile site
- Electronic Credentialing
  - providing high-level design
  - system architect support from APL
- CVIEW
  - build on SAFER implementation
  - install and test
  - develop interim legacy system interface using "bulk loaders"
- Maryland Project Manager support from APL

Virginia CVISN Prototype

- Develop System Design Document
- Roadside Electronic Screening
  - prototyping and demonstrating RES functions
  - coordinating with DSRC Project
  - demonstrate ROVER capability
  - specifying & Integrating RES at a Fixed site: Stephens City VA
  - specifying RES for a Mobile site with VA NOMAD
- Electronic Credentialing
  - providing high-level design
  - providing project leader support
- CVIEW
  - build on SAFER implementation
  - install and test
  - develop interim legacy system interface using "bulk loaders"

CVISN Pilot
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CVISN Pilot Program Purpose

To implement the primary CVO user services through a FHWA, state, and industry partnership in multiple states to demonstrate their technical and institutional feasibility, costs, and benefits and to encourage further deployment.

The specific services to be implemented are:

- Safety Information Distribution
- Electronic Credentialing
- Electronic Clearinghouses
- Electronic Clearance

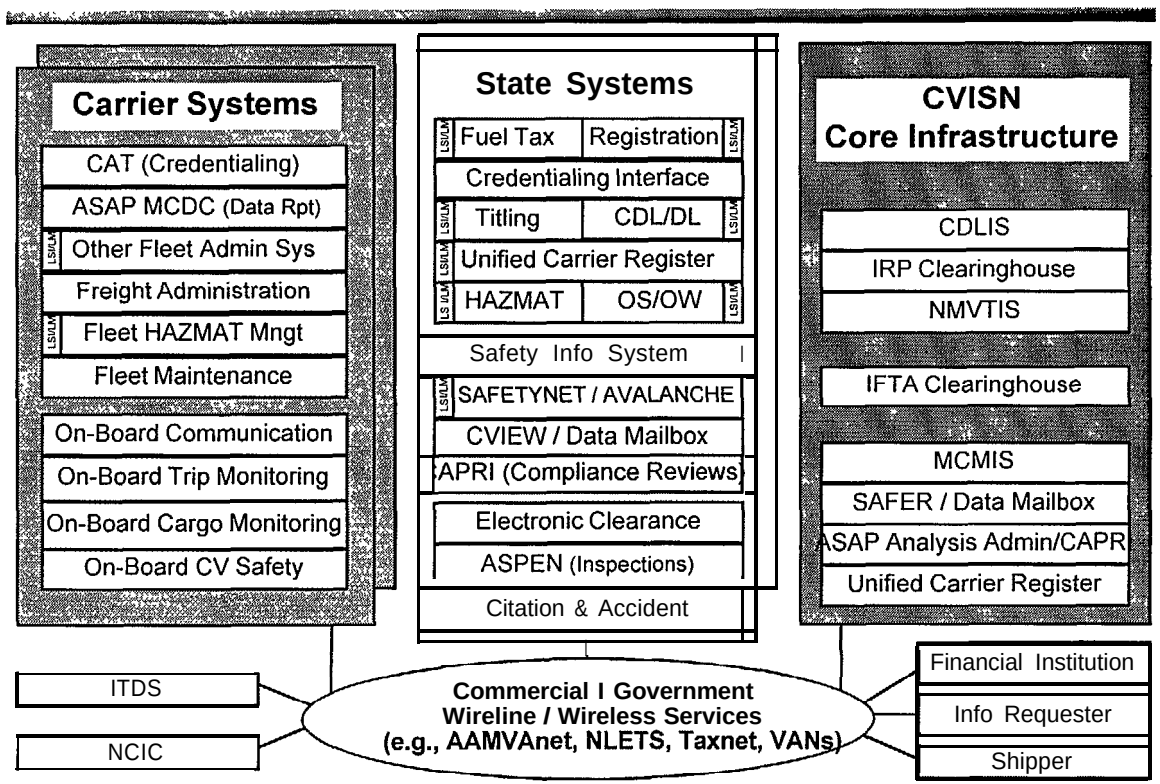
Implementing these ITS/CVO services leads to

- Safety
- Simplicity
- Savings

CVISN Pilot Scope

The CVISN Architecture ensures inter-operability through open electronic data interchange and authoritative sources

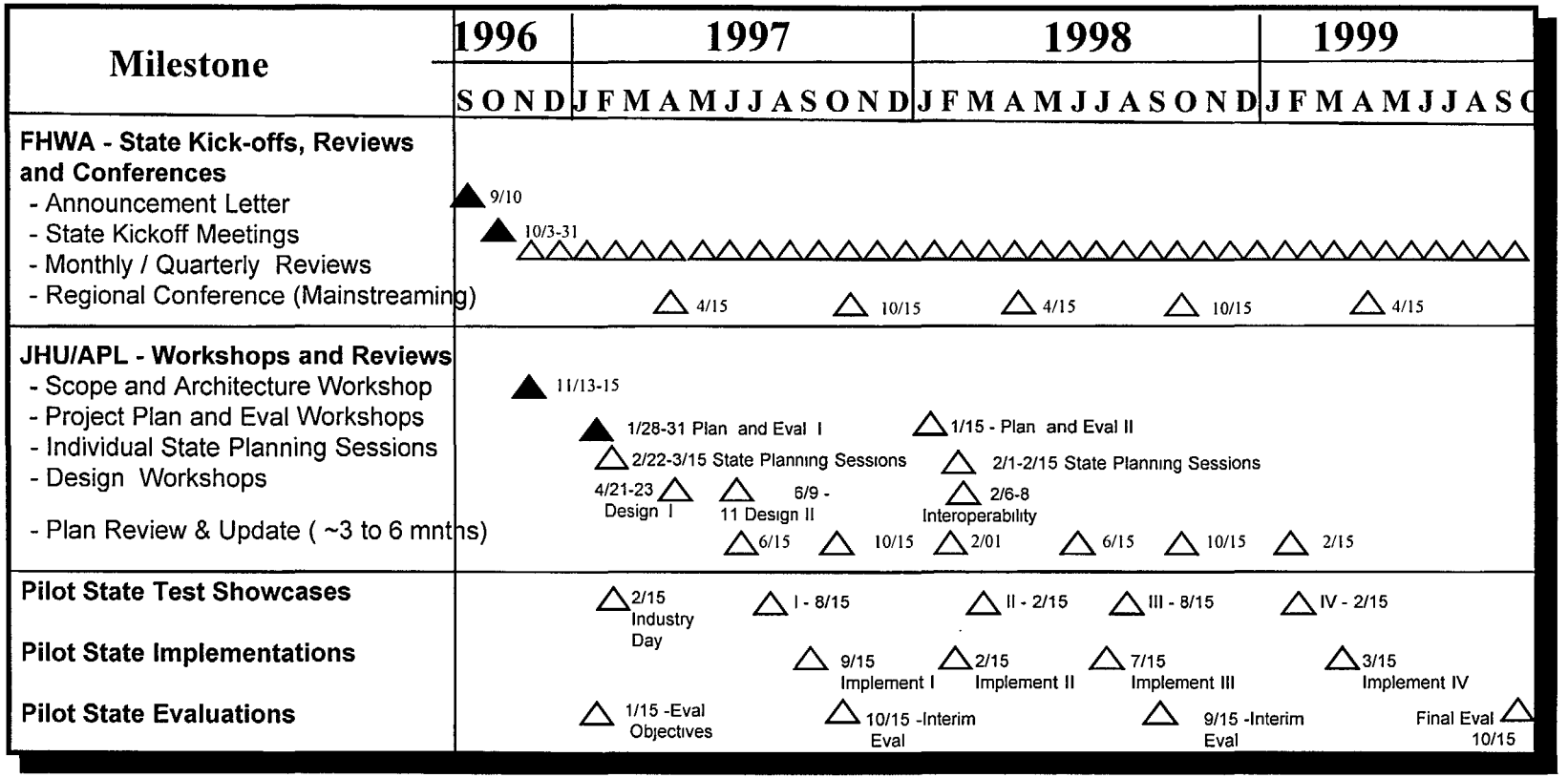
CVISN System Design - Stakeholder View



Capability not required for pilot

CVISN Pilot Major Milestone Schedule

Thorough planning and support leads to well managed and effective CVISN Pilot State Projects



△ Denotes Quarterly Review

▲ Denotes Completed Milestone

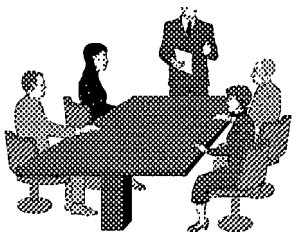
CVISN Pilot Program
Methods and Tools

Use of lessons learned, best practices, workshops, pilot state consultants, and conferences ensures the success of the CVISN Pilots

Lessons Learned

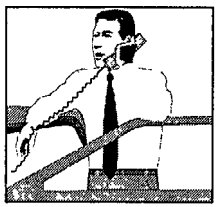
Best Practices
Critical Success Factors
MD prototype Lessons Learned
VA prototype Lessons Learned

workshops



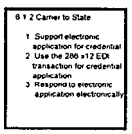
Architecture Template
Project Plan Template
Work Plan Template
Quarterly Status Template
Design Template

Pilot State Advisors

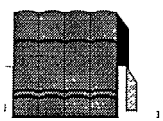


JHU/APL Points of contact assigned to each state

CVISN Operational & Architectural Handbook (COACH)

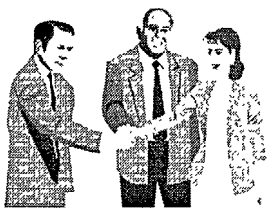


CVISN Tool Kit



CVISN Prototype Documentation
CVISN Documentation

Regional Conferences



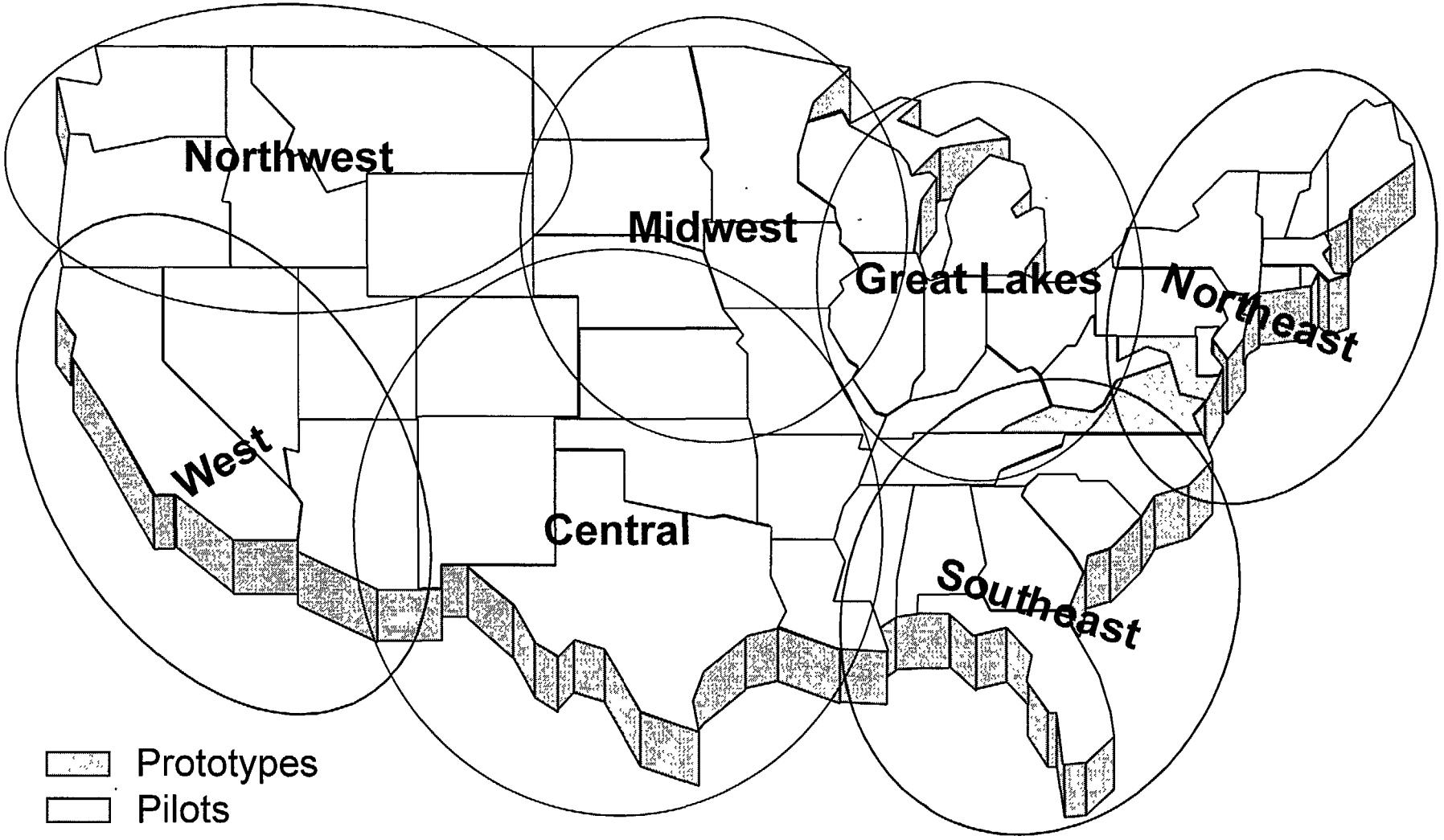
Project Room

State 2...7
Tech Support
FHWA

State 1

Data Conferencing

Pilot States were selected based on geographic distribution and responses to RFI/RFA



CVISN Mainstreaming
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Note: This section is based on material developed by Cambridge Systematics, Inc.

CVISN Mainstreaming is intended to organize and manage ITS/CVO deployment

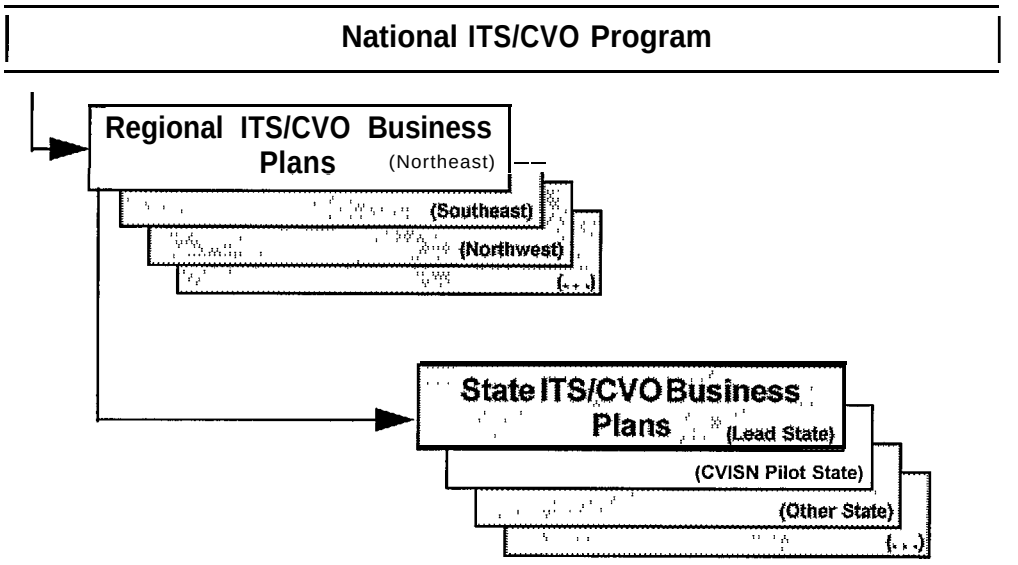
- **Objectives**
  - **Incorporate ITS/CVO more fully into state and metropolitan transportation planning activities**
  - **Coordinate ITS/CVO activities among agencies and among states**
  - **Explain the ITS/CVO program to key decision-makers in the public and private sector**

- **Approach**
  - **Develop business plans**
  - **Support public/private, multi-agency forums**
  - **Appoint regional "champions" to coordinate and promote ITS/CVO deployment in each regional "truckshed"**
  - **Conduct benefit/cost analyses and other technical studies**
  - **Conduct outreach and educational activities**

Mainstreaming Occurs at Three Levels

- **National**
  - Ensure national uniformity of services in key program areas
- **Regional ("trucksheds")**
  - 'Coordinate efforts and share "lessons learned" among states with common economic and transport needs
- **State**
  - 'Integrate ITS/CVO into ongoing agency planning and operations

ITS/CVO Business Plans



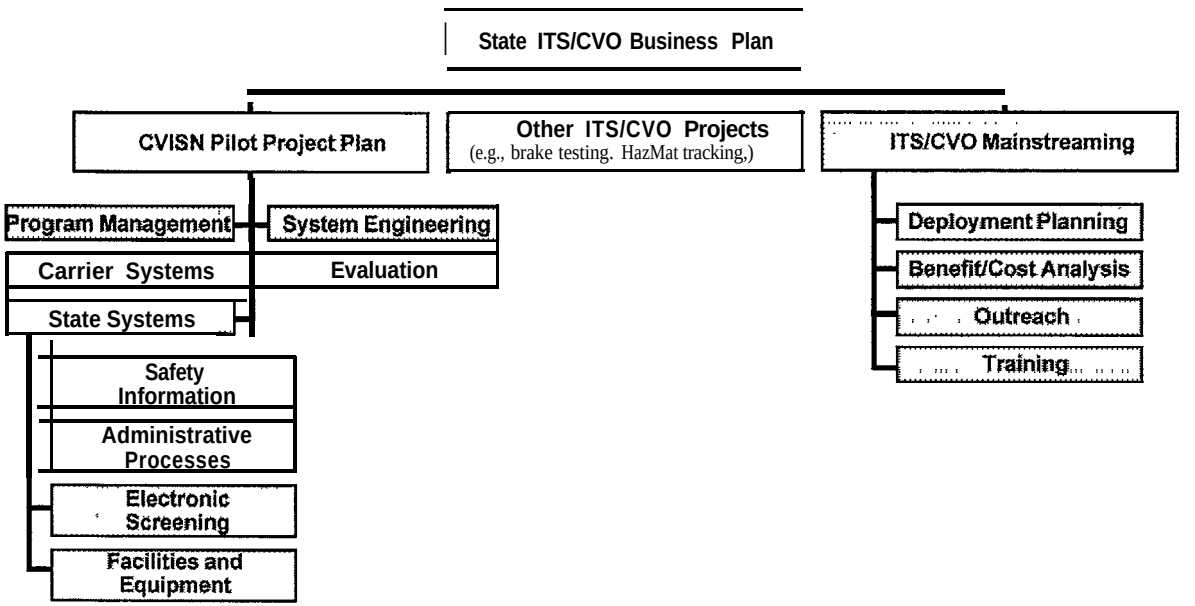
State ITS/CVO Business Plan and the CVISN Pilot

- **CVISN pilot project plan is one element of the state ITS/CVO business plan**

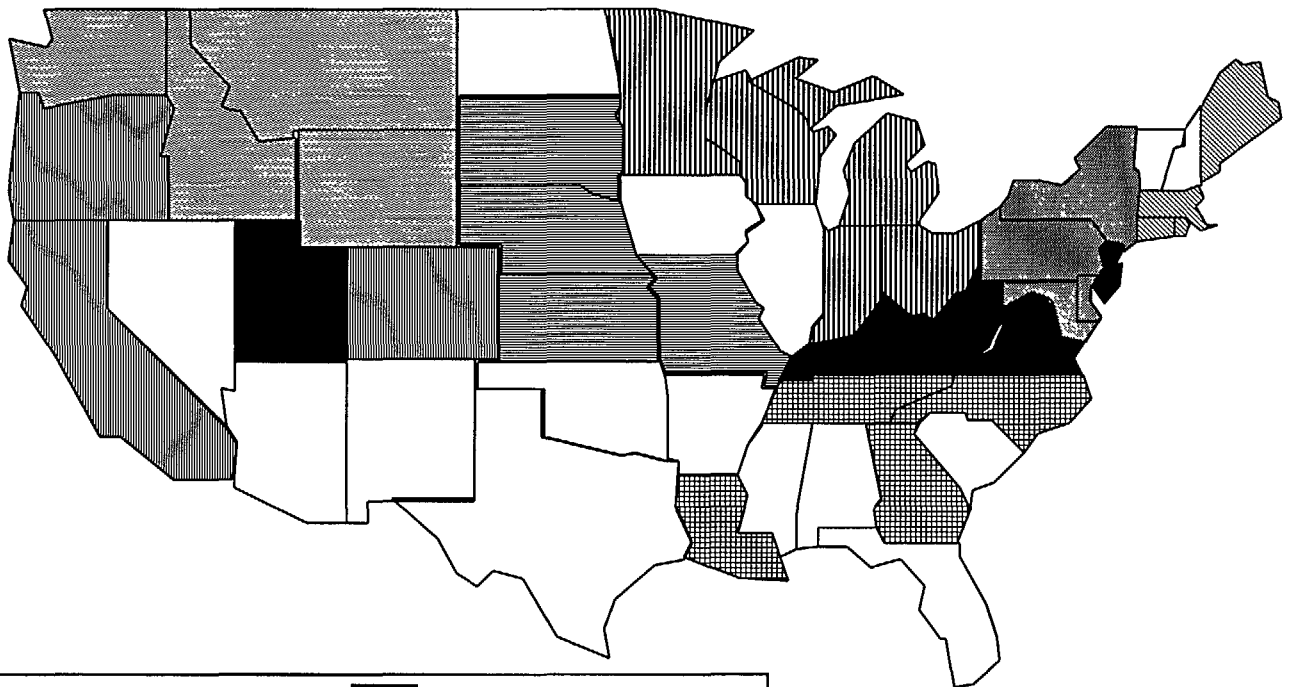
- **ITS/CVO business plan indicates how other projects relate to the CVISN pilot**

- **Cross-cutting business plan initiatives will affect CVISN pilot**
  - Education and training
  - Outreach and communications
  - Customer service

Business Plan Example
CVISN Pilot State



Regional Mainstreaming Consortia, January 1997



- I-95 Corridor Coalition/ Northern States
- I-95 Corridor Coalition/ Eastern States
- Advantage CVO/Southeast
- Advantage CVO/Great Lakes
- Mississippi Valley
- Northwest
- West
- Multiple Consortia
- Not Participating

Note:
The following states are participating in two CVO consortia: Kentucky (Great Lakes and Southeast), Utah (Northwest and West), Virginia (Eastern States and Southeast), New Jersey (I-95/Northern and I-95/Eastern), and West Virginia (Eastern States and Great Lakes).

Regional Champion Roles and Responsibilities

- **Support CVISN pilot project**
- **Support state and regional ITS/CVO planning**
- **Promote CVISN and ITS/CVO programs to state and industry**
- **Support regional ITS/CVO forum**
- **Guide benefit/cost analyses and technical studies**
- **Ensure coordination with other "trucksheds" and national program**

Regional Mainstreaming Activities Will Facilitate Expansion of CVISN Pilot

- **Regional ITS/CVO Business Plans**
  - **Plan for expansion of CVISN beyond pilots to other states in the region**
- **Regional ITS/CVO Forums**
  - **Share benefits and lessons learned from CVISN pilot experiences**
- **Regional Champions**
  - **Participate in planning meetings**
  - **Disseminate information**
  - **Organize conferences**

CVISN Expansion Phase
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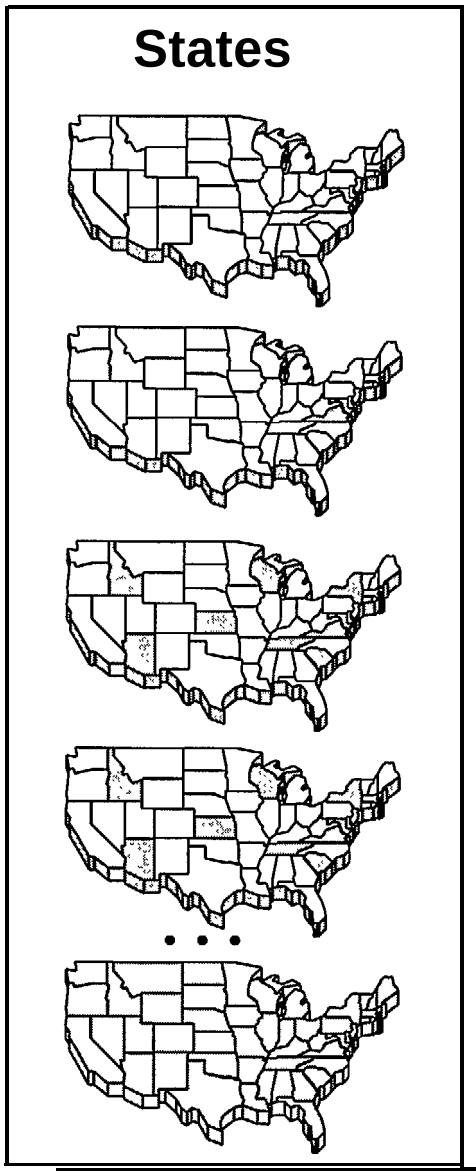
Expansion should be planned in several dimensions

States	Capabilities	Carriers
CVISN Prototype & Pilot Phases		
Group 1 	• Safety Information • Administrative Processes • Electronic Clearance	
Add Group 2 	• International Clearance • Fleet & Freight Admin • HazMat Incident Response • Automated Inspection • On-Board Safety	  . . .  
Add Group 6 		

Expand to all interested states



- 5 groups of states, 8 states in each group
- Three-year projects for each group
- Next group starts in 1998; last group starts in 2002
- Select states from multiple regions for each group
- Learn from early CVISN (prototype, pilot) deployment states
  - *Incorporate lessons learned into CVISN Deployment Toolkit, COACH, Workshops, Integration Test Facility, Standards
- Apply to next group of states
- Learn.. .
- Apply. . .

11 CVISN Expansion Phase

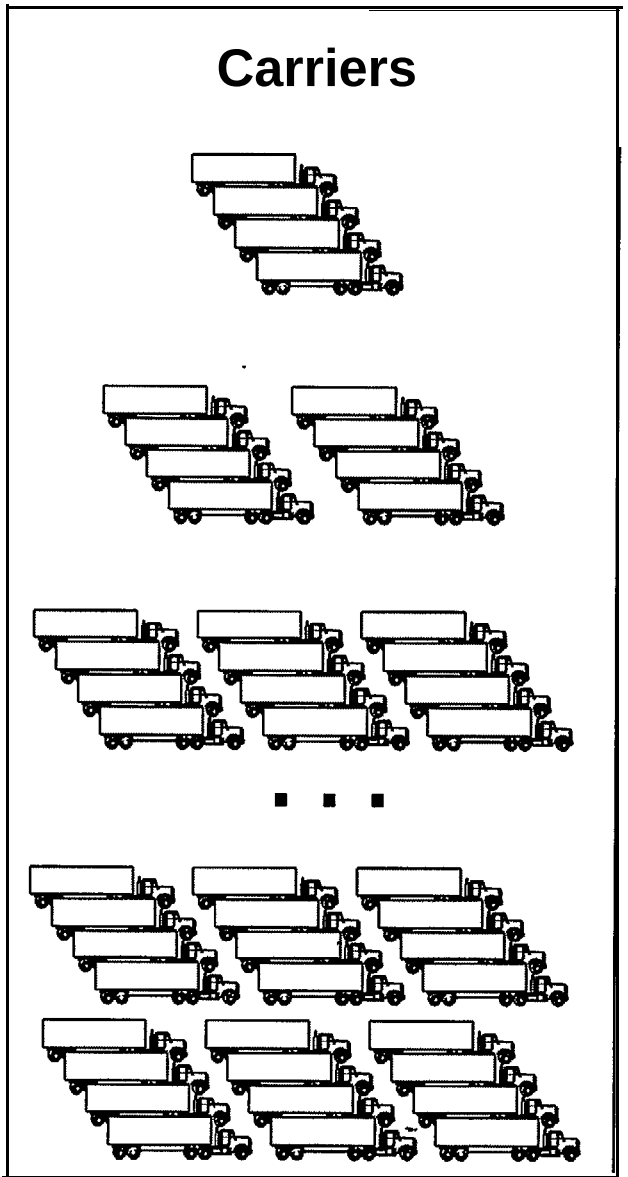
Expand to all capability areas

Capabilities

- Safety Information
- Administrative Processes
- Electronic Clearance
- International Clearance
- Fleet & Freight Admin
- HazMat Incident Response
- Automated Inspection
- On-Board Safety

- **Follow progress of Operational Tests**
- **Pace expansion based on need and availability of proven technology**
- **Learn from early CVISN (prototype, pilot) capability deployment**
  - **Incorporate lessons learned into CVISN Deployment Toolkit, COACH, Workshops, Integration Test Facility, Standards**
- **Apply to next group of capabilities**
- **Learn.. .**
- **Apply. . .**

Expand to all interested carriers



- As more states adopt CVISN, carriers involved in early deployment states will participate in additional states
- As transnponder usage expands, prices should come down, and more carriers (and vehicle makers) will add them to their vehicles
- As benefits to carriers are realized, participation will grow
- Learn from early CVISN (prototype, pilot) carrier experience
  - Incorporate lessons learned into CVISN Deployment Toolkit, COACH, Workshops, Integration Test Facility, Standards
- Apply to next group of carriers
- Learn. . .
- Apply. . .