

## **R3. Architecture & Design**

# UNDERSTANDING ITS/CVO TECHNOLOGY APPLICATIONS

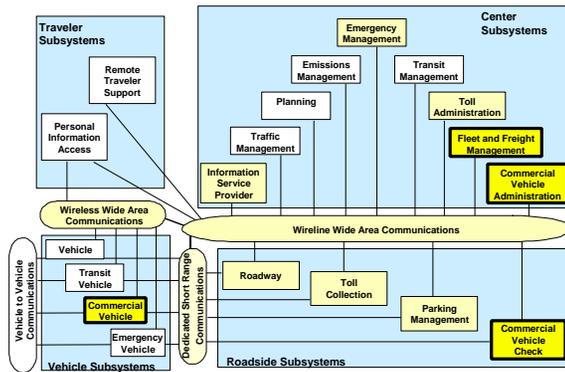
## Reference Manual

### MODULE 3 - ARCHITECTURE & DESIGN



US Dept of Transportation

# 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.

# ITS/CVO 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.

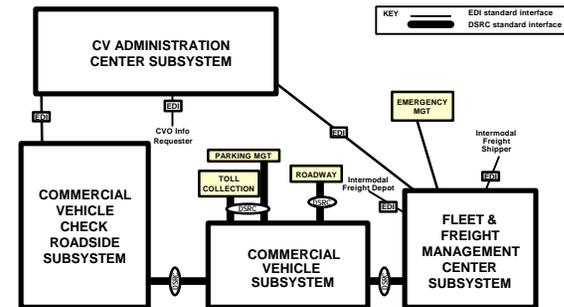
The diagram shows two **interface types critical to the CVO** portion of ITS: DSRC (Dedicated Short Range Communications) and EDI (Electronic Data Interchange).

**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. EDI 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.**



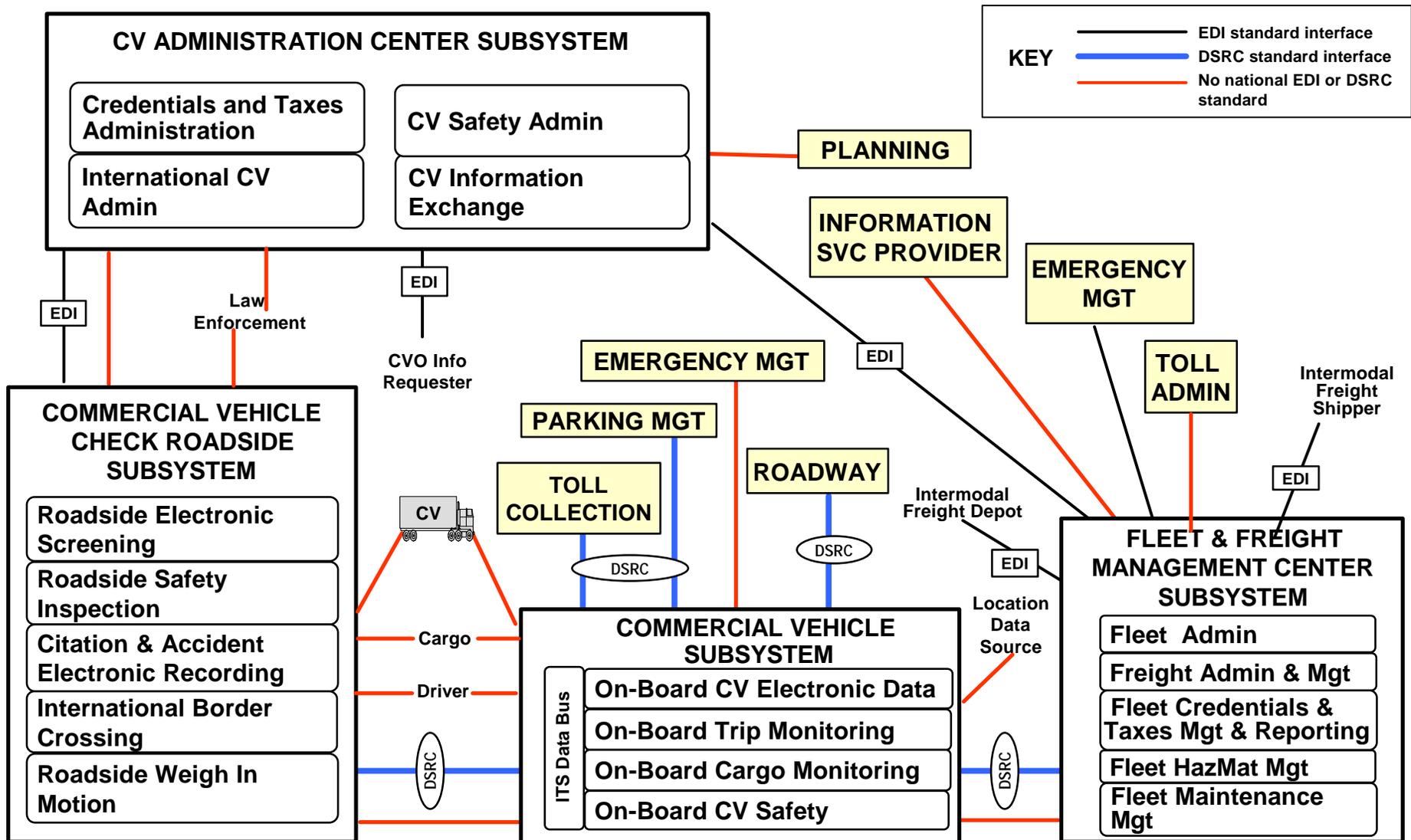
The **Commercial Vehicle Administration Center Subsystem** will operate at one or more fixed locations within a region. This subsystem performs administrative functions supporting credentials, tax, and safety regulations. The subsystem coordinates with other Commercial Vehicle Administration Subsystems (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.

# The ITS/CVO architecture comprises the CVO-unique elements of the National ITS Architecture



# CVO Functions Are Allocated to Equipment Packages

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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 electronic screening at international borders 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:

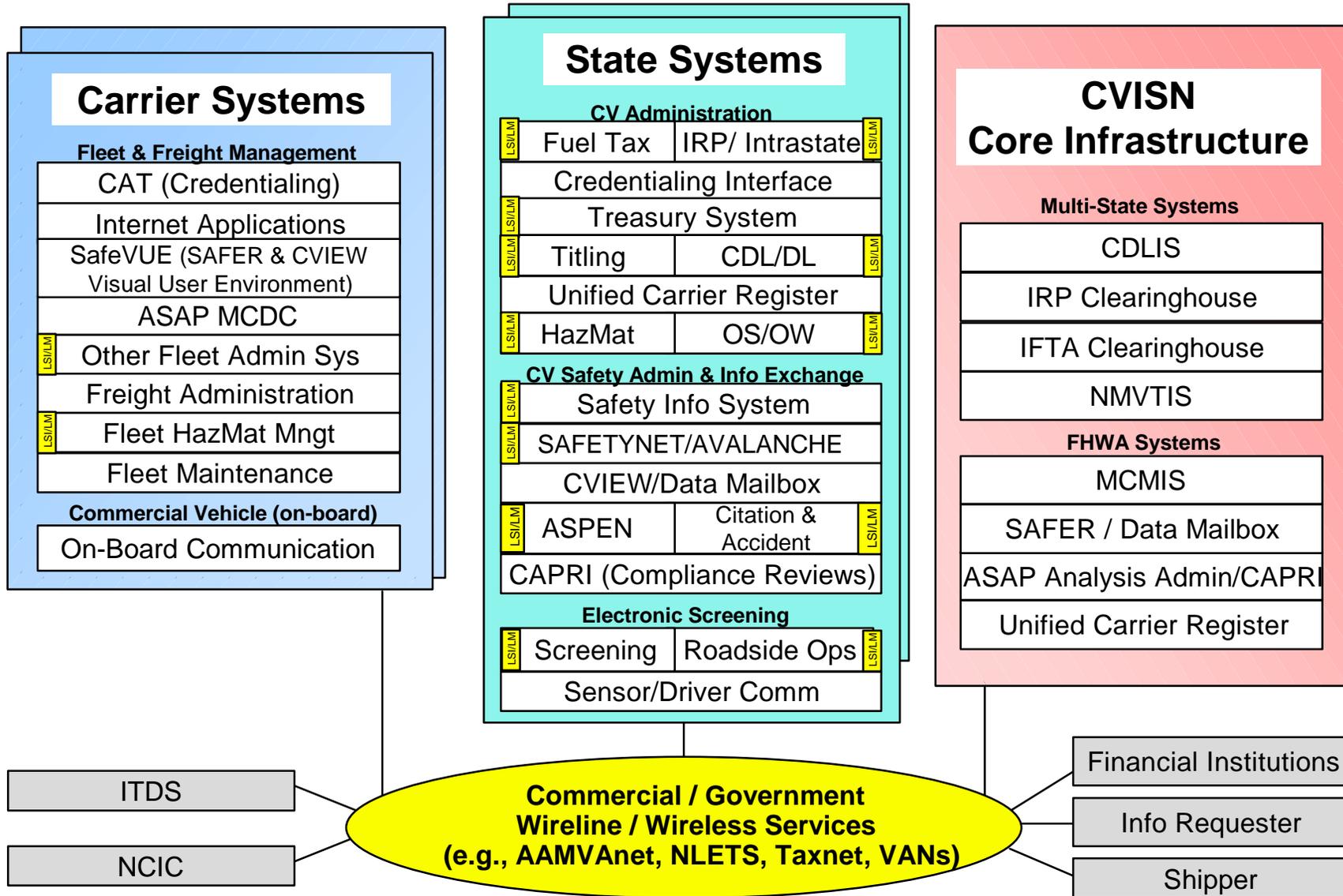
On-Board Commercial Vehicle Electronic Data, supporting the communication of IDs and other status and messages from/to the vehicle and driver through DSRC and wireless communications

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.

# CVISN Systems - Stakeholder View



## Introduction

The previous page illustrates how many systems operated by different stakeholders can be viewed as part of one large whole - CVISN.

Under Carrier Systems, the first grouping (CAT through Fleet Maintenance) are systems for fleet & freight management. The second grouping (On Board Communication through On-Board Cargo Monitoring) are commercial vehicle (on-board) systems.

The three groupings of state systems are commercial vehicle administration, commercial vehicle safety administration and information exchange, and commercial vehicle roadside check.

The two groupings of the CVISN Core Infrastructure systems are multi-state and FHWA systems.

### Carrier Systems

**CAT** = Carrier Automated Transactions.

Apply for and receive responses about credentials; file fuel tax returns.

**Internet applications.** Via Internet browser, access governmental or private web sites to apply for credentials and perform other CV-related functions.

**SafeVUE** = SAFER & CVIEW Visual User Environment. Check on own snapshot records.

**ASAP MCDC** = Automated Safety Assessment Program Motor Carrier Data Collection. Report compliance information.

**Other Carrier Systems, Freight Administration, Fleet Hazardous Materials Management, Fleet Maintenance.** Other elements of fleet and freight management.

**On-Board Communication** = Communicate via DSRC, voice, etc. Record trip events.

### State Systems

**Fuel Tax** = International Fuel Tax Agreement systems.

Register for fuel tax credential and process fuel tax returns.

**IRP/Intrastate** = International Registration Plan and intrastate registration systems. Register commercial vehicles.

**Credentialing Interface.** Single interface for carrier interactions related to credentialing; handles EDI.

**Treasury System.** Process electronic payments.

**Titling = Title new and used vehicles**

**CDL/CL** = Commercial Driver's License/ Driver's License.

**Unified Carrier Register.** State component of carrier registration system.

**HazMat** = Hazardous Material. Register to carry HazMat and issue HazMat permits.

**OS/OW.** Issue Oversize/Overweight permits.

**Safety Info System.** Collect and analyze safety performance data.

**SAFETYNET/AVALANCHE.** Collect safety inspections and report to FHWA.

**CVIEW/Data Mailbox** = Commercial Vehicle Information Exchange Window/Data Mailbox. Collect snapshot segments for interstate and intrastate carriers, vehicles, and drivers. Interface with SAFER for interstate snapshot exchange. Provide snapshots to other state systems.

**ASPEN.** Support safety inspections.

**Citation & Accident.** Record citation and accident data.

**CAPRI.** Support compliance reviews.

### State Systems (continued)

**Screening.** Make pass/pull-in decision.

**Roadside Ops** = Roadside Operations. Process snapshots and control site traffic.

**Sensor/Driver Comm** = Sensor/Driver Communications. Process vehicle measures and communicate via DSRC with driver.

### CVISN Core Infrastructure Systems

**CDLIS** = Commercial Vehicle Driver Information System. Pointer to past performance records for commercial drivers.

**IRP Clearinghouse** = International Registration Plan Clearinghouse.

**IFTA Clearinghouse** = International Fuel Tax Agreement. Administration of base state agreements

**NMVTIS** = National Motor Vehicle Titling Information System. Pointer to title information for all vehicles.

**MCMIS** = Motor Carrier Management Information System. Store inspection data.

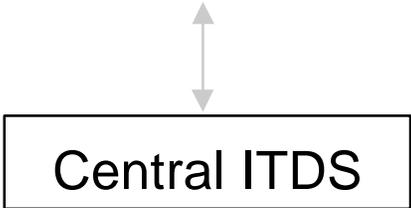
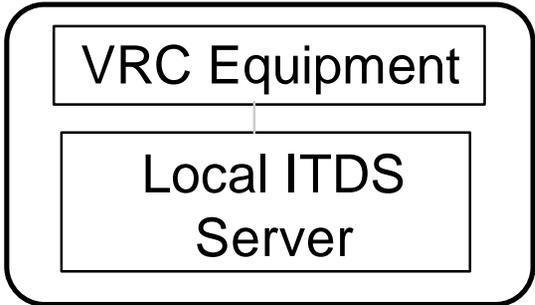
**SAFER/Data Mailbox** = Safety and Fitness Electronic Record/Data Mailbox. Collect snapshots for interstate carriers, vehicles, and drivers. Provide snapshots to user systems.

**ASAP Analysis Admin/CAPRI** = Automated Safety Assessment Program Analysis Administration/CAPRI. FHWA component of systems that support compliance reviews.

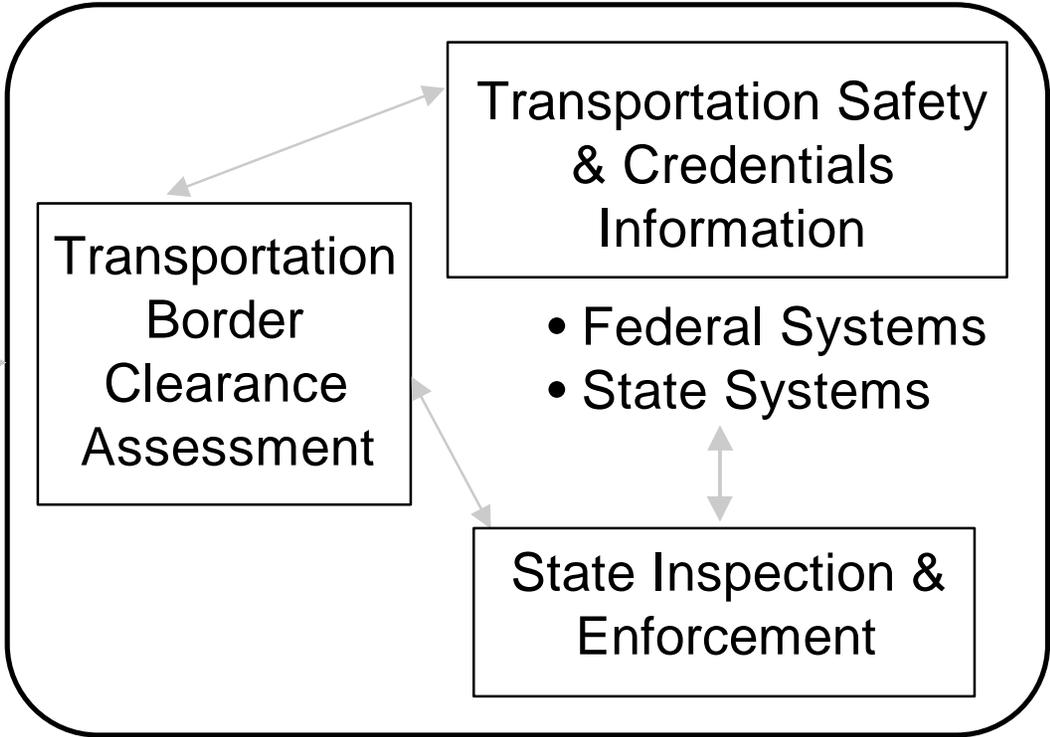
**Unified Carrier Register** = National component of carrier registration.

# IBC Architecture

## Commercial Vehicle Check Subsystem



## Commercial Vehicle Administration Subsystem



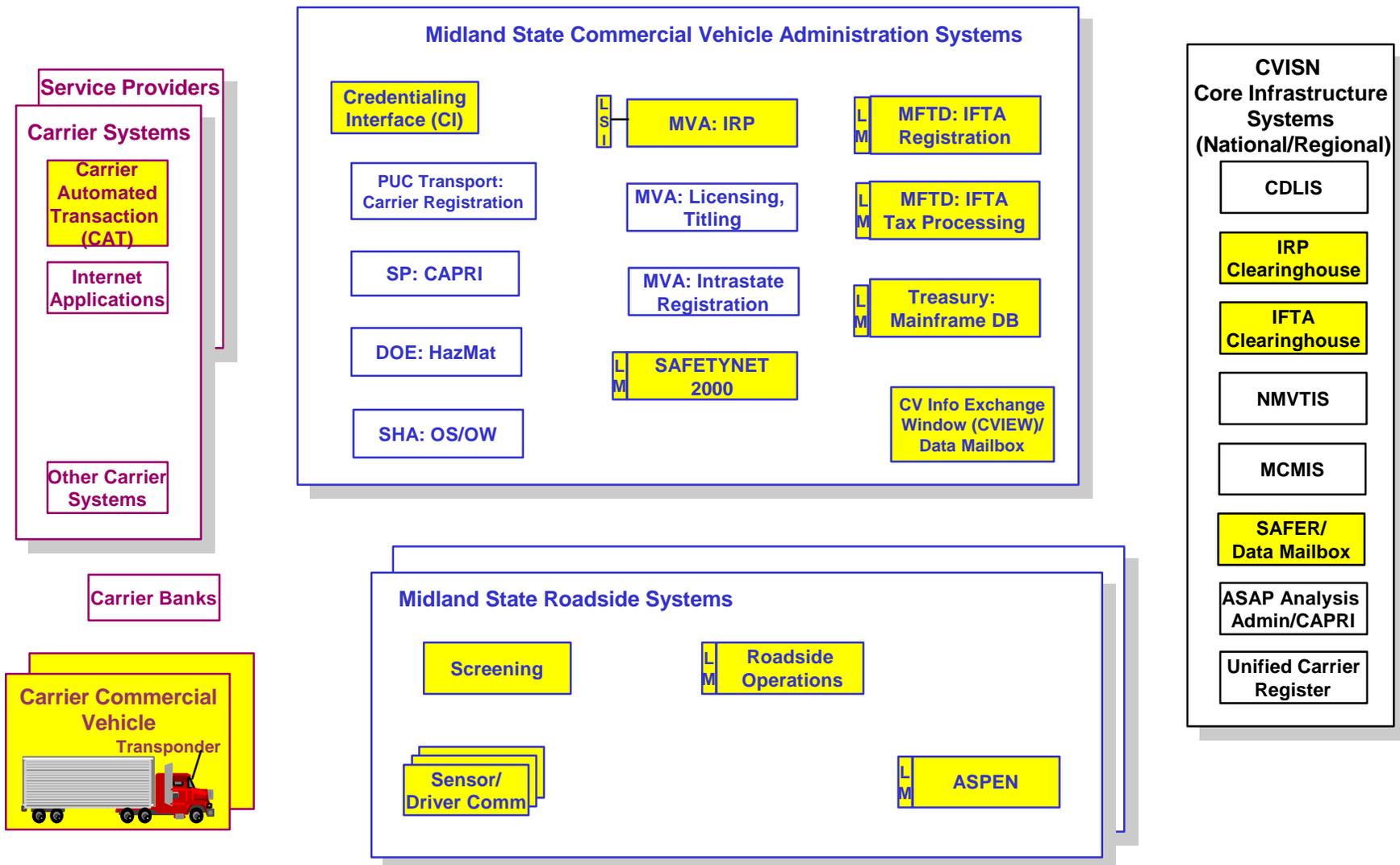
Based on a drawing from Booz-Allen & Hamilton, architects for IBC

# Summary of Key CVISN Architectural Features

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- 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 provides **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 screening, toll, traffic, fleet applications, and border crossing processes throughout North America
- Encryption & password technology ensure **data privacy**
- Architecture supports **customized & evolving capabilities**

# Proposed Midland Design Template



# ITS/CVO and CVISN

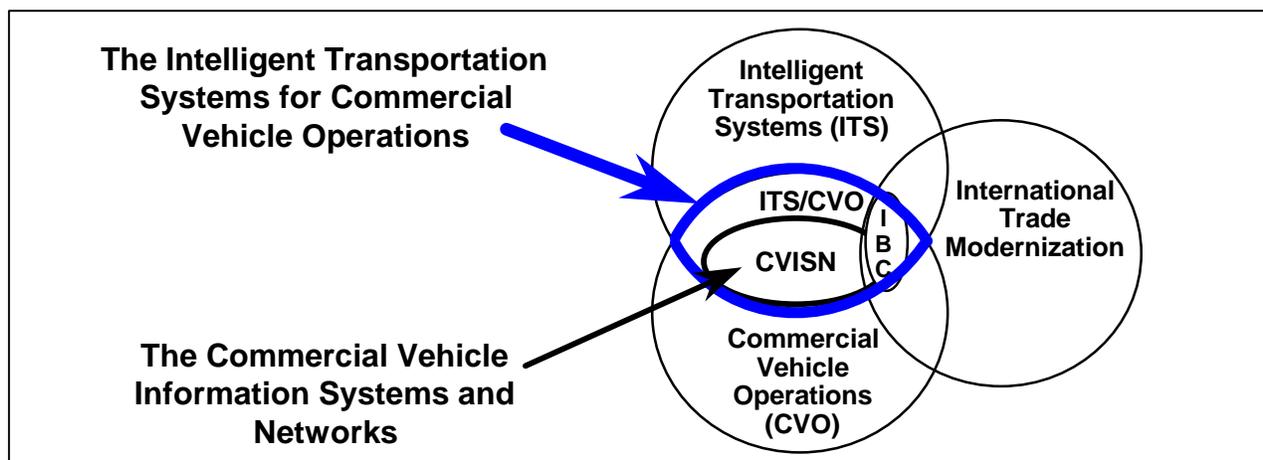
**ITS ( Intelligent Transportation Systems)** - Electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.

**CVO (Commercial Vehicle Operations)** - The motor carrier operations and motor vehicle regulatory activities associated with the commercial movement of goods, including hazardous materials, and passengers. With respect to the public sector, includes the issuance of operating credentials, the administration of motor vehicle and fuel taxes, and roadside safety and border crossing inspection and regulatory compliance operations.

**ITS/CVO** - The ITS elements that support commercial vehicle operations. These include information systems, networks, sensor systems such as weigh in motion, technologies such as brake testing equipment, border crossing systems, and the components of the intelligent commercial vehicle. The ITS National Program Plan defines these Commercial Vehicle Operations UserServices: Commercial Vehicle Electronic Clearance, Automated Roadside Safety Inspection, On-Board Safety Monitoring, Commercial Vehicle Administrative Processes, Hazardous Materials Incident Response, Freight Mobility.

**CVISN (Commercial Vehicle Information Systems and Networks)** - The information systems and communications networks that support commercial vehicle operations. CVISN includes information systems owned and operated by governments, carriers, and other stakeholders. It excludes the sensor and control elements of ITS/CVO.

**IBC (International Border Clearance)** - The clearance of commercial carriers and vehicles at US borders with Canada and Mexico using transponders, the information exchange infrastructure, and roadside sensors.



**Architecture** -The overall structure (elements & interfaces) and unifying design characteristics (principles, concepts, & standards) of a system.

**National ITS Architecture** - The functions associated with ITS user services; the physical entities or subsystems within which the functions reside; the data interfaces and information flows between physical subsystems; and the communications requirements associated with the information flows.

**CVISN Architecture** - The ITS/CVO information systems and networks 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., operational concepts and the Electronic Data Interchange (EDI) message requirements) to facilitate further development.

**IBC Architecture** - The commercial vehicle border crossing portion of the National ITS Architecture. The structure and unifying design characteristics of an IBC Architecture will permit electronic clearance of commercial motor vehicles at North American land border crossings. This architecture addresses both transportation and non-transportation stakeholders in the IBC community.

# ITS/CVO and CVISN

ITS/CVO and CVISN are often used as adjectives to describe on-going projects associated with deploying ITS/CVO and the CVISN components. For example,

**ITS/CVO Program.** A voluntary effort involving public and private partnerships focused on improving highway safety and motor carrier productivity through the use of technology. The Federal Highway Administration (FHWA) is the lead Federal agency for the program, and the ITS/CVO Division is directly responsible for oversight of the program. The role of the ITS/CVO Program is to foster the development and implementation of technology designed to assist trucks and buses in moving safely and freely throughout North America. The program includes many parts including the CVISN program, the IBC project, ITS/CVO mainstreaming and outreach, ITS/CVO training, and various operational tests and technical support. There are also commercial vehicle elements of the Intelligent Vehicle Initiative.

**The CVISN Program consists of the:**

- CVISN Architecture & Standards Project
- CVISN Model Deployment Project (Prototype & Pilot)
- DSRC Demonstration Project

**CVISN Architecture and Standards Project.** Developed the CVISN operational concepts and CVISN Architecture and refined them through the design stage. Developing EDI interface standards through the standards development organization (SDO) to promote information exchange through common open interfaces. Continues to feed back lessons learned from model deployment and standards efforts into the architecture/design. Developing interoperability tests.

**CVISN Model Deployment Project (Prototype & Pilot).** **CVISN Prototype,** started demonstrating CVISN in MD and

VA in 1996 to verify the operational concepts, architecture, design, standards, deployment methodology, and interoperability tests.

**CVISN Pilot,** started the model deployment of CVISN in CA, CO, CT, KY, MI, MN, OR, WA in 1996 to put CVISN operational concepts, designs, standards, methods, and interoperability testing into practice.

The CVISN Prototype & Pilot states are deploying **CVISN Level 1 capabilities:** safety information exchange through snapshots, inspection reporting using ASPEN, electronic screening using transponders and snapshot data, electronic credentialing for IRP and IFTA, and supporting base state agreements via the IRP and IFTA Clearinghouses.

**CVISN was originally defined to be a very broad term covering all ITS/CVO information systems and networks. In common usage, many people use “CVISN” to refer to only the parts of CVISN being developed as part of the CVISN prototype and pilot projects.**

**DSRC Demonstration Project.** Assisting SDOs in developing dedicated short range communications (DSRC) message set standards. Assisting FHWA in refining a migration plan by demonstrating simultaneous deployment of existing messages and standard messages, identifying technological and institutional barriers, and gaining “real world” experience in deploying ITS concepts. Seed deployment by prototyping related infrastructure software and conducting interoperability tests.

