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FINAL

WSDOT Intermodal Data Linkages
ITS Field Operational Test Evaluation Plan

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NOTICE

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1.0 Introduction

In mid-1999, the U.S. Department of Transportation (USDOT) awarded funding for an Intermodal ITS Field Operational Test (FOT) to a regional consortium led by the Washington State DOT (WSDOT). The primary focus of this "WSDOT Intermodal FOT" is to demonstrate the use of electronic container seals on containers (combined with automatic vehicle identification (AVI) transponders attached to the truck) to track movements and monitor the security of containerized freight. This technology can potentially provide the information necessary for U.S. Customs, and other federal agencies and state governments, to automate the clearance and credentialing of commercial vehicles through ports and terminals, across international borders, and through weigh stations. Additionally, these technologies can potentially lead to substantial increases in the efficiencies involved in the movement of goods by the intermodal freight industry.

In addition, the WSDOT Intermodal FOT will also provide for the demonstration of two other intermodal ITS technologies. First, Internet-based video of access roads to port gates will be provided, via integration with the existing Seattle Smart Trek traveler information system, to provide truck drivers/dispatchers with real-time information on traffic congestion, specifically around the Port of Seattle. A changeable message sign system will also be tested for access to the Port of Tacoma (Congestion Notification System). Secondly, in support of the USDOT's desire to leverage ITS research to support metropolitan planning organizations (MPOs), this FOT will demonstrate the potential use of trucks/containers equipped with electronic seals, transponders, and wireless global positioning system (GPS) devices, to both augment and reduce the resources associated with transportation data collection on regional freight movements.

In support of the USDOT's intermodal ITS program, an evaluation team lead by SAIC, under the direction of the USDOT Joint Program Office (JPO), was selected in January 2000 to develop and implement an evaluation of the WSDOT Intermodal FOT. The ultimate goal of this evaluation, as defined by the JPO, is to identify "lessons learned" with respect to implementing intermodal ITS technologies for four study areas: system operational processes, technology applications, institutional agreements, and user acceptance. These "lessons learned" will provide guidance to other states, regions and MPOs that are contemplating implementing similar technologies, and will also provide guidance to the USDOT on the need and market for an intermodal information systems architecture and standards.

The Evaluation Plan presented here has been developed to serve as a planning and guidance document from which a successful evaluation effort can be implemented. The Evaluation Plan is typically the first major step in the evaluation life cycle.[1] This document will be followed by the development of Detailed Evaluation Test Plans, which will provide more detailed guidance on the conduct of the specific four evaluation study areas mentioned above.

[1] There is sometimes also a preceding step in the evaluation life cycle with the creation of an Evaluation Strategy document. The Evaluation Strategy document is at a higher level than the Evaluation Plan, and is considered preliminary to the evaluation. In this case, the SAIC Team proposal to the USDOT-JPO in December 1999 contained the Evaluation Strategy for this FOT.

2.0 WSDOT Intermodal FOT Project Descriptions

2.1 Test #1: Tracking Containers with Disposable Electronic Seals

Introduction

In the intermodal freight world, container tags are often discussed as a potentially valuable tool for monitoring and tracking containers. However, beyond several trials (such as an American President Lines test out of Seattle in the mid-1990s), and closed domestic systems (such as that of Matson Lines), container tagging has not occurred. One reason is that the number of containers in circulation (over 15 million) makes system-wide tagging costly. This test will circumvent this limitation because intermodal freight carriers can track containers using inexpensive disposable electronic door seals (in combination with AVI transponders on the vehicles), instead of having to mount more expensive and complex tags on containers.

The ability to track containers with electronic seals has potential benefits to intermodal freight carriers that include better accuracy, reduced paperwork, and improved port and Customs clearance. Because the electronic seal will hold more than a container ID, the shipper has the option to add information such as the destination and consignee's name. Such information on the container would also benefit intermodal service providers such as brokers because they would have better information about the container's progress along the freight movement chain. The information would also benefit customers because it can lead to faster cargo throughput and better tracking.

The ability to determine if the seal has been tampered with, plus the greater overall accuracy of an electronic transponder system, translates into enhanced enforcement benefits. If U.S. Customs is satisfied with the security of the seal, it may accept the use of the seal in the Customs process. The seal could also be an attractive adjunct to U.S. Customs' ongoing program to develop a system that tracks containers over the Washington border into Canada. Moreover, because shippers are responsible for the cargo, a future large-scale deployment of this seal could potentially provide shippers reduced insurance claims which, in turn, could lead to corresponding reductions in their insurance rates.

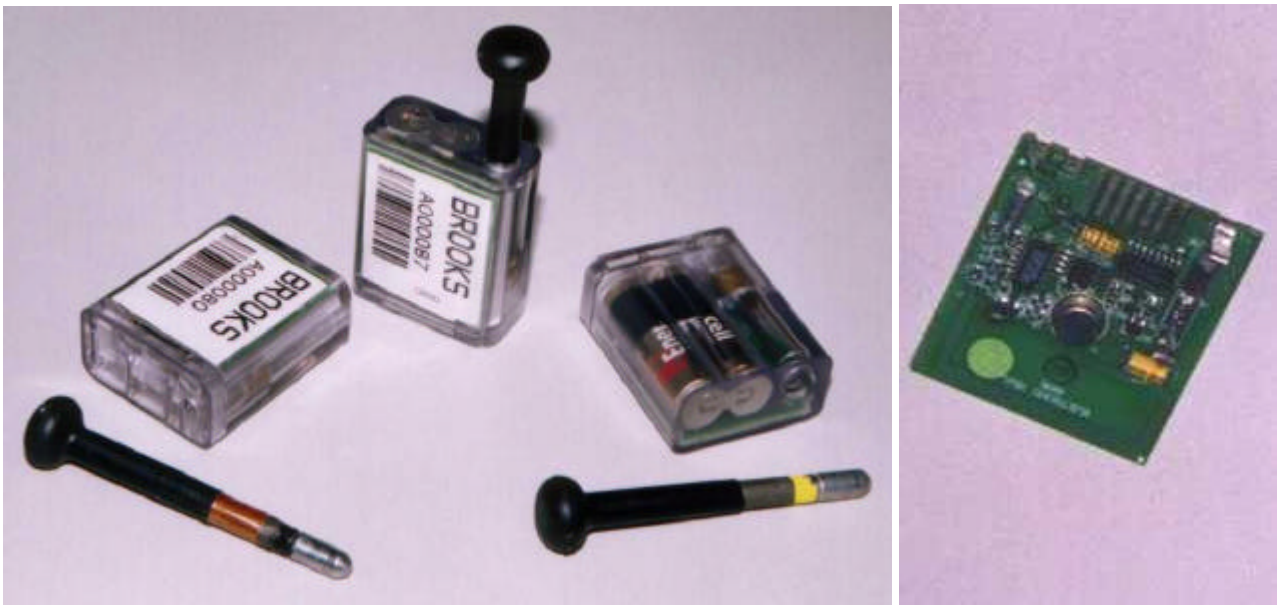
System Overview

This test includes the implementation of a new type of electronic disposable seal system which will be deployed at the Maersk-Sealand (formerly Sea-Land) marine terminal at the Port of Tacoma, and at the Blaine, Washington, international border crossing on I-5. This system will be integrated with a recently deployed AVI (Automated Vehicle Identification) truck transponder tracking system which has also been deployed at both of these locations, as well as at the Bow Hill truck weigh station on I-5 between Seattle and the Canadian Border. A second component of this test will be the use of AVI transponders at the Port of Seattle.

The additional hardware necessary to implement this test will include 5,000 electronic seals (e-seals), fixed station gate readers for two lanes, and some additional handheld readers. The fixed station gate readers will be installed at the U.S. approach to the Canadian Border at Blaine. Seals will be affixed in the foreign Port of Origin (an Asian port TBD) and will be read upon their departure to Canada at the Maersk-Sealand exit gate. U.S. Customs could also use handheld readers at the Port of Tacoma Maersk-Sealand marine terminal if affixing the e-seals in the Port of Origin proves problematic. Note here that it may also prove possible later in the test to place readers on

roads leading to a consignee facility which will give the consignee arrival warning and will permit a shipping dock or assembly lines to be prepared for the container.

Figure 2-1: Electronic Bolt Seal/Tag Hardware



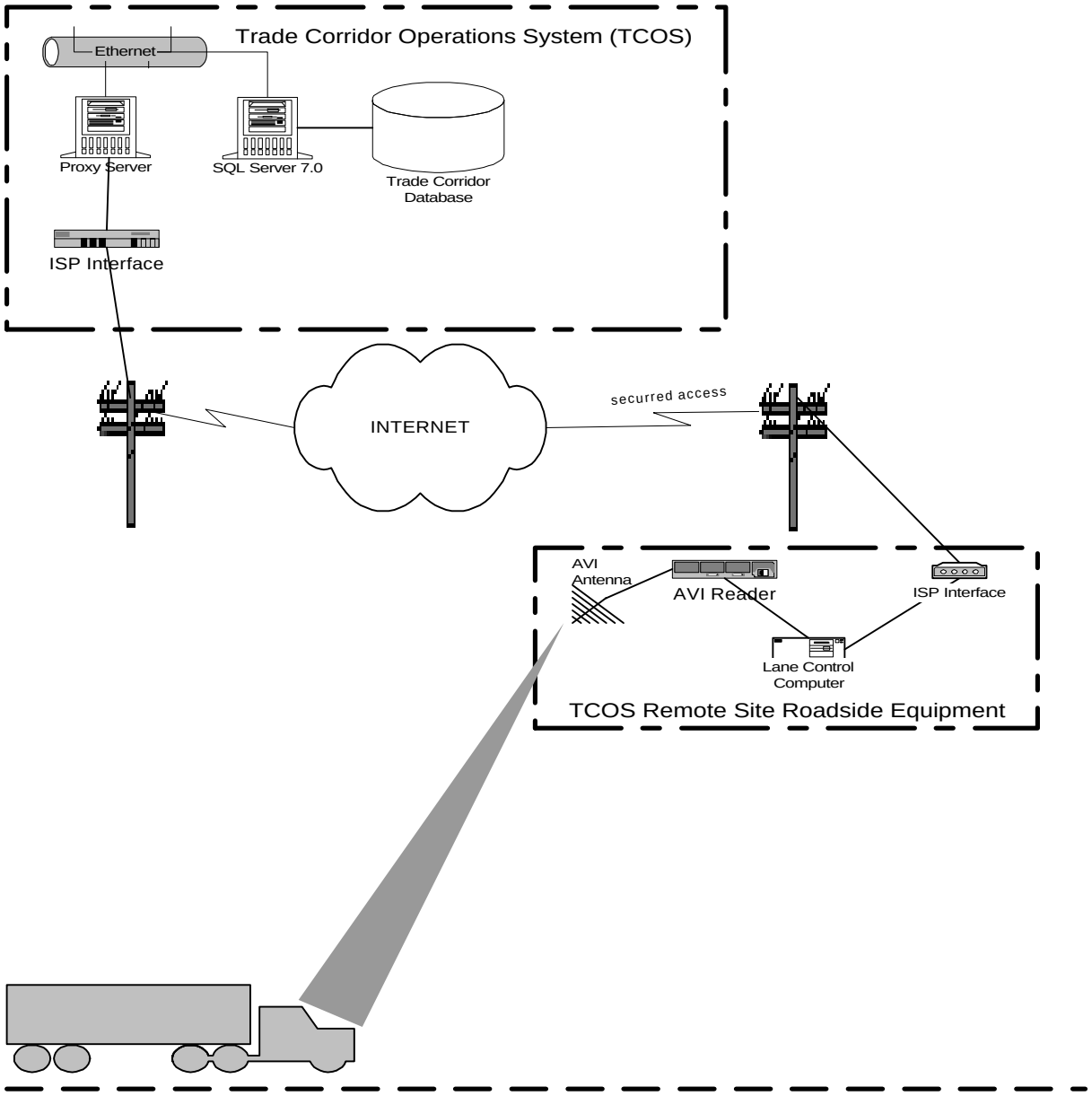
For trucks, the seal reader will be placed in conjunction with truck transponder readers installed at the port gates. The truck AVI transponders and readers are currently being installed by TransCore under several ongoing WSDOT commercial vehicle projects. An overview of TransCore's AVI system architecture is presented below in Figure 2-2. The E-seal readers and tags will be integrated into this system. If both the container seal and a truck tag were read, a container ID will be associated with a truck ID. Other truck tag readers at the Bow Hill weigh station and at the U.S. Customs Blaine border crossing facility will be able to monitor the truck's progress and, by association in the data base, the ID of the container.

As the truck and container passes through a Maersk-Sealand terminal gate, the following data can be recorded or verified and communicated over the Internet to the TransCore AVI System[2]:

- Container Seal Number
- Container Number
- Vehicle ID (Transponder Serial Number)
- Date & Time of Entrance Event
- Shipping Facility ID

[2] Note here that the design of the TransCore AVI system and TransCorridor web site also have provisions to allow for the following additional information to be provided by the AVI system in the future: Gate/Lane Number, In-Bond (yes or no), Container Weight, HAZMAT ID Code. The TransCore AVI system has been designed so that it can be interoperable with the Washington State CVISN prototype system being deployed at the Bow Hill weigh station.

Figure 2-2. TransCore Current AVI Transponder System Architecture [3]



More specifically, the container seal number data will be provided in a 10 byte ASCII file to the TransCore system and linked with the above data provided from both the now resident e-seal system data in the Maersk-Sealand terminal system data base, as well as the truck AVI transponder data already in the TransCore system.[4] This linking of information on the TransCore system will

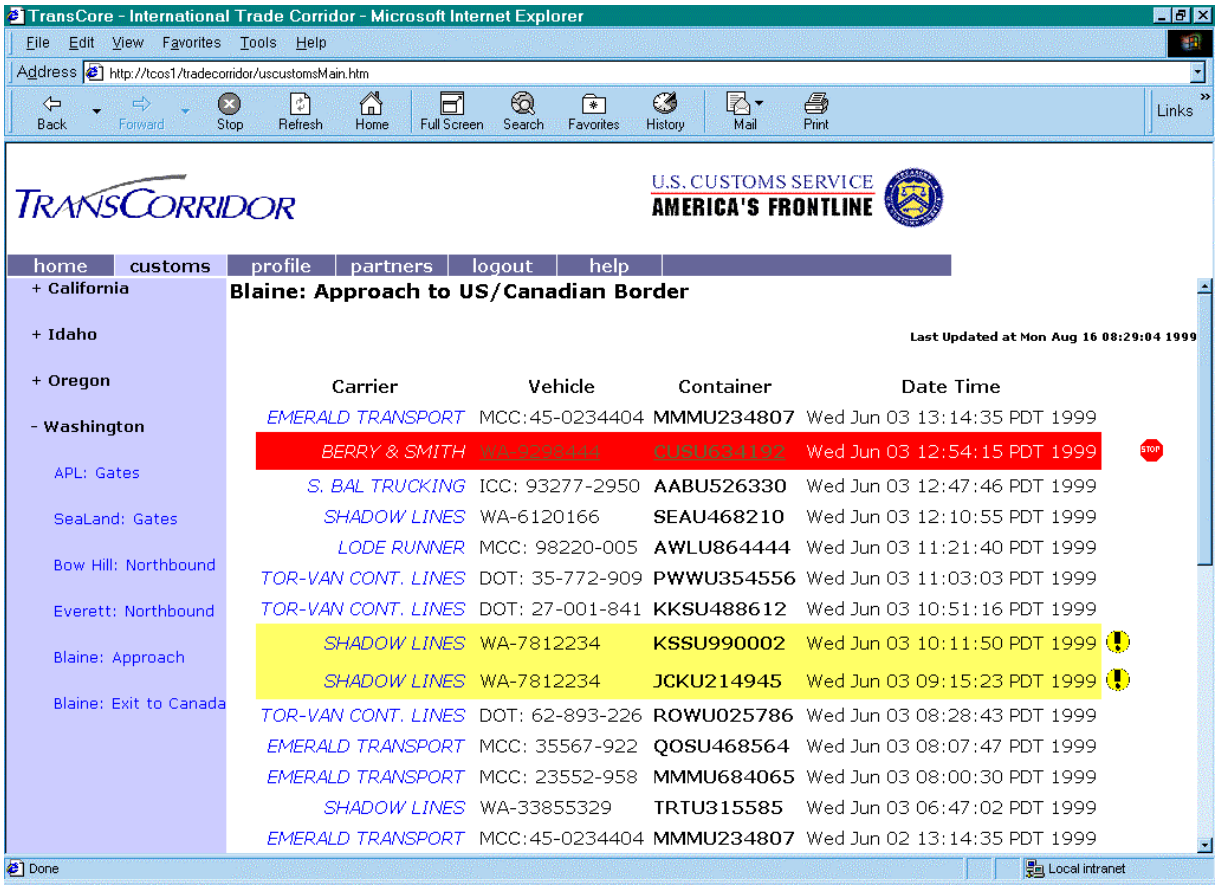
[3] Graphic courtesy of TransCore

[4] The AVI reader data would already be in the system via data entry at the shipper's site. For example, at APL in Seattle, the shipping information necessary for the AVI tag is captured by a legacy system, which then uses an interface to send an automated e-mail (which contains the required AVI data) to the TransCore system.

provide for unique identification tracing of the container to the shipper's facility (e.g. Maersk-Sealand), and the date/time of a specific event (e.g., terminal gate clearance). The event data can then be continually verified as the container and vehicle proceed through the Bow Hill weigh station and across the Canadian border.

The TransCore system provides for all tracking and data functions to be viewed and managed over the Internet. This is accomplished by the user (e.g. a shipping company) logging on to the "TransCorridor" Web site, and entering in a pre-approved user name and password. An overview of the "container tracking view" function of this web site is provided in Figure 2-3. Here, containers highlighted in red may have a problem, and will need to stopped by U.S. Customs at the border for inspection. Containers that are highlighted in yellow may have some special considerations, such as a truck hauling two or three containers with the same vehicle.

Figure 2-3. TransCorrdior Web Site (Container Tracking View: Customs – Border Crossing)



Participants and Users

The main participants in this test will be WSDOT, the Port of Tacoma, Maersk-Sealand, TransCore as the system integrator, the seal manufacturer (Electronic Seal Pte Ltd), and U.S. Customs. APL at the Port of Seattle also will participate, with only the TransCore AVI transponder system.

The main users of this system during this test phase will be Maersk-Sealand, U.S. Customs (and other enforcement agencies), and potential private industry participants (e.g., a trucking company and a freight forwarder) which will be determined later.

The seals will be integrated into the WSDOT and Customs'ongoing program to facilitate the export of in-bond containers over the Washington/British Columbia international border. U.S. Customs supports the tagging of all containers, and this test would be an important step in facilitating that process. Customs has also indicated that such a seal might be useful for monitoring the movement of containers from maritime terminals to Customs inspection facilities.

The initial operation and maintenance of the container seal hardware and software system will be supported by the grant applications funds. Because the test is expected to demonstrate a notable benefit to the steamship line, maritime shippers, and other users, WSDOT believes that these organizations will likely provide for the continued operation and maintenance of the system.

Schedule

The original schedule provided by WSDOT and TransCore forecasted that deployment of the e-seal system on top of the AVI transponder system would be completed by July 2000, and that tests involving the 5,000 available e-seals would then commence by late summer 2000, and would continue for an approximate period of six months (i.e., until the supply of e-seals were used up).

A number of factors have contributed to a delay in the deployment of the e-seal system to the Spring of 2001. Chief among these has been the failure of the original e-seal to meet the required specifications for a gate reader antenna to consistently read an e-seal mounted on a moving truck. However, this problem seems to have been overcome by TransCore and Electronic Seal Limited working together to successfully re-engineer the e-seal system. Production units of the re-engineered e-seal are now expected to be shipped in early Spring 2001, which should mark the beginning of the operational phase of this test.

2.2 Test #2: Providing Traveler Information to Reduce Congestion Leading to a Port's Gate

Introduction

A common theme in almost any discussion about freight movement in the Puget Sound region concerns problems caused by congestion on the roadway system leading to and from the port marine terminals. This test will addresses this issue in two ways. First, a Congestion Notification System will be developed and tested for access to the Port of Tacoma. Here, a beacon sign-based system will be installed along I-5 southbound that notifies truck drivers of congestion on access roads, providing the opportunity for the driver to take an alternate route. A camera will be used to monitor the access roads to the marine terminals; when a queue or heavy congestion occurs the beacon sign will be activated instructing drivers to use the next southbound exit off of I-5 for accessing the marine terminals.

Secondly, low cost, Internet-based video will be used to let truck dispatchers monitor access to the Port of Seattle. This will provide congestion information to truck dispatchers and truckers of specific terminal gate approaches at the Port of Seattle. The existing Smart Trek WSDOT traveler information web site will be augmented to provide the video snapshots of traffic conditions at these gates to the trucking firms that routinely use the gates. Use of strategic web links and other

information outreach activities by WSDOT and the FOT partners will make the local trucking industry aware of this service.

This test will most significantly benefit trucking firms. At the 1998 USDOT Intermodal Program "Listening Session" in Seattle, one trucking company president noted that only 30 percent of his drivers' time was spent actually driving, and he identified queues at port gates as a major source of delay.[5] If successful, this test would benefit truckers that move freight in and out of the ports.

System Description

Congestion Notification System: Port of Tacoma

It has bee postulated that truckers accessing the Port of Tacoma could benefit if they were provided with information about congestion on the approaches to the port. This is supported by the road system servicing the port – several alternative roads into the port are available, and thus such information should allow truckers to optimize their travel.

WSDOT has been working with traffic engineers and the port to design a simple truckers' Congestion Notification System. The system will use a video queue detection camera at the I-5 southbound off-ramp to the Port of Tacoma road. This camera will be linked to WSDOT's regional traffic management center. When the video cameras detect a queue of a preset length it will alert an operator at the center. The operator will then turn on flashing beacons mounted on a sign along I-5 to the north of the port. The sign will divert truckers to an alternative exit by reading "PORT OF TACOMA TRUCKERS USE EXIT 124 WHEN FLASHING".

Note here that later in the test, WSDOT may also investigate if technology such as a video-based vehicle counting system or roadway detector loops used in conjunction with cameras might result in a better system to inform truckers about congestion.

Video Congestion System: Port of Seattle

Video camera images sent to the WSDOT traveler information Web page are an extremely well used, but relatively inexpensive, source of roadway information in the Puget Sound region. As part of this test, three low-cost (around $5,000 each, including installation) cameras will be installed on several intermodal connectors leading to the Port of Seattle, and their images will be linked to WSDOT's regional traveler information Web page. This information will give truckers or their dispatchers an easy way to remotely explore traffic conditions before heading to a port. An example of this type of application is shown below in Figure 2-4, where Stevedoring Services of America, a major terminal operator, recently installed a gate camera at Terminal 18 at the Port of Seattle. Views of this terminal approach can accessed on the Internet at http://207.141.0.21.

In an effort to determine where cameras could be used most effectively, WSDOT has engaged the transportation staff at the City of Seattle. The result of this is that several potential locations near marine terminal gates at the Port of Seattle have been identified as candidate sites.

[5] Source: Ed McCormack, WSDOT.

Figure 2-4. Example of Port Terminal Web-Based Video Snapshot

Participants and Users

The main participants in this test will be WSDOT, and the transportation agencies of the City of Tacoma and the City of Seattle. This test will support WSDOT's, as well as the other transportation agencies' ongoing efforts to provide travel information in a variety of formats and mediums, including the highly successful WSDOT traveler information Web Site.[6]

Some of the roadways leading to the ports belong to the cities of Seattle and Tacoma. This test can benefit these agencies by reducing queues that block roadways, driveways, and intersections. The City of Seattle should be able to easily integrate the video information from this test into their existing ITS system. Additionally, video camera maintenance and operations from this test system are expected to be quickly transferred to the transportation agency that owns the right-of-way on which the devices are located – WSDOT or the City of Seattle.

The main users of this system will be the trucking community – this group will most likely consist of trucking company dispatchers, who will be able to view the web-based video from their remote location, and relay any associated dispatch instructions (based on congestion levels viewed) to the truckers in the field typically via radio or cellular telephone. Additionally, any truck drivers with in-vehicle Internet connectivity could use the system as well. The Congestion Notification System at the Port of Tacoma can be used directly by the drivers on the road.

Schedule

For the Port of Tacoma Congestion Notification System, it is anticipated the system will be installed by early spring 2001, at which time WSDOT can start the camera calibration process. At

[6] The USDOT Joint Program Office recently completed an evaluation of the WSDOT Traveler Information Web Site. See: Jensen, Mark, Chris Cluett et. al., "Seattle Smart Trek Metropolitan Model Deployment Initiative Final Evaluation Report," prepared by SAIC for the USDOT-JPO, May 2000.

this time the equipment has been ordered and most of it has arrived. WSDOT is setting up phone and power contracts, and bids have been let to put in necessary conduits.

For the Port of Seattle Video Congestion System, deployment of the three cameras by WSDOT is imminent, and all of the cameras are expected to be up and operating by spring 2001.

2.3 Test #3: Collecting Regional Freight Data

Introduction

A major impact on freight movement is urban roadway congestion. As congestion increases, MPOs such as the Puget Sound Regional Council (PSRC) are seeking regional travel time data to determine exactly when, how, and where congestion effects freight mobility. In the past, the only major source of such data was from visual truck count data and from loop detection systems. Both of these data collection methods required considerable public resources, especially if region-wide freight data including arterials is desired.

This test will serve two related purposes. The first is to test the utility of using new relatively inexpensive wireless GPS devices to support freight movement data collection within the Puget Sound region. The second purpose of the test will examine how different types of ITS freight movement data could be integrated into a common database to support the types of freight movement analysis that is desired by MPO's.

If successful, this test could most directly benefit the region's MPO (the PSRC). The PSRC develops and maintains a regional database and forecasts and monitors economic, demographic, and travel conditions in the region. This information is the foundation for local and regional planning. Freight-oriented travel data are needed to identify freight movement bottlenecks, to explore the reliability of freight movements, and to determine the frequency and costs of nonrecurring events such accidents and weather. Such information justifies the development of freight-oriented highway construction and ITS projects. This information could potentially also assist in identifying and modifying the impacts of activities such as port gate closures and, in the case of Seattle, sporting events – the new baseball and football stadiums are situated right next to the Port of Seattle; significant event traffic on certain days will conflict with truck traffic in and out of the port.

Better freight movement data could also benefit WSDOT and other transportation agencies. On a basic level, such data can provide a convenient picture of urban freight movements. At a project level, these data provide transportation agency staff with the tools to correlate existing and predicted roadway conditions with changes in freight movements. Such a process could better allow roadway construction projects to more effectively address concerns about their effect on freight mobility. On a regional level, these data could provide a tool to help WSDOT address many questions centered on freight mobility and economic growth. Using indicators from this test, WSDOT staff would be better able to discuss the impacts of increased regional congestion on truck flows and freight mobility. This analysis, in turn, could help in answering basic policy questions.

System Overview

WSDOT has five wireless DGPS (Differential GPS) devices on loan from TransCore that have been placed in trucks to collect urban freight flow information. These devices are made by Air-Trak and are small windshield mounted GPS receivers with a two-way pager channel messaging capability. An overview of the Air-Trak Automated Vehicle Location (AVL) concept of operations is shown below in Figure 2-5.

Figure 2-5. Air-Trak AVL Wireless GPS System Overview

Two trucking companies agreed to let WSDOT put the Air-Trak devices in their trucks. One is Puget Sound Freight Lines whose trucks travel regionally throughout the Puget Sound metropolitan region. The other company, CSX, provides drayage moves, which is permitting WSDOT to explore freight flows between port facilities and the surrounding area.

Activation of the truck wireless equipment involved meeting with the trucking companies to install the equipment and to do some minimal driver training (how to turn on and off the device). WSDOT and TransCore set up wireless accounts for each device and have developed a method to transfer data to master database.

For the integration component, WSDOT's TRAC research center is spending considerable time this year developing an semi-automated freight movement database that will be able to be populated with the following types of ITS data:

- Loop sensors available at various points on the regional freeway network
- AVI transponder data at ports, weigh stations, and border crossings (including NorPass)
- E-seal data at ports and border crossings
- Wireless GPS data available at all times (from this Test)

Linking these systems should result in enough coverage on the region's freeways and arterials to start collecting meaningful freight travel time data. Additionally, TransCore is currently investigating the possibility of linking (through software) the wireless DGPS data with their AVI Transponder/E-Seal system under development. This capability could allow for near-continuous tracking and verification of vehicles and containers throughout the region and across the Canadian border.

The integration of the ITS freight movement data into a consolidated database will support the development of performance and usage information. This capability can allow for the development of report outputs that are usable for improving policy decisions by public agency's and operational decisions by private firms. The data are expected to fit in the following categories:

- Vehicle classifications and volumes on the roadway segments,
- Reliability of freight flows (i.e. if congestion significantly interferes with delivery schedules)
- Time and location of recurring congestion.

This type of information can, in turn, provide for the following capabilities:

- Guidance on where to locate freight-oriented variable message signs
- Routing information for motor carrier dispatchers
- Policy guidance on the most freight oriented roadway construction
- Calibration information for freight modeling

Participants and Users

The main participants in the test of the DGPS wireless devices will be WSDOT-TRAC, TransCore, and the two trucking companies. Users in this test will consist of the two trucking companies, WSDOT-TRAC, and the Puget Sound Regional Council (PSRC), which is the regional MPO.

The main participant in the proposed integration of the ITS freight movement data will be WSDOT-TRAC. The main user of the potential integrated freight movement database will be the PSRC.

Schedule

The test of the DGPS wireless devices by WSDOT began in fall 2000, and will continue through June 30, 2001.

The activities involving the integration of the ITS freight movement databases are in progress. It is anticipated that results from this integration will be developed in late 2001.

3.0 Evaluation Plan

3.1 Evaluation Objectives/Study Areas

At the direction of the USDOT-JPO, this evaluation is based on the following four major objectives, which will serve as the main "study areas" for this evaluation:

- Identify improvements in ***Intermodal Freight System Operations*** resulting from ITS technologies;
- Assess the ***Technical Effectiveness*** of the technology applications in fulfilling their stated functions (this assessment will also include consideration of implications for the ITS National Architecture and Standards);
- Assess the ***Customer Satisfaction*** expressed by key information users; and
- Identify the key ***Institutional Challenges*** encountered in establishing partnerships and sharing information among public agencies and private businesses.

The ultimate goal of these evaluations as defined by the JPO is to identify "lessons learned" with respect to implementing intermodal ITS technologies for these study areas. These lessons learned will provide guidance to other states, regions and MPO's for planning and implementing similar technologies, and will also provide guidance to the USDOT on the need and market for an intermodal information systems architecture and standards.

The remainder of Section 3 provides a detailed discussion of the analysis plan for conducting the evaluation of the four study areas presented above.

3.2 Intermodal Freight System Operations Evaluation

In evaluating the introduction of ITS technologies in the WSDOT Intermodal FOT it is necessary to evaluate the impacts on the overall freight system. For this evaluation, the focus will be to assess what benefits are derived from the deployed systems to the private and public participants. For example, the benefits to the freight industry may include delay reductions, travel time savings, productivity increases, security improvements, logistics improvements, credentialing benefits, and economic benefits. For the public sector agencies, the benefits may include better use and management of the available infrastructure capacity, the ability to collect freight data for planning purposes, and the ability to monitor the movement of and security of freight shipments. These measures characterize the implementations in terms of global intermodal freight measures of improvement and they are quantified in the terms of the overall ITS goals of improvements in Mobility, Effectiveness, Safety, Productivity and Energy and Environment.

The overall freight system impacts will be evaluated within the context of the three separate tests proposed by the WSDOT. These tests have been defined in detail in Section 2.0 of this document and consist of the following:

- **Tracking containers with disposable electronic seals.** This project will test the use of electronic seals (in combination with AVI transponders) to track shipments of in-bond containers across multiple modes, to facilitate movements through key gateways, and to ensure shipment security across all movements. This will consist of the paperless movement of in-bond containers and the automated clearance of the vessel manifest by U.S. Customs, followed by electronic assignment of the container (electronic seal) to a truck (transponder), and the tracking and clearance of that load along I-5 northbound to Canada. The electronic seals will be installed in Asia[7] and linked to a truck transponder at time of pick-up at the Port of Tacoma based on the TransCore software program. Initially, no actual read of the electronic seal will be taken at the marine terminal; however, an e-seal reader at the Port of Tacoma will be deployed later in the test. The test will consist of the installation of 5,000 electronic seals and multiple readers along I-5. Electronic seal readers will initially be installed in advance of the U.S./Canadian border and at the border. AVI transponder readers will be located at the marine terminal gate, on the I-5 corridor at the Bow Hill weigh station, in advance of the U.S./Canadian border, and at the border. Since the technology deployed under this test has the greatest potential for impacting the operation of freight movements in the region, it will therefore receive the highest priority focus of the evaluation efforts under this study area**.**

[7] At this time, it is yet not fully certain as to whether the e-seals can be installed at the Asian Port of Origin. As a backup, U.S. Customs at the Port of Tacoma could potentially install the e-seals. The evaluation effort will reflect the final conditions of the operational test.

- **Providing traveler information to reduce roadway congestion leading to a port's marine terminal gate.** This project will test the use of ATIS-based data to alleviate congestion at the ports' gates and access routes by providing queue information to dispatchers responsible for scheduling pickups and drop-offs of containers at the marine terminals. The use of traveler information will be tested at two sites; the Port of Tacoma, and the Port of Seattle. At the Port of Tacoma, a beacon sign-based system will be installed along I-5 southbound that notifies truck drivers of congestion on access roads, providing the opportunity for the driver to take an alternate route. A camera will be used to monitor the access roads to the marine terminals; when a queue or heavy congestion occurs the beacon sign will be activated instructing drivers to use the next southbound exit off of I-5 for accessing the marine terminals. This is referred to as the Congestion Notification System. At the Port of Seattle, an Internet-based camera system will be installed at strategic locations on access routes to monitor gateway and access road queues. It will benefit participants that have the flexibility to stagger their arrival times and routes. Images from the cameras will be available on WSDOT's traffic web site and can be used by dispatchers to assist in determining arrival times and access routes used. Access to these camera views will likely be made accessible through additional forums to be defined by WSDOT.
- **Collecting regional freight data.** This project will test the combined use of the electronic seals, vehicle transponders, wireless GPS devices, and loop detectors as tools for detailed data collection of regional freight traffic flows. In addition, a private company has offered to make available data from its fleet tracking system. The deployment will be limited geographically to the corridors used by the participating motor carriers and deployed technologies. The evaluation will focus on the ability of the technologies to provide accurate, real-time truck traffic data. The collection and analysis of this data will be conducted by the TRAC and incorporated into the findings by the evaluation team.

Each of these individual tests represents a component of a regional system that will be developed and deployed as part of the WSDOT Intermodal Data Linkages Project. The individual components fit together to provide motor carriers and shippers with tools to better manage their freight operations in the impacted region. In developing the plan for the freight system operations evaluation, it is important to understand what new capabilities these tests provide the region's shippers and carriers, and how each of these tests will be integrated to form the new service. Figures 3-1 and 3-2 illustrate the existing and proposed flow of freight and information. For example, Figure 3-2 shows at what stage the electronic seals, transponders, and traffic surveillance technology become installed and operational (shown in yellow), as well as highlights the locations in the system where there is potential for time and cost savings as a result of the new system (shown in green).

These information/freight flow figures will be referenced and modified as appropriate as the evaluation progresses. It is intended that based on the evaluation results at the end of this study (and possibly elements of the other three study areas), that example freight timelines would be created using these flow charts which would clearly show the time and cost benefits realized by the ITS solutions at each stage of a typical container journey. For the Port of Tacoma (electronic seals, transponders, ATIS), the journey will be from the marine terminal to the Bow Hill weigh station, and across the Canadian Border. For the Port of Seattle (ATIS) the journey will locally focused on time savings in accessing and exiting the marine terminals.

The remainder of Section 3.2 describes the details of the system operations evaluations planned for each test.

Figure 3-1. Existing Flow of Freight and Information

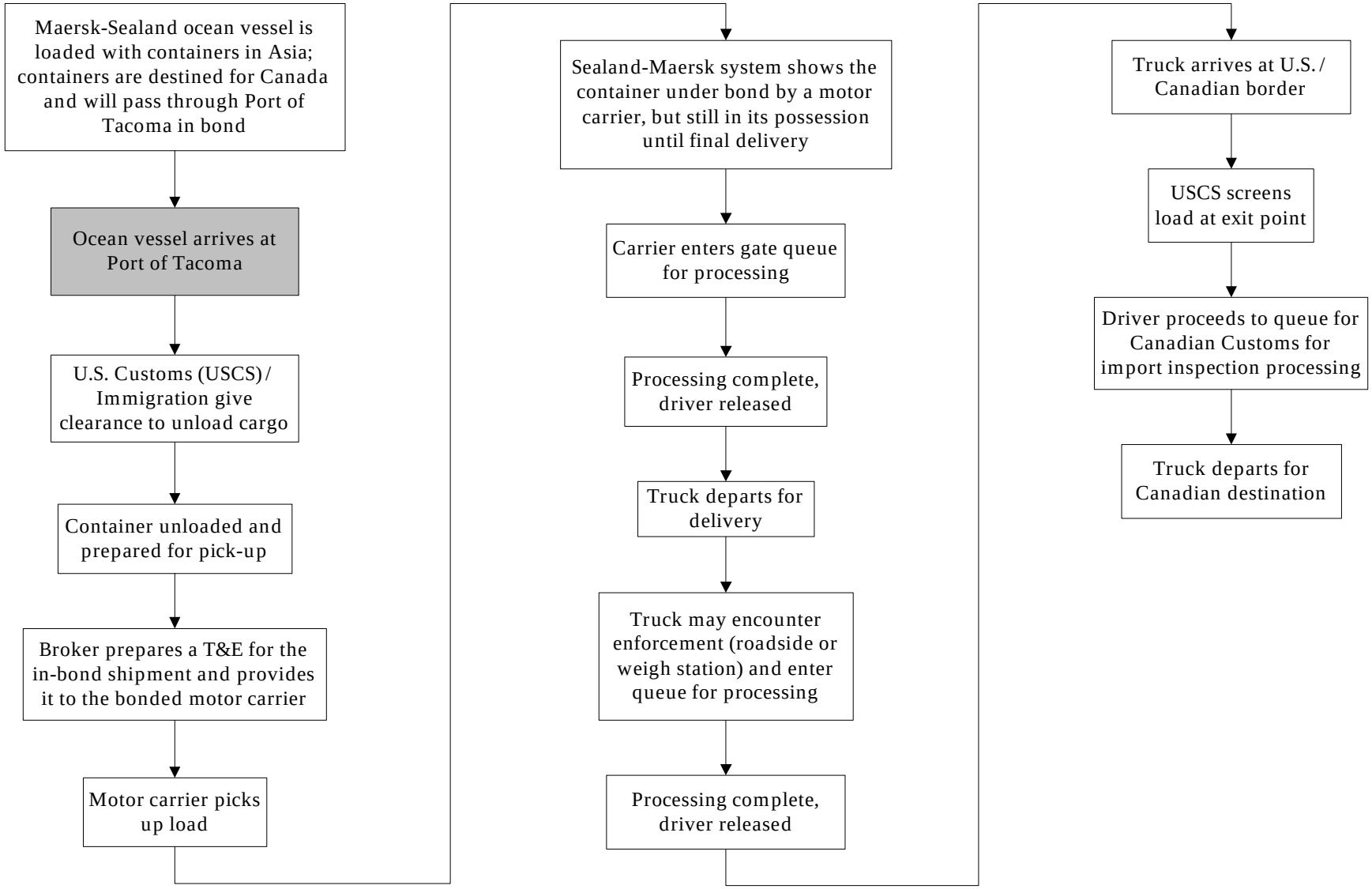
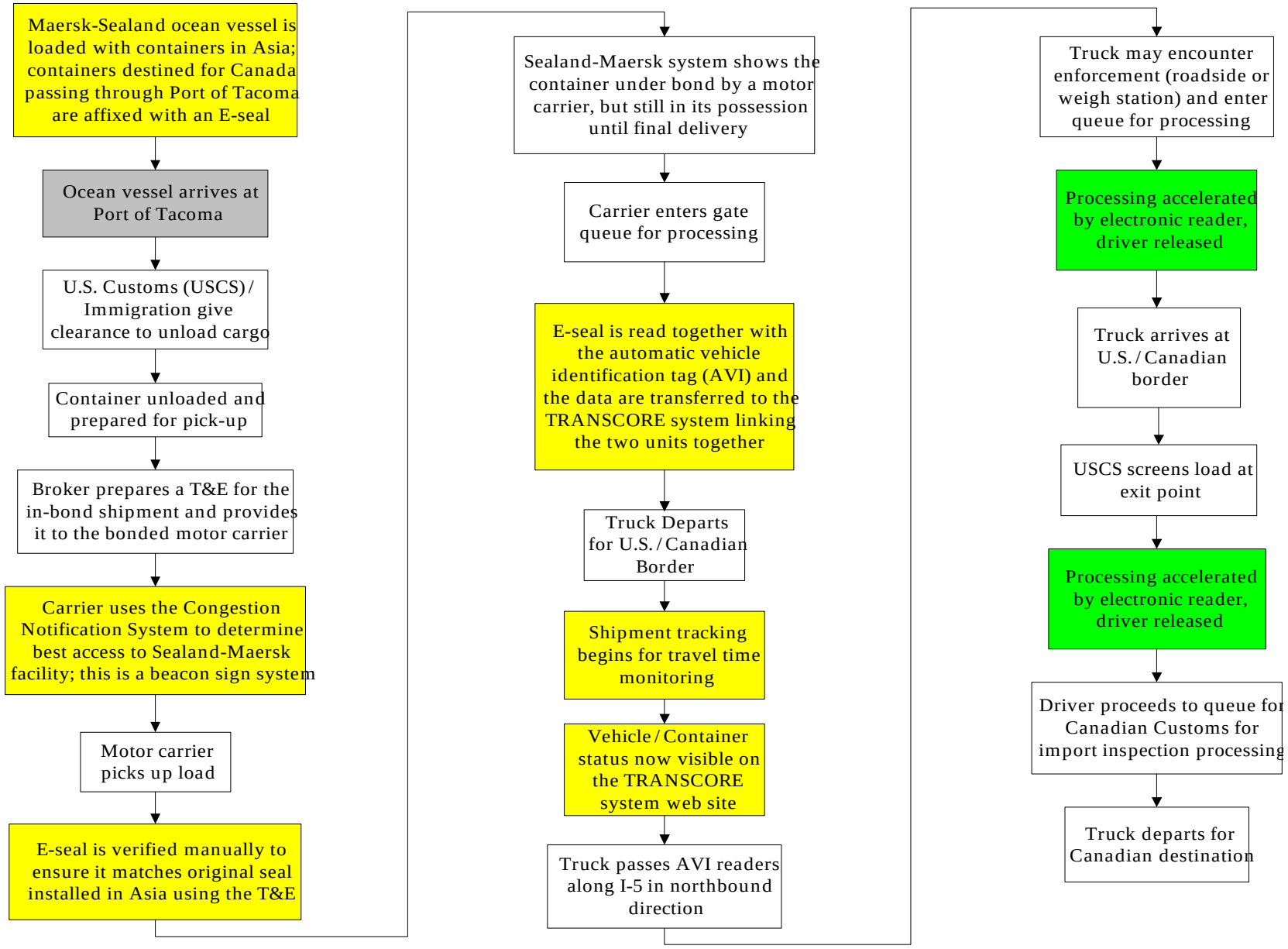


Figure 3-2. Proposed Flow of Freight and Information



3.2.1 Tracking Containers with Disposable Electronic Seals (Test 1)

As detailed in Section 2.1, this test will use electronic seals, AVI transponders, and readers to monitor the movement of containers and vehicles from the Port of Tacoma to the U.S.--Canadian Border. Each participating container will be equipped with an electronic seal - applied overseas at the port of origin (see footnote #6). This seal will then be linked to a vehicle transponder at the time of pick-up. As the load departs through the port gates, the transponder will be read and the electronic seal and transponder will be linked in the database. At key points along the trip additional readings will be taken (truck weigh stations, key highway interchanges, border crossing) to track the progress of the load. In addition, the information contained in these tags will be used by enforcement personnel and U.S. Customs to streamline the regulatory and enforcement operations encountered by the loads as they move through the system. This system will make it possible to track the progress of a container as it passes by transponder readers along I-5. This will contribute to the collection of travel time data as well as provide the potential for a higher level of shipment tracking.

Evaluation Approach

The objective here is to evaluate the use of e-seals and AVI transponders to provide expedited and secure electronic processes for moving containerized goods though our nations ports and across our international border with Canada, resulting in significant benefits (on-time delivery, reduced theft, reduced gate queue time). The specific goals, in order of importance, consist of the following:

- Reduce total travel time from the Port of Tacoma through weigh stations and across the Canadian border;
- Facilitate paperless in-bond movement of containers from the Port of Tacoma to Canada;
- Associate a container positively with a vehicle at the Port of Tacoma;
- Provide an anti-theft/tampering system for containers moving from Asian ports through the Port of Tacoma to Canada; and
- Provide low cost container electronic identification capabilities

Table 3-1 summarizes the evaluation approach for each of the Test 1 goals, providing the hypotheses, measures of effectiveness, data requirements, and planned analysis.

Data Collection and Analysis

In order to conduct an effective evaluation of this test, the appropriate set of data, and potential sources of the data, must be defined and identified. Later in the process, detailed data collection plans will be developed that provide a specific scope of work to be completed for this evaluation. At this stage, it is important to describe the methodology that the evaluation team plans to use for this specific activity. As the deployment activities progress, there may be variances in what is actually deployed versus what was planned. The evaluation team will monitor the progress of the deployment and be prepared to modify and adjust the data collection plan as necessary within the available resources.

This plan will address the data components required for this test. The focus of the efforts will be to identify and interview the key participants involved in the development and deployment activities. This process will consist of interviewing the information systems staff, WSDOT project management representatives, participating shippers, steamship lines, motor carriers, U.S. Customs

Table 3-1. Intermodal Freight System Operations Evaluation Approach: Test 1

Goal	Hypothesis	MOE	Data Sources or Requirements	Analysis
Reduce total travel time from the Port of Tacoma through weigh stations and across the Canadian border.	Delays at the marine terminal gates, weigh stations, and the U.S.—Canadian border crossing will be reduced.	Change in queue time at key clearance/ inspection points.	Collection of system performance reports. Interviews with participating shippers, steamship lines, and motor carriers. Interviews with U.S. Customs and Washington State Patrol. Data logs maintained by U.S. Customs and Washington State Patrol. Data logs maintained by participating shippers, steamship lines, and motor carriers. Direct observations at key gateways (Port of Tacoma, weigh stations, and U.S.—Canadian Border Crossing).	Comparison of interview findings. Documentation and analysis of on-site observations. Analysis of system generated reports to calculate time savings from automated proceccing.
Facilitate paperless in-bond movement of containers from the Port of Tacoma to Canada. *Note: Dual manual and automated systems will be in operation. Evaluation will measure the differences.*	Shippers and carriers will reduce paper work and time associated with shipments.	Changes in dispatch operations. Change in labor hours required for credentialing and other logistics functions.	Interviews with participating shippers and carriers. Data logs maintained by participating shippers and carriers.	Comparison of interview findings. Review and analysis of data logs.
Associate a container positively with a vehicle at the Port of Tacoma.	E-seals will be successfully linked to vehicle transponders.	Were the e-seals linked to vehicle transponders?	Interviews with the information systems staff responsible for the deployment. Collection of system performance reports.	Comparison of interview findings. Review and analysis of system generated reports.
Provide an anti theft/ tampering-system. ***Note: In Bond containers are required to have a high security seal applied already. The e-seal does not provide any additional or new security. However, use of e-seals will assist in tracking any tampering/theft attempts.***	There will be a reduction in theft and damage rates.	Change in loss/ damage rates of steamship lines and motor carriers. Perceptions of increased security.	Interviews with participating shippers and carriers. Data logs maintained by participating shippers and carriers.	Comparison of interview findings. Review and analysis of data logs.
Provide low cost electronic container identification capabilities for steamship operators at the Port of Tacoma.	The e-seals will successfully be deployed and linked to vehicle transponders at low cost.	Did the technology work within the proposed cost parameters?	Interviews with the information systems staff and WSDOT project management responsible for the deployment. Review of supporting documentation regarding cost.	Comparison of interview findings. Review of cost documentation.

representatives, and Washington State Patrol officers. These interviews will collect data on how the system was implemented, how it worked, what the key issues were, how it could have been improved, whether or not it met expectations, etc. In addition, more quantitative data will be collected. This process will include automated system performance reports, and logs maintained by the shippers, steamship lines, motor carriers, U.S. Customs, and Washington State Patrol. These materials will identify actual quantitative changes in the freight operations of the participants, such as change in queue time at key clearance/inspection points, or data that show whether or not the e-seals were linked to the vehicle transponders consistently

3.2.2 Providing Traveler Information to Reduce Congestion Leading to a Port's Gate (Test 2)

Test Overview

As detailed in Section 2.2, this test will consist of the deployment of the Congestion Notification System at the Port of Tacoma and the Internet-based camera system at the Port of Seattle to monitor the local access roads in an attempt to provide motor carriers with real time traffic information. This deployment will provide carriers with real-time information on highway congestion and should assist them in reducing the amount of time spent in queue waiting to pick-up and/or drop-off containerized loads. These data will be available to carriers via beacon signs at the Port of Tacoma and the WSDOT web site for the Port of Seattle. The beacon signs at the Port of Tacoma will be activated to instruct truck drivers to use the next southbound exit off of I-5. The web-based cameras will be available through multiple sites for use by dispatchers to facilitate deployment of their trucks to pick-up loads at the Port of Seattle.

Evaluation Approach

The objective of this test is to better manage the gate queues at the Port of Tacoma and Port of Seattle to minimize the time spent in queue by motor carriers picking up and dropping off containerized loads. The goal for this test is to provide motor carriers with traffic information for the access roads leading to the marine terminal gates.

Table 3-2 summarizes the evaluation approach for the Test 2 goal, providing the hypothesis, measure of effectiveness, data requirements, and planned analysis.

Table 3-2. Intermodal Freight System Operations Evaluation Approach: Test 2

Goal	Hypothesis	MOE	Data Sources or Requirements	Analysis
Provide motor carriers with traffic information for the access roads leading to the port gates.	Use of the traffic information will be beneficial to the motor carriers in planning their container deliveries and pick-ups at marine terminals.	Motor carrier perception of the usefulness of the beacon signs and Internet-based camera system for traveler information. Vehicle counts on the access roads (Port of Tacoma only). Measure of the hits on the camera web page (Port of Seattle only).	Interviews with participating motor carrier dispatchers and drivers. WSDOT will collect traffic count data on access roads. Log of hits on web pages providing camera-based congestion information.	Comparison of interview findings. Review and analysis of traffic counts on access roads. Review and analysis of hit logs.

Data Collection and Analysis

As described above, the appropriate set of data, and potential sources of the data, must be defined and identified for this test and used to develop a detailed data collection plan. This plan will address the required data components required for this test. The focus of the efforts will be to identify and interview the key motor carrier participants, specifically the dispatchers that will use the ATIS data to inform their drivers on appropriate arrival times at the marine terminal gates at the Port of Seattle, and drivers that are using the beacon signs when accessing the Port of Tacoma. These interviews will collect data on how the system was used and how it impacted the motor carriers' abilities to improve the transit and wait times. WSDOT also will provide vehicle count data on the access roads. In addition, the number of hits on the web-based system at the Port of Seattle will be collected and analyzed.

3.2.3 Collecting Regional Freight Data (Test 3)

Project Description

As detailed in Section 2.3, this test will consist of using the combination of several technologies to collect real-time traffic data for use by the MPO in freight planning activities. The technologies will consist of the e-seals, vehicle transponders, and wireless GPS units installed in trucks serving the region, and the loop detector system currently in place in the region. The transponders (to which the e-seals are linked) will be read at the marine terminals, weigh stations, and border crossings. The e-seals will be read at the marine terminals and the final delivery point. The wireless GPS units will be monitored by the Air-Trak software system, which will be available to the participating planning agencies, motor carriers, and shippers. All of this data will be combined, along with the loop detector data, to describe truck flows in this corridor. The data will then be evaluated to determine their usefulness to local planning agencies and the industry. TRAC is leading this effort and will report its findings to the evaluation team.

Evaluation Case Study Approach

The objective of this test is to evaluate the usefulness of ITS technologies to measure and record travel times on the region's highway infrastructure for freight movements. This will focus on monitoring traffic flows in congested areas using the participants as traffic probes. It is anticipated that this combination of technologies will prove to be an effective methodology for the collection of regional highway freight flow data. The evaluation of this test will consist of a "Case Study" which will address the following questions:

- **How did the industry use the system to track and monitor fleet operations?** Was it useful to the carriers and shippers to be able to graphically view their shipments in real-time as they moved through the region? What were the benefits? What data were most useful?
- **How was each piece of data used by the Washington State Transportation Center (TRAC)?** What piece of data was most useful and why? How were the real-time data used? How were the integrated data used after the post processing was complete?
- **What are the strengths and weaknesses of each separate database as well as the integrated database?** Which data components were most useful and why? Were they easily integrated into one database? What were the limitations?

- **How did WSDOT and PSRC assess the utility of the different data components?** Which data characteristics were most useful? What characteristics were used to evaluate the data? What reports were generated as part of this analysis?

Data Collection and Analysis

The case study will consist of data collection activities that collect all available quantitative data, as well as interview-based qualitative data. The quantitative data will include system reports and the actual databases developed. Interviews will be conducted with the information system staff, local planning staff, WSDOT project management representatives, and participating carriers and shippers to collect the qualitative data. The result will be the development of a case study write-up that highlights the key findings.

3.3 Technical Effectiveness Evaluation

To assess the effectiveness of the technologies and to identify needed system improvements it will be necessary to evaluate the technologies based on an assessment of the actual technical performance of system components in their operating environment. Table 3-3 illustrates the major new technologies introduced from these tests[8], and provides the corresponding performance assessments which will be made to evaluate these technologies.

Table 3-3. Evaluation Technology Assessment Overview

Technologies Introduced	Performance Assessments and Data Sources
• Electronic Container Seal Tags and Readers (Test #1)	• TransCore & Electronic Seal Pte. Ltd Joint Test Results (May 2000, October 2001, TBD - 2001)

• AVI/E-Seal Vehicle and Container Tracking System with Internet Data Delivery (Test #1).	• TransCore System Administration Reporting & Statistics
	  • Positive Vehicle Identification
	  • Reliability of Seal/AVI tag association
	  • System Reliability/Availability/Maintainability
	  • Automated e-mail reception and delivery

• Wireless DGPS Tracking System (Test #3)	• TransCore & TRAC Joint Test Results (Summer 2001)
	  • Accuracy of data
	  • Reliability of data
	  • Delivery of data
	  • System Reliability/Availability/Maintainability

This table was developed following technical discussions with the TransCore system engineering team. TransCore has provided the Evaluation Team access to its system engineering documentation,

[8] Since Test #2 (provids web-based video on port congestion and a traffic queing congestion notification system) is not introducing any new technologies, none of its elements are being considered in the Technical Effectiveness Evaluation.

as well as an account on the Internet-based TransCorridor system (see description in Section 2.1). TransCore's system includes the following elements:

- A central operations Windows NT-based system located at TranCore's San Diego office consisting of two database servers (NT and SQL), a Web Server, an application server (contains the AVI, automated e-mail and all of the other necessary applications), and a firewall server
- Remote elements in the field (e.g., readers at port gates) which contain Windows NT-based computers, RS-232 connections to lane controllers and readers, and Internet connectivity to the central operations system defined above

This evaluation will rely extensively on the examination of the TransCore System Administration Reports. These reports provide detailed logs which contain the vehicle and container identification parameters (Container Number, Vehicle ID, Gate/Lane Number, Date & Time of Entrance Event, Shipping Facility ID, In-Bond, Container Weight, HAZMAT ID). These reports also provide detailed logs on the failure modes of the system. As an example, Figures 3-3 provides a portion of the system administration "Hardware Problems" log. Correspondingly, the detailed "Hardware Status" for "Record 1873" is shown in Figure 3-4. Both the container identification logs and the hardware problem logs will be used in this evaluation to develop statistics to support the assessments presented above.

The technology evaluation of the DGPS tracking system will rely on the joint test results that will be published by TRAC and TransCore in the summer of 2001. It is anticipated that these results will address system accuracy, reliability, data delivery, and availability.

Figure 3-3: TransCore AVI System Administration Hardware Problems Log

TRANSCORRIDOR

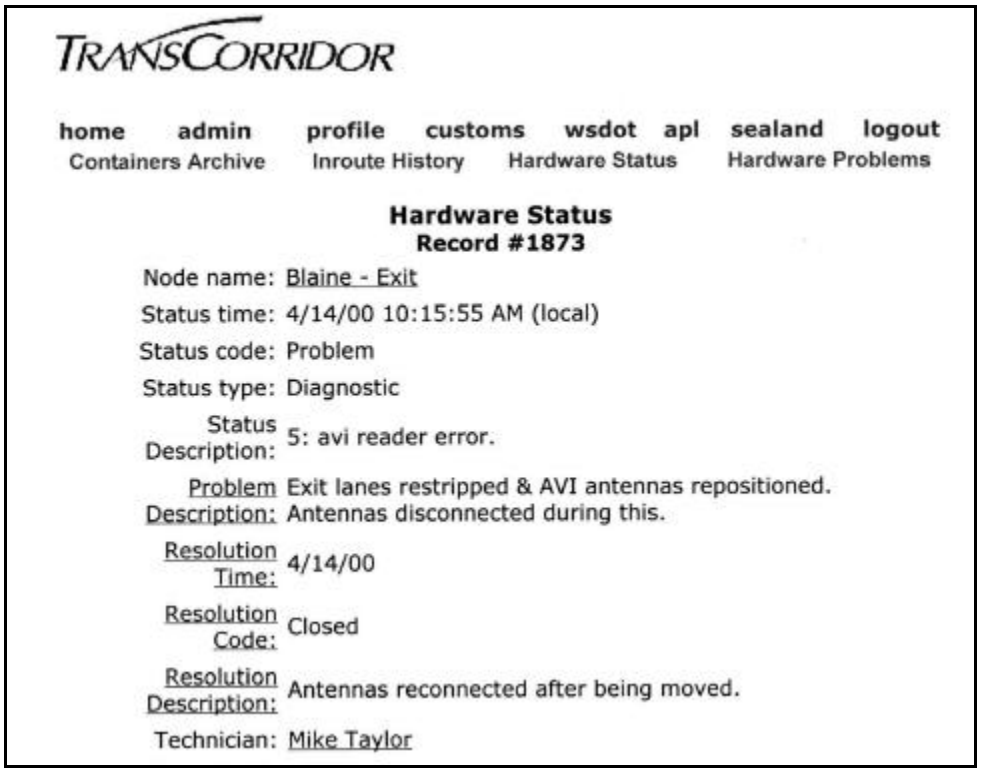
home admin profile customs wsdot apl sealand logout

Archived Containers Inroute History Hardware Status Hardware Problems

Hardware Problems

Record	Local Time	Node Name	Status	Resolution Code	Description	Technician
1874	4/16/00 4:00:00 PM	TCOS	Problem	Closed	Application Server Down	Mike Taylor (Not Notified)
1873	4/14/00 10:15:55 AM	Blaine - Exit	Problem	Closed	5: avi reader error.	Mike Taylor (Not Notified)
1872	4/14/00 6:59:54 AM	Blaine - Exit	Problem	Closed	5: avi reader error.	Mike Taylor (Not Notified)
1179	4/3/00 10:15:00 AM	TCOS	Problem	Closed	T1 line down	Mike Taylor (Not Notified)
667	3/24/00 9:31:04 AM	Blaine - Approach	Problem	Open	AVI driver timeout occurred.	Mike Taylor (Not Notified)
666	3/24/00 9:30:04 AM	Blaine - Approach	Problem	Open	AVI driver timeout occurred.	Mike Taylor (Not Notified)
665	3/24/00 9:29:04 AM	Blaine - Approach	Problem	Open	AVI driver timeout occurred.	Mike Taylor (Not Notified)
662	3/24/00 9:27:27 AM	Blaine - Approach	Problem	Open	AVI driver timeout occurred.	Mike Taylor (Not Notified)

Figure 3-4: TransCore AVI System Administration Hardware Status Record


TRANSCORRIDOR

home admin profile customs wsdot apl sealand logout
Containers Archive Inroute History Hardware Status Hardware Problems

Hardware Status
Record #1873

Node name: Blaine - Exit
Status time: 4/14/00 10:15:55 AM (local)
Status code: Problem
Status type: Diagnostic
Status Description: 5: avi reader error.
Problem Description: Exit lanes restripped & AVI antennas repositioned. Antennas disconnected during this.
Resolution Time: 4/14/00
Resolution Code: Closed
Resolution Description: Antennas reconnected after being moved.
Technician: Mike Taylor

In addition, under the direction of the USDOT-JPO, the Technical Effectiveness Study must also produce a separate **National Architecture Implications Summary Report** which will provide the following:

- An assessment of adherence to the ***ITS National Architecture*** and appropriate ***Standards***
- Potential new architecture components and data exchange methods utilized in these tests which could be considered for a new intermodal component of the ITS National Architecture; i.e., focusing on the potential emergence of technologies, procedures and deployment experience which could lead to the development of Standards for merging the FOT hardware and communications elements with the ITS National Architecture
- An assessment of the technical ability to scale these systems a regional or national levels

Here, with regard to ITS Standards, the WSDOT Intermodal FOT will implement several user service functions involved with freight mobility. A review and analysis will be performed on the ITS standards relevant to the User Services provided in this FOT. The primary user services to be exercised in this FOT are Commercial Vehicle Electronic Clearance, Commercial Vehicle Administrative Processes, and Commercial Fleet Management.

The Administrative Processes function is the service that is most likely to generate issues. The International Border Electronic Clearance (IBEC) portion of this service addresses border crossing functions. The regulations imposed by U.S. Customs and the Federal Aviation Administration (FAA) regarding movement of freight and the associated data required for its transfer is complex. Further complicating the issue are the carriers' sensitivity to the confidentially of the data.

With regard to examining the system elements and standards in this test to support the possible development of new intermodal elements of the Natiional ITS Architecture, the analysis will focus on the following two areas:

- Use of an open Internet-based architecture by the TransCore AVI system with connectivity to legacy EDI systems through the use of Automated E-mail
- Standards related to the use of wireless DGPS devices for fleet management

The National Architecture Implications Summary Report will be in a "Case Study" format, and will present conclusions based on the technology evaluations described earlier. This report will also contain corresponding results from the other ITS intermodal evaluation being conducted (O'Hare Electronic Manifest Evaluation).

3.4 Institutional Challenges and Customer Satisfaction Lessons Learned

Based on discussions with USDOT, the Institutional Challenges and Customer Satisfaction evaluation objectives are being combined under a single qualitatively-based "lessons learned" study area. The overall approach to this lessons learned study will be to first make the best use of existing FOT documentation, meeting minutes, surveys and analyses produced by the FOT partners and others to define and incorporate institutional and customer satisfaction data already collected to date (or that the FOT partners plan to collect in the future). Following this, where required, the Evaluation Team will then conduct interviews or administer surveys to the appropriate stakeholder/user groups as necessary to further augment the lessons learned.

A discussion of the evaluation plan for both the Institutional Challenges and the Customer Satisfaction component of this lessons learned evaluation are presented below.

3.4.1 Institutional Challenges Lessons Learned

The Institutional Challenges Lessons Learned Evaluation will focus on the degree to which the FOT improves interagency and public/private cooperation in each region, particularly with respect to information exchange and coordinated operations. In addition, the evaluation will identify non-technical issues that affected the planning and implementation of the operational test, and strategies that were successful (or unsuccessful) in mitigating the impact of these issues. Objectives, hypotheses, MOEs, and analytical tasks for this evaluation are provided in Table 3-4.

Particular attention in the evaluation will be given to the challenges encountered in establishing information-sharing agreements among these diverse entities. Private sector participants express two major concerns: 1) how data is used; and 2) who has access to the data. Public sector participants frequently raise as an issue involving the difficulty of getting agencies that historically have not worked together to begin sharing data. A particular concern here is the sharing of cost information. Additionally, establishing effective public-private agreements can be difficult. Although these are well accepted in concept, partnering between a government agency that provides a service and a private sector entity that is profit-oriented requires the blending of what can be contradictory models. Public agencies often use a consensus-based decision making process while private sector entities respond to market (customer) demands.

Table 3-4. Preliminary Institutional Challenges Evaluation Approach

Objectives	Hypothesis	Measures of Effectiveness	Data Sources or Requirements	Analysis
Assess the impact of the FOTs on interagency coordination.	ITS systems will improve interagency information sharing and enable coordinated planning and operations.	Agency perceived impacts.	Interviews with key public sector agencies involved in each FOT; review of meeting minutes and other related documentation.	Documentation of findings and lessons learned.
Assess the impact of the FOTs on public/private coordination.	ITS systems will improve public/private information sharing and enable coordinated planning and operations.	Agency and user-perceived impacts.	Interviews with key public sector agencies and private businesses involved in each FOT; review of meeting minutes and other related documentation.	Documentation of findings and lessons learned.
Assess challenges relative to the development of information sharing agreements	Participants will experience but overcome challenges to establishing information-sharing agreements.	Institutional challenges: successes and, failures	Interviews with key public sector agencies and private businesses involved in each FOT; review of meeting minutes and other related documentation.	Documentation of findings and lessons learned

This evaluation is also structured to address some of the unique institutional aspects of this FOT. For example, in the intermodal ITS community, there is a perception that the maritime industry and seaports have had little interest in exploring ITS solutions or connectivity to ITS to improve their operations. Thus, it will be of major interest to determine both how WSDOT was successful in involving SeaLand and the Ports of Seattle and Tacoma in this effort, and to see what benefits and issues this partnership fostered during the operational test.

The focus of the interviews (and a survey, if that data collection technique is also utilized) will be to address the following questions:

- What type(s) of information needed to be shared? Who needed to have access to this information? What was the intended use of the information?
- Were any institutional challenges or concerns expressed about sharing this information? What were these concerns or challenges? How were these issues addressed? What type of process was used to resolve these challenges and concerns?
- Was there a cost involved in addressing these challenges and concerns? Who absorbed this cost?
- If you raised an issue or challenge, were you satisfied with the agreement that was reached? Do you feel your concerns were adequately addressed?
- Did you participate in a public-private partnership during the course of the FOT? How did you feel this partnership worked? Was the partnership an effective vehicle for addressing and resolving issues and challenges? What in particular worked well/did not work well?
- If you were to repeat this process, what would you do differently?

- If you were advising another group of stakeholders about to implement a similar project, what would you say to them about how to resolve institutional challenges and concerns?

These questions will be asked to varying institutional participants, depending on which of the three tests is involved. Table 3-5 provides a listing of the potential institutional interview candidates by test.

Table 3.5. Potential Targets for Institutional Interviews

E-Seal/AVI Container and Vehicle Tracking (Test #1)	Port Web-Based Traffic Information/ Congestion Notification System (Test #2)	Wireless GPS & Freight Data Integration (Test #3)
• WSDOT/TRAC • Port of Tacoma • TransCore • Maersk-Sealand (Tacoma) • U.S. Customs • Bow Hill Weigh Station	• WSDOT/TRAC • City of Seattle • Port of Tacoma	• WSDOT/TRAC • PSRC • TransCore • Air-Trak • Puget Sound Freight Lines • CSX

3.4.2 Customer Satisfaction Lessons Learned

The customer satisfaction lessons learned evaluation will focus on the degree to which the transportation and information needs of "customers" are met by the ITS services. The customers for this FOT are defined here as those who are affected by changes in the intermodal freight system that are brought about by ITS solutions.

The WSDOT Intermodal FOT comprises three tests, each with its own set of customers. Customers for the electronic container seals and transponders (Test #1) will include two maritime carriers (-Maersk-Sealand at the Port of Tacoma, and APL at the Port of Seattle), two ports (Tacoma and Seattle), multiple motor carriers (to be defined by WSDOT), and U.S. Customs. Additional customers might also potentially include shippers, receivers, and forwarders. Motor carriers will be the primary customers for the web-based camera congestion information (Seattle) and Congestion Notification System (Tacoma) (Test #2) on port access routes, although this also will benefit traffic management centers in the region. Public agencies (particularly the PSRC and TRAC) will be the primary customer for the regional freight data (Test #3) integrated and collected through this FOT, as well two trucking companies (CSX and Puget Sound Freight Lines) who will utilize the GPS wireless devices also provided as an element of this test.

The Customer Satisfaction Lessons Learned technical approach is presented in Table 3-6. The key objectives of this evaluation are as follows:

- Identify the perceived benefits of the ITS services to users, and the perceived relationship of these benefits to the costs (financial resources or staff time) required to use the ITS systems
- Assess user awareness and acceptance of ITS services and information

- Assess the ability to use data provided by these ITS systems, including whether the information provided by these systems is being integrated into routing and dispatching and other supply-chain management activities, and including the system capabilities that are of greatest value to customers and the potential system enhancements that would be of greatest value to customers

The customer satisfaction evaluation will have a major focus on trucking companies. Particular attention will be given to the subjective perception of the benefits and performance of the systems among motor carrier dispatchers and drivers. Similar impacts on terminal operators, shippers, and receivers also will be considered. In addition, the evaluation will consider the perceptions of public agencies (such as U.S. Customs, FAA, or the PSRC) that are users of the data collected and exchanged by these systems.

Table 3-6. Preliminary Customer Satisfaction Evaluation Approach

Objective	Hypothesis	MOE	Data Sources or Requirements	Analysis
Identify the perceived benefits of the systems to users.	Users will find the ITS systems to be a valuable aid for logistics or transportation management that is worth the cost or time involved in using the system.	User-perceived system benefits . User-perceived system costs.	User interviews, surveys, or focus groups.	Comparison of survey/ interview findings.
Assess user acceptance.	Carriers, drivers, terminal operators, and shippers will be aware of and prefer to use ITS systems.	User-stated awareness of ITS systems. User-stated preference toward using ITS systems.	User interviews, surveys, or focus groups.	Comparison of survey/ interview findings.
Assess ability to use ITS data.	Customers will use the ITS data as part of their decision-making processes. Users will find the ITS data to be accessible, accurate, and secure.	User-stated integration of ITS data into operations User perceptions regarding ease of use. User-perceived change in quality/ accuracy of data. User-perceptions regarding data security. User-stated priorities among system capabilities. User-stated ideas for system enhancements.	User interviews, surveys, or focus groups.	Comparison of survey/ interview findings.

The experience of the Evaluation Team in previous evaluations has been that standardized questionnaires or data request forms are useful to direct respondents in the collection of existing and readily available data into a usable format. However, personal interviews may also be used to collect information that is not easily quantified in a consistent format or may require follow-up questions for clarification. Interviews are particularly useful in collecting information that may call for the respondent to state an opinion or formulate an estimate based on personal experience. Focus groups may also be considered as an alternative method to gather input from a broader audience.

Separate interview formats will be developed for major categories of users (e.g., carriers, shippers/receivers, terminal operators, and public agencies). The surveys generally will be conducted via e-mail or facsimile. The interviews generally will be conducted in-person, drawing upon the resources of the site evaluators, although time constraints may require some interviews to be conducted via telephones.

4.0 Management Plan

4.1 Evaluation Organization

An organizational overview for the conduct of this evaluation is presented below in Figure 4-1. Note here that the SAIC Project Manager reports directly to the USDOT Contracting Officer's Technical Representatives (COTR's), Dr. Joseph Peters (USDOT-ITS Joint Program Office) and Mr. Chip Wood (USDOT-Office of the Secretary of Transportation).

Figure 4-1: Evaluation Organizational Overview

EVALUATION MANAGEMENT AND COORDINATION	
Project Manager:	M. Jensen, SAIC
Senior Project Advisor:	L. Grenzeback, CSI
National Coordination:	M. Carter, SAIC
EVALUATION STUDY AREA LEADERS	
Intermodal Freight Sys. Ops Study Lead:	M. Williamson, CSI
Technical Effectiveness Study Lead:	M. Jensen & R. Sanchez, SAIC
Institutional Challenges & Customer Satisfaction Lessons Learned Lead:	M. Jensen & K. Chen, SAIC
EVALUATION DATA COLLECTION AND ON-SITE COORDINATION	
Data Collection Coordination:	E. Flanigan, TranSystems
On-Site Evaluation Coordinator:	M. Mariano & A. Lickteig, TranSystems

The organizational approach for this project is based largely upon the leadership of the Evaluation Study Leaders. The On-Site Evaluation Coordinator will serve as a support resource to the Study Leaders to assist them in implementing their evaluations at that site, and will also be responsible for implementing many of the evaluation data collection activities under the direction of the Data Collection Coordinator. The Data Collection Coordinator will be the single point of contact for managing all data collection activities under the direction of the Study Leaders. The Data Collection Coordinator will report to the Study Leaders and to the Project Manager. The Project Manager will have the final say in resolving any issues within the Evaluation Team.

4.2 Overview of Evaluation Deliverables

The technical reports that will be developed from this evaluation will be as follows:

- **Evaluation Test Plans**. Following the completion of the Final Evaluation Plan, each Study Leader will be required to produce a detailed Test Plan (e.g., "WSDOT FOT Technical Effectiveness Study Test Plan"). Here, there will be a draft review process with input from both the USDOT and the local FOT partners.
- **Evaluation Final Report**. This will be the comprehensive final report which will document both the methodology and the detailed results of the WSDOT FOT evaluation. This report will consist of six major sections: an Executive Summary, an Introduction section, a Methodology section, a Results section, a Conclusions Section and a Recommendations section. The Methodology and Results sections would each be further divided into four subsections based on the evaluation study (e.g., Technical Effectiveness). The report is expected to be around 50 to 75 pages, with more detailed information on the analyses to be included in Appendices if necessary.
- **National Architecture Implications Summary Report**. This report will be an output of the Technical Effectiveness Study, and will also incorporate inputs from the O'Hare Electronic Manifest FOT. This report will be focus on the potential emergence of technologies, procedures and deployment experience which could lead to the development of Standards for merging the hardware and communications elements from each FOT with the ITS National Architecture.
- **Evaluation Video and Photographic Record**. A video and photographic record of hardware and other visual aspects of the FOT will be developed, using video footage and digital photos that are recorded by the Evaluation Team during the course of the evaluation. Based on the quality and availability of the images collected, recommendations will be made to USDOT regarding the potential format and message for a video that could potentially be developed and distributed in partnership with ITS America, the Intermodal Association of North America, the American Trucking Associations (ATA), or other industry associations.

4.3 Evaluation Schedule

The Evaluation Schedule is provided in Table 4-1. The major deliverables are discussed above in Section 4.2.

Table 4-1. Evaluation Schedule

Date	Milestone or Deliverable
March 28, 2001	Final Evaluation Plan
June 15, 2001	Draft Test Plans
Continuous to November 2001	Evaluation Data Collection and Analysis Activities
September 2001	Preliminary Results Input to USDOT to Support Planning Activities
October 2001	Draft Evaluation Report
October 2001	Preliminary Results Presentation at ITS World Congress
November 2001	Presentation of Draft Evaluation Report to Test Site Participants
December 2001	Video/Digital Photo Record
December 2001	Draft ITS National Architecture Implications Summary Report
January 2002	End of Evaluation Briefing to Interested Parties at USDOT
January 31, 2002	Final Evaluation Report, Final National Architecture Implications Summary Report