

# Puget Sound Regional Council

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## PUGET SOUND REGIONAL INTELLIGENT TRANSPORTATION SYSTEMS INTEGRATION STRATEGY

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in association with:

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# Table of Contents

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<b>1</b>	<b>Introduction .....</b>	<b>1</b>
1.1	Project Overview .....	1
1.2	Purpose of Document.....	1
<b>2</b>	<b>Development of Integration Strategy.....</b>	<b>2</b>
2.1	Identified Transportation Needs .....	2
2.2	Stakeholder Outreach .....	3
2.3	Existing and Planned Systems .....	4
2.4	Summary of Findings .....	8
<b>3</b>	<b>Integration Strategy Components.....</b>	<b>9</b>
3.1	Smart Trek ITS Backbone .....	9
3.2	Center-to-Center Connections.....	10
3.2.1	<i>ITS Standards-Based .....</i>	<i>11</i>
3.2.2	<i>Why Two Ways to Exchange Information?.....</i>	<i>15</i>
3.2.3	<i>Traditional Information Exchange Paradigm .....</i>	<i>15</i>
3.3	Transit Agency Integration .....	16
3.4	Emergency Management Links .....	18
3.5	Commercial Vehicle Operations .....	20
3.6	Information Service Provider Accommodation.....	20
3.7	Other Users and Providers of Transportation Data .....	21
3.8	Archived Data Management.....	23
<b>4</b>	<b>Summary of Integration Strategy .....</b>	<b>24</b>
4.1	Traffic Management .....	24
4.2	Transit Management .....	25
4.3	Emergency Management .....	26
4.4	Commercial Vehicle Operations .....	27
4.5	Other Transportation Related Organizations.....	28
4.6	Information Service Providers .....	29
4.7	Archived Data Management.....	30
<b>5</b>	<b>Challenges to Integration .....</b>	<b>32</b>
5.1	Traffic Signal Control Legacy Systems.....	32
5.2	Multiple DSRC Protocols.....	32

## Table of Contents (Cont'd)

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5.3	Railroads .....	33
5.4	Communications Infrastructure.....	33
5.5	Ongoing Resources for Operations and Maintenance.....	33
<b>6</b>	<b>Conclusion.....</b>	<b>34</b>

## 1 INTRODUCTION

### 1.1 Project Overview

The Puget Sound region has been at the forefront of deploying intelligent transportation system (ITS) applications. Until the Seattle Model Deployment Initiative – Smart Trek, the majority of ITS applications in the region had primarily served the interests of individual state, regional, county and local jurisdictions and modes. The Smart Trek project led the effort to link and integrate these various applications into a comprehensive, integrated transportation management and information system. This project builds upon these past efforts to define the technical and institutional relationships among transportation related organizations to move these separated systems into an integrated whole.

The National Intelligent Transportation Systems (ITS) Architecture was developed for the U.S. Department of Transportation (US DOT) to serve as a common framework for planning, defining, and integrating intelligent transportation systems. Specifically, this project is developing the Regional ITS Architecture and Integration Strategy for the Puget Sound region to provide for the continued development and integration of the area's ITS infrastructure.

The development of the Regional ITS Architecture and Integration Strategy is also necessary to meet The Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21) requirements, which states that all ITS projects using federal funding must “conform” to the National ITS Architecture. A recent Notice of Proposed Rule Making (NPRM) issued on May 25, 2000 will implement the TEA-21 requirements. The US DOT NPRM for the new Section 1410.322 (b) (11) under 23 CFR Part 1410 would require the development of a regional ITS integration strategy. As defined in the Section 1410.322 (b) (11), ITS integration strategy means a systematic plan for coordinating and implementing ITS investments funded with highway trust funds to achieve an integrated regional transportation system.

### 1.2 Purpose of Document

This document presents a recommended regional ITS Integration Strategy for the Puget Sound Region. The next section of the document summarizes the approach employed in the development of the strategy. The individual components of the strategy are presented in Section 3 and a full summary is found in Section 4. Challenges to integration are discussed in Section 5. The final section presents conclusions and next steps.

## 2 DEVELOPMENT OF INTEGRATION STRATEGY

The development of the Puget Sound Regional ITS Integration Strategy is based on the following approach:

- Build upon the work of the Metropolitan Transportation Plan (MTP).
- Engage stakeholders to define needs.
- Examine existing and planned ITS systems and applications.
- Define an integration strategy to merge these multiple systems into an integrated whole.

### 2.1 Identified Transportation Needs

The first step in developing the Regional ITS Architecture is to understand the regional transportation needs in the Puget Sound area. The Metropolitan Transportation Plan (MTP) identifies the regional transportation issues and needs, and points the way to potential ITS based solutions. MTP policies were compared to user services defined by the National ITS Architecture to determine how ITS can address the previously defined regional goals and transportation needs.

The overall adopted transportation policy for the region is to “develop a transportation system that emphasizes accessibility, includes a variety of mobility options, and enables the efficient movement of people, goods and freight, and information.”<sup>1</sup> Specific policies that can be fostered by the deployment of ITS applications include:

- Promote convenient intermodal connections between all elements of the regional transit system (bus, rail, ferry, air) to achieve a seamless travel network, which incorporates easy bike and pedestrian access.
- Promote efficient multimodal access to interregional transportation facilities such as airports, seaports, and inter-city rail stations.
- Support transportation system management activities, such as ramp metering, signalization improvements, and transit priority treatments, to achieve maximum efficiency of the current system without adding major new infrastructure.
- Promote demand management and education programs that shift travel demand to non-single occupant vehicle travel modes and to off-peak travel periods, and reduce the need for new capital investments in surface, marine and air transportation.
- Support transportation system management programs, services, and facility enhancements, which improve transit’s ability to compete with single-occupant vehicle, travel times.
- Support opportunities to use advanced transportation and information technologies, which demonstrate support for regional growth and transportation strategies.

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<sup>1</sup> Puget Sound Regional Council Web Site, 2020 Policies,  
<http://www.psrc.org/projects/vision/2020policies.htm#transportation>

- Promote and support the development of arterial HOV lanes and other transit priority treatments in urban areas to facilitate reliable transit and HOV operations.
- Improve intermodal connections between high capacity transit stations, (including ferry terminals, rail stations, and bus centers), major transfer points, and the communities they serve, primarily through more frequent and convenient transit service.
- Support opportunities to redevelop the road system as multi-modal public facilities, which accommodate the needs of pedestrians, cyclists, transit, high-occupancy vehicles, automobiles, and trucks.

## 2.2 Stakeholder Outreach

Two stakeholder advisory groups provided guidance and direction for this project. The Regional ITS Advisory Panel fulfilled this role for the development of the overall Regional ITS integration strategy and architecture. The Advisory Panel consists of representatives from federal, state, county, and local transportation agencies and private sector organizations engaged in providing transportation services and consulting. The Regional Transit Technology Group (RTTG) performed this function for the development of the more detailed transit architecture. The RTTG includes members from all the regional transit agencies.

Besides the dialogue with the Advisory Panel, the following discussion group meetings were held with key stakeholder groups:

- Freight Systems Improvement Team
- Traffic Control System Managers
- Emergency Management Coordinators
- Advanced Traveler Information System Developers
- Regional Transit Technology Group

The purpose of these meetings was to collect and summarize information about agency roles and responsibilities, identify and discuss operational issues, and identify the potential future need for operational and technology agreements. The discussions were also used to confirm and gather additional information about existing systems and confirm plans for the expansion of existing systems and/or the deployment of new ITS systems.

The five discussions groups were held to inform the members of these groups about the regional architecture project and to seek input to help shape the planning process. While the discussion group members represented a wide-range of interests and levels of familiarity with ITS, there were several over-arching themes – or gaps identified in the current ITS system – that emerged from all the groups, which were consistent across most sessions. The detailed results are contained in the Puget Sound Regional ITS Architecture Discussion Groups Summary, May 8<sup>th</sup>, 2000.<sup>2</sup>


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<sup>2</sup> Prepared for Puget Sound Regional Council, Puget Sound Regional ITS Architecture - Discussion Groups Summary, Prepared by Pacific Rim Resources, May 8, 2000

In addition, briefing sessions with transportation system managers were conducted with representatives from cities, counties, WSDOT, and transit agencies to gather their input and to determine their acceptance of the recommended integration strategy.

### 2.3 Existing and Planned Systems

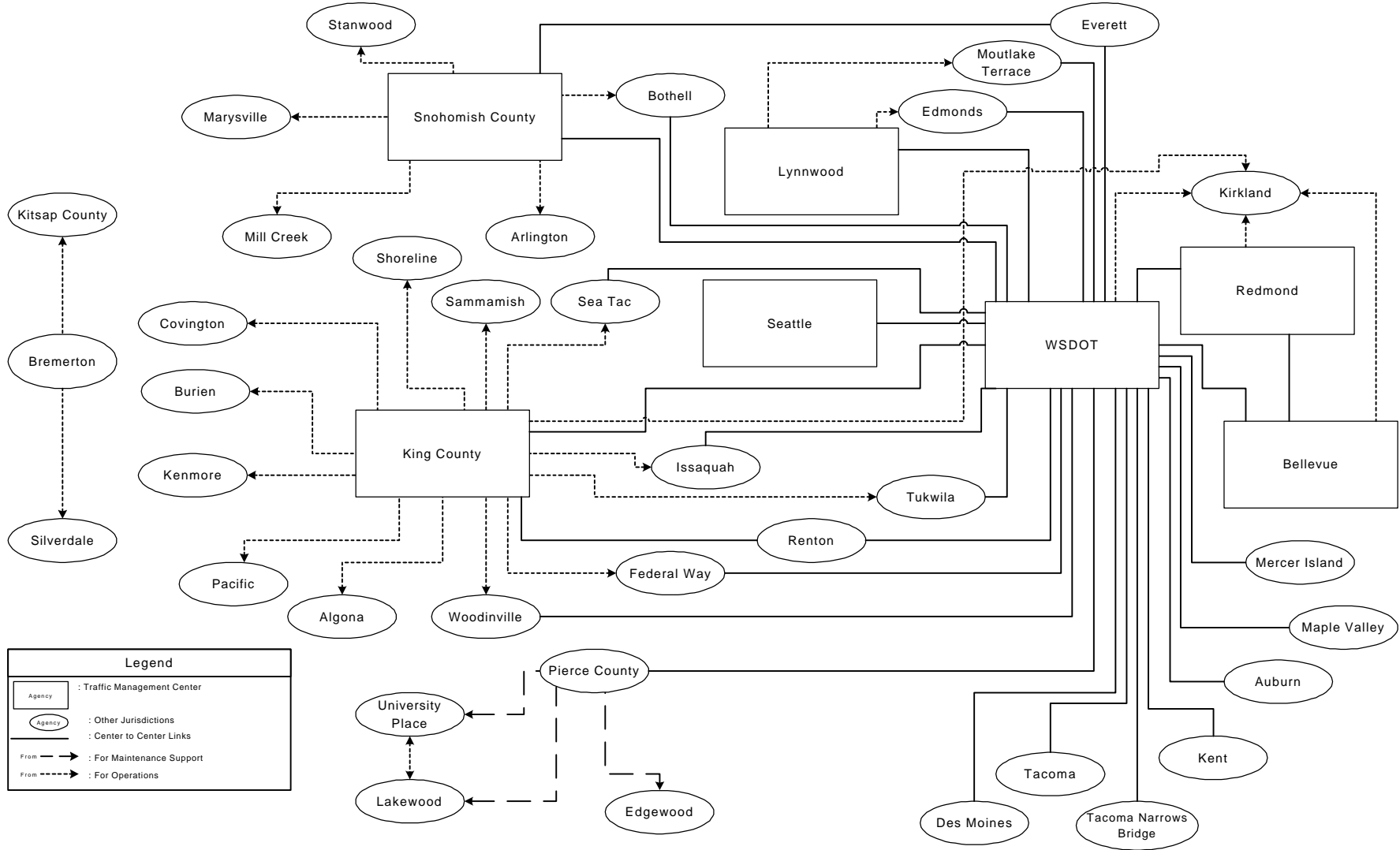
A baseline inventory of existing and planned ITS activities in the region was compiled. The inventory identifies what ITS work has already been done, and discovers other needs or issues that should be incorporated into the planning process through discussions with key ITS stakeholders. From this effort, information collected formed part of the basis for developing both the Regional ITS Architecture and Integration Strategy. For this project, a Regional ITS Survey was distributed to the agencies within the region and supplemented by interviews. A database of existing and planned ITS applications was compiled. Significant regional ITS initiatives that are multi-jurisdictional and/or multi-modal, affect regional integration of ITS systems, and directly support national interoperability include:

- **WSDOT Freeway Management System:** Washington State Department of Transportation (WSDOT) operates an extensive freeway traffic management system for the Puget Sound region. The traffic management system includes vehicle detectors, Closed Circuit Television (CCTV) cameras, ramp meters, variable message signs, and highway advisory radio. Most of the field equipment is linked through a fiber optic communications network. It provides the data for the traffic congestion map as well as the video for the camera snapshots that are available over the World Wide Web. The system is controlled from two-linked traffic system management centers (TSMC), one in Shoreline and the other in Tacoma. Coverage for the remainder of the regional freeways and other controlled access facilities is planned for the future.<sup>3</sup>  

- **Traffic Operations Centers:** Beyond the WSDOT managed TSMCs, cities and counties through out the region have or are building traffic operations centers to house advanced, centralized traffic signal control centers. These centers are being established with the capabilities to monitor traffic conditions with CCTV cameras and roadway traffic surveillance equipment and facilitate the implementation of transit signal priority. Existing and planned centers are shown in Figure 2.1.

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<sup>3</sup> WSDOT Northwest Region Web Site, <http://www.wsdot.wa.gov/PugetSoundTraffic/future.htm>

Figure 2.1: Existing and Planned Traffic Management Links



- **Regional Advanced Transportation Management System (ATMS):** WSDOT is also leading a project to provide electronic connections between WSDOT TSMC in Shoreline with traffic signal control systems operated by local and county jurisdictions in King and Snohomish Counties. This effort began as the North Seattle ATMS and as expanded to include jurisdictions in eastern and southern King County. This project will deploy the first center-to-center interface using the emerging National Transportation Communications for ITS Protocol (NTCIP) standard between WSDOT and Bellevue.
- **Traffic Operations Center-to-Center Links:** Figure 2.1 illustrates the existing and near-term planned electronic links among regional traffic operations centers. These include the links planned under the Regional ATMS effort.
- **Traffic Signal System Operations:** Figure 2.1 also depicts the significant number of traffic signal systems that are operated by one jurisdiction (usually a county) for other jurisdictions. This cross-jurisdictional responsibility is enabling the implementation of arterial corridor management strategies.
- **Smart Trek:** In response to the U.S. DOT request for participation in the ITS Metropolitan Model Deployment Initiative (MMDI), WSDOT entered into a partnership with public and private organizations to implement ITS solutions. This partnership was named Seattle Smart. The project assists travelers in making informed choices as they plan and make trips in the Puget Sound region. Major improvements to traffic and transit management systems were implemented that increased the safety and efficient use of roads and transit. The \$17.9 million project involved 25 different public and private organizations and included 25 interrelated projects. One significant outcome of the effort was the deployment of the Smart Trek web site that serves as a summary and portal for traveler information in the region.
- **511 Three-Digit Traveler Information Telephone Number:** The Federal Communications Commission (FCC) has designated 511 as the new telephone number for traveler information across the country. This number is designed to be the single telephone number for obtaining traveler information for all modes. Jurisdictions within the Puget Sound region have begun a cooperative process to transition the multiple transportation information numbers in the region to this one number.
- **ITS Backbone:** As part of the Smart Trek project, a common standard and facility for the real-time sharing of traveler information among jurisdictions was established. Information from the WSDOT freeway management system and King County Metro bus location information are available on the ITS Backbone. A more detailed discussion of the backbone is found in Section 3.1.
- **Transit Fare Coordination:** A joint effort among the region's seven transit agencies are in the process of planning and designing the implementation of a regional smart card fare collection system for the Puget Sound region. The card will operate across a variety of modes (bus, commuter rail, light rail, and ferries), and provide stored value, period pass, and other fare payment functions.
- **Transit Traveler Information:** The region's transit agencies have been cooperating on a joint project to build an automated transit schedule and route information system that provides each of the transit agencies with information for all transit systems. The

Regional Automated Trip Planning (RATP) links Pierce Transit, Community Transit and King County Metro.

- **Transit Signal Priority:** In cooperation with cities, counties and WSDOT, transit agencies throughout the region have been implementing the capability to provide transit vehicles with priority at traffic signals. Pierce and Kitsap Counties are deploying infrared bus detection technology and Snohomish and King Counties are using radio frequency based automatic vehicle identification (AVI) transponders. The building of at-grade light rail transit in the region will expand the deployment of transit signal priority.
- **CVISN:** WSDOT is implementing the national Commercial Vehicle Information Systems and Networks (CVISN) to enhance safety for drivers and trucks and to improve the operating efficiencies for both government agencies and motor carriers. One aspect of the project allows trucks with proper credentials and the correct weight to by-pass weigh stations. AVI transponders are used to identify trucks and provide a key to a roadside database to check credentials. A weigh in motion (WIM) sensors measures the weight of the truck. The dedicated short-range communications (DSRC) protocol and data exchange content of AVI transponders used by commercial vehicle roadside and on-board subsystems differs from that used by transit properties. The two operational domains are distinct and separate.
- **Electronic Border Crossing:** WSDOT is implementing a US-Canada electronic border clearance for commercial vehicles carrying cargo from the Port of Seattle. The same AVI technology and DSRC protocol that are used for the weigh station bypass program are deployed here.
- **Intermodal Freight:** WSDOT has begun a project to develop a means for integrating intermodal data at the Port of Seattle. This local effort and other national efforts could provide a model for future deployments. The DSRC protocol and data exchange content used for cargo seals is different than both that of commercial vehicle and transit subsystems deployed in the region. The cargo seals are primarily a freight pre-clearance and logistical tracking system that is related to CVO, and distinctly separate from transit systems. The distinction between CVO the “vehicle” and CVO “the cargo” is also somewhat distinct such that separate legacy systems are acceptable, but migration to a single interoperable system would be preferred.
- **Electronic Toll Collection:** Several initiatives may result in the introduction of tolling or road pricing schemes in the region. These efforts include the construction of a parallel Tacoma Narrows Bridge, the recommended introduction of High Occupancy and Toll (HOT) lanes on I-405 or roadway pricing as a potential source of transportation funding. An electronic toll collection system will be deployed using a fourth DSRC protocol and data exchange content (e.g., transit, CVO, freight containers and toll collection). The purpose of the toll collection system is electronic commerce; this is different than that of commercial vehicle, transit, and cargo container subsystems deployed in the region such that separate legacy systems are acceptable. If it is desirable that the toll collection subsystem be able to collect probe data from passing commercial or transit vehicles or that trucks and transit vehicles are only required to use on transponder, then migration to a single interoperable system would be preferred.

## 2.4 Summary of Findings

Key trends and directions were identified during this needs assessment and inventory efforts. These included:

- Continuing trend toward deployment of ITS technology by cities, counties and WSDOT including the deployment of more formal traffic management centers.
- Transit agencies are working together on joint projects and looking for a more integrated approach for the provision of transit service. The implementation of the Sound Transit program is providing another opportunity for the regional transit agencies to work more closely together.
- Need and desire to share real-time travel condition information among agencies including video images and incident data.
- Need and desire to expand these interactions beyond the highway and transit agencies to others including commercial vehicle operations, emergency management, ports, railroads, transshipment facilities, etc.
- Emerging recognition that corridor and cross-jurisdictional coordinated transportation system control is desired in the medium-term (2 – 10 years).
- Need and desire to find more cooperative ways to disseminate information to the general public and other agencies.
- Emerging requirement for a regional ITS communications plan to provide the physical linkages demanded for linking transportation management centers.
- Lack of trained operations staff to manage and maintain new ITS applications, especially at the local level.
- Emerging need to develop arrangements and/or agreements among agencies to define roles and responsibilities for operations and maintenance.

### 3 INTEGRATION STRATEGY COMPONENTS

The recommended integration strategy should provide guidance for the region in the management and investment of ITS applications to achieve a regionally integrated system. Accordingly, the strategy must acknowledge the requirement to transition legacy systems, accommodate new systems and provide for links to other stakeholders. The complexity of the undertaking requires multiple activities and a phased approach to meet the overall objective of an integrated system. The recommended strategy can be summarized into the following elements:

1. Use the Smart Trek ITS Backbone as the initial mechanism for the sharing of real-time transportation system and other related information among jurisdictions and private information service providers (ISPs).
2. Transition to structured, emerging National Transportation Communications for ITS Protocol (NTCIP) center-to-center (C2C) interfaces among transportation management systems for the future sharing of information and device control coordination.
3. Continued sharing of common ITS applications and systems among regional transit agencies and build links to other traffic management and other information sources.
4. Build information interfaces between transportation management systems and emergency management centers.
5. Connect local commercial vehicle regulatory functions to the Washington State deployment of the Commercial Vehicle Information Systems and Network (CVISN).
6. Use Smart Trek as basis for the deployment of a regional multi-modal traveler information system (RMTIC) and the new three-digit traveler information telephone number (511) to provide basic traveler information to the general public.
7. Accommodate the electronic flow of information to private ISPs through the deployment of a common interface standard via the ITS Backbone.
8. Build electronic links to other transportation stakeholders including ports, rail operators, clean air agency, toll agencies, and freight management organizations.
9. Capture and archive real-time transportation system data for future analysis and to support transportation planning.

Each of these elements of the ITS integration strategy are discussed below.

#### 3.1 Smart Trek ITS Backbone

The Puget Sound region Smart Trek project was one of four metropolitan model deployment initiative (MMDI) projects sponsored by the U.S. Department of Transportation to demonstrate the integration of ITS technologies. A critical component of the Smart Trek project was the ITS Backbone. Developed by the University of Washington, the ITS Backbone provides a structured means to electronically share real-time data among organizations. The backbone is:

**FOR MORE INFORMATION**

Smart Trek  
<http://www.smarttrek.org/>  
 ITS Backbone  
<http://www.its.washington.edu/bbone/>  
 Self-Describing Data for Dummies  
[http://www.its.washington.edu/bbone/sdd\\_dummy.pdf](http://www.its.washington.edu/bbone/sdd_dummy.pdf)

- **Conceptually:** Provides a coordinated method that specifies how participants organize information flows (gathering, processing, and dissemination) from the data source to the final user.
- **Functionally:** Receives information from various organizations that wish to share data; redistributes information to processors, who process and add value; and give to other agencies or the traveler in the desired form.
- **Technically:** Provide a computer software system specification to be developed for and integrated into computer systems at each participating organization to run processes to allow for the sharing of information among the participating organizations via the Internet.<sup>4</sup>

The specification is based upon a concept called self-describing data. “Self-Describing Data (SDD) is an approach to transmitting and delivering data, such as transportation data, where a stream of actual data is prefixed with a set of data that “describes” it. This descriptive data can be anything. Yet the intent is to provide descriptive data that helps users, and applications, to understand the actual data that follows.”<sup>5</sup> SDD data stream consists of descriptive data, followed by a continuous stream of data. The descriptive data defines the data structure or "schema" of the data stream. When the content of the data changes the schema is updated and thus the application using the data is automatically informed of changes in the data stream. SDD is ideal for real-time or near real-time data such as WSDOT traffic loop sensor data, or the King County Metro Transit bus location data but is less effective for static or near-static sets of data such as a set of reports, or transit schedule data that is updated infrequently. The SDD protocols are available to the public at the ITS Backbone web site as well as any currently available data streams.

### 3.2 Center-to-Center Connections

Critical to the deployment of an integrated regional ITS system is the specification and development of electronic interfaces for the full exchange of system status information and control data. These interfaces enable the regional sharing of data and information for the purposes of situational awareness and for the future sharing of ITS devices among the transportation management systems operated by local, county, state and transit organizations. The regional acceptance of a standard interface specification would ease this deployment effort. There are at least two alternatives that would meet the needs of the Central Puget Sound region: ITS standards-based, or a traditional information exchange paradigm.

#### FOR MORE INFORMATION

US DOT Standards Web Page  
<http://www.its.dot.gov/standard/standard.htm>

ITE Standards Web Site  
<http://www.ite.org/standards/index.html>

NTCIP Web Page  
<http://www.ntcip.org/>

NTCIP Guide  
<http://www.ntcip.org/library/guide.asp>

<sup>4</sup> Seattle MMDI Integration Case Study: ITS Information Backbone, Presentation at the ITS America 9th Annual Meeting -- Washington, DC -- April 22, 1999 by John Collura, James Chang, and Mark Carter.

<sup>5</sup> Mark A. Whiting, Self-Describing Data for Dummies, Version 1.4, November 17, 1997.

### 3.2.1 ITS Standards-Based

Over the past several years, US DOT has been working to develop the National Transportation Communications for ITS Protocol (NTCIP) to organize and promote the development of consensus ITS standards. This effort is led by the NTCIP Joint Committee (NTCIP JC) bringing together standard development organizations including: the American Association of State Highway Transportation Officials (AASHTO), National Electrical Manufacturers Associations (NEMA), and the Institute of Transportation Engineers (ITE).

ITS standards are essential to achieve information sharing and operational consistency and interoperability between ITS systems in the Puget Sound region, and in the nation. Of particular interest is the NTCIP Center-to-Center (C2C) family of standards that provide both the rules for communicating (e.g., the profiles and protocols) and the vocabulary (e.g., the data elements, message structures and objects). These standards specify the design details that enable the development of ITS system-to-system and system-to-device interfaces that will implement consistent and interoperable regional ITS. Following these standards will allow electronic traffic and transit information and control equipment, and roadside devices of all types (e.g., message signs, ramp meters, etc.) from different manufacturers and transportation management centers to operate with each other as a regional system.<sup>6</sup>

Figure 3.2 depicts the NTCIP framework. This framework illustrates that there are five layers in the model, these include: Information, Application, Transport, Sub-network, and (physical media connection) Plant Levels. The middle three of these five levels loosely relate to the seven layers of the International Standards Organization (ISO) Open Systems Interconnect (OSI) reference model. The Plant Level is included as a reference to show the relationship to typical ITS field infrastructure. The figure shows the interface options at each level, these represent the choices that must be made during the specification development process. In general, there are NTCIP standards associated with each choice in the five layers illustrated, and there are NTCIP Profile standards that ease these choices by packaging the best choices for typical ITS implementations.

- **Information Level:** Information Profiles define the meaning of data and structure of messages, and generally deal with ITS information (rather than information about the communications network). This is similar to defining a dictionary and phrase list within a language. These standards are above the traditional ISO seven-layer stack.
- **Application Level:** Application Profiles define the rules and procedures for exchanging information data. The rules may include definitions of proper grammar and syntax of a single statement as well as the sequence of allowed statements. This is similar to combining words and phrases to form a sentence or a complete thought and defining the rules for greeting each other and exchanging information. These standards are equivalent to the Application, Presentation and Session layers of the seven-layer OSI protocol stack.

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<sup>6</sup> U.S. Department of Transportation, Intelligent Transportation Systems, Standards Fact Sheet, October 1999, AASHTO/ITE/NEMA TS 3.1, National Transportation Communications for ITS Protocol (NTCIP) Overview

- **Transport Level:** Transport Profiles define the rules and procedures for exchanging the Application data between point 'A' and point 'X' on a network. This includes any necessary routing, message disassembly/re-assembly and network management functions. This is similar to the rules and procedures used by the telephone company to connect two remotely located phones.
- **Subnetwork Level:** Subnetwork Profiles define the rules and procedures for exchanging data between two 'adjacent' devices over some communications media. This is equivalent to the rules used by the telephone company to exchange data over a cellular link versus the rules used to exchange data over a twisted pair copper wire.
- **Plant Level:** The Plant Level is shown in the NTCIP Framework as a means of providing a point of reference to those learning about NTCIP. The Plant Level includes the communications infrastructure over which NTCIP communications are intended. The NTCIP standards do not prescribe any one media type over another.<sup>7</sup>

The typical center-to-center links would follow the paths on the left side of the diagram. At the information level, significant progress has been in the development of a traffic management data dictionary<sup>8</sup> and message sets for traffic management center communications.<sup>9</sup>

The use of NTCIP provides two alternative protocol choices for center-to-center communications at the application level. One is Data Exchange (DATEX) and the other is an ITS adaptation of the industry standard Common Object Request Broker Architecture (CORBA). These two different protocols are suggested to meet the variety of requirements for inter-system data exchanges. It is feasible to use both protocols in the same network, with some centers acting as a bridge, or translator, between the two. Each C2C connection will likely have different functional and policy-related requirements which will determine what type(s) of protocols are alternatives, and which of those is the “best” for that implementation. Factors that influence protocol choice include:

- Characteristics of systems to be linked (e.g., real-time, polled, etc.)
- Functions to be supported
- System life cycle considerations
- System performance
- Communications infrastructure and demand

Other issues that agencies must address when specifying and developing C2C communications links include: levels of security/access, location identification conventions, and device use conflict resolution. These issues should all be determined through operational agreements

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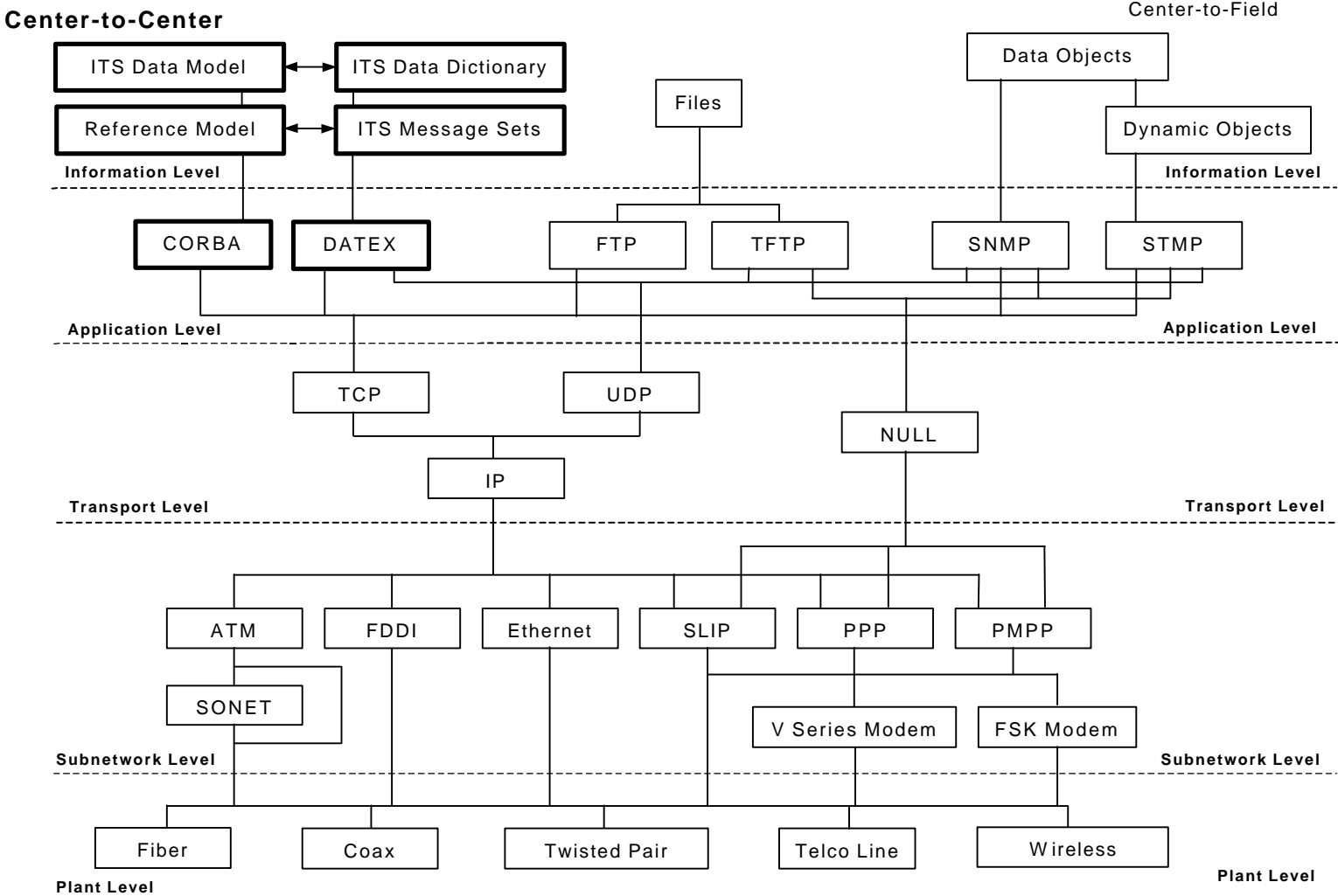
<sup>7</sup> American Association of State Highway and Transportation Officials (AASHTO), Institute of Transportation Engineers (ITE), and National Electrical Manufacturers Association (NEMA), THE NTCIP GUIDE - National Transportation Communications for ITS Protocol, September 1999

<sup>8</sup> U.S. Department of Transportation, Intelligent Transportation Systems, Standards Fact Sheet, September 2000, ITE-AASHTO TM1.03 (Draft) Standard for Functional Level Traffic Management Data Dictionary (TMDD)

<sup>9</sup> U.S. Department of Transportation, Intelligent Transportation Systems, Standards Fact Sheet, September 2000, ITE-AASHTO TM2.01 (Draft) Message Sets For External Traffic Management Center Communication (MS/ETMCC)

between participating agencies. Additional dialogue among the transportation management center operators and managers will be required before a choice is made for the Central Puget Sound region.

Figure 3.2: NTCIP Standards Framework



\* Not all combinations between the Subnetwork and Plant Levels are feasible.

Source: THE NTCIP GUIDE, September 1999

### 3.2.2 Why Two Ways to Exchange Information?

The implementation of an NTCIP-based, computer system to computer system, electronic data transfer link offers a formal, structured approach to connecting to transportation management systems. Its structure and intent is to provide a means for closely coupling transportation management systems together to allow for the sharing of all levels of information and data down to the details of device status and transportation system data (volume, occupancy, bus location), and offers the potential for sharing control of equipment installed along the roadways (dynamic message signs, etc.). This type of relationship would require the establishment of a formal agreement between the two center organizations for sharing this level of detailed information. The software development effort required to establish an NTCIP electronic data transfer link (i.e., the interface) is a significant undertaking. The data or information exchange processes that are required to access each system must be developed in compliance with the NTCIP standards. But once an NTCIP-compliant interface is developed, then other organizations can easily be linked via the regionally defined standardized interface. Implementation would occur over time most likely as each organization upgrades existing legacy systems, or installs a new center-to-center based transportation management system.

### 3.2.3 Traditional Information Exchange Paradigm

The ITS Backbone is a Smart Trek legacy subsystem and is an example of a traditional information exchange paradigm—in essence it is an on-demand computer-to-computer over inter-network communications path. The backbone provides a less formal approach for sharing real-time information without the development of a formal agreement among jurisdictions. The ITS Backbone is a mechanism to exchange real-time or dynamic data through the use of sound principles of information sciences and engineering—more specifically, the backbone receives and redistributes a self-describing data stream. Each regional data source and jurisdiction would be free to send any data or information through the backbone that they are willing to share with others. They are also able to receive and use data and information that is sent by others through the ITS Backbone for their applications. However, with the exception of internal encoding of “objects” and the definition of some data elements, the legacy ITS Backbone is not currently NTCIP-compliant. The participating sender/receiver systems could share NTCIP-compliant data or message structures via the backbone, but the ITS Backbone as a collector-redistributor mechanism is essentially unaware that this is happening.

The application software to implement the transmitter and/or receiver interface to the ITS Backbone is available free from the University of Washington web site (see sidebar Section 3.1). This software is both platform and operating system independent, and enables rapid application development and regional integration for data sharing. Thus, the continued use of the legacy ITS Backbone would speed the regional sharing of transportation and travel information while the more formal NTCIP interfaces are developed over time.

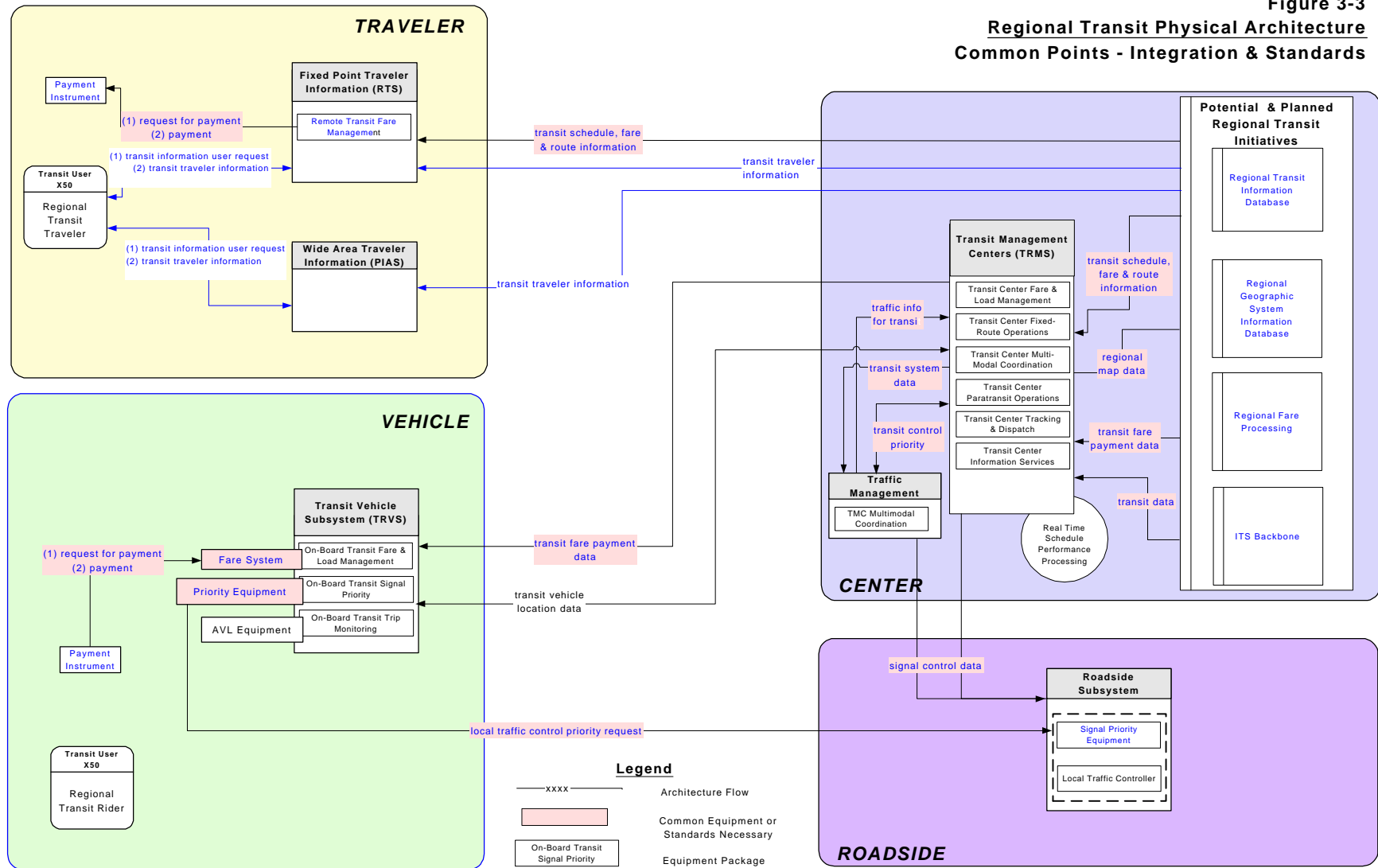
Finally, with the anticipated growth of wireless devices, the demand for real-time transportation information should increase. The use of the ITS Backbone would provide a single connection point for private sector information service providers (ISPs) to access for real-time information. The alternative is that private sector ISPs will be contacting every jurisdiction for information.

### 3.3 Transit Agency Integration

Working with the Regional Transit Technology Group, opportunities for integration and interoperability of transit ITS elements were identified. These opportunities were explored with each of the transit service providers in the Central Puget Sound Region, as well as with Washington State Ferries. Figure 3.3 illustrates the common points where compatible equipment, or standards, can provide the opportunity to achieve regional integration and inter-operability of transit ITS services. The identified opportunities for integration and inter-operability can foster enhanced provision of passenger services, while achieving costs efficiencies for transit service providers implementing, operating, and maintaining ITS.

1. **Transit Signal Priority:** A common standard for both roadside and bus TSP equipment will ease deployment for areas that are served by multiple transit agencies.
2. **Transit Fare Management:** The regional Smart Card program will allow customers to use one fare card on multiple systems. The current plans for the Smart Card will support the implementation of an integrated fare system across the region.
3. **Transit Data Management:** The individual transit management systems for each agency could provide transit system data for analysis and planning purposes.
4. **Transit Traveler Information:** The Regional Automated Trip Planning (RATP) project is the beginning of a regional transit information system.
5. **Geographic Information Systems:** Currently, there is not a common GIS for the region. As the regional sharing of information and data grows, a common GIS based referencing system will be desired.

**Figure 3-3**  
**Regional Transit Physical Architecture**  
**Common Points - Integration & Standards**



### 3.4 Emergency Management Links

Police, fire, and other emergency management agencies are responsible for responding to a wide range of incidents and events on the highway system. They also have special demands on the transportation network for priority treatment when responding to emergencies.

Emergency response agencies are working with local traffic management agencies to deploy emergency vehicle signal preemption in many jurisdictions across the region. While this offers an opportunity to establish a dialogue between the traffic and emergency management agencies, it generally does not lead to the future collaborative efforts. Also the activities usually only involve one jurisdiction.

#### FOR MORE INFORMATION

US DOT ITS Public Safety Program  
<http://www.its.dot.gov/pubsafety/index.htm>

ComCARE Alliance – Communications for Coordinated Assistance and Response to Emergencies  
<http://www.comcare.org/>

ITS for CVO Emergency Response

Operation Respond  
<http://www.avalon-ais.com/itscvo/emerg.htm>

Both transportation management and emergency management agencies could benefit from the development of formal arrangements for the coordinated management of incidents during daily operations and especially during major construction projects. This activity would be greatly enhanced by the electronic sharing of information concerning incident and transportation system conditions. Many jurisdictions across the country have developed coordinated strategies for incident management for heavily traveled corridors and major construction projects. A pre-planned, coordinated approach to managing incidents addresses the key components of:

#### Incident Detection and Verification

- Incident Response
- Incident Site Management
- Traffic Diversion
- Incident Clearance
- Incident Information Sharing
- Motorist Information Dissemination

Development of a successful systematic approach requires:

- Definition of the Problem (Existing Conditions)
- Establishment of Goals and Objectives
- Development of Alternative Strategies for Each Segment
- Evaluation of Alternative Strategies
- Evaluation of Technology Alternatives
- Development of Management System Guidelines and Operations Manual
- Implementation of Selected Strategies
- Refinement of the Approach Based upon Experience

Success is dependent on a strong, inter-agency planning process. All agencies that respond to incidents must be involved in program development to ensure that the program meets their needs and will be implemented in a coordinated partnership. A coordinated planning process should include management and response personnel from all affected agencies representing:

- Engineering and Maintenance (State, County and Local transportation agencies)
- Law Enforcement (State Police, county sheriffs, and local police)
- Fire/Rescue (local fire and rescue units, private tow companies)
- Emergency Medical (hospitals, ambulance services, etc.)

The incident management planning process would provide an excellent opportunity to build relationships among traffic and emergency management agencies and identify what technologies and data linkages could best benefit both types of organizations. Organizations like the ComCARE Alliance could provide assistance in gathering the needed stakeholders together. ComCARE is a broad-based national coalition of more than 50 organizations that includes nurses, physicians, emergency medical technicians, 911 directors, wireless companies, public safety and health officials, law enforcement groups, automobile companies, consumer organizations, telematics suppliers, safety groups, and others who are working to encourage the deployment of life saving wireless communications networks and technologies that will more efficiently connect America's mobile public to emergency agencies.<sup>10</sup>

Many of the major freeway corridor studies have recommended the development of coordinated Incident Management Plans to address the congestion resulting from incidents both during and after.

An excellent example of sharing information in the Puget Sound region is the direct link between the WSDOT Traffic Systems Management Centers and the Washington State Patrol (WSP). WSDOT provides WSP with access and control to freeway CCTV cameras and freeway condition data. WSP provides WSDOT with real-time incident information from their computer aided dispatch (CAD) system. Opportunities for building on this success should become available as 911 (public service answer points) upgrade their systems to accommodate the cellular phone location technology and as emergency response agencies upgrade or implement CAD systems. Emerging standards may provide a future direction or the ITS Backbone could be used to provide a means to electronically share incident information from these upgraded 911 and CAD systems.

These links to other emergency management organizations should be developed over time. Unfortunately, the national dialogue to determine the nature of the relationship between ITS and emergency management is just beginning. Jurisdictions in the region should look for opportunities to share information and build relationships. The electronic linking of these two functional areas is a longer-term goal.

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<sup>10</sup> ComCARE Alliance web site: <http://www.comcare.org/what.htm>

### 3.5 Commercial Vehicle Operations

Individual jurisdictions throughout the region regulate and permit the movement of commercial vehicles on their highway network. Permits are issued by each local jurisdiction with limited coordination with other local jurisdictions or state regulatory agencies. The bulk of commercial vehicle regulatory activity occurs at the state level where responsibilities are shared among WSDOT, WSP, and the Department of Licensing. To add to the complexity, trucks that travel outside the state are subject to the regulations of the states in which they travel.

**FOR MORE INFORMATION**

Commercial Vehicle Information Systems and Networks (CVISN) Web Site

<http://www.avalon-ais.com/itscvo/cvisn.htm>

Johns Hopkins University Applied Physics Laboratory CVISN Program

<http://www.jhuapl.edu/cvisn/>

Introductory Guide To CVISN

<http://www.jhuapl.edu/cvisn/downdocs/#general>

The US Department of Transportation, Federal Motor Carrier Safety Administration (FMCSA) has embarked on a program to called CVISN (Commercial Vehicle Information Systems and Networks). CVISN refers to the collection of information systems and communications networks that support commercial vehicle operations (CVO). “These include information systems owned and operated by governments, motor carriers, and other stakeholders. FMCSA’s CVISN program is not trying to create a new information system, but rather to create a way for existing and newly designed systems to exchange information through the use of standards and available communications infrastructure. The CVISN program provides a framework or “architecture” that will enable government agencies, the motor carrier industry, and other parties engaged in CVO safety assurance and regulation to exchange information and conduct business transactions electronically. The goal of the CVISN program is to improve the safety and efficiency of commercial vehicle operations”.<sup>11</sup>

The three agencies in Washington who are responsible for aspects of CVO are participating in the implementation of CVISN, which would include the eventual sharing of information with private fleet management systems. Local jurisdictions should be encouraged to take advantage of this national development information to gain access to relevant commercial vehicle regulatory information. Local agencies could be given access to the state’s CVISN system for inquiry purposes. In the future, an interoperable regional permitting and pre-clearance system should be an operational deployment goal.

### 3.6 Information Service Provider Accommodation

Information service providers (ISP) collect, process, store, and disseminate transportation information to system operators and the traveling public.<sup>12</sup> There are two aspects to consider in developing the integration strategy for the region. First is the need to enable a publicly sponsored ISP that provides basic traveler information over technically stable information platforms. The

<sup>11</sup> Kim E. Richeson, Introductory Guide to CVISN (POR-99-7186) Preliminary Version P.2, February 2000

<sup>12</sup> US DOT, National ITS Architecture, Version 3.04

second is to provide a means to share information with private ISPs for the customized distribution of traveler information to their customers.

WSDOT transportation policy calls for the distribution of baseline traveler information to the general public. Currently, this is provided through the WSDOT web site and highway condition information telephone line. The information is not customized for individual travelers but rather provides an overall picture of current conditions. Regional transit agencies provide similar services. However, these sites do not, nor were they designed to be a single, common source for traveler information. Feedback from stakeholders in the region has revealed the need and desire for the establishment of a source for providing basic traveler information to the general public.

The recommended electronic data source is the expansion of the Smart Trek web site. Currently this web site is acting as a portal to the information provided by other transportation agencies and organizations in the region. Its role could be expanded in the future to incorporate information, specifically, on arterial roadways and also, from other transportation information sources as they become available.

**For More Information**

- Smart Trek  
<http://www.smarttrek.org/>
- ITS America – Traveler Information  
<http://www.itsa.org/traveler.html>
- AccuTraffic – [www.accutrafic.com](http://www.accutrafic.com)
- Traffic.com – [www.traffic.com](http://www.traffic.com)
- Etak Traffic – [www.etaktraffic.com](http://www.etaktraffic.com)
- Traffic Station – [www.trafficstation.com](http://www.trafficstation.com)

The distribution of traveler information via the telephone would be supported by the regional implementation of the new national three-digit traveler information number – 511. Each interactive voice response system deployed by each agency could be linked to this common number. This implementation would provide a very accessible source for traveler information.

Hardly a day goes by without the announcement of another product or alliance to provide real-time information services or equipment. Travel information is frequently mentioned as one type of desired information. There are already multiple private sector companies that provide traveler information for the Seattle area. As more wireless based services are deployed, the demand for more traffic information will increase. Many of these private ISPs will request access to real time information gathered by local, county, and state jurisdictions. The proposed integration strategy offers two approaches to making this link. One is through the use of the ITS Backbone. This would provide the private ISPs with one place to gather information. The second approach would be through direct links from the ISP to the individual jurisdiction. The strategy supports both approaches.

### 3.7 Other Users and Providers of Transportation Data

Several other types of organizations should be accommodated by the recommended regional integration strategy. They include the following:

- **Ports:** Ports in the Puget Sound region serve as hubs for multi-modal freight and goods movement. Ports deal with goods shipped by train, truck and vessel, which require high levels of transportation logistical coordination. Information concerning conditions on the highways and rail lines approaching the port, weather, incidents, and conditions at the port are of interest to users of the ports. WSDOT is currently managing several tests to

develop means for integrating intermodal regulatory data at the Ports of Seattle and Tacoma. This local effort and other national efforts will provide a model for expansion in the future. Vehicle congestion at the entrances to the terminals at the ports could require a more active approach to management in the future. The companies operating the terminals, water ports, airport and regional traffic management agencies will need to work together to deploy congestion management solutions over time.

**For More Information**

US DOT Intermodal Freight Web Site  
<http://www.its.dot.gov/ifreight/ifreight.htm>

WSDOT Intermodal Data Integration Project  
<http://www.wsdot.wa.gov/eesc/atb/atb/intermod.pdf>

Blue Ribbon Commission on Transportation  
<http://www.brct.wa.gov/>

Tacoma Narrows Bridge Project  
<http://www.tacomanarrowsbridge.com/>

- **Railroads:** Throughout the region there exist many at-grade highway rail intersection (HRI) crossings. Rail operators could provide information such as train schedules and train locations that will result in HRI closures. With access to this information, cities and counties will have the ability to implement advanced traffic control strategies or enhance traveler information minimize disruptions for highway vehicles. This information could be provided to travelers to allow better route choices to be made. The two major railroads operate national network operations centers and provide shippers with on-line information on the location of shipments and equipment. Efforts should continue in the region to develop means to gain access to this data.
- **Toll Administration:** The Tacoma Narrows Bridge, located on State Route 16, may in the future be equipped with a new toll plaza using both manual and high-speed electronic tolling collection. Vehicles will be equipped with automatic vehicle identification (AVI) technology. The Blue Ribbon Commission on Transportation has also recommended the implementation of congestion pricing which would employ the same technology. Links to these future and other potential toll operations should be developed.
- **Emissions Management:** The Puget Sound region may not be able to achieve current air quality standards in the future. Transportation related emissions data gathered by PSRC, Washington State Department of Ecology and the Puget Sound Clean Air Agency should be shared with transportation system managers to improve system operations and improve air quality.

### 3.8 Archived Data Management

As more transportation management systems come on line and are interconnected to share information, there will be an emerging opportunity to capture and archive real-time operational data and information for future analysis and planning. WSDOT already captures much of the information gathered electronically from the regional freeway system. Many local jurisdictions post traffic volume data on their web sites. The legacy ITS Backbone enables the extraction of real-time data for archive uses. The NTCIP C2C standards and Archive Data Management market packages further define the protocols, content and structure for the design and deployment of a uniform regional data archive system.

**For More Information**

US DOT Archived Data User Service (ADUS)  
Web Site

<http://www.its.dot.gov/TravelManagement/adus.htm>

Traffic Volumes on Major Routes and Ramps  
Within the Northwest Region

[http://www.wsdot.wa.gov/regions/northwest/NWFLOW/rmp\\_rdwy/mainindex.htm](http://www.wsdot.wa.gov/regions/northwest/NWFLOW/rmp_rdwy/mainindex.htm)

## 4 SUMMARY OF INTEGRATION STRATEGY

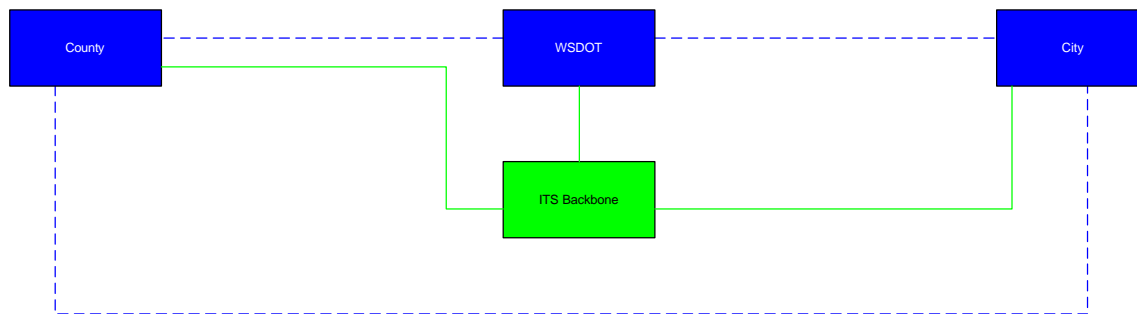
The previous section provided a component-by-component discussion of the recommended regional integration strategy. This section illustrates how each of these components fit together to provide, in time, an integrated ITS system for the region.

### 4.1 Traffic Management

Traffic management agencies include counties, cities, and WSDOT. Traffic management agencies monitor and manage traffic flow, identify and respond to incidents, and operate and maintain traffic operation center and roadside equipment. Each organization will deploy ITS applications to address the transportation problems on the portion of the highway network for which it is responsible. For example, WSDOT has focused on freeway management systems because of the high proportion of traffic that is served by the region’s freeway system. Cities like Bellevue, Seattle and Lynnwood with denser street networks have invested in centralized traffic signal control systems with interconnected signals. King and Snohomish Counties use closed loop traffic control system with dial-up capabilities because of the higher cost of interconnecting geographically separated roadways to a central location. All of these organizations work together to manage the highway system as it crosses jurisdictional borders. The recommended integration strategy offers a path to establish electronic links among all levels of governments to provide “seamless” roadway control and traveler information to the general public.

The communication interface between the traffic management centers operated by each agency should move toward the use of NTCIP based, center-to-center interfaces. These interfaces would allow data and status information exchange and enable shared control of roadway ITS components. Written agreements between agencies will most likely be required. Until NTCIP center-to-center links are implemented, it would be desirable for regional traffic management agencies share information through the ITS Backbone. The ITS Backbone would allow other traffic and transit agencies and travelers to have access to highway system status information from the traffic management agencies without a direct link with each individual traffic management agencies. Figure 4.1 shows the links between local, county, and state traffic management agencies and the ITS Backbone. Dashed lines are used to illustrate NTCIP center-to-center links. Solid links show the link to the Backbone.

Figure 4.1: Traffic Management Agencies



## 4.2 Transit Management

In general, transit service providers in the Central Puget Sound Region are responsible for the provision of a variety of transit services to customers as well as managing and maintaining vehicle fleets. To a limited extent, these transit service providers also coordinate operations with other transit service providers and other local and regional transportation service providers.

Integration and inter-operability of transit services will in part be fostered by enhanced center-to-center, and vehicle-to-center communications. This would be inclusive of interfaces between transit service providers, and other transportation services providers such as WSDOT and WSF. Interfaces among transit service providers and other transportation service providers could foster the exchange of operational data, as well as, allowing for the control of roadside equipment. This was recently the case in Lynnwood. Many intersections within the City of Lynnwood are being equipped for transit signal priority (TSP). A center-to-center agreement had to be formed between Lynnwood and Community Transit (CT) for linking the TSP Base Computer (located at CT) to the Lynnwood signal system. The agreement outlined what aspects of Lynnwood's system, Community Transit would have the ability to access, such as the sharing of TSP operational data and the ability to update signal control strategies required for granting transit priority.

Interfaces among transit service providers and other entities, such as agencies responsible for incident and emergency management, and ISP's also provide the opportunity to enhance the safety and efficiency of transit services in the Puget Sound Region. For example, operational data such as fares, on-time adherence, routes, schedules, and transfer options can be exchanged among transit service providers to enhance the efficiency of services provided to passengers. Further, information related to other agencies transit operations, special events, travel-time, incidents, weather, and pavement conditions could be exchanged among agencies to foster coordination and efficiency of services. In many cases, these data transfers could be handled using the ITS Backbone. The Backbone could act as a central location to provide these agencies and ISPs with a single access point to the information. Figure 4.2 builds on the previous diagram showing the links required with the addition of transit management agencies. Dashed lines are used to illustrate center-to-center links.

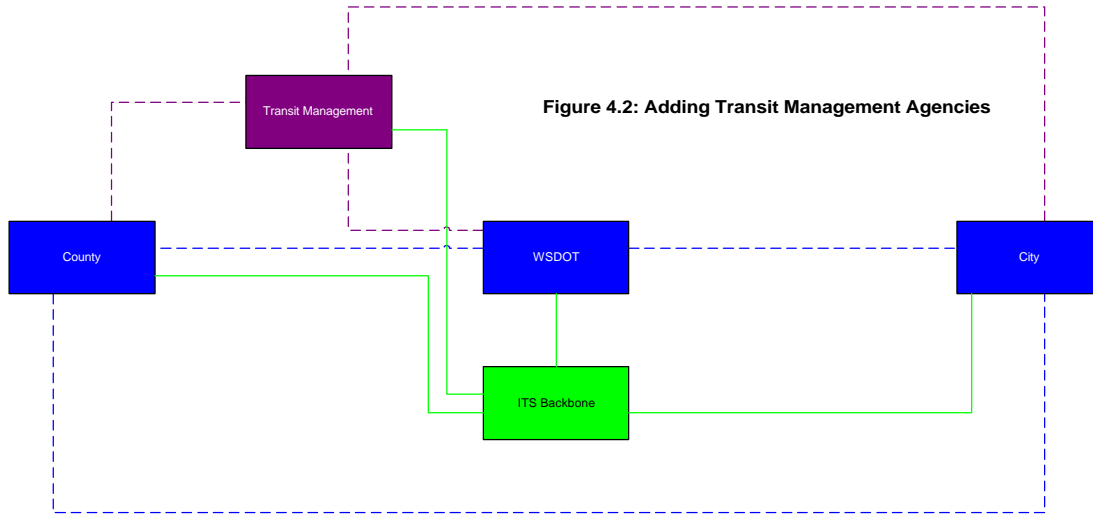


Figure 4.2: Adding Transit Management Agencies

### 4.3 Emergency Management

Emergency management services include police, fire, medical, search and rescue, tow trucks, transportation agency maintenance crews, courtesy patrols, and HAZMAT response teams. These organizations respond to incidents, accidents and other emergency on the roadway and transit network. Coordinated incident management strategies enhanced by the electronic sharing of information would result in timely response to and removal of incidents during daily operations and especially during major construction projects. Real-time traffic information received from other traffic management agencies could be used to aid the emergency dispatcher in selecting the emergency vehicle(s) and routes that will provide the timeliest response.

The integration strategy calls for the development of major corridor and construction project incident management strategies to facilitate the development of multi-agency relationships among emergency and transportation management organizations. The incident management strategies would define the type of information that should be shared and identify appropriate applications of technology to meet the identified needs.

Further, emergency management agencies could build upon the example set by WSDOT and Washington State Patrol (WSP) who electronically share freeway surveillance information from WSDOT’s CCTV cameras and sensors and WSP CAD data. Interfaces to the ITS Backbone could be developed for existing CAD systems or included as part of new CAD systems for the near-term. Full function center-to-center links could be developed as standards in this area developed. The following diagram (Figure 4.3) builds upon the previous diagram showing the additional links required for emergency management agencies. Dashed lines are used to illustrate center-to-center links that could be developed over time.

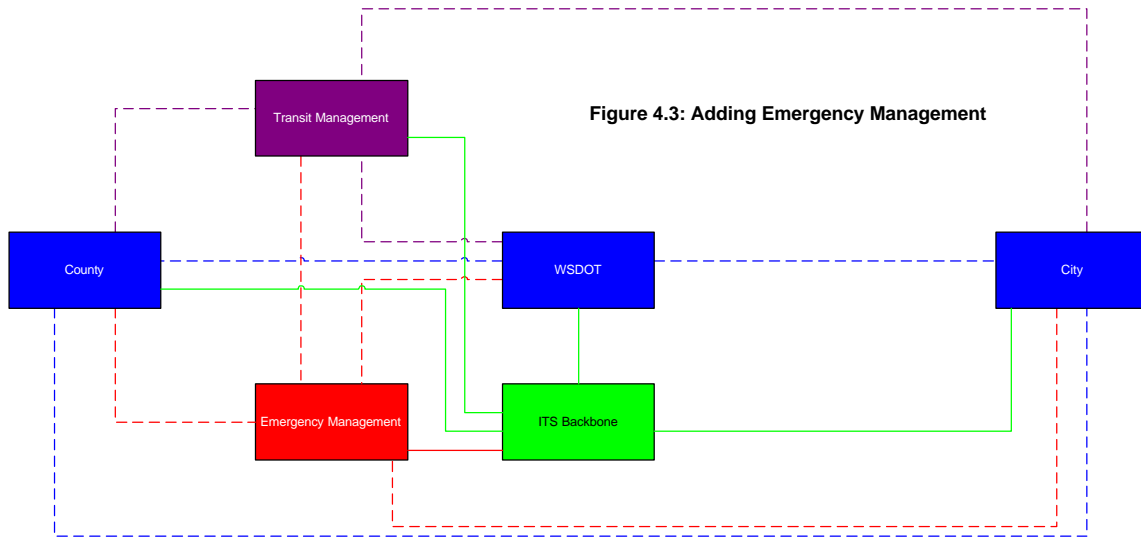


Figure 4.3: Adding Emergency Management

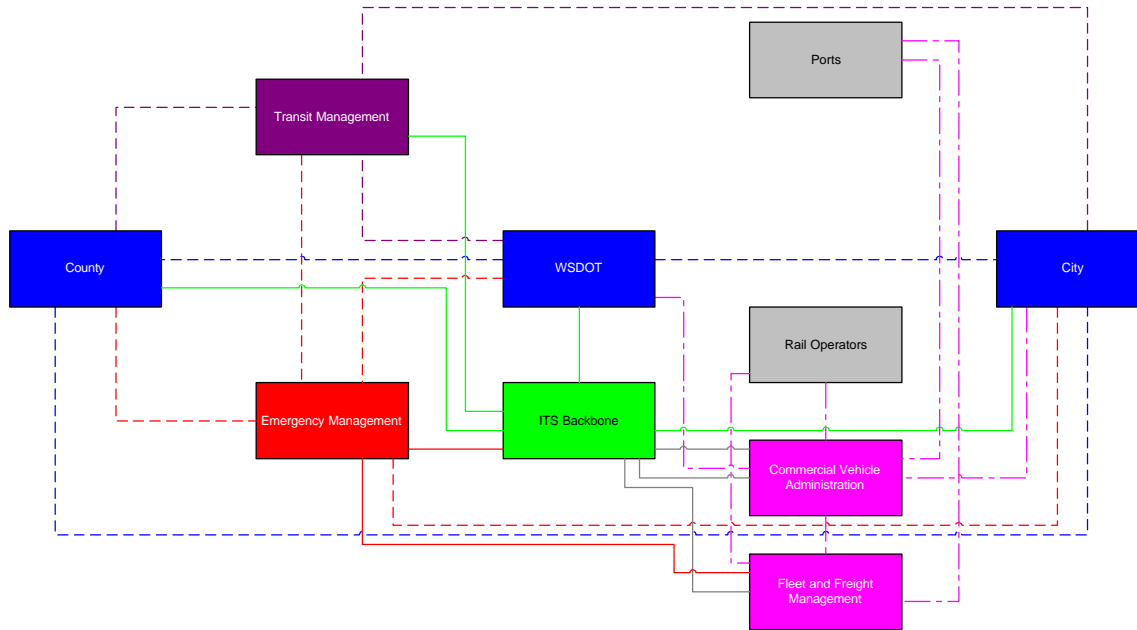
#### 4.4 Commercial Vehicle Operations

Commercial Vehicle Operations (CVO) address the movement, regulation and monitor of commercial vehicles. Two types of organizations are involved:

- Commercial Vehicle Administration:** Commercial vehicle operations (CVO) play a prominent role in the economy of the region. Making this process as efficient as possible is vital. The State of Washington is implementing the national Commercial Vehicle Information Systems and Networks (CVISN) to enhance safety for drivers and trucks and to improve the operating efficiencies for both government agencies and motor carriers (<http://cvisn.wsdot.wa.gov>). Information sharing with CVISN will improve local jurisdiction CVO functions.
- Fleet and Freight Management:** These primarily private organizations have three relevant informational requirements. The first is manage the routing and dispatching of their fleets. They would be potential users of traffic conditions, construction notices, and weather conditions that can be provided from traffic management centers, and ISPs. Secondly, private commercial vehicle operations are required to provide regulatory agencies with driver, vehicle, and cargo information. The national CVISN initiative will lead to the increased use of electronic data exchange between the regulatory agencies and the private trucking firms. Information on vehicle characteristics such as current weight, over dimensional loads, and safety data could also be made available electronically for sharing with all levels of government. Finally, fleet and freight management organizations are also concerned with the safety of their commercial vehicle drivers and fleet. These organizations could make HAZMAT cargo information available electronically to emergency response organizations. This later feature will develop overtime as national standards are established.

Both organizations could share information with Ports and Railroads. Figure 4.4 illustrates the addition of the CVO function to the regional integration diagram. Both the backbone and direct center-to-center links would be established. CVISN information would employ C2C links following the structure developed by the CVISN national deployment.

Figure 4.4: Adding Commercial Vehicle Operations



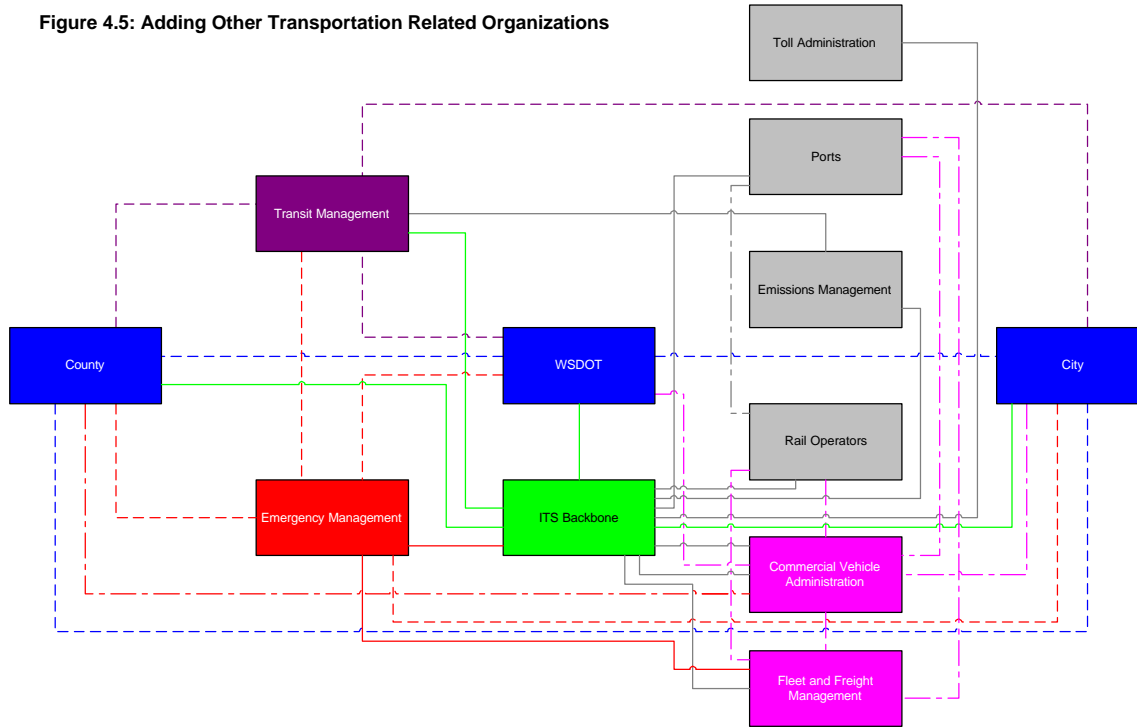
#### 4.5 Other Transportation Related Organizations

This group of organizations, represented in Figure 4.5, resides outside the realm of direct regional transportation system management, but can impact overall system performance. These organizations would interact with other agencies predominately on an information-sharing basis. Relevant regional organizations included:

- Port Authorities (Seattle, Tacoma, Everett, Bremerton, etc.)
- Railroads (BNSF, Union Pacific,)
- Toll Administration
- Emissions Management (Department of Ecology, Puget Sound Regional Council and Puget Sound Clean Air Agency)

Each of these organizations has a role in the region that could be enhanced or made more efficient by sharing information with other agencies. The ITS Backbone should be used as a means for gathering and distributing information between these organizations and other traffic, transit, and emergency management agencies. Figure 4.5 illustrates the addition of these organizations.

Figure 4.5: Adding Other Transportation Related Organizations



#### 4.6 Information Service Providers

ISPs repackage and provide information for distribution to users through a host of current and emerging technologies including the newer wireless devices. The ISP can play several different roles in an integrated regional system. In one role, the ISP provides a bridge between the various transportation systems that produce the information and the other ISPs and their subscribers that use the information. Another role of an ISP is focused on delivery of traveler information to subscribers and the public at large. In the Puget Sound Region, there are five types of ISPs: public, private, regional, 511, and ITS Backbone.

- Public ISP:** Many of the previously mentioned agencies operate web sites, fax broadcast networks, interactive phone systems, etc. These are examples of how public agency based ISP function allows these organizations to disseminate information to the general public. For example, WSDOT’s web site (<http://www.wsdot.wa.gov>) allows travelers to get information on traffic flow, road closures, and incident locations around the State of Washington. King County Metro web site (<http://transit.metrokc.gov>) is where travelers can find transit schedules, routes, and fares.
- Private ISP:** Private ISPs gather information from multiple sources and disseminate the value added information to their subscribers. Several collect their own traffic condition data and information. They might provide specific directions to travelers based upon origin and destination requests, generating least-time-based route plans, and returning the calculated plans to the users. In addition to general route planning for travelers, the Private ISP may also support specialized route planning for vehicle fleets including traffic and weather conditions. Private ISPs will be looking to regional agencies as primary sources of travel conditions.

- **Regional ISP:** Currently, the Smart Trek web site is providing a first step toward the deployment of a virtual regional multi-modal traveler information center (RMTIC). Currently this web site is acting as a portal to the information provided by other transportation agencies and organizations in the region. Its role could be expanded in the future to incorporate and process information, specifically, on arterial roadways and also, from other transportation information sources as they become available.
- **511:** The distribution of traveler information via the telephone would be supported by the regional implementation of the new national three-digit traveler information number – 511. Each interactive voice response system deployed by each agency could be linked to this common number. This implementation would provide a very accessible source for traveler information.
- **ITS Backbone:** The ITS Backbone, in essence, acts as a trusted ISP for the participating agencies by providing them with a single location for sending their information, which in turn is available for redistribution to both public and private ISPs. The Backbone would provide a single source of information for private ISPs.

The integration strategy allows for both direct connections to any organization and a link to the ITS Backbone. The following diagram (Figure 4.6) adds ISPs to the previous diagram showing the additional links required between ISPs and other agencies. Dashed lines are used to illustrate center-to-center links.

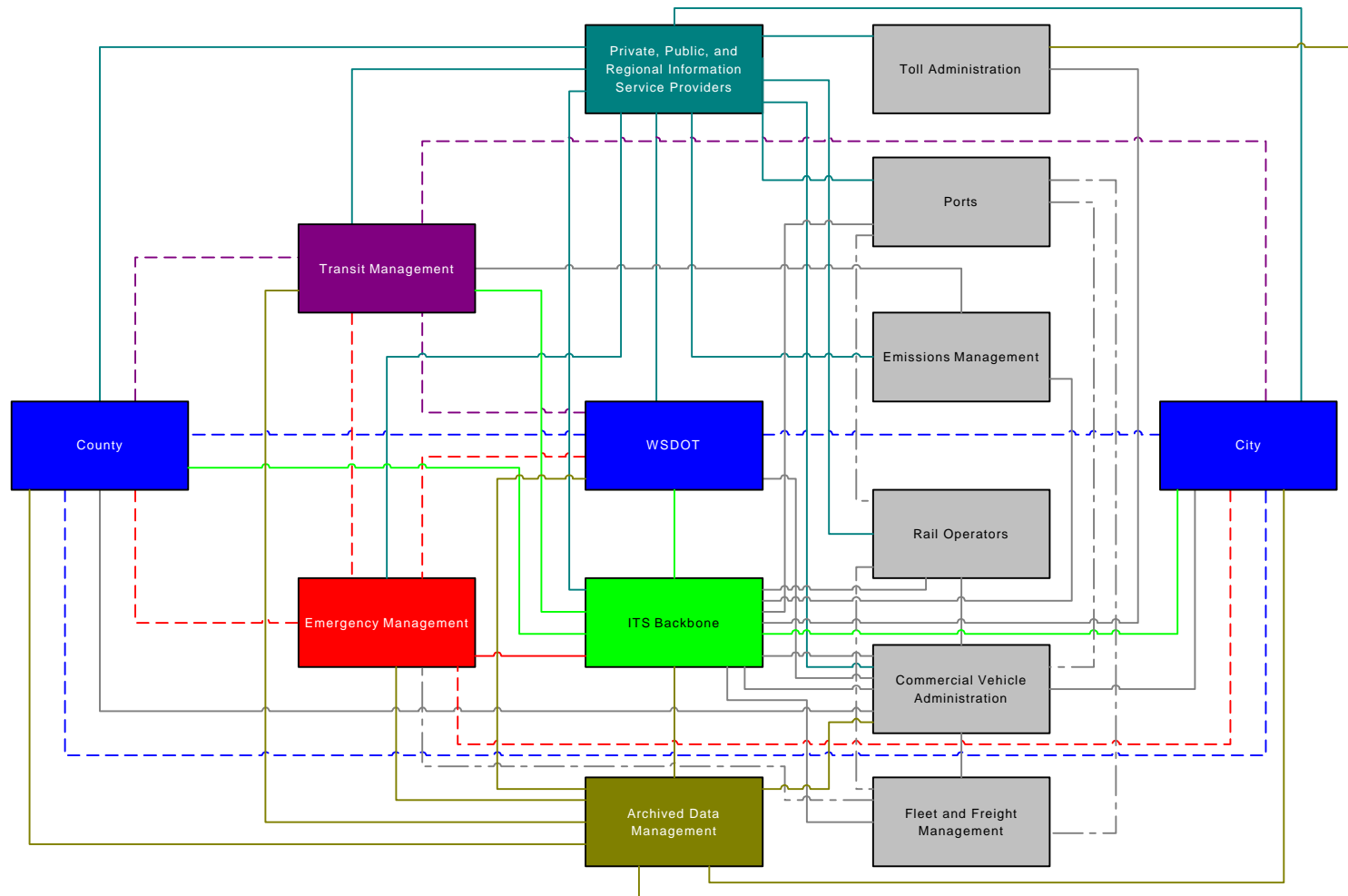
#### 4.7 Archived Data Management

The archived data management function collects, archives, manage, and distributes data generated from ITS sources for use in transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment, operations, and research applications. This function may reside within an operational center and provide focused access to a particular agency's data archives. Alternatively, it may operate as a distinct center that collects data from multiple agencies and source and provides a general data warehouse service for a region.

It may be desirable that each of the public sector agencies provides data to an archive data management function. This level of interaction could result in a significant burden to each of these organizations. The ITS Backbone could take some of that burden and support the archived data management function by allowing just one interface between the public sector/archived data management agency and the trusted ISP.

Figure 4.6 represents the completed recommended integration strategy diagram showing the additional links to and from the archived data management agency. Dashed lines are used to illustrate center-to-center links.

Figure 4.6: Puget Sound Regional Integration Strategy



## 5 CHALLENGES TO INTEGRATION

The recommended integration strategy will face several significant challenges as it is deployed. Many will be addressed as older systems are replaced and ITS standards are adopted. The ITS integration strategy provides a potential path to address these challenges which include:

- Traffic Signal Control Legacy Systems
- Multiple DSRC Protocols
- Railroads
- Communication Infrastructure
- Ongoing Resources for Operations and Maintenance

Each is discussed below.

### 5.1 Traffic Signal Control Legacy Systems

Traffic signal control systems represent a significant investment in center and field software, firmware, hardware and communications infrastructure. Often the choice of the initial supplier requires that future expansions and replacements be purchased from the same supplier to ensure compatibility. In the past, these systems were not generally designed as open systems that provided electronic links to other systems developed by different firms or the use of field equipment from other suppliers. The integration of these legacy systems with other traffic signal control systems will require the development of supplier specific interface protocols. Some of this type of work was conducted for the Regional ATMS and the transit signal priority project. In the future, newer systems will be required to be compliant with the emerging NTCIP standards that will provide for interoperability between centers and equipment from different manufacturers. The investment in custom interface or newer center and field systems will be undertaken by each jurisdiction based upon their individual transportation problems and/or desire for sharing information with other jurisdictions. This transition will not take place in the short term. An active dialogue among traffic managers in the region will be required to smooth this transition and the designation of a common C2C standard.

### 5.2 Multiple DSRC Protocols

At this time, AVI transponders using four different DSRC protocols are being deployed in the region. The number of transponder-equipped vehicles on the roadway is now limited and their applications are very different. The potential for vehicles to be equipped with multiple transponders is small at this time. If the electronic toll collection is implemented, the number of transponders on the roadway will increase significantly. At the national level, US DOT is fostering the work to develop a national DSRC standard. While a single regional DSRC protocol and RF standard is ideal and should be a goal, these regional toll collection, CVO clearance, transit priority and tracking, and cargo inter-modal logistics applications are diverse. With a regional DSRC standard, there would remain data content and structure differences unique to the application domain.

### **5.3 Railroads**

Two major railroads serve the region with an emphasis on moving goods to and from the region's major ports. The rail access to the ports requires these longer trains to cross many at-grade intersections. The result can be significant delays to vehicles waiting for the trains to clear. Both railroads operate national network centers for the scheduling and dispatching trains. These centers are potential sources for information on the location and movement of these longer trains. The challenge will be to develop a value proposition that would gain access to this information by local transportation management organizations.

### **5.4 Communications Infrastructure**

The integration of these multiple systems in order to share information will require the development of a supporting communications infrastructure. While data sharing can be done over leased telephone lines, the longer-term operational cost and the requirement to share real-time video images can argue for the deployment of a dedicated ITS communications infrastructure. A regional communications plan could provide a guide for a coordinated deployment effort.

### **5.5 Ongoing Resources for Operations and Maintenance**

The deployment of ITS applications comes with the requirement to operate and maintain these technically sophisticated computer systems, communications networks, hardware, and equipment. Each organization will be faced with the task of finding qualified staff and securing funds to provide the needed resources for operations and maintenance. Unfortunately, many of the technical skills need for this type of work are difficult to find in this technology driven region. Many agencies are having difficulty recruiting and retaining qualified technical staff.

Traditionally, state departments of transportation (DOTs) and metropolitan organizations (MPOs) have been organized to manage construction projects. Now that the Interstate System is complete and very few additional lane miles are being added to the highway system, the transportation community must begin to focus on much more effort on effectively operating the infrastructure to get the most capacity out of what we have. This is a fundamental change for many transportation agencies which requires a new "mind set."<sup>13</sup> This traditional approach has made it more difficult to obtain funding for operations and maintenance activities.

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<sup>13</sup> FHWA Web site - National Dialogue on Transportation Operations, [http://ops.fhwa.dot.gov/nat\\_dialogue.htm](http://ops.fhwa.dot.gov/nat_dialogue.htm)

## 6 CONCLUSION

The recommended regional ITS integration strategy provides guidance for the future investment and management of ITS applications in the region. As individual projects are developed, detailed designs should be developed to reflect the approach presented in this document. Critical to the implementation of the regional ITS integration strategy will be the fostering of dialogue among the transportation stakeholders in the region, especially the city, county and WSDOT highway management organizations. The Regional Council is in a unique position to foster this continuing dialogue.

Table 6.1 summarizes the recommendations contained in this report. The relative phasing for each recommendation is also provided.

**Table 6.1: Summary of Puget Sound Regional Integration Strategy Recommendations**

<b>RECOMMENDATION</b>	Short Term (0 to 3 years)	Middle Term (4 to 10 years)	Long Term (Over 10 years)
1. Develop a regional ITS communications plan to inventory the existing communications infrastructure, identify which transportation management centers will be interconnected, identify bandwidth loading, determine design requirements, and recommend relevant communication and equipment standards.	✓		
2. Develop model agreements for the sharing of transportation system information, sharing device control, coordinating operations, and detailing maintenance responsibilities.	✓		
3. Establish a regional forum for the exchange of information and ideas among regional traffic engineers to support the coordinated development of active management strategies and the appropriate deployment of ITS applications.	✓		
4. Use the Smart Trek ITS Backbone as the initial mechanism for the sharing of real-time transportation system and other related information among jurisdictions and private information service providers (ISPs).	✓	✓	

<b>RECOMMENDATION</b>	Short Term (0 to 3 years)	Middle Term (4 to 10 years)	Long Term (Over 10 years)
5. Transition to structured, emerging National Transportation Communications for ITS Protocol (NTCIP) center-to-center (C2C) interfaces among transportation management systems for the future sharing of information and device control.		✓	✓
6. Reach a regional agreement on the preferred center-to-center National Transportation Communications for ITS Protocol (NTCIP) to establish interfaces among transportation management systems for the future sharing of information and device control.	✓		
7. Expand Smart Trek web site into a virtual Regional Multi-Modal Traveler Information Center (RMTIC) to capture arterial and other traveler information for distribution to the general public.	✓	✓	
8. Deploy a 511 system to distribute traveler information using an interactive voice response telephone system.	✓	✓	
9. Continue development of common ITS applications and systems among transit agencies such as transit traveler information, fare coordination, system performance data, and geographic information systems.	✓	✓	
10. Build electronic links from transit agencies to traffic management agencies for the implementation of transit signal priority and sharing of highway system status information.	✓	✓	
11. Expand links from transit agencies to emergency management organizations.		✓	✓
12. Establish a regional forum to bring together medical professionals, police, fire, ambulance, 911 centers, emergency response organizations, wireless communications companies, traffic management organizations and transit agencies to foster the development of comprehensive incident management strategies and the electronic sharing of information.	✓		

<b>RECOMMENDATION</b>	Short Term (0 to 3 years)	Middle Term (4 to 10 years)	Long Term (Over 10 years)
13. Develop coordinated incident management strategies for major construction projects including the electronic sharing of incident and transportation system status information.	✓	✓	
14. Develop coordinated incident management strategies for major highway corridors including the electronic sharing of incident and highway system status information.	✓	✓	
15. Build electronic information interfaces between transportation management systems and emergency management centers.		✓	✓
16. Connect local commercial vehicle regulatory functions to the Washington State deployment of the Commercial Vehicle Information Systems and Network (CVISN).	✓	✓	
17. Enable the sharing of commercial vehicle weight information from both public and private organizations.		✓	
18. Accommodate the electronic flow of information to private ISPs through the deployment of a common interface standard (Self Describing Data) via the ITS Backbone.	✓	✓	
19. Build electronic data sharing and transportation system management links to regional ports.		✓	
20. Expand electronic data sharing and transportation system management links to airport.		✓	
21. Build electronic data sharing and transportation system management links to rail operators.		✓	✓
22. Build electronic data sharing and transportation system management links to clean air agency,		✓	✓
23. Build electronic data sharing and transportation system management links to toll agencies.		✓	✓
24. Build electronic data sharing and transportation system management links to freight management organizations.		✓	✓

<b>RECOMMENDATION</b>	Short Term (0 to 3 years)	Middle Term (4 to 10 years)	Long Term (Over 10 years)
25. Capture and archive real-time transportation system data for future analysis and to support transportation planning.		✓	✓