

Puget Sound Regional Council

**Puget Sound Regional
Intelligent Transportation Systems
Transit Architecture**

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Pacific Rim Resources

Battelle Memorial Institute

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1 PUGET SOUND REGIONAL TRANSIT ARCHITECTURE

1.1 INTRODUCTION

As part of a regional initiative to develop the multi-modal Intelligent Transportation System (ITS) architecture in the Puget Sound region, the Puget Sound Regional Council (PSRC) contracted with a consultant team of the IBI Group, PB-Farradyne, Battelle Memorial Labs and Pacific Rim Resources to carry-out the process. An essential element of the Puget Sound regional ITS architecture is the definition of an ITS architecture for the regional transit network. The transit network in the Puget Sound region consists of 6 transit service providers, and Washington State Ferries. Definition of a regional transit architecture will help transit agencies in the Puget Sound Region to benefit from cost efficiencies and meet interoperability goals for technology based applications by starting the process of defining project inter-relationships and associated system interfaces and standards.

1.2 CONFORMITY WITH THE NATIONAL ITS ARCHITECTURE AND STANDARDS

Another key benefit of developing an ITS Architecture for the Puget Sound Region is to address the intent of the National ITS Architecture and Standards Conformity Final Rule. Section 5206 of the Transportation Efficiency Act for the 21st Century (TEA-21) requires that ITS projects funded using the Highway Trust Fund (including the Mass Transit Account) conform to the National ITS Architecture and Standards. In response to this requirement, the FHWA rule and FTA policy on Intelligent Transportation Systems (ITS) Architecture and Standards were issued on January 8, 2001, to implement section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21). This final rule requires that ITS projects funded by the Highway Trust Fund and the Mass Transit Account conform to the National ITS Architecture, as well as to USDOT adopted ITS Standards.

The basis for the final rule is to ensure that current and future opportunities to integrate ITS across modes and jurisdictions for the purpose of improving transportation operations are not overlooked in the project development process. Further, the rationale for this requirement is to ensure key ITS projects and initiatives are targeted early in the planning process to facilitate more affective integration. The final rule is provided in its entirety in Appendix E. Additional information and guidance may also be found on-line at www.its.dot.gov/acconform/acconform.htm.

1.3 KEY CONCEPTS OF THE NATIONAL ITS ARCHITECTURE

The National ITS Architecture, adopted in 1996, provides a technical and institutional framework to guide the coordinated deployment of ITS by public agencies and private organizations alike. The National ITS Architecture is not a design, rather it defines the framework around which multiple design approaches can be developed, each one specifically tailored to meet the unique needs of the region. The National ITS Architecture also defines the functions that must be performed to implement a given service, the physical entities or subsystems where these functions reside, the interfaces/information flows between subsystems, and the communication requirements for the information flows. The National ITS Architecture may be found on-line at www.odetics.com/itsarch.

There are several concepts and terms used throughout the National ITS Architecture that should be defined to effectively use the National ITS Architecture. Concepts of the National ITS Architecture used to define the regional ITS architecture for the Puget Sound Region include:

- User Services - User services document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators. The concept of user services allows system or project definition to begin by establishing the high level services that will be provided to address identified problems and needs.
- Physical Architecture - A Physical Architecture is the physical (versus functional) view of a system. A Physical Architecture provides the agencies with a physical representation (though not a detailed design) of how the system should provide the desired functionality. A Physical Architecture takes the processes identified in the Logical Architecture and assigns them to physical entities (e.g., transit vehicles, transit management centers, and various roadside devices) or subsystems. In addition, the data flows from the Logical Architecture that link subsystems are grouped together into architecture flows (architecture flows may include several detailed data flows). The architecture flows and their communications requirements define interfaces between subsystems.
- Architecture Flows – Architecture Flows are the information that is exchanged between [subsystems](#) and [terminators](#) in the [Physical Architecture](#). Each architecture flow contains one or more [data flows](#). These architecture flows and their communication requirements define the interfaces which form the basis for much of the ongoing [standards](#) work in the ITS program. Figure 1-1 provides a depiction of the architecture flows between the traffic management and transit management subsystem.
- Market Packages – Market Packages are an alternative representation of groupings of ITS subsystems to support diverse ITS implementations which is the basis of the architecture development for the transit agencies in the Puget

Sound region. Market Packages address specific sets of users, service levels, regional needs, and incremental deployment scenarios. A Market Package is implemented with a combination of inter-related equipment.

- Equipment Packages – An Equipment Package represents a set of equipment/capabilities, which are likely to be purchased by an end-user to achieve a desired capability. Since equipment packages are both the most detailed elements of the physical architecture and associated with specific Market Packages, there is clear traceability between the interface-oriented architecture framework and the deployment-oriented Market Packages.

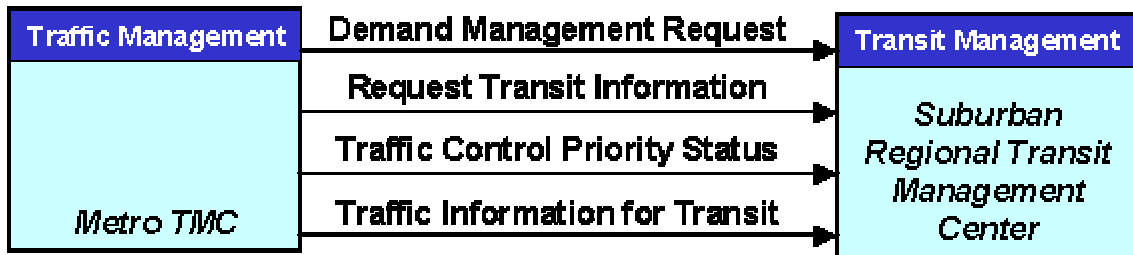


Figure 1-1 – Example Architecture Flow

Although the architecture is national in scope, it can be localized for regions, corridors, and transportation authorities. It can benefit state and local transportation agencies by helping them to save time and money in achieving maximum benefits through the implementation of integrated ITS.

1.4 TRANSIT COMMUNICATIONS FOR ITS PROTOCOLS

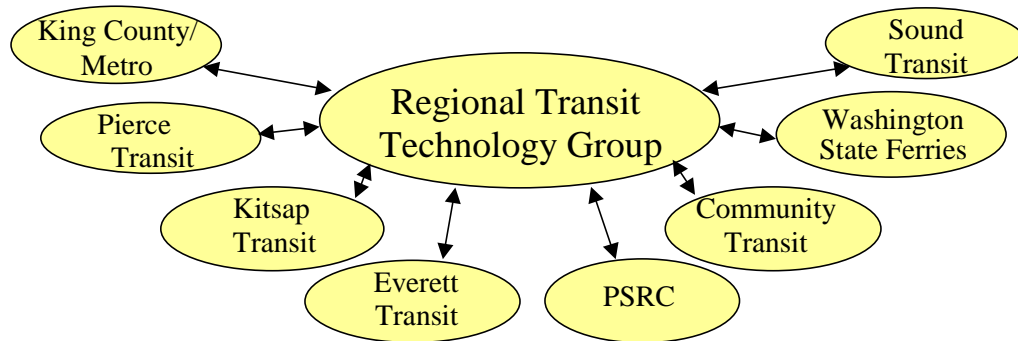
Another key goal of the National ITS Architecture development effort was the definition of common standards to achieve interoperability. The Transit Communications for ITS Protocols (www.tcip.org) project was established under joint sponsorship of the Institute of Transportation Engineers and funded by the US Department of Transportation's Joint Program Office for ITS with the intent to develop a suite of data interface standards for the transit industry.

With respect to standards, irrespective of meeting the intent of the final rule, the benefits of applying standards shows significant potential to achieve benefits. Benefits include convenience, compatibility, quality, cost savings, competition and innovation leading to interoperable and interchangeable system components. Past experience and history demonstrates that the use of standards does achieve these benefits, which are of paramount national interest in is achievement of interoperable, then interchangeable ITS.

1.5 PUGET SOUND REGIONAL TRANSIT ARCHITECTURE DEVELOPMENT PROCESS

In response to the Architecture and Standards Conformity Rule, the Puget Sound Regional Transit Architecture development represents a unified initiative by the regional transit agencies to define and maintain agency and regional architectures that meet the intent of the final rule. The Regional Transit Technology Group (RTTG) provided the institutional oversight to the development and review process. Figure 1-1 depicts the members of this regional organization. Service areas for each of transit service provider are illustrated in Figure 1-2.

Figure 1-1- Regional Transit Architecture Stakeholders



The first step in developing the transit component of the regional architecture was to undertake an inventory of both existing and planned ITS projects of the transit agencies in the region. The inventory included a survey that was sent to transit agencies in the region as well as follow-up interviews. Chapter 2 represents the results of this inventory, which are summarized for each agency. This information includes a physical architecture diagram for each agency, as well as a number of summary tables. Chapter 2 focuses on the physical architecture, and more specifically the market package approach to architecture definition.

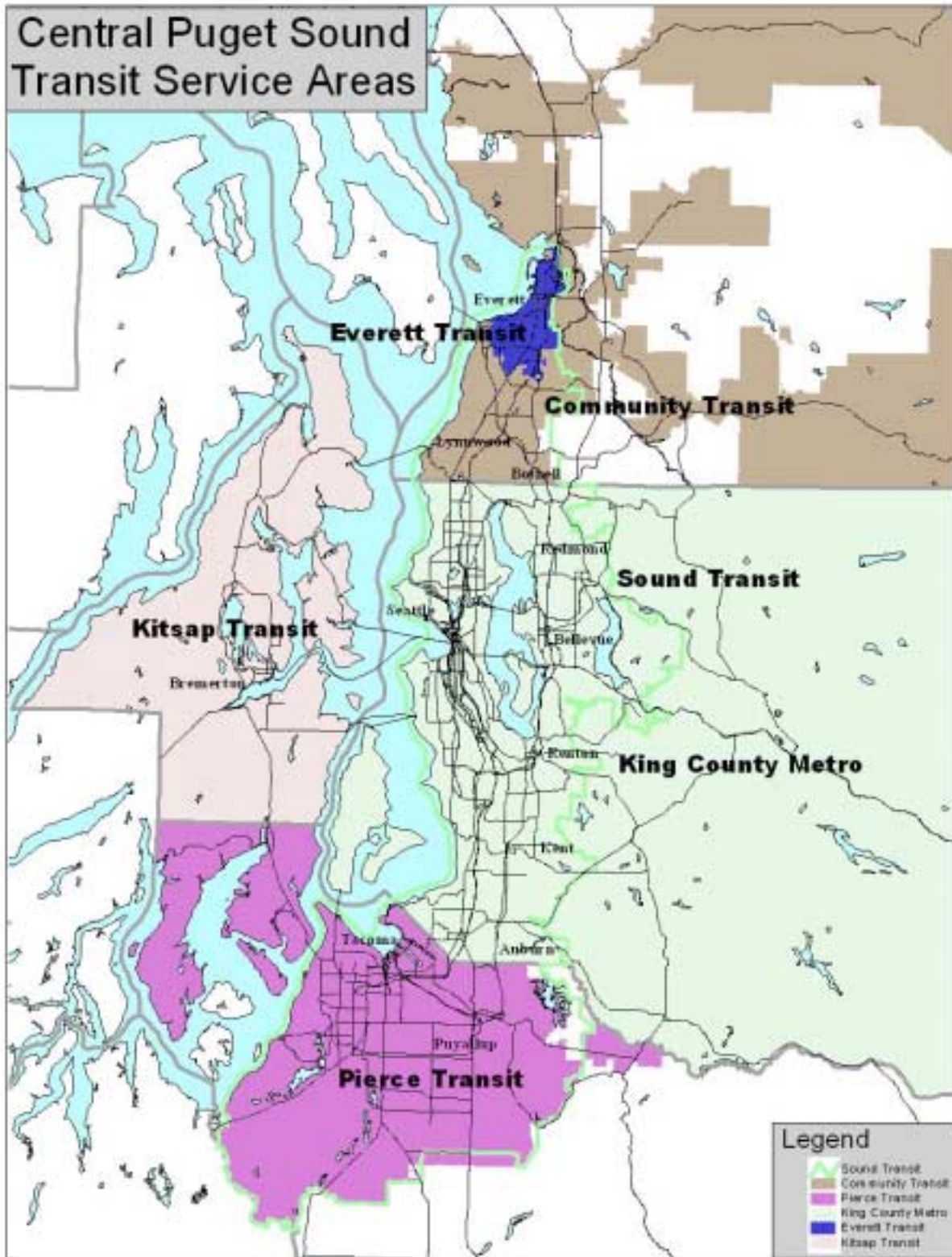


Figure 1-2 – Puget Sound Region Transit Providers Service Areas

2 TRANSIT AGENCY PHYSICAL ARCHITECTURE

Physical Architecture - The Physical Architecture provides agencies with a physical representation (though not a detailed design) of the important ITS interfaces and major system components. It provides a high-level structure around the [processes](#) and [data flows](#) defined in the [Logical Architecture](#). The principal elements in the Physical Architecture are the 19 [subsystems](#) and [architecture flows](#) that connect these subsystems and [terminators](#) into an overall structure. A physical architecture takes the processes identified in the logical architecture and assigns them to subsystems. In addition, the data flows (also from the logical architecture) are grouped together into architecture flows.

This section contains physical architectures for each of the transit agencies in the Puget Sound Region. These architectures are presented with three primary information pieces: 1) physical architecture diagram, 2) equipment package summary, and 3) architecture flow description.

Physical Architecture

The architecture diagram graphically presents the technology each agency is currently supporting or expects to enhance/implement in the next one to five years. As defined in the National ITS Architecture, the physical architecture includes the four subsystems that are applicable to the transit agencies in the Puget Sound region: 1) traveler, 2) center, 3) vehicle, and 4) roadside. Section 2.1 through 2.9 includes the physical architecture diagrams for each agency in the region and briefly summarizes the architecture focusing on a market package approach to architecture definition. As mentioned, additional information on each agency's transit architecture can be found in the tables of the Appendices. To provide additional background definition, a general description of the National ITS Architecture specific to transit is included in Appendix D.

Specific projects are defined in the National ITS Architecture as being part an *equipment package* or being part of a *market package*. A singular equipment package is noted in cases where a data flow does not exist, e.g., CCTV at a transit station that is recorded and accessed locally. A market package is shown where data is being passed between two equipment packages (basically, an architecture flow is present). For example, transit signal priority includes a roadside reader activates an on-board tag. In addition, the diagram identifies relationships between equipment packages and *terminators*. Terminators are defined by the National ITS Architecture as the people, systems, and general environment that interface with ITS. An example of a terminator would be a driver that triggers an on-board alarm system (or using architecture terminology provides input to the on-board transit security). The legend in each diagram denotes the different implementation scenarios that are possible:

- 1) Not Implemented: The transit agency does not anticipate implementing the applicable equipment package (at least in the next one to five years).
- 2) Equipment Package Implementation: The transit agency is currently supporting the applicable equipment package, but no data is being passed to or from the associated equipment package.
- 3) Existing Market Package Implementation: The transit agency is currently supporting the applicable market package. That is, data is being passed between two equipment packages, thus an architecture flow is present.
- 4) Future Enhancement Implementation: The transit agency expects to either implement or enhance an equipment package within the next one to five years.
- 5) Future Architecture Flow: Data will be passed between two equipment packages in the next one to five years.

Equipment Package Summary

Appendix A includes the summary of the equipment packages found in *the vehicle and center* subsystems for each agency. Two tables are provided to identify equipment packages in the physical architecture diagram by type of software and hardware/operating systems for the transit vehicle, and transit management subsystems. In addition, the tables note whether the transit agency is currently supporting the ITS application and expects to upgrade it or the agency plans to implement it in the next one to five years. The following table is an example of the information collected for each equipment package as found in the tables in Appendix A.

Table 2-1: Example of Equipment Package Summary from Appendix A

Equipment Package	On-Board Paratransit Operations
Existing/Planned	Existing
Upgrade/Implementation (1-5 years)	Upgrade
Description	Mobile Data Terminals
Software	Mentor Express, Trapeze PASS v.3.92
Hardware/Operating System	DOS, Novell 3.11

Appendix B includes a table for the Roadside Subsystem, which identifies the various jurisdictions that each transit agency passes through while providing transit service. This summary highlights possible locations where applications such as transit signal priority may benefit from coordination between multiple agencies, thus fostering regional interoperability.

Architecture Flow Description

Finally, Appendix C includes a table that identifies the architecture flows for each transit agency. In discussions with the various transit agencies, it became apparent that architecture flows as defined in the National ITS Architecture did not always map directly to the actual data flows of the various transit agencies in region; therefore, each transit agency was asked to define the specific data being communicated within the applicable organizational structure. A sample of the type of information that was included in this table is provided below in Table 2-2:

Table 2-2: Example of Transit Agency Architecture Flow Description from Appendix C

National ITS Architecture Definition			Agency Data Definition			
Architecture Flow	From	To	Agency Data	From	To	Device or Communication
Emergency notification	On-Board Transit Security	Transit Center Security	Call for assistance	Bus Driver	Fixed-Route Dispatch	Radio



2.1 COMMUNITY TRANSIT

Community Transit provides bus service in Snohomish County. Local service is provided to local municipalities including Everett, Lynnwood, Edmonds, Arlington, and Marysville. Commuter service is also provided to Everett Boeing, downtown Seattle, downtown Bellevue, and the University of Washington.

The following section provides detailed descriptions of Community Transit's current, and planned future, level of deployment of transit oriented market packages.

2.1.1 Transit Vehicle Tracking

Market Package Definition: This market package provides for an AVL system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

Community Transit plans to implement an AVL system in the next five years. Currently, the dispatch center at Community Transit is able to communicate with drivers while enroute using their two-way radio system providing approximate vehicle locations. Community Transit has plans to upgrade this radio system by 2001. The operations staff can monitor traffic conditions on its bus routes via video provided by the Washington State Department of Transportation's Traffic Management Center. The agency also hopes to upgrade to a Computer Aided Dispatch (CAD) in the next five years.

2.1.2 Transit Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

Community Transit currently supports the transit fixed-route operations market package, but the actual implementation is slightly different than the definitions defined in the National ITS Architecture. Community Transit does internal planning and scheduling using the HASTUS software package. However, the agency manages schedule performance through two-way voice and data communications between the transit vehicle and the transit center tracking and dispatch (not transit center fixed-route operations as defined in the National ITS Architecture). Transit garage operations are facilitated through the use of the MIDAS software, which performs the processing of operator's bids for assignments. Community Transit has plans to upgrade their radio system by 2001.

Community Transit also supports on-board fixed route schedule management through the use of mobile supervisors. The mobile supervisors are in the field to help the fixed-route buses with routing, scheduling and emergency issues. They are able to

communicate with the transit agency's tracking and dispatch center via two-way radio and cellular phone.

2.1.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

Community Transit provides paratransit services separately from its fixed-route bus routes. Route manifests for paratransit are developed using PASS scheduling software, and schedule changes are communicated to paratransit drivers over voice radio. Community Transit plans to upgrade their PASS software in the next one to five years.

2.1.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payment on-board vehicles using electronic means.

The Puget Sound region has plans to implement a regional electronic fare system called Smart Card. The project is currently engaged in the system procurement process to acquire a common fare collection and fare vending system for seven transit agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and rail. This smart card based system will utilize a wireless data communications process at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency, passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use.

2.1.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

Community Transit supports transit security on its vehicles via an on-board emergency alarm system, which allows drivers to trigger a silent alarm that is carried over the transit agency's radio network. The dispatch center in turn notifies the appropriate law enforcement agency. Each bus has a silent witness video camera and recorder on-board. These cameras record the activity in the passenger seating area. In addition, Community Transit has security cameras at five park & ride lots.

2.1.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

At the present time, the agency collects engine-operating data, which is accessed by laptop computers. The hubo-meter supplies data (via infrared) for scheduling routine maintenance. The agency does not have near-term plans to more fully deploy this market package.

2.1.7 Multi-Modal Coordination

Market Package Definition: This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Basically, the package supports the capability for transit vehicles to improve operating efficiency and on-time performance through transit signal priority.

Community Transit is implementing transit signal priority at 46 intersections in Snohomish County. Over half these intersections are located in the City of Lynnwood. The City of Lynnwood is in the process of establishing a traffic control center to manage the traffic signals. Community Transit hopes that approximately 100 intersections within Snohomish County will support transit signal priority by 2005. Community Transit uses Amtek readers and Gardner software for signal priority. The same equipment is being deployed in King County.

2.1.8 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

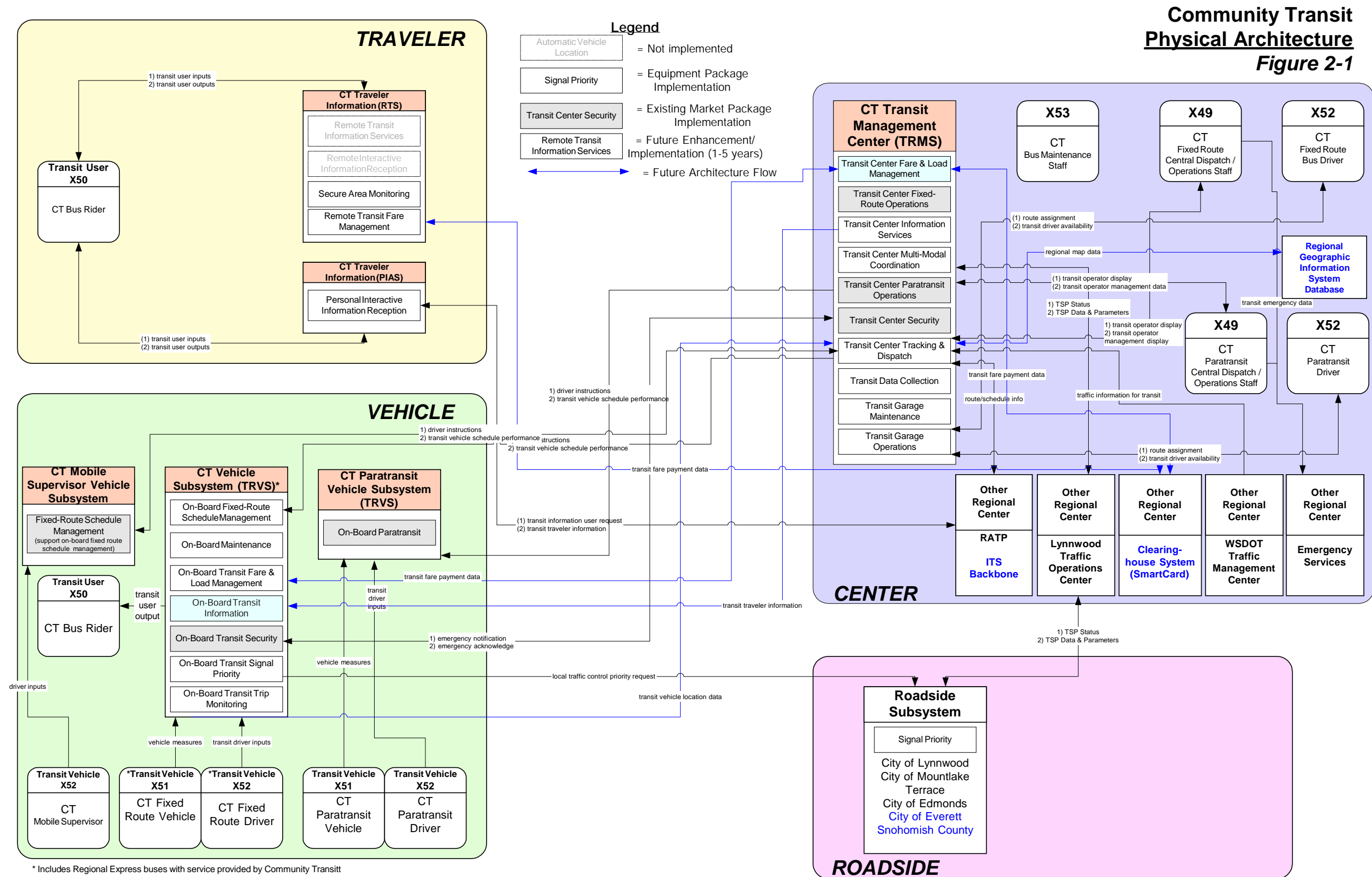
Community Transit hopes to provide on-board transit information in the future through both visual and audio automated stop announcements in the next five years. The agency has purchased HASTOP to automate the production of paper schedules. In addition, Community Transit along with Metro and Pierce Transit are in the process of implementing the Regional Automated Trip Planning (RATP) project. RATP will allow customers to contact one of the three sponsor agencies and receive detailed schedule and geographically based route information for any of the agencies. Everett Transit provides Community Transit with their route and schedule information, so customers can also have access to Everett Transit information through the RATP project.

2.1.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

At the equipment package level, all transit agencies are involved in data collection for use by operations and the majority of agencies are sharing data externally with other agencies. Community Transit currently shares data with the following parties:

- Lynnwood Traffic Center - signal priority data via e-mail;
- Snohomish County - geographic information systems data via e-mail;
- King County Metro - route and schedule information via e-mail;
- Various businesses with institutional fare accounts via e-mail.





2.2 EVERETT TRANSIT

Everett Transit provides fixed route and ADA demand response bus service around the greater City of Everett area. Connections are provided to Washington State Ferries, Amtrak, Greyhound, Sound Transit and Community Transit to support regional travel. The following sections provide detailed descriptions of Everett Transit's current, and planned future level of deployment of transit oriented market packages.

2.2.1 Transit Vehicle Tracking

Market Package Definition: This market package provides for an AVL system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

Currently, the Everett Transit fixed route dispatch center is able to communicate with drivers while enroute using their two-way radio system providing approximate vehicle locations. Everett Transit plans to fully deploy, in coordination with other regional transit agencies, an AVL system in the next one to five years.

2.2.2 Transit Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

Everett Transit plans to implement this market package in the next one to five years. At this point, Everett Transit is using a manual process for scheduling of their fixed-route services. They have purchased and installed a software run-cutting system to automate all of the scheduling functions by September 2001.

2.2.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

Everett Transit plans to fully deploy an upgraded market package in the next one to five years. Demand response schedulers are in direct contact with vehicle operators and create manifests in real time. Currently, the transit agency uses the PASS software program for paratransit scheduling.

2.2.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.

Everett Transit currently uses manual fare boxes and will be installing electronic fareboxes fleet-wide within the next one to three years. In addition, the Puget Sound region is considering the implementation of a regional electronic fare system called Smart Card. The project is currently engaged in the system procurement process to acquire a common fare collection and fare vending system for seven transportation agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and commuter and light rail services. The smart card based technology will utilize a wireless data communications process at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region and distributed equitably back to each system. .

2.2.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

Everett Transit plans to implement this market package in the next one to five years, using on-board digital cameras and recording devices.

2.2.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

Everett Transit has plans to deploy this market package in the next five years.

2.2.7 Multi-Modal Coordination

Market Package Definition: This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination.

Everett Transit expects to implement this market package in the next five years.

2.2.8 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

Everett Transit hopes to deploy this market package in the next one to five years. However, Pierce Transit, King County Metro and Community Transit have implemented the RATP system. RATP allows customers to contact one of the three sponsor agencies and receive detailed schedule and is currently participating in the RATP project via Community Transit. Everett Transit provides

Community Transit, with the necessary schedule and route data, handles Everett Transit's customer and information and service calls.

2.2.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

At the equipment package level, all transit agencies are involved in data collection for use by operations and the majority of agencies are sharing data externally with other agencies. Everett Transit is sharing data with the following parties:

- Sound Transit – schedule and system information via e-mail and interagency coordination efforts
- Community Transit – schedule and system information via e-mail and interagency coordination efforts
- Washington State Ferries – schedule and system information via email and interagency coordination efforts



2.3 KING COUNTY METRO

King County Metro provides bus and paratransit service in the central Puget Sound Region within King County. Service spans from Shoreline in the northwest and Duvall in the northeast, to Federal Way in the southwest and Enumclaw in the southeast. The following sections provide detailed descriptions of King County Metro's current, and planned future level of deployment of transit oriented market packages.

2.3.1 Transit Vehicle Tracking

Market Package Definition: This market package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

King County currently supports transit vehicle tracking through a signpost and odometer-based AVL system. Within the King County Metro system, the trip monitoring function is centralized in the Data Acquisition and Control System (DACS) software at the transit center. The vehicle collects odometer-like telemetry and signpost encounters. This data is uploaded in a poll response and used to calculate the vehicle's current location and progress within the trip.

King County expects to replace their radio system by 2005. The AVL system may be upgraded at the same time to incorporate GPS-related processing for vehicle location capabilities and on-board "smart-bus" functionality.

2.3.2 Transit Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

King County Metro currently supports the transit fixed-route operations market package, but the actual implementation is slightly different than the definitions provided in the National ITS Architecture. King County Metro does internal planning and scheduling using the HASTUS software package. However, King County Metro manages schedule performance through two-way voice and data communications between the transit vehicle and the transit center tracking and dispatch (not transit center fixed-route operations as defined in the National ITS Architecture). Metro's AVL system is used for monitoring schedule performance as well as radio contact with drivers. Data from automatic passenger counters (APC) provides both ridership, schedule and performance data. In turn, this data is used for scheduling and planning purposes. The BOSS software program supports transit garage operations through its capability to assign and track driver schedules for fixed-route services.

King County also supports on-board fixed route schedule management through the use of mobile supervisors. The mobile supervisors are in the field to help the fixed-route buses with routing, scheduling and emergency issues. They are able to communicate with Metro's tracking and dispatch center via two-way radio. In addition, Metro's supervisors are able to communicate with Pierce Transit's supervisors. The communication between Pierce Transit and Metro allows the supervisor that is the closest to the identified situation to respond regardless of agency association.

King County Metro hopes to upgrade this market package in one to five years, and the replacement of the BOSS software program is already underway.

2.3.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

King County Metro provides paratransit services separately from its fixed-route bus routes. Route manifests for paratransit are developed using PASS scheduling software, and schedule changes are communicated to paratransit drivers over voice radio. In addition, paratransit drivers are able to communicate with dispatch over the radio when schedule events are completed as well as any security issues. The PASS software not only schedules routes, but also assigns vehicles and drivers as well as tracks vehicle maintenance schedules, fuel consumption, and mileage.

King County Metro plans to enhance their current system of voice radio with mobile data terminals (MDTs) integrated with the PASS software. In addition, the agency hopes to upgrade the PASS software in the next one to five years.

2.3.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.

The Puget Sound region has plans to implement a regional electronic fare system called Smart Card. The project is currently in the procurement process to acquire a common fare collection and fare vending system for the seven transit agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and rail. This smart card based system will utilize a wireless data communications process at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency,

passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use.

2.3.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

King County supports transit security on its vehicles via an on-board emergency alarm system as part of the two-way radio's automatic vehicle location system that can be acknowledged from the transit control center. The transit control center in turn notifies the appropriate law enforcement agency. In addition, King County Metro supports an integrated CCTV monitoring and emergency telephone system in the downtown Seattle transit tunnel. King County has also equipped two transit centers and a park & ride lot with CCTV and on-site video tape recorders. At this point, the systems at the transit centers and park & ride lot are static and do not support customer interaction. Currently, the transit agency has five buses equipped with on-board CCTV monitoring systems linked to on-board digital recorders, and King County expects to purchase 150 to 200 more of these systems by 2001.

2.3.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

King County Metro collects engine-operating data, which is accessed by laptop computer. The agency also uses software by Control Software for automated maintenance systems. Metro hopes to more fully automate their on-board maintenance technology in the next one to five years.

2.3.7 Multi-Modal Coordination

Market Package Definition: This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Basically, the package supports the capability for transit vehicles to improve operating efficiency and on-time performance through transit signal priority.

King County Metro has implemented this market package using a dynamic tag onboard the bus. The tag currently contains static data such as vehicle identification number as well as dynamic data such as driver number. The tag remains passive until activated by the roadside antenna and tag reader unit. Once the tag is read at the roadside, the signal request is transmitted to King County's operation center where staff decides if and when the request is approved. McCain Traffic Supply supplies the roadside and central software systems. King County hopes to eventually have 100% of its fleet outfitted with the necessary equipment to support transit signal priority applications. Metro hopes to upgrade this system in the future and include more "smart" data such as ridership or delay information.

2.3.8 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

Metro has deployed a variety of traveler information services, which are facilitated through the University of Washington Information Service Provider (ISP) via the ITS Backbone. The agency supports Transit Watch, which provides real-time bus route information at two transit centers in the region. In addition, King County Metro and the University of Washington ISP have collaborated to produce BusView and MyBus, which provide real-time bus information via the Internet. The transit agency hopes to provide on-board transit information in the future. Metro along with Pierce Transit and Community Transit (as well as Everett Transit via CT) are in the process of implementing the Regional Automated Trip Planning project. RATP will allow customers to contact one of the three sponsor agencies and receive detailed schedule and geographically based route information for any of the agencies.

2.3.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

At the equipment package level, all transit agencies are involved in data collection for use by operations and the majority of agencies are sharing data externally with other agencies. King County Metro is sharing dynamic AVL location data with the University of Washington via the Internet.

2.4 KITSAP TRANSIT

Kitsap Transit is a Public Transportation Benefit Area Authority (PTBAA) providing bus and paratransit services within Kitsap County, including Bremerton, Port Orchard, Silverdale, and Poulsbo. The following sections provide detailed descriptions of Kitsap Transit's current, and planned future level of deployment of transit oriented market packages.

2.4.1 Transit Vehicle Tracking

Market Package Definition: This market package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

Currently, the Kitsap Transit dispatch center is able to communicate with drivers while enroute using their two-way radio system to determine vehicle locations.

2.4.2 Transit Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

Currently, Kitsap Transit is using an Excel spreadsheet-based system for scheduling of their fixed-route services.

2.4.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

Currently, the Kitsap Transit dispatch center is able to communicate with drivers while enroute using their two-way radio which system, which can provide approximate vehicle locations. Currently, the transit agency uses the Trapeze program for paratransit scheduling.

2.4.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.

The Puget Sound region has plans to implement a regional electronic fare system called Smart Card. The project is currently engaged in the system procurement process to acquire a common fare collection and fare vending system for seven transit agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and rail. This smart card based system will utilize a wireless data communications process at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency, passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use.

2.4.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

This market package is not functional at this time due to known hardware problems at Kitsap Transit. Under the current funding scenario, this situation is unlikely to change.

2.4.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

Kitsap Transit does not have plans to implement this market package at the present time.

2.4.7 Multi-Modal Coordination

Market Package Definition: This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Basically, the package supports the capability for transit vehicles to improve operating efficiency and on-time performance through transit signal priority.

Kitsap Transit is able to benefit from transit signal priority at a number of intersections on the Kitsap Peninsula. Kitsap Transit uses a package by Opticom (500 series) for signal priority.

2.4.8 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

Kitsap Transit currently does not have plans to implement this market package.

2.4.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management

Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

Kitsap Transit shares ridership and performance information with a number of agencies including the Washington State Department of Transportation, Puget Sound Regional Council, Kitsap County and local municipalities in the region via e-mail.



2.5 PIERCE TRANSIT

Pierce Transit provides bus and paratransit services within Pierce County, including Tacoma, Gig Harbor, Lakewood, and Puyallup. Pierce Transit also provides commuter service to downtown Seattle and downtown Olympia.

The following sections provide detailed descriptions of Pierce Transit's current, and planned future level of deployment of transit oriented market packages.

2.5.1 Transit Vehicle Tracking

Market Package Definition: This market package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

Pierce Transit hopes to implement a GPS/AVL system, which utilizes cellular data packets within the next one to five years. Currently, the dispatch center at Pierce Transit is able to communicate with drivers while enroute using their two-way radio system providing approximate vehicle locations.

2.5.2 Transit Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

Pierce Transit currently supports the transit fixed-route operations market package, but the actual implementation is slightly different than the definitions provided in the National ITS Architecture. Pierce Transit does internal planning and scheduling using the HASTUS software package. However, the agency manages schedule performance through two-way voice and data communications between the transit vehicle and the transit center tracking and dispatch (not transit center fixed-route operations as defined in the National ITS Architecture). The agency does support transit garage operations through the assignment of transit vehicles and drivers, but this system is not automated at this time as called for in the National ITS Architecture definition.

Pierce Transit also supports on-board fixed route schedule management through the use of mobile supervisors. The mobile supervisors are in the field to help the fixed-route buses with routing, scheduling and emergency issues. They are able to communicate with the transit agency's tracking and dispatch center via two-way radio. In addition, Pierce Transit supervisors are able to communicate with King County Metro's supervisors. The communication between Pierce Transit and Metro allows the supervisor that is the closest to the identified situation to respond regardless of agency association.

2.5.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements to the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

Pierce Transit provides paratransit services separately from its fixed-route bus routes. Route manifests for paratransit are developed using PASS scheduling software, and schedule changes are communicated to paratransit drivers over mobile data terminals (MDTs). Currently, 25 vehicles are operational with MDTs, and Pierce Transit hopes equip all 102 of its vehicles with MDTs in the near future. In addition, paratransit drivers are able to communicate to dispatch over the radio regarding matters such as security issues. The dispatch center in turn is able to notify the appropriate emergency services. The PASS software not only schedules routes, but also assigns vehicles and drivers as well as tracks vehicle maintenance schedules, fuel consumption, and mileage.

2.5.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.

The Puget Sound region has plans to implement a regional electronic fare system called Smart Card. The project is currently engaged in the system procurement process to acquire a common fare collection and fare vending system for seven transit agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and rail. This smart card based system will utilize wireless data communications processes at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency, passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use.

2.5.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

Pierce Transit supports transit security on its vehicles via an on-board emergency alarm system. The transit control center in turn notifies the appropriate law enforcement agency. In addition, cameras on a continuous loop video system are located at the Tacoma Dome station as well as panic buttons, which send an emergency signal to the security offices at the Tacoma Dome Station. The Regional Express service (that Pierce Transit operates for Sound Transit) has on-board cameras.

2.5.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

Pierce Transit does not currently have the full market package implementation of transit maintenance. The transit agency collects some operating data using laptop computers via hubometers.

2.5.7 Multi-Modal Coordination

Market Package Definition: This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Basically, the package supports the capability for transit vehicles to improve operating efficiency and on-time performance through transit signal priority.

Pierce Transit hopes to support transit signal priority within the next one to five years using the 3M Opticom system.

2.5.8 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

Pierce Transit is not currently implementing this market package. However, Pierce Transit along with Metro and Community Transit are in the process of implementing the Regional Automated Trip Planning project. RATP will allow customers to contact one of the three sponsor agencies and receive detailed schedule and geographically based route information for any of the agencies. In addition, Pierce Transit would like to provide real-time at public transportation areas (e.g., transit centers) in the next one to five years.

2.5.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

At the equipment package level, all transit agencies are involved in data collection for use by operations and the majority of agencies are sharing data externally with other agencies. Pierce Transit is providing data to both King County Metro and Community Transit as part of the RATP



2.6 SOUND TRANSIT (LINK)

Sound Transit is a public agency providing a regional public transportation system for the urban areas of King, Pierce and Snohomish counties. The Sound Transit system includes a mix of rail, regional bus routes and new transit facilities.

Central Link

As currently planned, Sound Transit's Central Link will provide light rail transit services within central King County, specifically Seattle, Tukwila, and SeaTac.

Central Link will carry passengers between 45th St in the University District, the Rainier Valley and Sea-Tac Airport. Still under design, Central Link is anticipate to include approximately 24 miles of track with 23 stations. The corridor will feature track and stations that will be located at grade, below grade, and above grade.

Tacoma Link

Starting in late 2002, Sound Transit's Tacoma Link will provide light rail transit services in Tacoma. Tacoma Link will carry passengers from the Tacoma Dome Station into downtown Tacoma.

The following sections provide detailed descriptions of Sound Transit's (Link) current, and planned future, level of deployment of transit oriented market packages.

2.6.1 Transit Vehicle Tracking

Market Package Definition: This market package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

Sound Transit hopes to implement this market package for LINK, but is uncertain of the system design at this time. In addition, LINK will have its own vehicle location system on the wayside in the form of track circuits. LINK will also have a Train to Wayside (TWC) system that identifies the train location to individual wayside antennas in the street median and other undetermined locations. A fiber optic link from the wayside equipment to the Central Control will provide the information necessary to track trains throughout the entire system. In turn, the Central Control will be able to provide train location information to patrons at the platforms through variable message signs.

2.6.2 Transit Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

It is not known if LINK will implement this market package.

2.6.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

Paratransit service will be provided by other transit agencies throughout the region.

2.6.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.

LINK (both Tacoma Link and Central Link will be free) will use the same ticket vending machine system platform that Sounder Commuter Rail is currently operating. The TVM's will be fully "Smart Card" capable.

The Puget Sound region has plans to implement a regional electronic fare system called Smart Card. The project is currently engaged in the system procurement process to acquire a common fare collection and fare vending system for seven transit agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound. When completed it will be fully integrated with the regional Smart Card when it is implemented.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and rail. This smart card based system will utilize a wireless data communications process at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency, passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use.

2.6.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

Sound Transit has not adopted a specific design for this market package.

2.6.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

Sound Transit has not adopted a specific design for this market package.

2.6.7 Multi-Modal Coordination

Market Package Definition: This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Basically, the package supports the capability for transit vehicles to improve operating efficiency and on-time performance through transit signal priority.

Sound Transit hopes to implement transit signal priority for LINK in the future. Sound Transit will likely work with the cities of Tukwila, Seattle and Tacoma in the design of this market package.

2.6.8 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

Sound Transit hopes to implement at least a part of this market package in the future. The agency is still in the process of designing this application for LINK.

2.6.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

At the equipment package level, all transit agencies are involved in data collection for use by operations and the majority of agencies are sharing data externally with other agencies. LINK's plans for external data sharing are not known at this point.

2.7 SOUND TRANSIT REGIONAL EXPRESS (ST EXPRESS)

Sound Transit is a public agency providing a regional public transportation system for the urban areas of King, Pierce and Snohomish counties. The Sound Transit system includes a mix of rail, regional bus routes and new transit facilities.

Sound Transit Regional Express (ST Express) provides regional bus services connecting the major urban centers of Bellevue, Everett, Tacoma and Seattle with other cities and communities in Central Puget Sound.

Sound Transit is contracting with King County Metro, Pierce Transit and Community Transit to provide ST Express service. More specifically, Sound Transit funds the construction of its buses and these buses are configured, for the most part, with existing systems currently operated by its transit agency partners. Sound Transit then contracts operations the operations and maintenance of its vehicles with its partners.

2.8 SOUND TRANSIT (SOUNDER)

Sound Transit is a public agency providing a regional public transportation system for the urban areas of King, Pierce and Snohomish counties. The Sound Transit system includes a mix of rail, regional bus routes and new transit facilities.

Sound Transit Sounder currently provides peak hour commuter rail service between Tacoma and Seattle, with additional stations at Tukwila, Kent, Auburn, Sumner, and Puyallup. In addition, future Sounder service is planned between Seattle and Everett, and between Tacoma and Lakewood. Also, Sounder hours of service will expand in the future.

The following sections provide detailed descriptions of Sound Transit's (Sounder) current, and planned future level of deployment of transit oriented market packages.

2.8.1 Transit Vehicle Tracking

Market Package Definition: This market package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

Sound Transit anticipates using GPS-based AVL/AVI equipment, linked to a central reporting/data processing system by a passive cellular packet data system. The centralized portion of the system will be based on the existing transit tracking program currently in use throughout the region. Sounder will then take modified output from this system and route it to Sound Transit's operations center and to reader boards/variable message signs at Sounder stations. Initially, Sound Transit will utilize cellular phones that allow operators to communicate with operation staff in case of delay or an emergency situation. It is likely the cellular communications will be retained in the future. As far as vehicle location determination, Sound Transit hopes to utilize Positive Train Separation (PTS), which is a GPS-based vehicle location/vehicle control system.

2.8.2 Transit Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

Sounder hopes to implement this market package in the next one to five years, but the actual architecture is not yet designed.

2.8.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

Paratransit service will be provided by other transit agencies throughout the region.

2.8.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.

Sounder currently uses ticket vending machines that support cash and credit/debit card transactions to issue daily, weekly, monthly, and annual passes. The ticket machines will be capable of supporting future “smart card” applications. The Puget Sound region has plans to implement a regional electronic fare system called Smart Card. The project is currently engaged in the system procurement process to acquire a common fare collection and fare vending system for seven transit agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and rail. This smart card based system will utilize a wireless data communications process at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency, passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use.

2.8.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

Sounder operators are using cellular phones to notify the operations staff of any emergency situations that may arise while enroute. In addition, Sound Transit plans to monitor station platforms and parking areas with cameras, and telephones will be located on platforms for emergency use.

2.8.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

Sound Transit does not anticipate implementing this market package for Sounder in the near term.

2.8.7 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

Sound Transit hopes to implement at least a part of this market package in the next one to five years with system design still being considered.

2.8.8 Standard Rail Crossing (Equipment Package)

Equipment Package Definition: This Equipment Package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Either passive (e.g., the crossbuck sign) or active warning systems (e.g., flashing lights and gates) are supported depending on the specific requirements for each intersection.

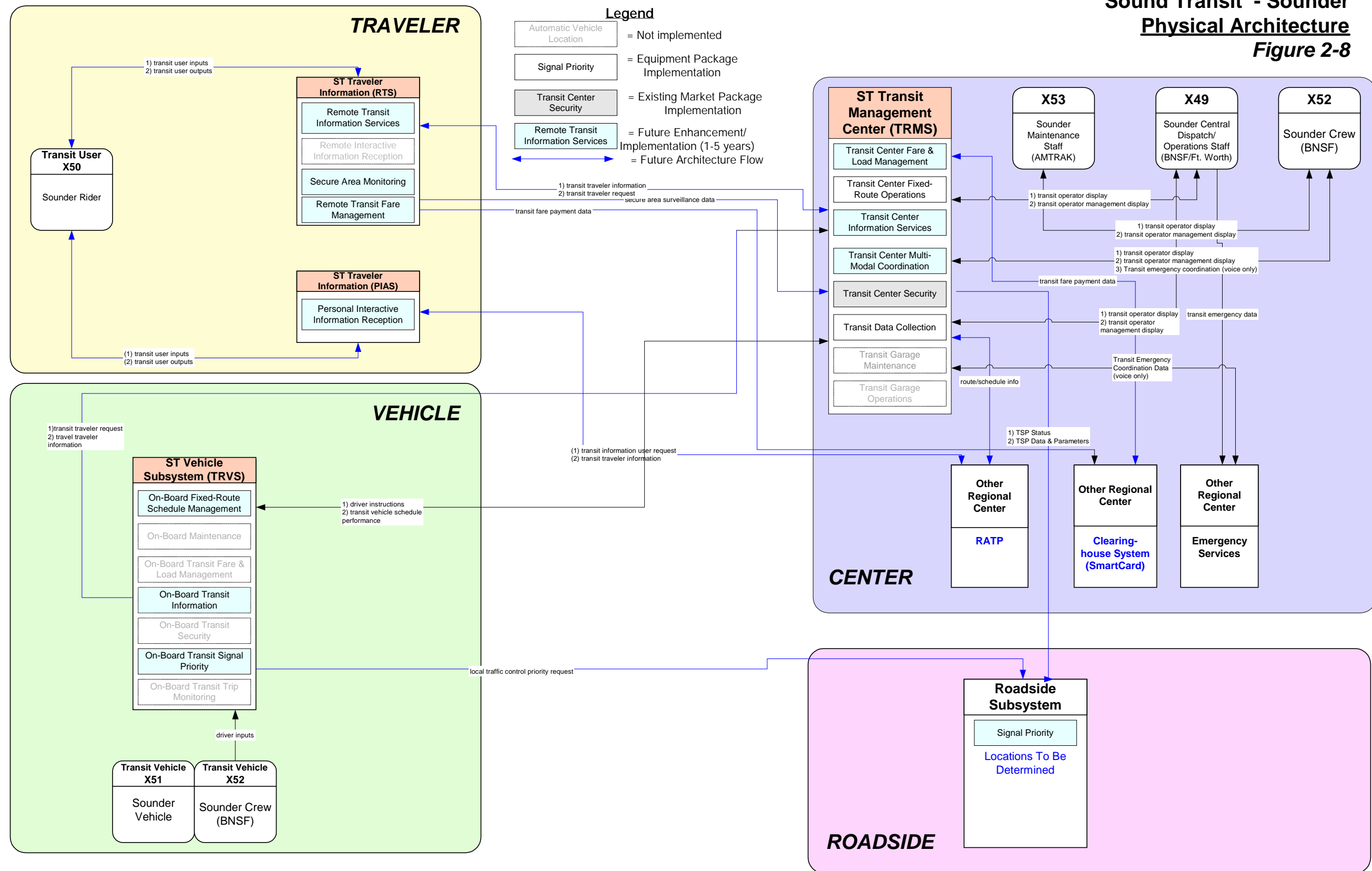
Sound Transit utilizes this equipment package at high-rail intersections throughout Pierce and King County. This infrastructure was previously deployed to support other rail operations.

2.8.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

Sounder's plans for external data sharing are not known at this point.

**Sound Transit - Sounder
Physical Architecture
Figure 2-8**





2.9 WASHINGTON STATE FERRIES (WSF)

Washington State Ferries is the largest ferry system in the United States, serving eight counties within Washington and the Province of British Columbia in Canada. Counties served include Pierce, King, Snohomish, Kitsap, Skagit, Island, San Juan, and Jefferson Counties. WSF's existing system has 10 routes and 20 terminals that are served by 29 vessels.

The following sections provide detailed descriptions of Washington State Ferries' current, and planned future level of deployment of transit oriented market packages.

2.9.1 Transit (Vessel) Vehicle Tracking

Market Package Definition: This market package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real-time.

WSF determines vehicle location for both passenger-only and passenger/vehicle vessels utilizing a Fleet Location System that provides real-time location information. Each vessel is equipped with global positioning system and a low band radio signal is transmitted to provide vessel locations. This system provides vessel location information to the WSF Operations Center and VTS (Coast Guard).

2.9.2 Transit (Vessel) Fixed-Route Operations

Market Package Definition: This market package performs automatic driver assignment and monitoring, as well as routing and scheduling for fixed-route services.

WSF performs vessel and driver assignments and scheduling internally through an Automated Dispatch System. This information is not exchanged with other system at this time. The Coast Guard provides information regarding other marine traffic and routing via radio.

2.9.3 Demand Response Transit Operations

Market Package Definition: This market package forwards paratransit dispatch requests to the driver and forwards acknowledgements the center. It coordinates with, and assists the driver in managing multi-stop runs associated with demand responsive, flexibly routed transit services.

WSF does not provide paratransit services.

2.9.4 Transit Passenger and Fare Management

Market Package Definition: This market package allows for the management of passenger loading and fare payments on-board vehicles using electronic means.

The Puget Sound region has plans to implement a regional electronic fare system called Smart Card. The project is currently engaged in the system procurement process to acquire a common fare collection and fare vending system for seven transit agencies (Metro, Community Transit, Kitsap Transit, Pierce Transit, Everett Transit, Washington State Ferries, and Sound Transit) in the Central Puget Sound.

The Smart Card will allow customers to use one fare card on multiple systems throughout the region, and it will support linked trips between transit, ferries and rail. This smart card based system will utilize a wireless data communications process at applicable operating bases and terminals and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency, passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use.

WSF is currently evaluating their participation in the program.

2.9.5 Transit Security

Market Package Definition: This market package provides for the physical security of transit passengers.

On-board security for both passenger-only and passenger/vehicle vessels is facilitated through radio communication with the WSF dispatch and operations center, which in turn contact the appropriate emergency service as necessary. In addition, all terminal ticket booths have an alarm system that notifies WSF operations of any security issues. Finally, there are video monitors at Bremerton and Edmonds terminals.

2.9.6 Transit Maintenance

Market Package Definition: This market package supports automatic maintenance scheduling and monitoring.

WSF has plans to implement a Maintenance Management Information System (MMIS) in the next one to five years. This system will support real time monitoring of vessel's conditions, which will be transmitted to the WSF transit maintenance center.

2.9.7 Multi-Modal Coordination

Market Package Definition: This market package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Basically, the package supports the capability for transit vehicles to improve operating efficiency and on-time performance through transit signal priority.

This market package is not applicable to the ferry system.

2.9.8 Transit Traveler Information

Market Package Definition: With the implementation of this market package transit information is provided to transit users at transit stops and on-board transit vehicles.

WSF monitors the vehicle queues at the Bainbridge, Kingston, Edmonds, Seattle, Mukilteo terminals that is translated as delay information to the general public.

2.9.9 Transit Data Collection (Equipment Package)

Equipment Package Definition: This equipment package collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Subsystem. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

WSF provides the general public with real-time fleet location over the Internet.

2.10 FUTURE SUBSYSTEM CONSIDERATIONS

In identifying existing and planned market packages and related subsystems, two future opportunities were discussed but not specifically identified by any regional agency for implementation or integration in the next one to five years.

2.10.1 Parking Management

The Parking Management Subsystem provides electronic monitoring and management of parking facilities. It supports a DSRC communications link to the Vehicle Subsystem that allows electronic collection of parking fees. It also includes the instrumentation, signs, and other infrastructure that monitors parking lot usage and provides local information about parking availability and other general parking information.

Parking management and associated information systems have been considered for some regional park & ride lots and it is anticipated that this will continue to be a consideration in the region in the next few years.

2.10.2 Toll Collection

The Toll Collection Subsystem provides the capability for vehicle operators to pay tolls without stopping their vehicles using locally determined pricing structures and including the capability to implement various variable road pricing policies.

Several regional initiatives for toll collection are under evaluation or in the planning process. If these initiatives proceed to deployment, regional agencies will need to be prepared to account for some level of integration within their systems.

3 REGIONAL TRANSIT ARCHITECTURE

The Puget Sound regional transit architecture is the aggregation of the individual architectures from each transit agency. Definition of the individual architectures supports demonstration of conformity with the intent of the final rulemaking for individual agencies, as well as providing a mechanism to identify regionally significant projects and initiatives within a five-year time frame. A key goal for regional architecture definition is to identify opportunities for regional integration. Table 3-1 provides a summary of the existing transit market packages deployed in the region as well as identification of market packages that regional agencies intend to deploy in the next one to five years.

Table 3-1 – Market Package Summary – Existing and Planned Deployment

	APTS1	APTS2	APTS3	APTS4	APTS5	APTS6	APTS7	APTS8	AD 01
Agency	Transit Vehicle Tracking	Transit Fixed Route Operations	Demand Response Transit Operations	Transit Passenger & Fare Management	Transit Security	Transit Maintenance	Multi-Modal Coordination	Transit Traveler Information	Data Mart
Community Transit	5	35	35	25	2	2	35	5	5
Everett Transit	25	5	35	5	5	5	5	5	25
King County Metro	35	35	35	5	35	25	35	35	35
Kitsap Transit	3	2	3	5			3		2
Pierce Transit	5	31	1	5	3	2	5	5	2
Sound Transit LINK	5	5		5	?	?	5	5	?
Sound Transit SOUNDER	5	3		5	3			5	?
Washington State Ferries	3	3		5	3	5		35	3

Legend

- 2 Existing (Partial - Equipment Package Only)
- 3 Existing (Market Package - Limited or Full Deployment)
- 5 Deploy or Enhance, 1 to 5 Years
- 1 Deploy or Enhance, 5 to 10 Years
- ? Status undetermined due to ongoing development

Figure 3-1 depicts the regional transit architecture in a simplified format, depicting “common points” where common equipment or standards provide regional and agency benefits through potential cost efficiencies while supporting regional interoperability goals.

As identified, the regional architecture is dynamic and will require periodic updates as funding, technology and agency policy may change over time. The transit agencies in the region are currently in the process of developing the Sound Transit Transit Technology Plan and Composite Technology Plan. These plans will develop specific

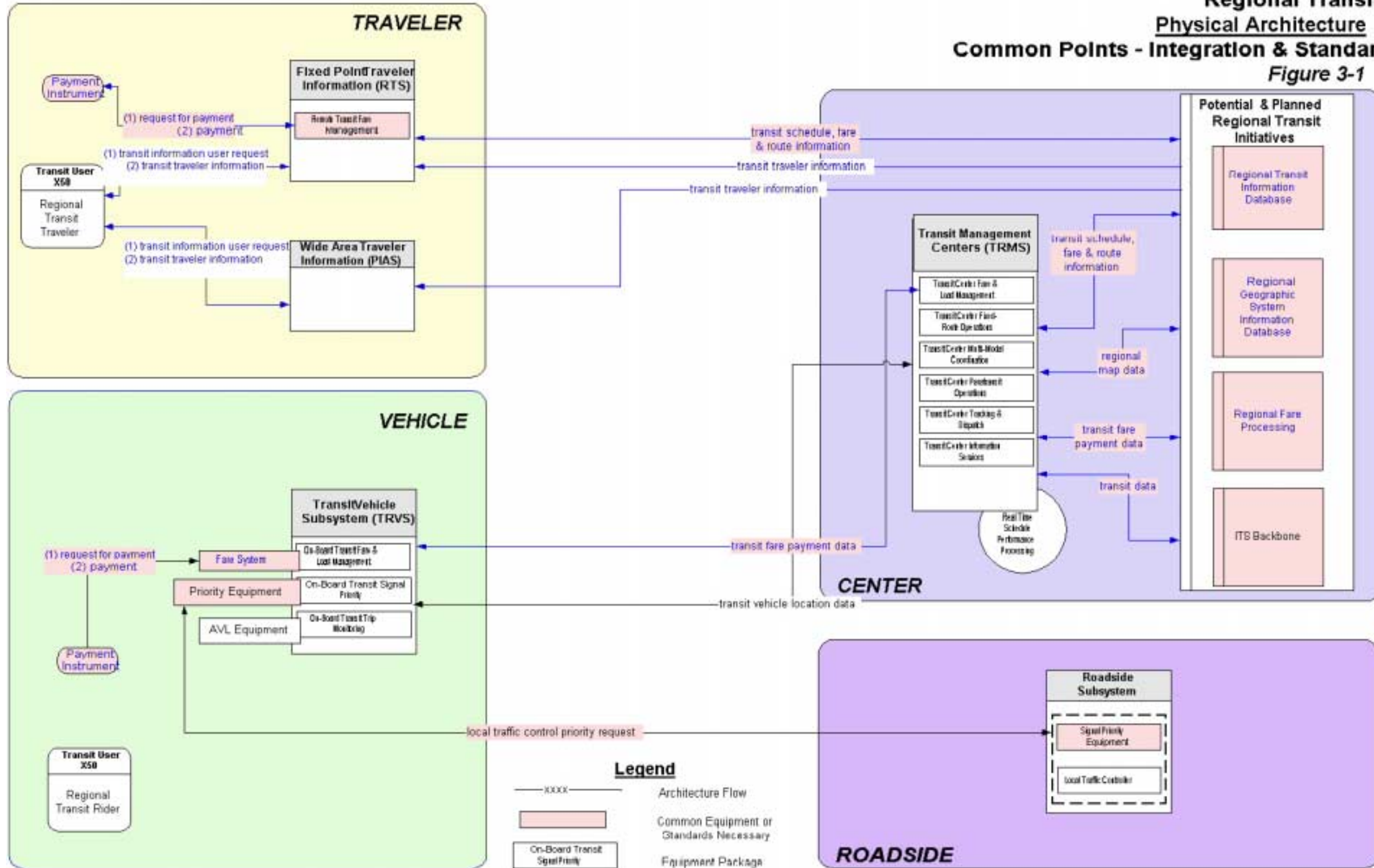
agency and regional projects and, in such, may amend the architecture currently defined in this summary. It is recommended that as these projects are implemented that the regional architecture be revised to reflect the new transit ITS elements.

3.1 REGIONAL PROJECTS

Through the creation of the individual transit agency architectures, five ongoing or proposed ITS programs or initiatives were identified that will require, or would benefit from regional implementation. It is anticipated that additional projects or refinements to these projects will occur after completion of the ongoing Sound Transit Technology Plan and Composite Technology plan. Figure 3-1 highlights opportunities for integration or joint development most likely in the next one to five years, including:

- Transit Signal Priority
- Transit Fare Management
- Transit Data Management
- Transit Traveler Information
- Geographic Information Systems

**Regional Transit
Physical Architecture
Common Points - Integration & Standards
Figure 3-1**



3.1.1 Transit Signal Priority

King County Metro and Community Transit are currently supporting transit signal priority. Pierce Transit also hopes to benefit from the efficiencies of transit signal priority in the near future. Transit signal priority requires communication between the transit vehicle and the roadside. Under King County Metro's current architecture, communication between the roadside and the transit management center is also required. These relationships become complex in a region where the transit agencies pass through numerous jurisdictions (as seen in the table in Appendix B). These communication links are further complicated when transit agencies use different signal priority systems. Real efficiencies are possible when common transit signal priority technology are seamlessly implemented across multiple jurisdictions. To ensure these efficiencies are possible, common equipment or standards are important (especially between the priority equipment on the bus and the signal priority equipment on the roadside).

As signal priority continues to be deployed in the region, consideration of common equipment and standards is recommended, particularly in areas that are serviced by multiple transit agencies.

3.1.2 Transit Fare Management (Smart Card)

The Smart Card will allow customers to use one fare card on multiple systems throughout the region and will support linked trips between transit, ferries and rail alike. This smart card based system will utilize a wireless data communications process at applicable operating bases and a central clearinghouse where all smart card-generated trip data and revenue is reconciled for the region. Transit fare payment data will be collected from vehicles at the maintenance bases for each transit agency, passed to the regional clearinghouse for processing, and then returned to each transit agency for their internal use. The current plans for the Smart Card will support common equipment throughout the region.

3.1.3 Transit Data Management

The transit agencies were surveyed regarding their transit data collection at the equipment package level, and not within a market package. At this point, it does not appear that the transit agencies have near-term plans (in the next one to five years) to support a regional achieved data user system (ADUS), specific to transit data. However, a regional data management system specific to transit has been included in the transit architecture as a future project that will require regional integration and data standards. As agencies develop and deploy new systems during the next five-year period, consideration should be given to future regional transit data archive requirements. Integration with the ongoing transit traveler information initiatives may provide a platform for expanded archive data user system.

3.1.4 Transit Traveler Information

The Regional Automated Trip Planning (RATP) project is the beginning of regional transit information management. The development of the regional system is currently underway. RATP will allow a traveler to call Pierce Transit, Community Transit or King County Metro and receive a transit itinerary for travel within all three of the transit agencies service areas. The schedule and route information eventually will be stored in a central server with updates electronically transmitted from the agencies. Common data standards will be necessary to implement the RATP project. As noted in the previous section, the RATP project will hopefully set the stage for the implementation of a regional transit information database.

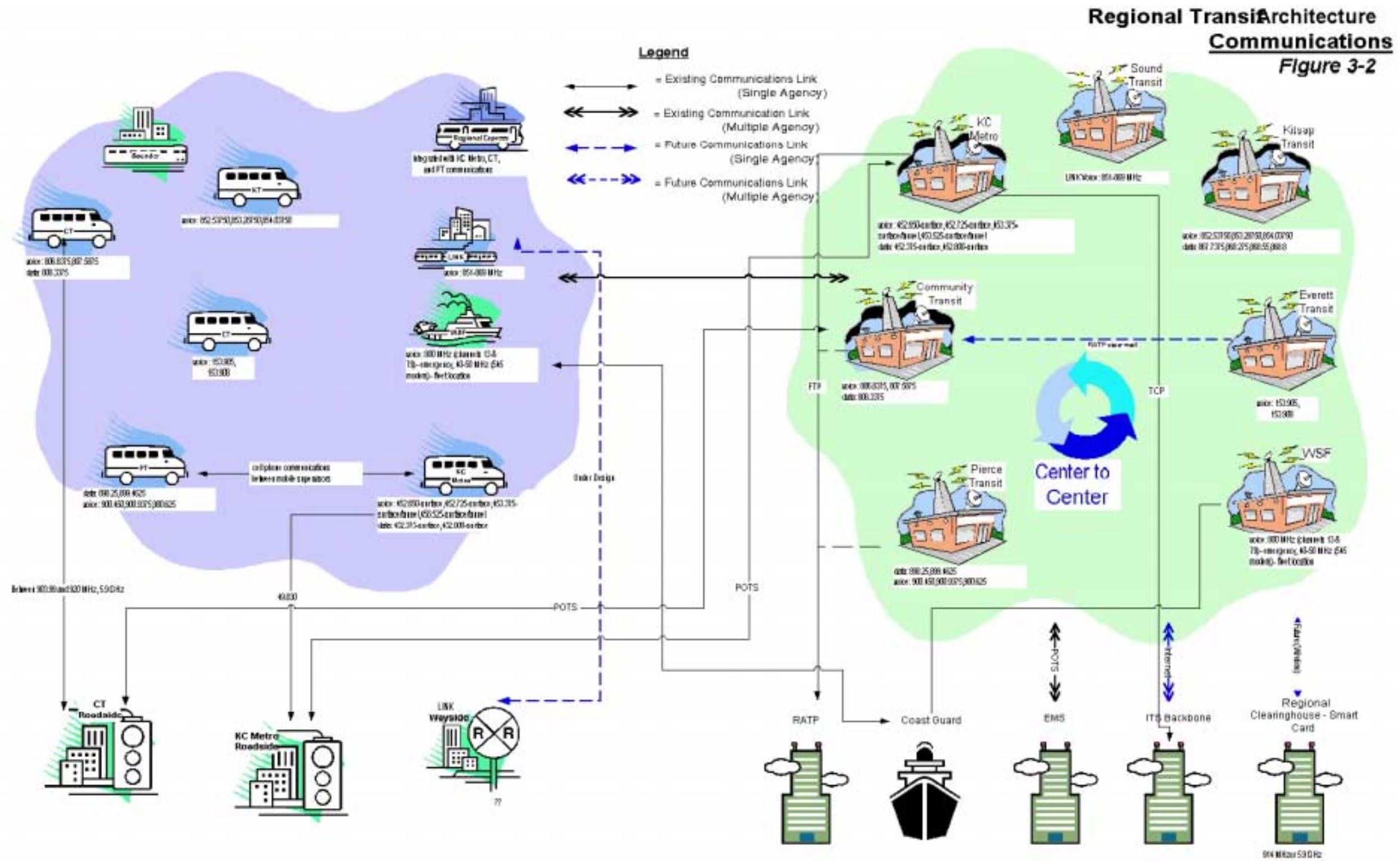
3.1.5 Geographic Information Systems

The region currently maintains several non-integrated Geographic Information Systems used for a variety of data management, analysis and operational functions. As regional data sharing and information management develops, the need for and benefit of a common GIS based referencing system will be increasingly apparent. This need extends beyond the transit element of the regional architecture into traffic management, emergency management and all systems that will benefit from sharing information that is geographically based. Within the next five years, continued development of regional trip planning, real time transit arrival data and archive data user systems and implementation of major service improvements, e.g., Sound Transit, will warrant a focused review of opportunities for a common GIS referencing system.

3.2 REGIONAL COMMUNICATIONS

The development of the regional transit architecture also included an inventory of the communications being used by the transit agencies in the region. Figure 3-2 presents the communication links that are supporting regional projects as well as the specific frequencies the agencies are using. This figure also identifies future linkages anticipated in the region including center to center (C2C) and trusted information service provider (ISP) communication links.

Detailed descriptions of communication linkages that support regional integration are provided in the Integration Strategy. A brief description of these regional approaches is presented here. A brief description of these regional approaches is presented here.



As presented for the Puget Sound Regional Architecture, the trusted ISP would be the primary location for the distribution of real-time dynamic information to public agencies and private ISPs. This process would require regional traffic agencies, transit, and others to “publish” data and information to the trusted ISP. Data and information would then be available to any agency, or private ISP who chooses to “subscribe” to it. With respect to the regional transit agencies, this approach would apply primarily to transit traveler information. This model was demonstrated as part of the Smart Trek project through the BusView and MyBus features (www.smarttrek.org). The ITS backbone demonstrated under the Smart Trek project represents a model for trusted ISP implementation. The individual as well as regional architectures identified as part of this current process, highlight future enhancements and connections to the ITS backbone.

As presented in the Puget Sound Regional Intelligent Transportation Integration Strategy, the sharing of device control throughout the region is a more complex operation, and will require a longer implementation period. For control sharing, it is proposed that center-to-center (C2C) interfaces be created among agencies. This will allow one agency to have certain levels of agreed upon access to another agency’s device control and data. For the regional transit agencies, shared control has limited applications but it does apply in current practice to signal priority operations both amongst the transit agencies as well as the local traffic operations centers. It is anticipated that as individual projects are developed between select agencies, additional or enhance C2C connections will occur. Transit data management, when developed, may follow a C2C or a trusted ISP architecture.

3.3 TRANSIT COMMUNICATIONS FOR ITS PROTOCOLS

As mentioned in Section 1, a key goal of the national architecture effort has been the definition of common standards to achieve interoperability through the Transit Communications for ITS Protocols (www.tcip.org) project. Phase 1 of the project was completed in 1999, and established a transit ITS data interface "Framework" and eight "Business Area Object Standards." Phase 2 of the project (TCIP2), will build on the work of Phase 1 by developing the transaction sets, application profiles and guidebooks required to test and implement TCIP.

A key objective of the TCIP standardization effort is to ensure that major transit systems interact in a plug and play environment. On-board systems must interact with a computer aided dispatch system, scheduling system, customer information system, active bus stop signs and kiosks, incident management and maintenance operations, which in most cases have all been implemented by multiple vendors. As is the case with most of the transit systems in the Puget Sound, each system is often composed of subsystems or components from multiple vendors, and there are existing or planned projects that require the region’s transit agencies to exchanging planning and operational data between their various systems.

The objective of the TCIP2 effort, currently underway, is to ensure cost-effective interoperability of transit applications and identify tools and procedures for transit ITS deployment in the transit industry. This effort will also fill in gaps in the standards developed for transit ITS with existing information technology standards. Specifically, the goals of the project, as defined by the project team, are as follows:

- ***User-defined application and communication profiles.*** *Develop a consensus around a set of application and communication profiles which meet transit industry needs (e.g., skill levels that are supportable by transit agencies, computing platforms, operating systems, communication interface requirements).*
- ***Generic application programming interfaces (API's).*** *Develop a detailed transit reference model and generic dialog mechanisms (e.g., application programming interfaces) that address information exchange behavior and registration issues.*
- ***Tools and Modules.*** *Identify a core set of tools and modules that will aid transit agencies and vendors to expedite the implementation of TCIP technologies.*
- ***Testing.*** *Define the test requirements and suites to test for interoperability.*

The suite of developing TCIP standards has recently been renamed and renumbered. Table 3-2 illustrates standards available for consideration and use, and traces their lineage from TCIP to their new nomenclatures as standards within the National Transportation Communications for ITS Protocol (NTCIP) suite. The table also suggests the area of applicability for the standard—how and where it is likely to be used.

Table 3-2. Transit Specific ITS Standards

Name	Formerly	Title	Use
NTCIP 1400 (Draft)	ITE-TCIP-FRAME	Transit Communications Interface Profiles (TCIP) Framework Standard	This standard defines a transit classification scheme, naming conventions, rules for identification of data elements and messages, guidance on the use of ASN.1 syntax, and levels of conformance for all TCIP standards.
NTCIP 1401 (Draft)	NTCIP-TCIP-CPT	Transit Communications Interface Profiles (TCIP) Common Public Transportation Business Area Standard	The common public transportation business area objects in this standard support all TCIP business areas and are used to meet the common communication requirements of those areas. The data elements and messages established by this standard support core transit business needs.
NTCIP 1402 (Draft)	ITE-TCIP-IM	Transit Communications Interface Profiles (TCIP) Incident Management Business Area Standard	This standard allows real-time information needed for incident management to be provided to and shared among incident management centers and other information centers and services.
NTCIP 1403 (Draft)	NTCIP-TCIP-PI	Transit Communications Interface Profiles (TCIP) Passenger Information Business Area Standard	This standard allows real-time information on schedules, schedule adherence, and transit amenities to be provided to ISPs, TMCs, inter-modal transportation operators, other transit managers and, most importantly, transit passengers. It allows the PI business area to receive information from TMCs, transit vehicle systems, transit garage management systems, other transit management centers, parking management systems, inter-modal transportations providers, and planning systems.

NTCIP 1404 (Draft)	ITE-TCIP-SCH	Transit Communications Interface Profiles (TCIP) Scheduling and Runcutting Business Area Standard	This standard allows real-time information on schedules and transit infrastructure to be provided to ISPs, TMCs, remote traveler support kiosks, inter-modal transportation service providers, and other transit management systems. It allows the SCH business area to receive information from TMCs, transit vehicle systems, parking management systems, and inter-modal transportations providers, among others.
NTCIP 1405 (Draft)	ITE-NTCIP-SP	Transit Communications Interface Profiles (TCIP) Spatial Representation Business Area Standard	This standard provides other business areas with the vocabulary and format for representing common attributes for referencing spatial transit data elements, or “objects.”
NTCIP 1406 (Draft)	ITE-NTCIP-OB	Transit Communications Interface Profiles (TCIP) On-Board Objects Business Area Standard	This standard covers the data needs of the TCIP functions related to on-board bus (rail, ferry) applications. This includes all data needed for communication between on-board components within the transit vehicle, and between on-board components and other transit applications. These objects are critical to transit agencies because they provide dynamic information on locations and operating status for vehicle performance monitoring and transit operations.
NTCIP 1407 (Draft)	ITE-NTCIP-CC	Transit Communications Interface Profiles (TCIP) Control Center Business Area Standard	This standard supports the transit control center business area which involves various components and systems within the public transportation management center operation. These functions include data-processing to provide, monitor and measure transit services in real-time, the use of CAD, and the dissemination of information on fleet performance, both in real-time and summary form, to ISPs, TMCs, and other transit management systems.

These additional ITS standards of related interest should be considered and consulted in support of those transit-specific standards enumerated above.

Table 3-3 Related or Supporting ITS Standards of Interest

Name	Title
NTCIP 1102 (Draft)	National Transportation Communications for ITS Protocol (NTCIP) – Octet Encoding Rules (OER)
SAE J1708	Serial Data Communications Between Microcomputer Systems in Heavy-Vehicle Applications
SAE J2313	On-Board Land Vehicle Mayday Reporting Interface
SAE J2374	Location Referencing Message Specification (LRMS) Information Report
NTCIP 2202 (Draft)	National Transportation Communications for ITS Protocol (NTCIP) – Internet (TCP/IP and UDP/IP) Transport Profile
NTCIP 2302 (Draft)	National Transportation Communications for ITS Protocol (NTCIP) – Application Profile for Trivial File Transfer Protocol
NTCIP 2303 (Draft)	National Transportation Communications for ITS Protocol (NTCIP) – Application Profile for File Transfer Protocol
NTCIP 2304 (Draft)	National Transportation Communications for ITS Protocol (NTCIP) – Application Profile for Data Exchange ASN.1 (DATEX-ASN)
NTCIP 2305 (Draft)	National Transportation Communications for ITS Protocol (NTCIP) – Application Profile for Common Object Broker Request Architecture (CORBA)
IEEE Std 1489-1999	Standard for Data Dictionaries for Intelligent Transportation Systems
IEEE Std 1488-2000	Trial Use Standard for Message Set Template for Intelligent Transportation Systems

3.4 APPLICABILITY AND USE OF ITS STANDARDS IN THE PUGET SOUND REGIONAL TRANSIT ARCHITECTURE

Of primary importance in the Puget Sound region is the proper application and consistent use of ITS standards in cases of:

- Inter-agency data or information sharing, and

- Any external data exchange between center, vehicle, roadside and traveler ITS equipment packages.

The use of standards in these cases will provide the best near-term opportunity to achieve regional integration and interoperability at the common points as illustrated in Figure 3-1.

The near-term continued use of legacy or proprietary subsystems to exchange inter- or intra-agency data and information using non-standard formats is acceptable. However, as enhancement, upgrade or new capability projects develop within the region, evaluation and consideration of applicable and available standards should be included in the project development stage. In addition, this should be documented and included in grant application materials.

Using the information exchanges expressed by the architecture flows in Figure 3-1 as a basis, Table 3-4 lists the standards that should be applicable to the common points in the regional transit architecture. Table 3-4 illustrates the applicable primary standards. These standards should be reviewed to determine if are applicable all or in part, and if there are supporting standards or related documents of interest.

Table 3-4. Primary Standards Applicable to “Common Points – Integration & Standards”

From	To	Architecture Flow(s)	Applicable Standard(s)
Fixed Point Traveler Information (RTS)	Payment Instrument	(1) request for payment (2) payment	NTCIP 1400, 1401, 1407
Fixed Point Traveler Information (RTS)	Transit User (X50) – Regional Transit Traveler	(1) transit information user request (2) transit traveler information	NTCIP 1400, 1401, 1403, 1404, 1407
Fixed Point Traveler Information (RTS)	<i>Potential & Planned Regional Transit Initiatives</i>	Transit schedule, fare & route information	NTCIP 1400, 1401, 1403, 1404, 1407
<i>Potential & Planned Regional Transit Initiatives</i>	Fixed Point Traveler Information (RTS)	Transit traveler information	NTCIP 1400, 1401, 1403, 1404, 1407
Transit User (X50) – Regional Transit Traveler	Wide Area Traveler Information (PIAS)	(1) transit information user request (2) transit traveler information	NTCIP 1400, 1401, 1403, 1404, 1407
<i>Potential & Planned Regional Transit Initiatives</i>	Wide Area Traveler Information (PIAS)	Transit traveler information	NTCIP 1400, 1401, 1403, 1404, 1407
Transit Management Centers (TRMS)	Transit Vehicle Subsystem (TRVS)	Transit fare payment data	NTCIP 1400, 1401, 1406
Transit Management Centers (TRMS)	Transit Vehicle Subsystem (TRVS)	Transit vehicle location data	NTCIP 1400, 1401, 1405, 1406, 1407
Transit Management Centers (TRMS)	<i>Potential & Planned Regional Transit Initiatives</i>	Transit schedule, fare & route information	NTCIP 1400, 1401, 1403, 1404, 1407
Transit Management Centers (TRMS)	<i>Potential & Planned Regional Transit Initiatives</i>	Regional map data	NTCIP 1400, 1401, 1404, 1405
Transit Management Centers (TRMS)	<i>Potential & Planned Regional Transit Initiatives</i>	Transit fare payment data	NTCIP 1400, 1401, 1407
Transit Management Centers (TRMS)	<i>Potential & Planned Regional Transit Initiatives</i>	Transit data	NTCIP 1400, 1401, 1403, 1404, 1407
Transit Vehicle Subsystem (TRVS)	Payment Instrument	(1) request for payment (2) payment	NTCIP 1400, 1401, 1406, 1407
Transit Vehicle Subsystem (TRVS)	Roadside Subsystem	Local traffic control priority request	NTCIP 1400, 1401, 1404, 1406

3.5 CONCLUSIONS

The regional transit architecture captures existing and planned transit technology deployments in the Puget Sound region. The regional architecture is a dynamic document that will require periodic updates and in the process provide an opportunity for regional agencies to share information about ongoing capital programs. Current opportunities for regional integration should be considered as agencies plan and deploy technology-based solutions for operations and maintenance. As identified in the Puget Sound Regional Intelligent Transportation Integration Strategy, continued dialogue amongst the regional transit providers is critical to successful implementation of integrated regional technology infrastructure.

APPENDIX A: EQUIPMENT PACKAGE SUMMARY (TRANSIT MANAGEMENT CENTER SUBSYSTEMS)

Equipment Package Summary	TRANSIT MANAGEMENT SUBSYSTEM									
	Transit Center Fare and Load Management	Transit Center Fixed-Route Operations	Transit Center Information Services	Transit Center Multi-Modal Coordination	Transit Center Paratransit Operations	Transit Center Security	Transit Center Tracking and Dispatch	Transit Data Collection	Transit Garage Maintenance	Transit Garage Operations
Sound Transit										
Fixed Route										
Existing/Planned	Planned	By Others	None	By Others	NA	By Others	By Others	By Others		
Upgrade/Implementation	Implementation (1-5 years)									
Description	Smart Card									
Software										
Hardware/Operating System										
Commuter Rail										
Existing/Planned	Planned	Planned	Planned	Planned	NA	Planned	Planned	Planned	None	Planned
Upgrade/Implementation	Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)		Implementation (1-5 years)	Implementation (5-10 years- GPS-based AVL/AVI equipment)	Implementation (1-5 years)		Implementation (1-5 years)
Description	Smart Card					Camera				
Software	MS Windows NT									
Hardware/Operating System	Pentium									
Light Rail										
Existing/Planned	Planned	Planned	Planned	None	NA	Planned	Planned	Planned	Planned	Planned
Upgrade/Implementation	Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)			Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)
Description	Smart Card	SCADA	Central control passenger assistance and VMS			CCTV Monitor and Passenger Assistance Phone	AVL and Signal System	SCADA memory and report generation	Unknown	Unknown
Software										
Hardware/Operating System										
KC Metro										
Fixed Route										
Existing/Planned	Planned	Existing	None	Existing	NA	Existing	Existing	Existing	Existing	Existing
Upgrade/Implementation	Implementation (1-5 years)	Upgrade (1-5 years)		Upgrade (1-5 years)		Upgrade (1-5 years)	Upgrade (1-5 years- radio replacement and AVL system)	Upgrade (1-5 years)	Upgrade (1-5 years)	Upgrade (Replacement of BOSS is underway)
Description	Smart Card					Video				
Software				KC Transit (Visual Basic)			Custom apps: DAC v1.2, DCC v1.96, AVL/CAD v. 1.0.14, 1.0.17, HASTUS DAC-Unit, DCC_Peritium w/Windows NT, AVL/CAD_Peritium w/Windows NT, TWiChkBsVwMyBts_Peritium w/Windows NT		Control Software Inc., M4	Vehicle Dispatch v. 3.10, BOSS on QLEO v. 3.0 via in-house app Univ. Prime minicomputer
Hardware/Operating System				Windows NT						
Paratransit										
Existing/Planned	None	NA	None	None	Existing	Planned	Planned		Planned	Existing
Upgrade/Implementation					Upgrade (1-5 years - upgrade PASS to Trapeze)	Implementation (1-5 years)	Implementation (1-5 years)		Implementation (1-5 years)	
Description										
Software					PASS v. 3.9x, ACTION					PASS v. 3.9x, E-Track v. 1.1
Hardware/Operating System					PCLAN					PC w/Windows NT
Everett Transit										
Fixed Route										
Existing/Planned	Planned	Existing	Planned	Planned	NA	Planned	Planned	Existing	Planned	Planned
Upgrade/Implementation	Implementation (1-5 years)	Upgrade (1-5 years)	Implementation (5-10 years)	Implementation (1-5 years)		Implementation (1-5 years)	Implementation (1-5 years)	Upgrade (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)
Description	Smart Card						Two-way Radio			
Software										
Hardware/Operating System										
Paratransit										
Existing/Planned	None	NA	None	None	Existing	Planned	Planned		Planned	Planned
Upgrade/Implementation					Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)		Implementation (1-5 years)	Implementation (1-5 years)
Description					Upgrade Trapeze v.3.1 to v.4.1					
Software										
Hardware/Operating System										
Community Transit										
Fixed Route										
Existing/Planned	Planned	Existing	Planned	Existing	NA	Existing	Existing	Existing	Existing	Existing
Upgrade/Implementation	Implementation (1-5 years)	Upgrade (Hastus v 10 and radio upgrade)	Implementation (5-10 years)	Upgrade (1-5 years)		Upgrade (Hastus v 10 and radio upgrade)	Upgrade CAD (1-5 years)	Upgrade (1-5 years)	None	None
Description	Smart Card	Radio (800 MHz Motorola Centracon II)	Next Stop Announcements (audio and visual)			Radio (800 MHz Motorola Centracon II)	Radio (800 MHz Motorola Centracon II)	Radio (800 MHz Motorola Centracon II)		
Software		HASTUS v. 5.2	Not known	Order Systems NextPhase			HASTUS v. 5.2	PeopleSoft v. 7.01, Oracle v. 8.1.5	Fleet Anywhere v.4.2, app v. 4.2.089, PeopleSoft v. 7.01, Oracle v. 8.1.5	MDUS 90 v. 3.2, Oracle v. 8.15, PeopleSoft v. 7.01
Hardware/Operating System		Windows NT, Oracle 8.15	Not known	2070L Signal Controller, T1 Cable			Windows NT, Oracle 8.15			
Paratransit										
Existing/Planned		Existing			Existing		Planned			
Upgrade/Implementation					Upgrade (Trapeze v.5)		Implementation (1-5 years)			
Description		2 way radio leased Motorola frequency								
Software					PASS 9.2					
Hardware/Operating System					DOS, Radio using Leased Motorola frequency					
Pierce Transit										
Fixed Route										
Existing/Planned	Planned	Existing	Planned	Planned	NA	Existing	Planned	Existing	Existing	None
Upgrade/Implementation	Implementation (1-5 years)	Upgrade (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)			Implementation (1-5 years)	Upgrade (1-5 years)	Upgrade (?)	
Description	Smart Card	Radio (800 MHz Motorola Centracon II)		3M Opticom		Radio (800 MHz Motorola Centracon II)	Radio (800 MHz Motorola Centracon II)			
Software		HASTUS v. 5.2		HASTUS 5.82						
Hardware/Operating System		Windows NT, MS Sequel Server							SCI v5.0	Oracle 8.05 database on an NT server
Paratransit										
Existing/Planned	None	NA	None	None	Existing	Planned	Planned		None	
Upgrade/Implementation					Upgrade (Trapeze v.5)		Implementation (1-5 years)			
Description										
Software					Trapeze PASS v. 3.92		AVL/GPS system using cellular data packets (exact system to be)			
Hardware/Operating System					Novel 3.11					
Kitsap Transit										
Fixed Route										
Existing/Planned	Planned	Existing	None	Existing	Existing	Not functional at this point	Existing	Existing	Existing	Existing
Upgrade/Implementation	Implementation (1-5 years)							Upgrade (1-5 years)		
Description	Smart Card	Spreadsheet Software		3M Opticom			Radio (852.5375,853.2875,854.0375)			
Software		Excel								
Hardware/Operating System										
WSF										
Passenger & Vehicle										
Existing/Planned	Planned	Existing	Existing	None	NA	Existing	Existing	Existing	Planned	Existing
Upgrade/Implementation	Implementation (1-5 years)	None planned	None planned			None planned	None planned	Upgrade (1-5 years)	Implementation (1-5 years)	None planned
Description	Smart Card	Spreadsheet Software				Video and Radio 800 MHz (Channels 13 & 79)	Radio 800 MHz (Channels 13 & 79)		Maintenance Management Information System (MMIS)	
Software		Excel								AOSS
Hardware/Operating System										

APPENDIX A: EQUIPMENT PACKAGE SUMMARY CONT. (TRANSIT MANAGEMENT VEHICLE SUBSYSTEMS)

Equipment Package Summary	TRANSIT VEHICLE SUBSYSTEM							
	On-board Fixed Route Schedule Management	On-Board Maintenance	On-board Parametric Operations	On-board Transit Fare and Load Management	On-board Transit Information Service	On-board Transit Security	On-board Transit Signal Priority	On-board Transit Trip Monitoring
Sound Transit								
Fixed Route								
Existing/Planned	By Others	By Others	NA	Planned	By Others	By Others	By Others	By Others
Upgrade/Implementation				Implementation (1-5 years: Smart Card)				
Description				Smart Card				
Software								
Hardware/Operating System								
Commuter Rail								
Existing/Planned	Planned	None	NA	Planned	Planned	None	Planned	Planned
Upgrade/Implementation	Implementation (1-5 years)			Implementation (1-5 years: Smart Card)	Implementation (1-5 years)		Implementation (1-5 years)	Implementation (5-10 years)
Description				Smart Card				
Software								
Hardware/Operating System								
Light Rail								
Existing/Planned	Planned	Planned	NA	Planned	NA	Planned	Planned	Planned
Upgrade/Implementation		Implementation (1-5 years)		Implementation (1-5 years: Smart Card)				Implementation (1-5 years)
Description		Event recorder, download in yard, Lonworks		Smart Card (wayside, not on vehicle)		Passenger to driver intercom	Train to wayside	Wayside systems (not on board)
Software								
Hardware/Operating System								
KC Metro								
Fixed Route								
Existing/Planned	Existing	Existing	NA	Planned	None	Existing	Existing	Existing
Upgrade/Implementation	Upgrade (1-5 years)	Upgrade (1-5 years- current buses with on-board data collection will form basis of smart bus, and future bus will be equipped with capabilities)		Implementation (1-5 years: Smart Card)		Upgrade (1-5 years- purchase 150 200 on-board CCTV monitoring systems)	Upgrade (1-5 years expand to 100% of Metro's fleet)	Upgrade (Radio replacement and AVL system upgrade)
Description	AVL (2-way voice/data)			Smart Card		MyDay	Antech RF Tag	
Software								
Hardware/Operating System								
Paratransit								
Existing/Planned	NA	None	Existing	None	None	Planned	None	None
Upgrade/Implementation			Upgrade (Replace video radio traffic with MDTs integrated with PASS)			Implementation (1-5 years)		
Description			Voice only					
Software			PASS v. 3.9x					
Hardware/Operating System			Motorola 900 MHz/Nextel Phone, Novell					
Everett Transit								
Fixed Route								
Existing/Planned	Existing	Planned	NA	Planned	Planned	Planned	Planned	Planned
Upgrade/Implementation	Implementation (1-5 years)	Implementation (1-5 years)		Implementation (1-5 years: Smart Card)	Implementation (5-10 years)	Implementation (1-5 years)	Implementation (1-5 years)	Implementation (1-5 years)
Description				Smart Card				
Software								
Hardware/Operating System								
Paratransit								
Existing/Planned	NA	Planned	Planned	None	None	Planned	None	None
Upgrade/Implementation		Implementation (1-5 years)	Implementation (1-5 years)			Implementation (1-5 years)		
Description								
Software								
Hardware/Operating System								
Community Transit								
Fixed Route								
Existing/Planned	Existing	Existing	NA	Planned	Planned	Existing	Existing (46 intersections)	Planned
Upgrade/Implementation	Upgrade by 2001: 800 MHz with Gold Elite	Data accessed using laptops		Implementation (1-5 years: Smart Card)	Implementation (1-5 years)		Upgrade to 100 intersections by 2005	Implementation (1-5 years)
Description	Radio (800 MHz Motorola Centracom II)	Hubometers (data accessed using laptops)		GPI (Busstop)	Next Stop Announcement - audio and visual	Video, Radio (800 MHz)	McCan Traffic Supply	AVL system (exact system & comm. to be determined)
Software		FlexMatch, Allen Bradley		GPI v. 4 and 7a, Peoplesoft	Not known			
Hardware/Operating System	Smulcast 2-Way (Motorola 800 MHz)			GPI	Not known	Silent Witness - video	AMTECH 5704 tags	
Paratransit								
Existing/Planned	NA	None	Existing	None	None	None	None	None
Upgrade/Implementation			Leased Motorola 2-way frequency					
Description								
Software								
Hardware/Operating System								
Pierce Transit								
Fixed Route								
Existing/Planned	Planned	Existing	NA	Planned	None	Existing	Planned	Planned
Upgrade/Implementation	Implementation (1-5 years)	Upgrade		Implementation (1-5 years: Smart Card)			Implementation (1-5 years)	Implementation (1-5 years)
Description	Radio (898.25, 899.4625, 900.450, 900.9375, 900.625)	Hubometers (data accessed using laptops)		Smart Card		Radio (898.25, 899.4625, 900.450, 900.9375, 900.625) and Video	3M Opticom	AVL/GPS system using cellular data packets (exact system to be determined)
Software								
Hardware/Operating System								
Paratransit								
Existing/Planned	None	None	Existing	None	None	Planned	None	None
Upgrade/Implementation						Implementation (1-5 years)		
Description			MDTs					
Software			Mentor Express, Trapeze PASS v.3.92					
Hardware/Operating System			DOS, Novell 3.11					
Kitsap Transit								
Fixed Route								
Existing/Planned	Existing	None	Existing	Planned	None	Not functional at this point	Existing	Planned
Upgrade/Implementation				Implementation (1-5 years: Smart Card)				
Description	Radio (862.5375, 863.3875, 864.0375)			Smart Card			3M Opticom	
Software								
Hardware/Operating System								
WSF								
Passenger & Vehicle								
Existing/Planned	Existing	Planned	NA	Planned	None	Existing	NA	Existing
Upgrade/Implementation	Not planned	Implementation (1-5 years)		Implementation (1-5 years: Smart Card)		Not planned		Upgrade (1-5 years)
Description		Maintenance Management Information System (MMIS)		Smart Card		Radio 800 MHz (Channels 13 & 75)		Meteor (S45 Model, 45 MHz)
Software								
Hardware/Operating System								

**APPENDIX B: EQUIPMENT PACKAGE SUMMARY
(ROADSIDE SUBSYSTEMS – AGENCY OPERATING AREAS)**

		ROADSIDE SUBSYSTEMS																												
Agency		WSDOT	King County	Pierce County	Snohomish County	City of Auburn	City of Bellevue	City of Bothell	City of Burien	City of Bremerton	City of Everett	City of Federal Way	City of Issaquah	City of Kent	City of Kirkland	City of Lacey	City of Lynnwood	City of Redmond	City of Renton	City of SeaTac	City of Tacoma	City of Tukwila	City of Seattle	City of Lakewood	City of Fife	City of Puyallup	City of Gig Harbor	City of University Place	City of Fircrest	
Sound Transit		X	X	X	X		X				X	x					X	X			X		X							
KC Metro		X	X		X	X	X	X		X	x	X	X	x				X	X	x		X	X							
Everett Transit					X						X																			
Community Transit		X	X		X			X			X				X		X	X						X						
Pierce Transit		X		X																	X			X	X	X	X	X	X	X
Kitsap Transit										X																				
WSF		Not applicable																												

APPENDIX C: ARCHITECTURE FLOW DESCRIPTION

Note: The architecture flow descriptions can be found in the following pages for most of the transit agencies. Some of the transit agencies such as Sound Transit do not have architecture flow descriptions as it is not clear at this point how data will be passed within the organizational structure of the agency

King County Metro Architecture Flow Description

Table C-3

Architecture Flow	National Architecture Definition		Agency Data Definition			
	From	To	Agency Data	From (Based on Agency Organizational Chart)	To (Based on Agency Organizational Chart)	Device/Communication
driver instructions	Transit Center Tracking & Dispatch	On-Board Fixed Route Schedule Management	driver instructions	Service Communications	Operator	Voice Radio (450 MHz)
driver instructions	Transit Center Paratransit Operations	On-Board Paratransit	driver instructions	KCM Paratransit Central	Paratransit Operator	Voice Radio (900 MHz) or
driver instructions	Transit Center Tracking & Dispatch	On-Board Fixed Route Schedule Management (Mobile Supervisor)	driver instructions	Service Quality	Operator	Voice Radio (450 MHz)
emergency acknowledge	Transit Center Security	On-Board Transit Security	emergency acknowledge	Service Communications	Operator	Data Radio (450 MHz)
emergency acknowledge	Transit Center Security	Secure Area Monitoring (Transit Tunnel)	emergency acknowledge	Service Communications	Customer and/or	Dedicated Ringdown
emergency notification	On-Board Transit Security (Fixed Route)	Transit Center Security	emergency notification	Transit operator (foot	Service Communications	Radio (450 MHz)
emergency notification	On-Board Transit Security (Paratransit)	Transit Center Security	call for assistance	Paratransit Operator	KCM Paratransit Central	Radio (900 MHz) or ESMR
emergency notification	Secure Area Monitoring (Transit Tunnel)	Transit Center Security	call for assistance	Customer and/or	Service Communications	Dedicated Ring-down/CCTV
local traffic control priority request	On-Board Transit Signal Priority	Roadside Signal Priority	route/run_VID	Transit vehicle	Local signal controller	DSRC
route/schedule information	Transit Center Tracking & Dispatch	RATP	static route and schedule info	GIS/Distribution	RATP	KC WAN
secure area surveillance video data	Secure Area Monitoring (Transit Tunnel)	Transit Center Security	surveillance data	Transit Tunnel	Service Communications	Video/fiber-optic link
transit emergency data	KCM Fixed Route Central Dispatch/Operations Staff	Emergency Services	transit emergency data	Service Communications	Emergency response	POTS/ring-down
transit emergency data	KCM Paratransit Central Dispatch/Operations Staff	Emergency Services	transit emergency data	KCM Paratransit Central	Emergency Services	POTS
transit fare payment data	On-Board Fare & Load Management	Roadside Data Collection	transit fare payment data	Transit vehicle	Operations Base DAC	DSRC
transit fare payment data	Remote Transit Fare Management, Roadside Data Collection	Clearinghouse System (SmartCard)	transit fare payment data	Operations Base DAC	Clearinghouse	WWW/KC WAN
transit fare payment data	Transit Center Fare & Load Management	Clearinghouse System (SmartCard)	transit fare payment data	Operations Base DAC	Clearinghouse	Dedicated Comm
transit information user request	Personal Interactive Information Reception	RATP	transit information user request	Traveler	Rider Information Office	Internet/Phone
transit information user request	Remote Transit Information Services	Transit Watch	transit information user request	Traveler	Remote Information	Remote display or Web
transit traveler information	Transit Watch	Remote Transit Information Services	transit traveler information	Remote Information	Traveler	Remote display or Web
transit traveler information	RATP	Personal Interactive Information Reception	transit traveler information	Rider Information Office	Traveler	Internet/Phone
transit vehicle schedule performance	On-Board Fixed-Route Schedule Management	Transit Center Tracking & Dispatch	transit vehicle schedule	Transit vehicle telemetry	Service Communications	Radio (450 MHz)
transit vehicle schedule performance	On Board Paratransit	Transit Center Paratransit Operations	transit vehicle schedule	Paratransit Operator	KCM Paratransit Central	Radio (900 MHz) or ESMR
TRMS coordination	KCM Fixed Route Central Dispatch/Operations Staff	KCM Paratransit Central Dispatch/Operations Staff	NA	NA	NA	NA
TSP Data & Parameters	City of Seattle TOC	Roadside Signal Priority	TSP data			
TSP Data & Parameters	Transit Center Multi-Modal Coordination	Roadside Subsystem	TSP data			POTS
TSP Status	Roadside Subsystem	City of Seattle TOC	TSP status			
TSP Status	Roadside Subsystem	Transit Center Multi-Modal Coordination	TSP status			POTS
roadside data (signpost ID data)	On-Board Transit Trip Monitoring	Transit Center Tracking & Dispatch	vehicle location data	Transit vehicle telemetry	Service Communications	Data Radio (450 MHz)
roadside data (signpost ID data)	On-Board Transit Trip Monitoring	Automatic Vehicle Location	vehicle location data			Data Radio (450 MHz)

POTS = telephone

APPENDIX D: TRANSPORTATION SYSTEMS VIEW - *ITS ARCHITECTURE OVERVIEW*

NATIONAL ITS ARCHITECTURE

To assist agencies in the development and deployment of ITS, the U.S. Department of Transportation has developed the National ITS Architecture. The National ITS Architecture provides a common framework for determining ITS solutions and implementing ITS technologies. The National ITS Architecture is not a design, rather it defines the framework around which multiple design approaches can be developed, each one specifically tailored to meet the unique needs of the region. The National ITS Architecture also defines the functions that must be performed to implement a given service, the physical entities or subsystems where these functions reside, the interfaces/information flows between subsystems, and the communication requirements for the information flows.

There are several concepts and terms used throughout the National ITS Architecture that must be understood to effectively use the National ITS Architecture. Concepts that are described below as they relate to transit operations include:

- User Services
- Logical Architecture
- Physical Architecture
- Architecture Flows
- Market Packages
- Equipment Packages

User Services

The National ITS Architecture has identified a number of “User Services” for application to the nation’s surface transportation needs. User services precisely encapsulate what the system must do to be considered successful. User Services that directly relate to transit operations that have been identified in the National ITS Architecture include:

- **Public Transportation Management** – This User Service provides functions such as the collection of information about the location of vehicles, and assessment of schedule variances, preparation of real time instructions for drivers to recover from variances in order to maintain schedules, as well as making appropriate requests for signal preemption. This User Service also collects information about passenger use of the transit service.
- **Enroute Transit Information** – This User Service provides travelers with real time transit and high-occupancy vehicle information allowing travel alternatives to be chosen once the traveler is enroute. This User Service has three major functions, (1) Information Distribution, (2) Information Receipt, and (3) Information Processing. This User Service

also integrates information from different transit modes and presents it to travelers for decision making when the trip requires inter-modal transfers. This User Service is made available to travelers through a variety of sources including kiosks and home/ office computers.

- Personalized Public Transit – This User Service functions as a "travel agent" for various modes of transit, including personalized transit. The Transit Management Subsystem computes the logistics for individual requests and communicates the personalized schedules to travelers.
- Public Travel Security – This User Service is implemented to create a safe environment for those using public transportation. This User Service provides surveillance of transit vehicles and facilities and identifies potentially hazardous situations and notifies the appropriate response agencies. This User Service encompasses all physical areas related to public transit travel including:
 - Bus-stop areas
 - Park and Ride areas
 - Transit vehicles
 - Kiosks
 - Transit transfer locations

Logical Architecture

A Logical Architecture is best described as a tool that assists in organizing complex entities and relationships. The Logical Architecture focuses on the functional processes and information or data flows. The development of a Logical Architecture helps identify the system functions and information flows, and guides the development of functional requirements for new systems and improvements. For example, this would assist transit agencies in neighboring jurisdictions to identify what data could be shared to improve operations. The Logical Architecture should be independent of institutions and technology; i.e., it should not define where or by whom functions are performed, nor should it identify how functions are to be implemented.

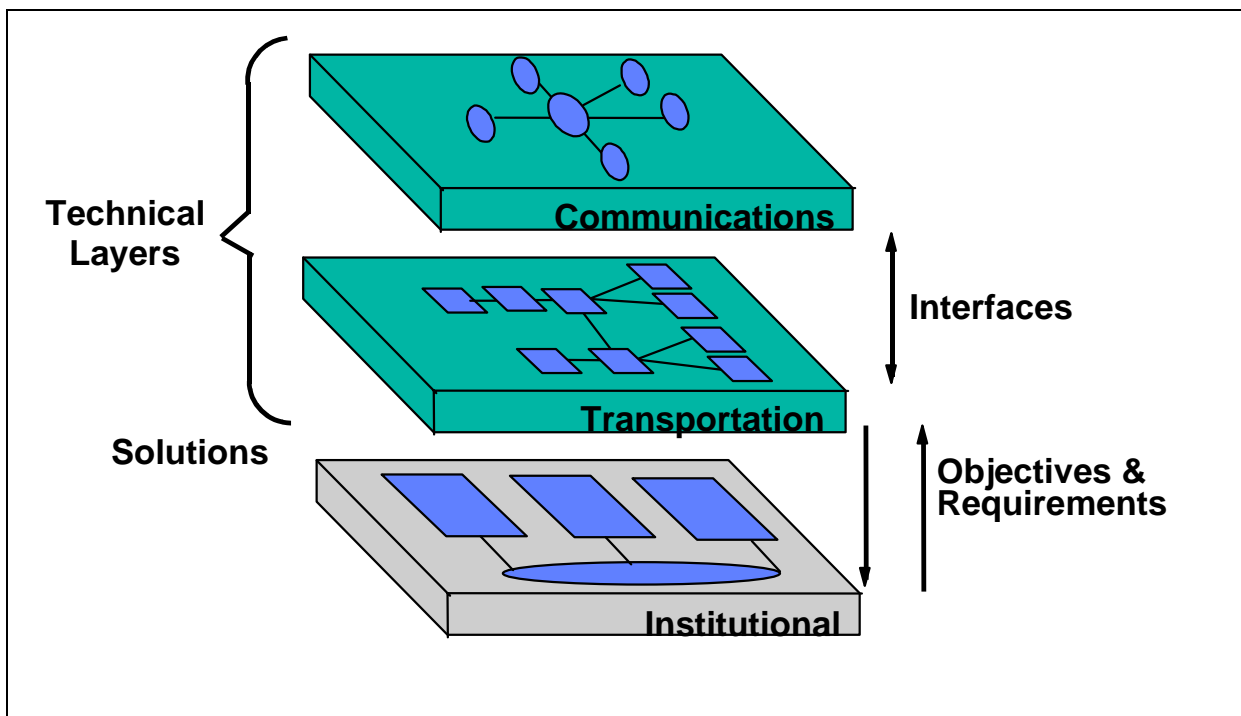
Physical Architecture

A Physical Architecture is the physical (versus functional) view of a system. A Physical Architecture provides the agencies with a physical representation (though not a detailed design) of how the system should provide the desired functionality. A Physical Architecture takes the processes identified in the Logical Architecture and assigns them to physical entities (e.g., transit vehicles, transit management centers, and various roadside devices) or subsystems. In addition, the data flows from the Logical Architecture that link subsystems are grouped together into architecture flows (architecture flows may include several detailed data flows). The architecture flows and their communications requirements define interfaces between subsystems. The definition of these interfaces form the basis of the ongoing standards work in the ITS industry.

The Physical Architecture is composed of two “layers”: transportation layer, and communications layer, as represented in

Figure 1. In order for ITS to properly function, interaction must take place among these layers. The third layer, the institutional layer, is not actually part of the physical architecture. However, definition of the physical architecture cannot be made without decisions regarding jurisdictional structure and working relationships that will provide a framework for ITS planning and implementation.

Figure 1: National ITS Architecture Layers



Transportation Layer

The Transportation Layer of the architecture provides for the transportation-related elements of the architecture. This layer is composed of travelers, vehicles, management centers, and field devices. The Transportation Layer as it relates to transit service providers could include:

- Real time customer information displays
- Transit management centers

Communications Layer

The Communication Layer of the National ITS Architecture provides information and data transfer for the transportation layer subsystems. The Communications Layer includes all of the communications necessary to transfer information and data among transportation entities. The Communications Layer of the architecture identifies:

- What information and communications are needed
- How data should be shared and used by which physical entities
- Where standards are needed to facilitate this sharing

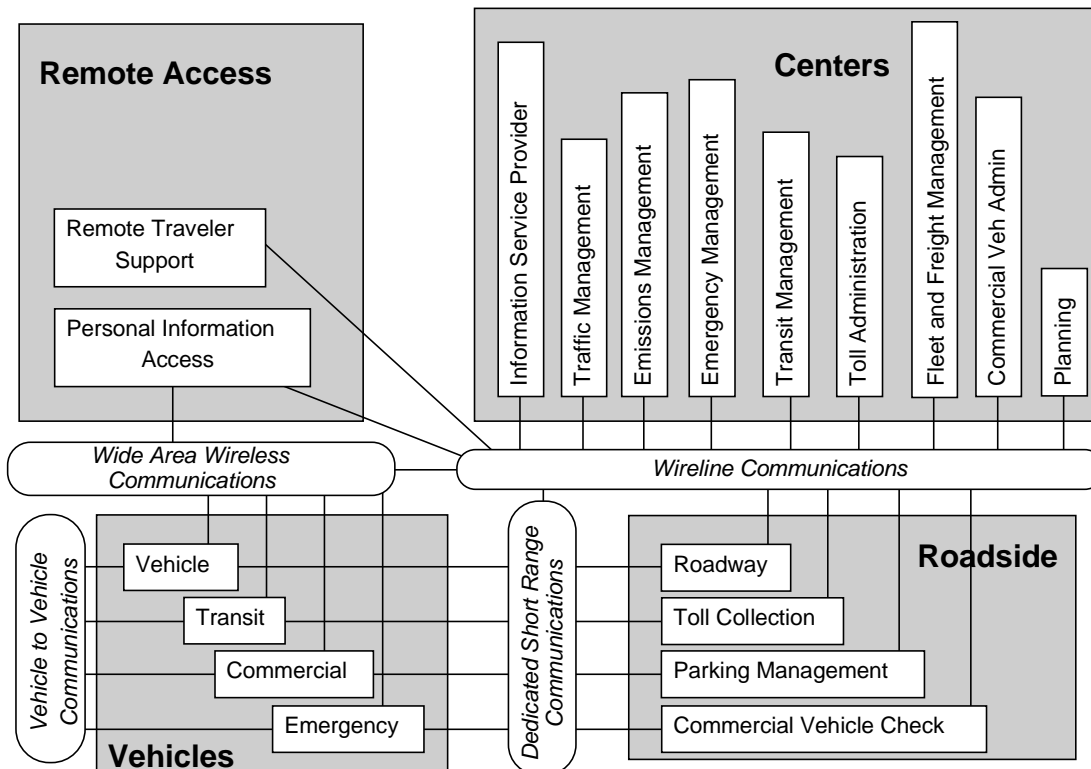
Institutional Layer

The Institutional Layer of the architecture contains policies regarding funding and working arrangements, as well as the jurisdictional structure that supports the other layers of the architecture. Activities on this level as it relates to transit agencies in the Puget Sound include:

- Developing information sharing policies
- Identifying and procuring financing for systems
- Developing inter-agency policies and agreements

Typically institutions are in place and operate in a manner that meets the unique needs of a specific metropolitan area. Therefore, the National ITS Architecture does not require, nor suggest modifications to the institutional layer. The National ITS Architecture does, however, recommend who should communicate with whom, and what information should be communicated. Figure 2 represents the relationship between the Transportation and Communication Layers, which forms the Physical Architecture. This figure is commonly referred to as the “Sausage Diagram.” Transportation elements are represented in the Subsystems. Subsystems are defined as groupings of processes based upon on the physical world. These Subsystems are grouped into the following four areas: Remote Access or Traveler, Centers, Vehicles, and Roadside. All four subsystems are applicable to the transit agencies in the region.

Figure 2: Systems and Sub-Systems of the National ITS Architecture



Architecture Flows

Architecture Flows are the information that is exchanged between [subsystems](#) and [terminators](#) in the [Physical Architecture](#). Each architecture flow contains one or more [data flows](#). These architecture flows and their communication requirements define the interfaces which form the basis for much of the ongoing [standards](#) work in the ITS program

Subsystems

ITS Subsystems perform transportation functions (e.g., scheduling of transit services). Subsystems are group processes that are likely to be collected together under one physical agency, jurisdiction, or physical unit. An example of a Subsystem is a transit operations center that is operated by a transit agency. Subsystems identified in the National ITS Architecture that relate to transit operations include:

- Roadside Subsystem – This subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic. As it relates to transit operations, this subsystem would include the part of the functions that provide traffic signal pre-emption for transit vehicles.
- Transit Management Center Subsystem - This subsystem manages transit vehicle fleets and coordinates with other modes and transportation services. It provides operations, maintenance, customer information, and planning and management functions for the

transit property. This Subsystem applies to central dispatch and garage management systems and supports the spectrum of fixed route, flexible route, and paratransit services. It provides current transit operations data to other center subsystems. The Transit Management Subsystem collects and stores accurate ridership levels and implements corresponding fare structures. It collects operational and maintenance data from transit vehicles, manages vehicle service histories, and assigns drivers and maintenance personnel to vehicles and routes.

- **Transit Vehicle Management** - This Subsystem resides in a transit vehicle and provides the sensory, processing, storage, and communications functions necessary to support safe and efficient movement of passengers. The Transit Vehicle Subsystem collects accurate ridership levels and supports electronic fare collection. This Subsystem also contains the functions, along with the roadway subsystem to support traffic signal preemption for transit vehicles. On-board sensors support transit vehicle maintenance. The Transit Vehicle Subsystem also furnishes travelers with real time travel information, continuously updated schedules, transfer options, routes, and fares.
- **Remote Traveler Support** - This Subsystem provides access to traveler information at transit stations, transit stops, other fixed sites along travel routes, and at major trip generation locations such as special event centers, hotels, office complexes, amusement parks, and theatres. Traveler information access points include kiosks and informational displays supporting varied levels of traveler interaction and information access. At transit stops, information that is provided to travelers could include real time transit vehicle arrival times as well as schedule information.

Market Packages

Market Packages are an alternative representation of groupings of ITS subsystems to support diverse ITS implementations which is the basis of the architecture development for the transit agencies in the Puget Sound region. Market Packages address specific sets of users, service levels, regional needs, and incremental deployment scenarios. A Market Package is implemented with a combination of inter-related equipment. This equipment often resides in several different subsystems within the architecture framework and may be operated by different stakeholders. For instance, the Transit Vehicle Tracking Market Package includes vehicle-location equipment in the Transit Vehicle Subsystem and a base station element in the Transit Management Subsystem. In this example, all Market Package elements are owned and operated by the same transit stakeholder. Market Packages that are specific to transit operations that have been addressed in the National ITS Architecture include:

- **APTS1: Transit Vehicle Tracking** - This Market Package provides for an Automated Vehicle Location (AVL) system to track the transit vehicle's real time schedule adherence and updates the transit system's schedule in real time. Vehicle position is determined by the vehicle (e.g., through GPS) and relayed to the transit operations center. A two-way wireless communication link with the Transit Management Subsystem is used for relaying vehicle position and control measures. Fixed route transit systems may also employ beacons along the route to enable position determination and facilitate communications with each vehicle at fixed intervals. The Transit Management

Subsystem processes this information, updates the transit schedule and makes real time schedule, information available to multiple users.

- APTS2: Transit Fixed-Route Operations - This Market Package performs automatic driver assignment and monitoring, as well as vehicle routing and scheduling for fixed-route services. This service uses the existing AVL database as a source for current schedule performance data, and is implemented through data processing and information display at the transit management subsystem. These data are exchanged and integrated with data from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules
- APTS3: Demand Response Transit Operations - This Market Package performs automatic driver assignment and monitoring as well as vehicle routing and scheduling for demand response transit services. This Market Package uses the existing AVL database to monitor current status of the transit fleet and supports allocation of these fleet resources to service incoming requests for transit service, while also considering traffic conditions. The Transit Management Subsystem provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet.
- APTS4: Transit Passenger and Fare Management - This Market Package allows for the management of passenger loading and fare payments on-board vehicles using electronic means. The payment instrument may be either a stored value or credit card. This Market Package is implemented with sensors mounted on the vehicle to permit the driver and central operations to determine vehicle loads, and readers located either in the infrastructure or on-board the transit vehicle to allow fare payment. These data are processed, stored and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem using existing wireless infrastructure.
- APTS5: Transit Security - This Market Package provides for the physical security of transit passengers. An on-board security system is deployed to perform surveillance and warn of potentially hazardous situations. Public areas (e.g., stops, park-and-ride lots, stations) are also monitored. Information is communicated to the Transit Management Subsystem using wireless communications. Security-related information is also transmitted to the appropriate response agency.
- APTS6: Transit Maintenance - This Market Package supports automatic maintenance scheduling and monitoring of transit vehicles. On-board condition sensors monitor critical system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes data and schedules routine and emergency maintenance activities.
- APTS7: Multi-Modal Coordination - This Market Package establishes two-way communications between multiple transit and traffic agencies to improve service coordination. Inter-modal coordination between transit agencies can increase traveler convenience at transfer points and can also improve operating efficiency. Coordination between traffic and transit management is intended to improve on-time performance of the transit system to the extent that this can be accommodated without degrading overall performance of the traffic network. More limited local coordination between the transit vehicle and the individual intersection for signal priority is also supported by this market package.

- APTS8: Transit Traveler Information - This Market Package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information service includes in-vehicle audible announcements of stops and announcements of vehicle arrivals and real-time transit schedule displays that are of general interest to transit users.

Equipment Packages

An Equipment Package represents a set of equipment/capabilities, which are likely to be purchased by an end-user to achieve a desired capability. Since equipment packages are both the most detailed elements of the physical architecture and associated with specific Market Packages, there is clear traceability between the interface-oriented architecture framework and the deployment-oriented Market Packages.

**APPENDIX E: ARCHITECTURE AND STANDARDS
CONFORMITY RULE**

DEPARTMENT OF TRANSPORTATION**Federal Highway Administration****23 CFR Parts 655 and 940**

[FHWA Docket No. FHWA-99-5899]

RIN 2125-AE65

Intelligent Transportation System Architecture and Standards**AGENCY:** Federal Highway Administration (FHWA), DOT.**ACTION:** Final rule.

SUMMARY: The purpose of this document is to issue a final rule to implement section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21), enacted on June 9, 1998, which required Intelligent Transportation System (ITS) projects funded through the highway trust fund to conform to the National ITS Architecture and applicable standards. Because it is highly unlikely that the entire National ITS Architecture would be fully implemented by any single metropolitan area or State, this rule requires that the National ITS Architecture be used to develop a local implementation of the National ITS Architecture, which is referred to as a "regional ITS architecture." Therefore, conformance with the National ITS Architecture is defined under this rule as development of a regional ITS architecture within four years after the first ITS project advancing to final design, and the subsequent adherence of ITS projects to the regional ITS architecture. The regional ITS architecture is based on the National ITS Architecture and consist of several parts including the system functional requirements and information exchanges with planned and existing systems and subsystems and identification of applicable standards, and would be tailored to address the local situation and ITS investment needs.

EFFECTIVE DATE: February 7, 2001.

FOR FURTHER INFORMATION CONTACT: *For technical information:* Mr. Bob Rupert, (202) 366-2194, Office of Travel Management (HOTM-1) and Mr. Michael Freitas, (202) 366-9292, ITS Joint Program Office (HOIT-1). *For legal information:* Mr. Wilbert Baccus, Office of the Chief Counsel (HCC-32), (202) 366-1346, Federal Highway Administration, 400 Seventh Street, SW., Washington, DC 20590. Office hours are from 8 a.m. to 4:30 p.m., e.t., Monday through Friday, except Federal holidays.

SUPPLEMENTARY INFORMATION:**Electronic Access and Filing**

You may submit or retrieve comments online through the Docket Management System (DMS) at: <http://dmses.dot.gov/submit>. Acceptable formats include: MS Word (versions 95 to 97), MS Word for Mac (versions 6 to 8), Rich Text Format (RTF), American Standard Code Information Interchange (ASCII) (TXT), Portable Document Format (PDF), and WordPerfect (version 7 to 8). The DMS is available 24 hours each day, 365 days each year. Electronic submission and retrieval help and guidelines are available under the help section of the web site.

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Background

A notice of proposed rulemaking (NPRM) concerning this rule was published at 65 FR 33994 on May 25, 2000, and an extension of the comment period to September 23, 2000, was published at 65 FR 45942 on July 26, 2000.

In the NPRM on this rule, the FHWA had proposed that the regional ITS architecture follow from the ITS integration strategy proposed in another NPRM entitled "Statewide Transportation Planning; Metropolitan Transportation Planning" published at 65 FR 33922 on May 25, 2000. That rule is being developed according to a different schedule and will be issued separately. For this reason, all references to the proposed integration strategy have been removed from this rule. However, it is still the intent of this rule that regional ITS architectures be based on established, collaborative transportation planning processes. The other major changes to the final rule relate to options for developing a regional ITS architecture and the time allowed to develop such an architecture. Additional changes to the final rule largely deal with clarification of terms, improved language dealing with staging and grandfathering issues, and clarification of use of ITS standards.

Intelligent Transportation Systems represent the application of information processing, communications

technologies, advanced control strategies, and electronics to the field of transportation. Information technology in general is most effective and cost beneficial when systems are integrated and interoperable. The greatest benefits in terms of safety, efficiency, and costs are realized when electronic systems are systematically integrated to form a whole in which information is shared with all and systems are interoperable.

In the transportation sector, successful ITS integration and interoperability require addressing two different and yet fundamental issues; that of technical and institutional integration. *Technical integration* of electronic systems is a complex issue that requires considerable up-front planning and meticulous execution for electronic information to be stored and accessed by various parts of a system.

Institutional integration involves coordination between various agencies and jurisdictions to achieve seamless operations and/or interoperability.

In order to achieve effective institutional integration of systems, agencies and jurisdictions must agree on the benefits of ITS and the value of being part of an integrated system. They must agree on roles, responsibilities, and shared operational strategies. Finally, they must agree on standards and, in some cases, technologies and operating procedures to ensure interoperability. In some instances, there may be multiple standards that could be implemented for a single interface. In this case, agencies will need to agree on a common standard or agree to implement a technical translator that will allow dissimilar standards to interoperate. This coordination effort is a considerable task that will happen over time, not all at once. Transportation organizations, such as, transit properties, State and local transportation agencies, and metropolitan planning organizations must be fully committed to achieving institutional integration in order for integration to be successful. The transportation agencies must also coordinate with agencies for which transportation is a key, but not a primary part of their business, such as, emergency management and law enforcement agencies.

Successfully dealing with both the technical and institutional issues requires a high-level conceptual view of the future system and careful, comprehensive planning. The framework for the system is referred to as the *architecture*. The architecture defines the system components, key functions, the organizations involved, and the type of information shared

between organizations and parts of the system. The architecture is, therefore, fundamental to successful system implementation, integration, and interoperability.

Additional background information may be found in docket number FHWA-99-5899.

The National ITS Architecture

The Intermodal Surface Transportation Efficiency Act of 1991, Public Law 102-240, 105 Stat. 1914, initiated Federal funding for the ITS program. The program at that time was largely focused on research and development and operational tests of technologies. A key part of the program was the development of the National ITS Architecture. The National ITS Architecture provides a common structure for the design of ITS systems. The architecture defines the functions that could be performed to satisfy user requirements and how the various elements of the system might connect to share information. It is not a system design, nor is it a design concept. However, it does define the framework around which multiple design approaches can be developed, each one specifically tailored to meet the needs of the user, while maintaining the benefits of a common approach.

The National ITS Architecture, Version 3.0 can be obtained from the ITS Joint Program Office of the DOT in CD-ROM format and on the ITS web site <http://www.its.dot.gov>. The effort to develop a common national system architecture to guide the evolution of ITS in the United States over the next 20 years and beyond has been managed since September 1993 by the DOT. The National ITS Architecture describes in detail what types of interfaces should exist between ITS components and how they will exchange information and work together to deliver the given ITS user service requirements.

The National ITS Architecture and standards can be used to guide multi-level government and private-sector business planners in developing and deploying nationally compatible systems. By ensuring system compatibility, the DOT hopes to accelerate ITS integration nationwide and develop a strong, diverse marketplace for related products and services.

It is highly unlikely that the entire National ITS Architecture will be fully implemented by any single metropolitan area or State. For example, the National ITS Architecture contains information flows for an Automated Highway System that is unlikely to be part of most regional implementations.

However, the National ITS Architecture has considerable value as a framework for local governments in the development of regional ITS architectures by identifying the many functions and information sharing opportunities that may be desired. It can assist local governments with both of the key elements: technical interoperability and institutional coordination.

The National ITS Architecture, because it aids in the development of a high-level conceptual view of a future system, can assist local governments in identifying applications that will support their future transportation needs. From an institutional coordination perspective, the National ITS Architecture helps local transportation planners to identify other stakeholders who may need to be involved and to identify potential integration opportunities. From a technical interoperability perspective, the National ITS Architecture provides a logical and physical architecture and process specifications to guide the design of a system. The National ITS Architecture also identifies interfaces where standards may apply, further supporting interoperability.

Transportation Equity Act for the 21st Century

As noted above, section 5206(e) of the TEA-21, Public Law 105-178, 112 Stat. 457, requires ITS projects funded from the highway trust fund to conform to the National ITS Architecture, applicable or provisional standards, and protocols. One of the findings of Congress in section 5202 of the TEA-21, is that continued investment in systems integration is needed to accelerate the rate at which ITS is incorporated into the national surface transportation network. Two of the purposes of the ITS program, noted in section 5203(b) of the TEA-21, are to expedite the deployment and integration of ITS, and to improve regional cooperation and operations planning for effective ITS deployment. Use of the National ITS Architecture provides significant benefits to local transportation planners and deployers as follows:

1. The National ITS Architecture provides assistance with technical design. It saves considerable design time because physical and logical architectures are already defined.
2. Information flows and process specifications are defined in the National ITS Architecture, allowing local governments to accelerate the process of defining system functionality.
3. The architecture identifies standards that will support

interoperability now and into the future, but it leaves selection of technologies to local decisionmakers.

4. The architecture provides a sound engineering framework for integrating multiple applications and services in a region.

ITS Architecture and Standards NPRM Discussion of Comments

The FHWA received 105 comments on this docket from a wide range of stakeholders, including major industry associations, State departments of transportation, Metropolitan Planning Organizations (MPOs), and local agencies. The comments were generally favorable about the scope and content, but requested additional clarification and guidance on implementation of specific items. On many issues, some commenters wanted more specific requirements, while others wanted more flexibility. Most commenters, including major industry associations and public sector agencies, agreed with the overall scope, but some felt that the specifics might be difficult to implement and asked for clarification of key terms. A few commenters wanted the FHWA to reduce the number of requirements or convert the rulemaking into a guidance activity until more ITS deployment experience is gained.

In summary, the FHWA received a large number of generally favorable comments about the NPRM that suggested minor specific changes and expressed a need for further guidance on implementation. Since the general tenor of the comments was positive, the FHWA has kept the scope of the NPRM and made appropriate clarifications to the text of the final rule to address concerns raised in comments. In response to the many comments requesting it, starting in early 2001, the FHWA will also provide a program of guidance, training, and technical support to assist with the implementation of this rule. The following is a detailed discussion of the comments and their disposition, organized by subject matter.

Section 940.3 Definitions

ITS Project. There were 34 comments submitted to the docket concerning the definition of an ITS project. Many of the commenters felt the definition was not clear enough, was too broad, or was too subject to interpretation. Some comments questioned how much of a project's budget would have to be spent on ITS before a project would be considered an ITS project. Some suggested specific language to more narrowly define an ITS project by

focusing on the portion of the overall project that is actually ITS or by suggesting language that would narrow the definition of an ITS project to only include projects which introduce new or changed integration opportunities.

Since the intent of this rule and the supporting legislation is to facilitate the deployment of integrated ITS systems, it is the position of the FHWA that the definition of an ITS project must be fairly broad to include any ITS system being funded with highway trust fund dollars. It is only by properly considering all planned ITS investments in the development of a regional ITS architecture that the integration opportunities and needs can even be identified. This consideration should be carried out in the development of an architecture prior to the specific project being advanced. If, in the development of a regional ITS architecture, it is determined that a specific planned project offers no real integration opportunities for the region, then the impact of this rule on that specific project is minimal.

As a response to the comments concerning the clarity of the definition, the definition of an ITS project has been slightly modified to remove the examples since they were considered misleading. The FHWA recognizes that any definition will be subject to interpretation by the stakeholders and acknowledges the need for guidance in this area to ensure clear and consistent interpretation of this rule. Guidance on what constitutes an ITS project (including examples) will be developed to assist the various stakeholders, including the FHWA Division Offices, to better understand what projects should be considered ITS projects.

Region. There were 26 comments submitted related to the definition of a region. Seven comments supported the open definition provided in the NPRM, arguing that the possible integration opportunities in an area should define the region and that there were too many possible variations to allow a restrictive definition. Six commenters who expressed concern over varying conditions interpreted the definition to mean Metropolitan Planning Area (MPA). Five comments suggested an MPA was too restrictive. Eight other comments indicated that the proposed definition of a region did not clearly identify what entity would have the lead in developing a regional ITS architecture or thought the definition implied the MPO should have the lead. Nine comments suggested various limits or boundaries to fit specific situations. Ten comments expressed a need for

greater clarification of the definition for a region.

The intent of the proposed definition was to allow considerable flexibility on the part of the stakeholders in defining the boundaries of a region to best meet their identified integration opportunities. While there was no intent to generally restrict the definition to MPAs or States, the FHWA determined that regional ITS architectures should be based on an integration strategy that was developed by an MPO or State as part of its transportation planning process.

Given that the final rule does not require or reference an integration strategy, the FHWA feels a need to provide more specific guidance on the definition of a region. As such, the definition of a region has been revised to indicate that the MPA should be the minimum area considered when establishing the boundaries of a region for purposes of developing a regional ITS architecture within a metropolitan area. This should not be interpreted to mean that a region must be an MPA, or no less than an MPA, but the MPA and all the agencies and jurisdictions within the MPA should be at least considered for inclusion in the process of developing a regional ITS architecture within a metropolitan area. This rule is silent on other possible limits or minimum areas for defining a region, relying on the flexible nature of this rule to accommodate those special circumstances. The FHWA also acknowledges it is possible that overlapping regions could be defined and overlapping regional ITS architectures be developed to meet the needs of the regions.

Other Definitions. There were 20 comments suggesting that other terms used in the NPRM be defined. These included "interoperability," "standards," "concept of operations," "conceptual design," and "integration strategy." Several of these are no longer used in the final rule and, therefore, were not defined. Other terms, such as "interoperability" and "standards," were determined to be common terms whose definition did not effect the implementation of the final rule. Furthermore, language regarding standards conformity has been clarified in the body of the final rule.

Section 940.5 Policy

Twenty-eight commenters addressed the issue of consistency between the two related FHWA notices of proposed rulemaking (23 CFR parts 940 and 1410) and the Federal Transit Administration's (FTA) notice (FTA Docket No. FTA-99-6417) on National ITS Architecture published at 65 FR

34002 on May 25, 2000. The comments revealed a lack of understanding about the relationship between the regional ITS architecture and the integration strategy proposed as part of the revisions to FHWA's transportation planning rules. There were five comments suggesting a single DOT rule addressing how all ITS projects would meet the National ITS Architecture conformance requirements of the TEA-21 instead of an FHWA rule for highway projects and an FTA policy for transit projects. Four other comments acknowledged the need for two policies, but recommended they articulate the same process.

A final transportation planning rule is being developed on a different schedule than this rule, and comments regarding the portions of the National ITS Architecture conformity process included in the transportation planning rule will be addressed as it proceeds toward issuance. The FHWA and FTA have chosen to go forward with policies that have been developed cooperatively to implement the National ITS Architecture conformance process. This FHWA rule and the parallel FTA policy have been developed without reference to the proposed changes to the transportation planning process, including no mention of the development of an integration strategy. However, the policy statement of this rule notes a link to established transportation planning processes, as provided under 23 CFR part 450. This rule fully supports these collaborative methods for establishing transportation goals and objectives, and does not provide a mechanism for introducing projects outside of the transportation planning processes.

This final rule on National ITS Architecture conformance and the FTA policy on the same subject have been developed cooperatively and coordinated among the agencies to ensure compatible processes. Any differences between this rule and the parallel FTA policy are intended to address differences in highway and transit project development and the way the FHWA and the FTA administer projects and funds.

Fifteen commenters questioned the need for an integration strategy, and the relationship between the strategy and the regional ITS architecture.

Given the fact that proposed revisions to the FHWA's transportation planning rules are being developed according to a different schedule, this rule has been revised to remove any references to an integration strategy. Comments regarding the integration strategy will be addressed in the final transportation

planning rule, and the discussion of the regional ITS architecture in § 940.9 has been revised to clarify its content.

Section 940.7 Applicability

A few commenters noted that the proposed rule had not addressed the TEA-21 language that allows for the Secretary to authorize certain exceptions to the conformity provision. These exceptions relate to those projects designed to achieve specific research objectives or, if three stated criteria are met, to those intended to upgrade or expand an ITS system in existence on the date of enactment of the TEA-21. The legislation also included a general exemption for funds used strictly for operations and maintenance of an ITS system in existence on the date of enactment of the TEA-21.

The FHWA acknowledges this omission and has included the appropriate language in this section of the rule.

Section 940.9 Regional ITS Architecture

Several comments were received related to the way the proposed rule referred to developing regional ITS architectures. Eight comments, from State agencies and metropolitan planning organizations, supported an incremental approach to developing regional ITS architectures, starting with project ITS architectures and building them together. Four other comments, from metropolitan planning organizations and industry associations, noted that an ad hoc regional ITS architecture developed incrementally through projects would result in an architecture less robust than if there were a single, initial effort to develop it.

Also, thirteen comments from the Association of American State Highway and Transportation Officials (AASHTO) and a number of States recommended extending the time for developing regional ITS architectures, as the proposed two year implementation would be too short. Ten of the commenters preferred four years in order to acquire the necessary resources for developing regional ITS architectures.

Most commenters were in agreement with the content of the regional ITS architecture as defined in the proposed rule. However, there were 19 comments that dealt with confusion over the definition of both "conceptual design" and "concept of operations." In addition, there were 17 other comments on the makeup of the stakeholders, involvement of the private sector, and the need and desirability of "agreements" between stakeholders.

The comments indicated confusion regarding the development of regional ITS architectures, and especially so in discussing the period of time for their development. Therefore, the final rule has clarified the time period for developing regional ITS architectures by adopting the proposed extension to four years subsequent to beginning to deploy ITS projects (§ 940.9(c)), or four years from the effective date of this rule for those areas that are currently deploying ITS projects (§ 940.9(b)). In clarifying the time for development, this rule has eliminated any references to specific methods for developing regional ITS architectures. By not prescribing any methods, the rule provides flexibility to a region in deciding how it should develop its regional ITS architecture. Guidance and information related to developing regional ITS architectures is available from FHWA Division Offices and from the ITS web site, <http://www.its.dot.gov>, and will be expanded to provide assistance in meeting the intent of the rule.

Both the terms "conceptual design" and "concept of operations" have been deleted from the final rule. In their stead are descriptions of the content that is expected to form the basis for a regional ITS architecture. This content has not significantly changed from that defined in the NPRM but is now contained in § 940.9(d). The level of detail required is to the architecture flow level as defined in the National ITS Architecture. The regional ITS architecture must identify how agencies, modes, and systems will interact and operate if the architecture is to fulfill the objective of promoting ITS integration within a region.

The relevant stakeholders for a region will vary from region to region. The list articulated in § 940.9(a) is representative only and not meant to be inclusive or exclusive. On the specific issue of private sector participation, if the private sector is deploying ITS systems in a region or otherwise providing an ITS-based service, it would be appropriate to engage them in the development of a regional ITS architecture. Because of these variations from region to region, the FHWA felt it inappropriate to attempt to define an all inclusive list of stakeholders. The group of relevant stakeholders will be a function of how the region is defined and how transportation services are provided to the public. Section 940.9(d)(4) specifies that in the development of the regional ITS architecture, it shall include "any agreements (existing or new) required for operations." The formalization of these types of agreements is at the

discretion of the region and participating stakeholders.

There were 14 comments from a broad range of organizations questioning how existing regional ITS architectures, strategic plans or ITS Early Deployment Plans would be treated under this rule. It is the intent of the FHWA that any existing ITS planning documents should be used to the extent practical to meet the requirements of this rule. If a regional ITS architecture is in place, is up to date, and addresses all the requirements of a regional ITS architecture as described in this rule, there is no requirement to develop a "new" one. If the existing regional ITS architecture does not address all the requirements of the rule, it may be possible to update it so that it meets the regional ITS architecture requirements of this rule. What is necessary is that the end result is an architecture that meets the requirements of this rule and properly addresses the ITS deployments and integration opportunities of that region. This issue is specifically addressed in § 940.9(e) of this rule.

There were five comments related to the impact of this rule on legacy systems (*i.e.*, ITS systems already in place) and requesting some sort of "grandfathering" for them. The language in § 940.11(g) of the final rule clarifies the grandfathering or staging aspects of the process. The final rule does not require any changes or modifications to existing systems to conform to the National ITS Architecture. It is very likely that a regional ITS architecture developed by the local agencies and other stakeholders would call for changes to legacy systems over time to support desired integration. However, such changes would not be required by the FHWA; they would be agreed upon by the appropriate stakeholders as part of the development of the regional ITS architecture.

There were 15 comments dealing with the maintenance process and status of the National ITS Architecture. Two comments suggested the need for the FHWA to formally adopt the National ITS Architecture. Four other comments also supported the formalization of a process for maintaining or updating it with the full opportunity for public input.

Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture. This rule requires that the National ITS Architecture be used as a resource in developing a regional ITS architecture.

As a technical resource, it is important that the National ITS Architecture be maintained and updated as necessary in response to user input or to add new user services, but formal adoption of the National ITS Architecture is not necessary. However, the FHWA recognizes the need to maintain the National ITS Architecture and to establish an open process for configuration control that includes public participation. The process currently used by the DOT to maintain the National ITS Architecture is very rigorous and involves significant public participation. That process is currently being reviewed by the DOT with the intent of establishing a configuration management process that engages the public at key stages and ensures a consensus for updating the National ITS Architecture.

Four comments suggested that this rule should not be implemented until the National ITS Architecture was complete. The National ITS Architecture will never stop evolving since there always is a potential need to regularly update it as more is learned about ITS deployment. The FHWA believes the National ITS Architecture is developed to a stage where it can be used as a resource in developing regional ITS architectures, as required by this rule.

Seventeen comments asked the FHWA to define the agency that is responsible for the development and maintenance of the regional ITS architecture; specifically MPOs and/or the State as those entities that are already responsible for the planning process.

The FHWA did not define the responsibility for either creating or maintaining the regional ITS architecture to a specific entity because of the diversity of transportation agencies and their roles across the country. It is recognized that in some regions traditional State and MPO boundaries may not meet the needs of the traveling public or the transportation community. This is also why the FHWA did not rigidly define a region. The FHWA encourages MPOs and States to include the development of their regional ITS architectures as part of their transportation planning processes. However, the decision is best left to the region to determine the approach that best reflects their needs, as indicated in § 940.9. It is clear that the value of a regional ITS architecture will only be realized if that architecture is maintained through time. However, in accepting Federal funds under title 23, U.S.C., the State is ultimately responsible for complying with Federal

requirements, as provided in 23 U.S.C. 106 and 133.

Four commenters noted that the proposed rule did not adequately address planning for, or committing to, a defined level of operations and maintenance.

The final rule addresses this concern on two primary levels, in the development of the regional ITS architecture and the development of individual projects. Section 940.9(d)(4) specifies that in the development of the regional ITS architecture, it shall include "any agreements (existing or new) required for operations." The formalization of these types of agreements is at the discretion of the region and participating stakeholders.

Also, relative to operations and management at a project level, § 940.11(c)(7) specifies that the systems engineering analysis (required of all ITS projects) includes "procedures and resources necessary for the operations and management of the system."

Section 940.11 Project Implementation

In addition to the comments on regional ITS architecture development noted above, the docket received 86 comments on systems engineering and project implementation. These comments revealed that the structure of the NPRM in discussing regional ITS architecture development, project systems engineering analysis, and project implementation was confusing and difficult to read.

To clarify these portions of the rule, the systems engineering and project implementation sections of the NPRM have been combined into § 940.11, Project Implementation. Also, paragraphs that were in the regional ITS architecture section of the NPRM that discussed major ITS projects and the requirements for developing project level ITS architectures have been rewritten to clarify their applicability. Since these paragraphs deal with project development issues, they have been moved to § 940.11(e). A definition for "project level ITS architecture" was added in § 940.3 and a description of its contents provided in § 940.11(e).

The docket received 33 comments regarding systems engineering and the systems engineering analysis section of the proposed rule. Most of the comments related to the definition, the process not being necessary except for very large projects, and confusion as to how these requirements relate to existing FHWA policy.

In response to the docket comments, the definition of systems engineering in § 940.3 has been clarified and is more consistent with accepted practice. In

order to provide consistency in the regional ITS architecture process, the systems engineering analysis detailed in §§ 940.11(a) through 940.11(c) must apply to all ITS projects regardless of size or budget. However, the analysis should be on a scale commensurate with project scope. To allow for the greatest flexibility at the State and local level, in § 940.11(c), a minimum number of elements have been clearly identified for inclusion in the systems engineering analysis. Many of those elements are currently required as provided in 23 CFR 655.409, which this rule replaces. Recognizing the change in some current practices this type of analysis will require, the FHWA intends to issue guidance, training, and technical support in early 2001 to help stakeholders meet the requirements of the final rule.

Fifty-three comments were submitted regarding ITS standards and interoperability tests. The commenters expressed concern about requiring the use of ITS standards and interoperability tests prematurely, the impact on legacy systems of requiring ITS standards, and confusion regarding the term "adopted by the DOT."

In response to the comments, the FHWA has significantly modified the final rule to eliminate reference to the use of standards and interoperability tests prior to adoption in § 940.11(f). Section 940.11(g) addresses the applicability of standards to legacy systems. It is not the intent of the DOT to formally adopt any standard before the standard is mature; and also, not all ITS standards should, or will, be formally adopted by the DOT. Formal adoption of a standard means that the DOT will go through the rulemaking process, including a period of public comment, for all standards that are considered candidates for adoption.

The DOT has developed a set of criteria to determine when a standard could be considered for formal adoption. These criteria include, at a minimum, the following elements:

1. The standard has been approved by a Standard Development Organization (SDO).
2. The standard has been successfully tested in real world applications as appropriate.
3. The standard has received some degree of acceptance by the community served by the standard.
4. Products exist to implement the standard.
5. There is adequate documentation to support the use of the standard.
6. There is training available in the use of the standard where applicable.

Therefore, the intent of the rule is to require the use of a standard only when these criteria have been met, and there has been a separate rulemaking on adoption of the standard.

The only interoperability tests that are currently contemplated by the DOT are those associated with the Commercial Vehicle Operations (CVO) program. These tests are currently being used by States deploying CVO systems and will follow a similar set of criteria for adoption as those defined for standards.

Section 940.13 Project Administration

There were nine comments related to how conformity with the final rule would be determined, and by whom. There were 11 comments about how conformity with the regional ITS architecture would be determined, and by whom. Six comments specifically suggested methods for determining conformance, including a process similar to current Federal planning oversight procedures. Six other commenters suggested that determination be made by the MPO or State. For either case, the comments reflected a lack of clarity as to what documentation would be necessary. There were six related comments suggesting the level of documentation be commensurate with the scale of the planned ITS investments in the region.

In § 940.13 of the final rule, the FHWA has attempted to clarify the process for determining conformance. Conformance of an ITS project with a regional ITS architecture shall be made prior to authorization of funding for project construction or implementation as provided in 23 U.S.C. 106 and 133. We do not intend to create new oversight procedures beyond those provided in 23 U.S.C. 106 and 133, but in those cases where oversight and approval for ITS projects is assumed by the State, the State will be responsible for ensuring compliance with this regulation and the FHWA's oversight will be through existing processes.

There were 14 comments concerning the documentation requirements of the proposed rule and generally suggesting they be reduced. Certainly the development of a regional ITS architecture and evidence of conformance of a specific project to that regional ITS architecture implies some level of documentation be developed. However, to allow flexibility on the part of the State or local agency in demonstrating compliance with the final rule, no specific documentation is required to be developed or submitted to the FHWA for review or approval. The FHWA recognizes the need to be able to scale the regional ITS

architecture and the associated documentation to the needs of the region. Section 940.9(a) of the final rule contains specific language allowing such scaling.

Summary of Requirements

I. The Regional ITS Architecture

This final rule on the ITS Architecture and Standards requires the development of a local implementation of the National ITS Architecture referred to as a regional ITS architecture. The regional ITS architecture is tailored to meet local needs, meaning that it does not address the entire National ITS Architecture and can also address services not included in the National ITS Architecture. The regional ITS architecture shall contain a description of the region and the identification of the participating agencies and other stakeholders; the roles and responsibilities of the participating agencies and other stakeholders; any agreements needed for operation; system functional requirements; interface requirements and information exchanges with planned and existing systems; identification of applicable standards; and the sequence of projects necessary for implementation. Any changes made in a project design that impact the regional ITS architecture shall be identified and the appropriate revisions made and agreed to in the regional ITS architecture.

Any region that is currently implementing ITS projects shall have a regional ITS architecture within four years of the effective date of this rule. All other regions not currently implementing ITS projects shall have a regional ITS architecture within four years of the first ITS project for that region advancing to final design. In this context, a region is a geographical area that is based on local needs for sharing information and coordinating operational strategies among multiple projects. A region can be specified at a metropolitan, Statewide, multi-State, or corridor level. Within a metropolitan area, the metropolitan planning area should be the minimum area that is considered when establishing the boundaries of a region for purposes of developing a regional ITS architecture. A regional approach promotes integration of transportation systems. The size of the region should reflect the breadth of the integration of transportation systems.

II. Project Development

Additionally, this rule requires that all ITS projects be developed using a systems engineering analysis. All ITS

projects that have not yet advanced to final design are required to conform to the system engineering requirements in § 940.11 upon the effective date of this rule. Any ITS project that has advanced to final design by the effective date of this rule is exempt from the requirements of § 940.11. When the regional ITS architecture is completed, project development will be based on the relevant portions of it which the project implements. Prior to completion of the regional ITS architecture, major ITS projects will develop project level ITS architectures that are coordinated with the development of the regional ITS architecture. ITS projects will be required to use applicable ITS standards and interoperability tests that have been officially adopted by the DOT. Where multiple standards exist, it will be the responsibility of the stakeholders to determine how best to achieve the interoperability they desire.

Rulemaking Analyses and Notices

Executive Order 12866 (Regulatory Planning and Review) and DOT Regulatory Policies and Procedures

The FHWA has determined that this action is not a significant regulatory action within the meaning of Executive Order 12866 or significant within the meaning of the Department of Transportation's regulatory policies and procedures. It is anticipated that the economic impact of this rulemaking will be minimal. This determination is based upon preliminary and final regulatory assessments prepared for this action that indicate that the annual impact of the rule will not exceed \$100 million nor will it adversely affect the economy, a sector of the economy, productivity, jobs, the environment, public health, safety, or State, local, or tribal governments. In addition, the agency has determined that these changes will not interfere with any action taken or planned by another agency and will not materially alter the budgetary impact of any entitlements, grants, user fees, or loan programs. Copies of the preliminary and final regulatory assessments are included in the docket.

Costs

The FHWA prepared a preliminary regulatory evaluation (PRE) for the NPRM and comments were solicited. That analysis estimated the total costs of this rule over 10 years to be between \$38.1 million and \$44.4 million (the net present value over 10 years was between \$22.3 million and \$31.2 million). The annual constant dollar impact was estimated to range between \$3.2 million and \$4.4 million. We believe that the

cost estimates as stated in the PRE are negligible. The FHWA received only one comment in response to the PRE. That commenter, the Capital District Transportation Committee of Albany, New York suggested that our cost estimates were too low, but provided no further detail or rationale which would cause us to reconsider or increase our cost estimates in the initial regulatory evaluation.

These 10-year cost estimates set forth in the PRE included transportation planning cost increases, to MPOs ranging from \$10.8 million to \$13.5 million, and to States from \$5.2 million to \$7.8 million associated with our initial requirement to develop an ITS integration strategy that was proposed as part of the metropolitan and statewide planning rulemaking effort. The agency now plans to advance that proposed ITS integration strategy in the planning rule on a different time schedule than this final rule. Thus, the costs originally set forth in the PRE for the ITS integration strategy have been eliminated from the final cost estimate in the final regulatory evaluation (FRE) for this rule.

In the FRE, the agency estimates the cost of this rule to be between \$1 million and \$16 million over ten years, which are the estimated costs of this rule to implementing agencies for the development of the regional ITS architectures. These costs do not include any potential additional implementation costs for individual projects which are expected to be minimal and were extremely difficult to estimate. Thus, the costs to the industry are less than that originally estimated in the agency's NPRM.

Benefits

In the PRE, the FHWA indicated that the non-monetary benefits derived from the proposed action included savings from the avoidance of duplicative development, reduced overall development time, and earlier detection of potential incompatibilities. We stated that, as with project implementation impacts, the benefits of the rule are very difficult to quantify in monetary terms. Thus, we estimated that the coordination guidance provided through implementation of the rule could provide savings of approximately \$150,000 to any potential entity seeking to comply with the requirements of section 5206(e) of the TEA-21 as compared with an entity having to undertake compliance individually. The costs may be offset by benefits derived from the reduction of duplicative deployments, reduced overall

development time, and earlier detection of potential incompatibilities.

In developing a final regulatory evaluation for this action, we did not denote a significant change in any of the benefits anticipated by this rule. This is so notwithstanding the fact that our planning costs for the ITS integration strategy have been eliminated from the final cost estimate. The primary benefits of this action that result from avoidance of duplicative development, reduced overall development time, and earlier detection of potential incompatibilities will remain the same.

In sum the agency believes that the option chosen in this action will be most effective at helping us to implement the requirements of section 5206(e) of the TEA-21. In developing the rule, the FHWA has sought to allow broad discretion to those entities impacted, in levels of response and approach that are appropriate to particular plans and projects, while conforming to the requirements of the TEA-21. The FHWA has considered the costs and benefits of effective implementation of ITS through careful and comprehensive planning. Based upon the information above, the agency anticipates that the economic impact associated with this rulemaking action is minimal and a full regulatory evaluation is not necessary.

Regulatory Flexibility Act

In compliance with the Regulatory Flexibility Act (5 U.S.C. 601-612), the FHWA has evaluated, through the regulatory assessment, the effects of this action on small entities and has determined that this action will not have a significant economic impact on a substantial number of small entities. Small businesses and small organizations are not subject to this rule, which applies to government entities only. Since § 940.9(a) of this rule provides for regional ITS architectures to be developed on a scale commensurate with the scope of ITS investment in the region, and § 940.11(b) provides for the ITS project systems engineering analysis to be on a scale commensurate with the project scope, compliance requirements will vary with the magnitude of the ITS requirements of the entity. Small, less complex ITS projects have correspondingly small compliance documentation requirements, thereby accommodating the interest of small government entities. Small entities, primarily transit agencies, are accommodated through these scaling provisions that impose only limited requirements on small ITS activities. For these reasons, the FHWA certifies

that this action will not have a significant impact on a substantial number of small entities.

Unfunded Mandates Reform Act of 1995

This action does not impose unfunded mandates as defined by the Unfunded Mandates Reform Act of 1995 (Pub. L. 104-4, March 22, 1995, 109 Stat. 48). This rule will not result in an expenditure by State, local, and tribal governments, in the aggregate, or by the private sector, of \$100 million or more in any one year.

Executive Order 13132 (Federalism)

This action has been analyzed in accordance with the principles and criteria contained in Executive Order 13132, dated August 4, 1999, and the FHWA has determined that this action does not have sufficient federalism implications to warrant the preparation of a federalism assessment. The FHWA has also determined that this action does not preempt any State law or State regulation or affect the State's ability to discharge traditional State governmental functions.

Executive Order 12372 (Intergovernmental Review)

Catalog of Federal Domestic Assistance Program Number 20.205, Highway planning and construction. The regulations implementing Executive Order 12372 regarding intergovernmental consultation on Federal programs and activities apply to this program.

Paperwork Reduction Act of 1995

This action does not contain information collection requirements for the purposes of the Paperwork Reduction Act of 1995, 44 U.S.C. 3501-3520.

Executive Order 12988 (Civil Justice Reform)

This action meets applicable standards in sections 3(a) and 3(b)(2) of Executive Order 12988, Civil Justice Reform, to minimize litigation, eliminate ambiguity, and reduce burden.

Executive Order 13045 (Protection of Children)

We have analyzed this action under Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks. This rule is not an economically significant rule and does not concern an environmental risk to health or safety that may disproportionately affect children.

Executive Order 12630 (Taking of Private Property)

This rule does not effect a taking of private property or otherwise have taking implications under Executive Order 12630, Government Actions and Interference with Constitutionally Protected Property Rights.

National Environmental Policy Act

The agency has analyzed this action for the purposes of the National Environmental Policy Act of 1969, as amended (42 U.S.C. 4321-4347), and has determined that this action will not have any effect on the quality of the environment.

Regulation Identification Number

A regulation identification number (RIN) is assigned to each regulatory action listed in the Unified Agenda of Federal Regulations. The Regulatory Information Service Center publishes the Unified Agenda in April and October of each year. The RIN contained in the heading of this document can be used to cross reference this proposed action with the Unified Agenda.

List of Subjects

23 CFR Part 655

Design standards, Grant programs-transportation, Highways and roads, Incorporation by reference, Signs and symbols, Traffic regulations.

23 CFR Part 940

Design standards, Grant programs-transportation, Highways and roads, Intelligent transportation systems.

Issued on: January 2, 2001.

Kenneth R. Wykle,
Federal Highway Administrator.

In consideration of the foregoing, the FHWA amends Chapter I of title 23, Code of Federal Regulations, as set forth below:

PART 655—[AMENDED]

1. The authority citation for part 655 continues to read as follows:

Authority: 23 U.S.C. 101(a), 104, 109(d), 114(a), 217, 315, and 402(a); 23 CFR 1.32, and 49 CFR 1.48(b).

Subpart D—[Removed and reserved]

2. Remove and reserve subpart D of part 655, consisting of §§ 655.401, 655.403, 655.405, 655.407, 655.409, 655.411.

3. Add a new subchapter K, consisting of part 940, to read as follows:

Subchapter K—Intelligent Transportation Systems**PART 940—INTELLIGENT TRANSPORTATION SYSTEM ARCHITECTURE AND STANDARDS**

Sec.

- 940.1 Purpose.
- 940.3 Definitions.
- 940.5 Policy.
- 940.7 Applicability.
- 940.9 Regional ITS architecture.
- 940.11 Project implementation.
- 940.13 Project administration.

Authority: 23 U.S.C. 101, 106, 109, 133, 315, and 508; sec 5206(e), Public Law 105-178, 112 Stat. 457 (23 U.S.C. 502 note); and 49 CFR 1.48.

§ 940.1 Purpose.

This regulation provides policies and procedures for implementing section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21), Public Law 105-178, 112 Stat. 457, pertaining to conformance with the National Intelligent Transportation Systems Architecture and Standards.

§ 940.3 Definitions.

Intelligent Transportation System (ITS) means electronics, communications, or information processing used singly or in combination to improve the efficiency or safety of a surface transportation system.

ITS project means any project that in whole or in part funds the acquisition of technologies or systems of technologies that provide or significantly contribute to the provision of one or more ITS user services as defined in the National ITS Architecture.

Major ITS project means any ITS project that implements part of a regional ITS initiative that is multi-jurisdictional, multi-modal, or otherwise affects regional integration of ITS systems.

National ITS Architecture (also "national architecture") means a common framework for ITS interoperability. The National ITS Architecture comprises the logical architecture and physical architecture which satisfy a defined set of user services. The National ITS Architecture is maintained by the United States Department of Transportation (DOT) and is available on the DOT web site at <http://www.its.dot.gov>.

Project level ITS architecture is a framework that identifies the institutional agreement and technical integration necessary to interface a major ITS project with other ITS projects and systems.

Region is the geographical area that identifies the boundaries of the regional ITS architecture and is defined by and based on the needs of the participating agencies and other stakeholders. In metropolitan areas, a region should be no less than the boundaries of the metropolitan planning area.

Regional ITS architecture means a regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects.

Systems engineering is a structured process for arriving at a final design of a system. The final design is selected from a number of alternatives that would accomplish the same objectives and considers the total life-cycle of the project including not only the technical merits of potential solutions but also the costs and relative value of alternatives.

§ 940.5 Policy.

ITS projects shall conform to the National ITS Architecture and standards in accordance with the requirements contained in this part. Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture. Development of the regional ITS architecture should be consistent with the transportation planning process for Statewide and Metropolitan Transportation Planning.

§ 940.7 Applicability.

(a) All ITS projects that are funded in whole or in part with the highway trust fund, including those on the National Highway System (NHS) and on non-NHS facilities, are subject to these provisions.

(b) The Secretary may authorize exceptions for:

(1) Projects designed to achieve specific research objectives outlined in the National ITS Program Plan under section 5205 of the TEA-21, or the Surface Transportation Research and Development Strategic Plan developed under 23 U.S.C. 508; or

(2) The upgrade or expansion of an ITS system in existence on the date of enactment of the TEA-21, if the Secretary determines that the upgrade or expansion:

(i) Would not adversely affect the goals or purposes of Subtitle C (Intelligent Transportation Systems Act of 1998) of the TEA-21;

(ii) Is carried out before the end of the useful life of such system; and

(iii) Is cost-effective as compared to alternatives that would meet the conformity requirement of this rule.

(c) These provisions do not apply to funds used for operations and maintenance of an ITS system in existence on June 9, 1998.

§ 940.9 Regional ITS architecture.

(a) A regional ITS architecture shall be developed to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in applicable transportation plans. The National ITS Architecture shall be used as a resource in the development of the regional ITS architecture. The regional ITS architecture shall be on a scale commensurate with the scope of ITS investment in the region. Provision should be made to include participation from the following agencies, as appropriate, in the development of the regional ITS architecture: Highway agencies; public safety agencies (*e.g.*, police, fire, emergency/medical); transit operators; Federal lands agencies; State motor carrier agencies; and other operating agencies necessary to fully address regional ITS integration.

(b) Any region that is currently implementing ITS projects shall have a regional ITS architecture by February 7, 2005.

(c) All other regions not currently implementing ITS projects shall have a regional ITS architecture within four years of the first ITS project for that region advancing to final design.

(d) The regional ITS architecture shall include, at a minimum, the following:

- (1) A description of the region;
- (2) Identification of participating agencies and other stakeholders;
- (3) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture;
- (4) Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture;
- (5) System functional requirements;
- (6) Interface requirements and information exchanges with planned

and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture);

(7) Identification of ITS standards supporting regional and national interoperability; and

(8) The sequence of projects required for implementation.

(e) Existing regional ITS architectures that meet all of the requirements of paragraph (d) of this section shall be considered to satisfy the requirements of paragraph (a) of this section.

(f) The agencies and other stakeholders participating in the development of the regional ITS architecture shall develop and implement procedures and responsibilities for maintaining it, as needs evolve within the region.

§ 940.11 Project implementation.

(a) All ITS projects funded with highway trust funds shall be based on a systems engineering analysis.

(b) The analysis should be on a scale commensurate with the project scope.

(c) The systems engineering analysis shall include, at a minimum:

- (1) Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS Architecture);
- (2) Identification of participating agencies roles and responsibilities;
- (3) Requirements definitions;
- (4) Analysis of alternative system configurations and technology options to meet requirements;
- (5) Procurement options;
- (6) Identification of applicable ITS standards and testing procedures; and
- (7) Procedures and resources necessary for operations and management of the system.

(d) Upon completion of the regional ITS architecture required in §§ 940.9(b) or 940.9(c), the final design of all ITS projects funded with highway trust funds shall accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. If the final design of the ITS project is inconsistent with the regional ITS architecture, then the regional ITS architecture shall be updated as provided in the process

defined in § 940.9(f) to reflect the changes.

(e) Prior to the completion of the regional ITS architecture, any major ITS project funded with highway trust funds that advances to final design shall have a project level ITS architecture that is coordinated with the development of the regional ITS architecture. The final design of the major ITS project shall accommodate the interface requirements and information exchanges as specified in this project level ITS architecture. If the project final design is inconsistent with the project level ITS architecture, then the project level ITS architecture shall be updated to reflect the changes. The project level ITS architecture is based on the results of the systems engineering analysis, and includes the following:

- (1) A description of the scope of the ITS project;
 - (2) An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the ITS project;
 - (3) Functional requirements of the ITS project;
 - (4) Interface requirements and information exchanges between the ITS project and other planned and existing systems and subsystems; and
 - (5) Identification of applicable ITS standards.
- (f) All ITS projects funded with highway trust funds shall use applicable ITS standards and interoperability tests that have been officially adopted through rulemaking by the DOT.
- (g) Any ITS project that has advanced to final design by February 7, 2001 is exempt from the requirements of paragraphs (d) through (f) of this section.

§ 940.13 Project administration.

(a) Prior to authorization of highway trust funds for construction or implementation of ITS projects, compliance with § 940.11 shall be demonstrated.

(b) Compliance with this part will be monitored under Federal-aid oversight procedures as provided under 23 U.S.C. 106 and 133.

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