ELECTRONIC SCREENING

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Abstract: *The article deals with the electronic screening of the commercial vehicles, which can be done using mainline screening and ramp screening. Mainline screening allows vehicles to be cleared without pulling into the station and has the advantages of a reduced traffic volume entering the station facility and of a minimized delay for safe and legal vehicles, but also has the disadvantage that the in-road equipment repairs on the mainline can be very costly and disruptive. Ramp screening is performed at lower speeds within the confines of the station and approach ramp. The purpose of the e-screening is to ensure a safe and optimal traffic.*

Keywords*: e-screening, CVISN, PrePass, NorPass.*

1. INTRODUCTION

Commercial Vehicle Information Systems and Networks (CVISN) is the collection of state, federal, and private sector information systems and communications networks that support commercial vehicle operations. Electronic screening is one of the three key program areas in CVISN Level 1.

WHAT IS ELECTRONIC SCREENING?

Screening is a selection mechanism to target high-risk operators and make efficient use of weigh station and inspection resources. **Electronic screening (e-screening)** is the application of technology to make more informed screening decisions. Properly implemented, electronic screening results in improved traffic flow, focuses vehicle inspections and ultimately achieves the goals of increased safety and reduced operating costs. In electronic screening:

• DSRC is used to identify the vehicle, store and transfer other screening data, and signal the driver of the pull-in decision.
• Electronic Data Interchange (EDI) may be used to transmit safety and credentials history (snapshot) data from the information infrastructure to the roadside systems to assist in the screening decision.

The application of electronic screening will be affected by many constraints, including site limitations, availability of support staff, and funding. Each roadside check station is likely to have a unique design. Each station's design is unique because of:

• State policy and practices
• Traffic flow, volume, and number of lanes
• Available site space
• Legacy system characteristics
• Existing proprietary solutions
• Vintage of roadside facilities and communications equipment
• Resources available for making changes.

2. Technologies

There are a variety of technologies that can be applied to electronic screening in support of the commercial vehicle weigh and inspection process. There are also a number of ways in which these technologies can be applied. The purpose of this section is to briefly describe some of the basic technologies used in electronic screening.

2.1 Dedicated Short Range Communications (DSRC)

DSRC is used to provide data communications between a moving vehicle and the roadside equipment to support the screening process. This is accomplished by means of a transponder (also known as a "tag") mounted in the cab of the vehicle, and a reader and antenna mounted at the roadside. The tag may contain identifiers specific to the vehicle (carrier and vehicle IDs), plus optional prior screening event information. The transponder has audio and visual indicators that may be used to signal the driver. The term **Automated Vehicle Identification (AVI)** is often used when referring to DSRC systems. Strictly speaking, AVI is any technology, including DSRC, used to identify vehicles. This category also includes optical, audio, and other Radio Frequency (RF) identification systems.

2.2 Weigh In Motion (WIM)

WIM is used to measure approximate axle weights as a vehicle moves across the sensors, and to determine the gross vehicle weight and classification based on the axle weights and spacings. Although not as accurate as a static scale, WIM allows the weight of a vehicle to be estimated for screening purposes while maintaining traffic flow.

2.3 Automatic Vehicle Classification (AVC)

Axle detectors are used to classify the various vehicle types. This information is necessary at WIM-equipped sites because vehicle classification plays a role in the determination of legal weight. AVC units are also used in compliance subsystems to detect vehicles bypassing the station.

2.4 Vehicle Tracking Loops

Inductance loops may be used to track vehicle positions as they proceed through the site. This information is required to synchronize lane signaling with the correct vehicles and to verify compliance with these signals.

2.5 Automatic Signing

Lane signals and variable message signs should be automatically controlled by roadside operations and coordinated with the detected location of the vehicle. Precise timing and control of these signals is required in order to ensure that unambiguous direction is given to the intended vehicle. Misdirection, confusion and ambiguity may result if signals intended for one vehicle are visible to and misread by another.

3. Data Exchange

A critical component of the CVISN architecture is the standardization of two interfaces: computer-to-computer exchanges using EDI and vehicle-to-roadside exchanges via DSRC. The EDI interfaces are primarily used to transfer information between public agencies (e.g., state government to state government) or between a public agency and private sector entity (e.g., state

government to motor carrier). The computer-to-computer interfaces may evolve from the use of EDI to the use of XML and other Web-based protocols.

Another component to standardization of data exchange between state and/or public systems is the use of common data "snapshots." Snapshots contain information that provide a quick picture of carrier/vehicle/driver safety performance history and basic credentials information. Carrier and vehicle snapshots exchange safety and credentials data between state and national systems. The snapshots are used in conjunction with DSRC messages to support roadside operations as shown in Figure 1.

Figure 1 shows the data flow among the various systems supporting electronic screening.

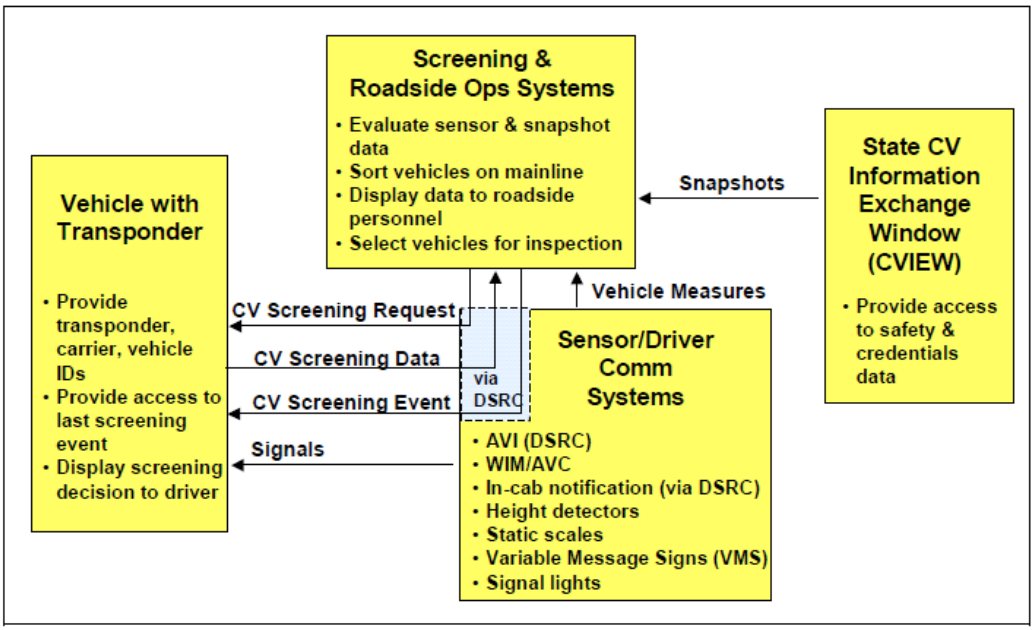

Figure 1. Roadside Systems Use Technology to Support Electronic Screening and Inspections

WHAT ALREADY EXISTS?

A large body of knowledge and experience already exists for deploying electronic screening systems and technologies. Member states of two major multi-state electronic screening programs, Heavy Vehicle Electronic License Plate (HELP) PrePass™ and North American Preclearance and Safety System (NorPass), have deployed a number of sites that are currently in operation. The CVISN pilot and prototype states have completed or are in the process of developing electronic systems that meet CVISN Level 1 requirements. Software products and design documents, developed for CVISN with FMCSA funds, are available in the public domain. These products include the Roadside Operations Computer (ROC), Perryville Screening Computer, and the Commercial Vehicle Information Exchange Window (CVIEW) systems.

4. Programs

Heavy Vehicle Electronic License Plate (HELP) PrePass™ is the largest North American electronic screening program with operational sites in Alabama, Arizona, Arkansas, California, Colorado, Florida, Illinois, Indiana, Iowa, Louisiana, Mississippi, Montana, Nebraska, Nevada, New Mexico, Ohio, Oklahoma, Tennessee, West Virginia, and Wyoming. The PrePass™ Service Center manages pre- and post-enrollment verification checks of carriers and provides transponders for

vehicles. At the roadside station, transponder-equipped vehicles are checked against a pre-clearance list and weighed using WIM equipment.

North American Preclearance and Safety System (NorPass) was created in the merger of Advantage CVO and Multi-jurisdictional Automated Preclearance System (MAPS). States that have signed the NorPass agreement include: Kentucky, Georgia, Idaho, Utah, and Washington. Information based on safety and credential records is passed to the roadside stations via an enrolled vehicle list. Weight enforcement may be conducted using WIM or weight compliance history.
Kentucky (KY) and Washington (WA), two CVISN pilot states that are also NorPass members, are nearing completion of electronic screening sites that should meet the roadside CVISN Level 1 requirements.

Greenlight – Oregon has implemented an e-screening program called Greenlight and has 21 Greenlight sites. Oregon provides its own transponder administration. Carriers are free to use the Oregon transponder in any or all other systems they choose. Oregon currently uses the carrier safety fitness rating and SafeStat score for its safety bypass criteria. Oregon Greenlight sites can only read the transponder ID code. If you are enrolled in Greenlight, the transponder ID will be associated with a license plate.

Maryland (CVISN prototype state) has implemented electronic screening, based on the CVISN architecture, at the Perryville, MD, inspection station. By successfully conducting several of the CVISN interoperability tests, Maryland became the first state to meet the roadside CVISN Level 1 requirements.

5. Operational concepts and scenarios

The term "operational concept" generally means "how a system is used in various operational scenarios." "System" is used here in a broad sense to include people and manual processes as well as automated information, sensors, and control systems. New operational concepts are adopted in order to solve a problem in the current operations or to take advantage of new knowledge or technology that enables improvements in current operations.

CVISN electronic screening operational concepts include necessary steps toward achieving the goal of national interoperability among electronic screening systems. Realizing this goal will promote seamless and safer movements, equitable treatment, increased productivity, and uniform enforcement for the motor carrier community.

5.1. Operational Scenario

The e-screening system deployed at Perryville, Maryland, is described in this section along with the associated operational scenario. This site is unique because it includes both mainline and ramp screening systems. Due to cost, most electronic screening systems are either mainline-only or ramp-only. Maryland has elected this dual-capability configuration in order to compare the relative performance of the two methods.
The listed scenario describes the combined operation of the two subsystems and function of the various components. The operational scenario for a ramp-only or mainline system can easily be derived from the information presented.

5.1.1 Site Layout

Figure 2 illustrates the site layout for the e-screening system being deployed at Perryville, MD. All major roadside equipment components are shown in the figure. The key features of this layout are:

• Mainline Piezo WIM/AVC in the right-hand southbound lane on I-95, approximately one mile upstream of the station
• Over-height (OH) detector collocated with mainline WIM
• DSRC reader (Advance) collocated with mainline WIM
• DSRC reader (Notification) located approximately ¼ mile upstream of the ramp approach. The location of the notification reader must allow sufficient time for the vehicle operator to receive the bypass/pull-in signal via DSRC and safely remain on I-95 or pull onto the station ramp
• AVCs across all three south-bound lanes of I-95, downstream of the station ramp
• DSRC reader (Compliance) collocated with AVCs. The compliance readers shall cover only the right-hand lanes on I-95. Trucks will be restricted to these lanes when bypassing the station
• Load-cell WIM in ramp lane
• DSRC reader (Ramp) on ramp, upstream of WIM
• Over-height detector installed near ramp reader
• Overhead signs directing traffic back to I-95 or onto the static scale
• DSRC reader (Static Scale) collocated with the station static scale
• Tracking loops installed as necessary.

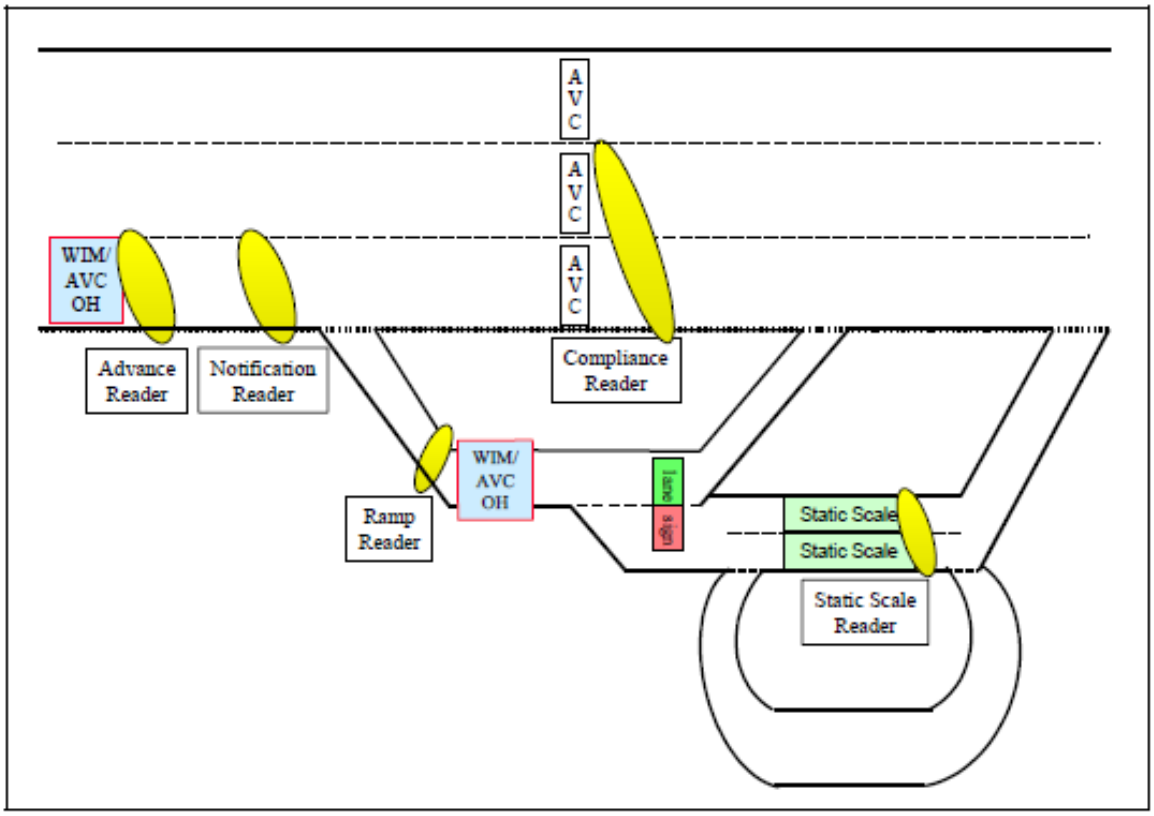

Figure 2. Perryville, Maryland, Site Layout

5.1.2 E-Screening Operational Scenario

In the site layout shown in Figure 2, there are five DSRC readers along with both ramp and mainline WIM. The five DSRC readers shown in this configuration are: advance reader, notification reader, compliance reader, ramp reader and static-scale reader. The advance reader's function is to read the screening message, including the carrier and vehicle identifiers, and to send this information to the screening computer for use in determining whether to clear the vehicle without pulling into the station. The reader is located far enough ahead of the notification reader that the mainline screening subsystem has time to complete all necessary processing as the vehicle approaches. The advantages of screening on the mainline are to control traffic volume entering the

station facility and to minimize the delay for safe and legal vehicles. The mainline WIM/AVC provide vehicle weight estimates as input to the mainline screening decision. Gross vehicle weight along with axle weights and spacing are available. Although not as accurate as either a static scale or ramp WIM, the weight estimates are sufficient to clear a significant portion of the vehicle traffic.

At the notification reader, a signal is transmitted to the vehicle to convey the screening decision status to the driver. Since a DSRC-equipped vehicle could be signaled to pull in, the notification reader must be deployed far enough from the roadside check facility for the vehicle's driver to be able to react without endangering other vehicles on the roadway. Reaction time budgets should account for slowing and turning off the mainline, as well as crossing lanes of traffic.

By the time the vehicle has passed the advance and notification readers, it has been electronically cleared. However, it is also necessary to verify that vehicles are not illegally bypassing a check station. Therefore, a compliance reader and an AVC system are located on the mainline, past the entrance ramp to the station. The AVC identifies un-tagged commercial vehicles that have illegally passed the station. The reader checks tagged vehicles to verify that the vehicle was cleared to bypass the station. If a violation is detected, an indication is given to enforcement personnel.

Vehicles entering the check facility ramp would fall into one of the following categories:

• DSRC-equipped, valid legal weight – the vehicle has been identified via DSRC, a valid weight has been recorded, and an active screening decision has been made to stop the vehicle for some type of closer review. This may be based on specifically identified problems or may be due to random selection. Closer review may be limited to a visual check while on the static scale, or may include an inspection based on the visual review, on data reported back in the screening process, or on random selection.

• DSRC-equipped, invalid or over-weight – the vehicle has been identified via DSRC; however, either the WIM failed to properly register the weight or the detected weight exceeded the criteria.

• DSRC-equipped, unrecognized – the vehicle is equipped with a transponder; however, the tag may either be incompatible with or not valid for use at the site.

• No DSRC.

Upon entering the facility ramp, vehicles will be processed by the ramp WIM. The DSRC ramp reader will interrogate the vehicle tag to retrieve the relevant identification data. A screening decision will be made and the vehicle will be subsequently directed by visual lane signals. Cleared vehicles will be signaled to return to the mainline. Vehicles receiving a pull-in decision on the ramp will be directed to the static scale. The static-scale reader is used to identify transponder-equipped vehicles that are on the scale. Snapshot-based safety and credential data for the vehicle will be available to the static scale operator.

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