SKAGIT MPO ITS ARCHITECTURE

APPROVED: December 21, 2011

Skagit Council of Governments

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Executive Summary

This architecture is a document illustrating what Intelligent Transportation Systems (ITS) in the Skagit Metropolitan Planning Organization (MPO) region of Skagit County, Washington are currently deployed or being planned or the near future. By showing what advanced technology systems are in place, this plan can illustrate opportunities for sharing resources and improve overall system functionality.

This regional architecture is built on the U.S. National Architecture version 6.1, and was developed on guidelines suggested by the National ITS Architecture team.

Within Skagit's MPO boundaries, several key stakeholders have ITS systems. The municipalities of Burlington, Mount Vernon, and Sedro-Woolley, as well as Skagit County itself all have signalized intersections, but most are maintained by WA State Department of Transportation (WSDOT).

WSDOT owns and maintains the majority of ITS components in the region, including all ITS system elements (fiber, CCTV cameras, data stations, etc.) on I-5 and State Route 20. WSDOT also collects some remote weather information, which is sent, along with transportation data, to be coordinated out of the WSDOT Traffic Management Center in Shoreline. WSDOT also works with WA State Patrol (WSP) to share real-time information.

Skagit Transit also has ITS components in place and plans to expand systems to provide more dynamic services and improved security to their customers.

In the U.S. National ITS Architecture, types of ITS equipment or projects are grouped into "market packages" which can be used to tie one region's architecture to the state, or to specific project architectures. Fifteen market packages have been selected to describe the kind of services stakeholders have installed, or plan to install.

Another key purpose of an architecture is to define what standards are used in ITS equipment to make it easier for one system to interact with another. The architecture defines what standards are currently being used and suggests relevant national standards which may be chosen to help make future projects more accessible to a wider range of stakeholders.

The architecture includes a list of data-sharing agreements within the region, showing how agencies work together to operate and maintain ITS systems.

This document fulfills the requirements set forth by the U.S. Federal Highway Administration Rule requiring regions with existing ITS applications to have a regional ITS architecture. It will be incorporated into the regional transportation plan update cycle, with any necessary amendments made as needed.

In addition to this report, a Turbo Architecture file of the Skagit MPO ITS Architecture is available upon request.

1. Introduction

Intelligent Transportation Systems (ITS) are technology solutions to improve the functionality, safety, and cost-effectiveness of transportation systems.

This architecture serves as a plan to illustrate what ITS systems are currently in place in the Skagit Metropolitan Planning Organization (MPO) boundaries; what systems are planned to be deployed in the next five years; and what opportunities exist to share resources and improve coordination between agencies to improve overall system functionality.

As a regional ITS architecture it has been designed to fit the structure of the current National ITS Architecture. More information about the National ITS Architecture and architecture's physical and informational structures is available as **Appendix A: Background Information on the U.S. National ITS Architecture**.

The architecture has been developed as per the specifications developed by the U.S. Department of Transportation Federal Highway Administration (FHWA) Rule and Federal Transit Administration (FTA) Policy requiring regions with existing ITS applications to have a regional ITS architecture.[1] This document meets these federal requirements.

In addition to this document, more specific information about functional requirements, standards, and information flows can be found in the Turbo Architecture version of the Skagit MPO ITS Architecture, available through Skagit Council of Governments.

Process for developing the architecture

Following outlines suggested by National ITS Architecture guidelines, these steps were taken to develop this architecture:

1. A stakeholder meeting and follow-up individual meetings were held to identify current and future ITS needs which should be incorporated into the architecture. Responses from this process are summarized in **Appendix B: Stakeholder Input to the Architecture**.

2. Relevant service areas, or market packages, were identified with the stakeholder agencies responsible. Information flows between services were mapped.

3. Market packages were mapped to subsystems and terminators as specified in the National Architecture.

4. A draft version of the architecture was distributed to stakeholder agencies for feedback and revised accordingly.

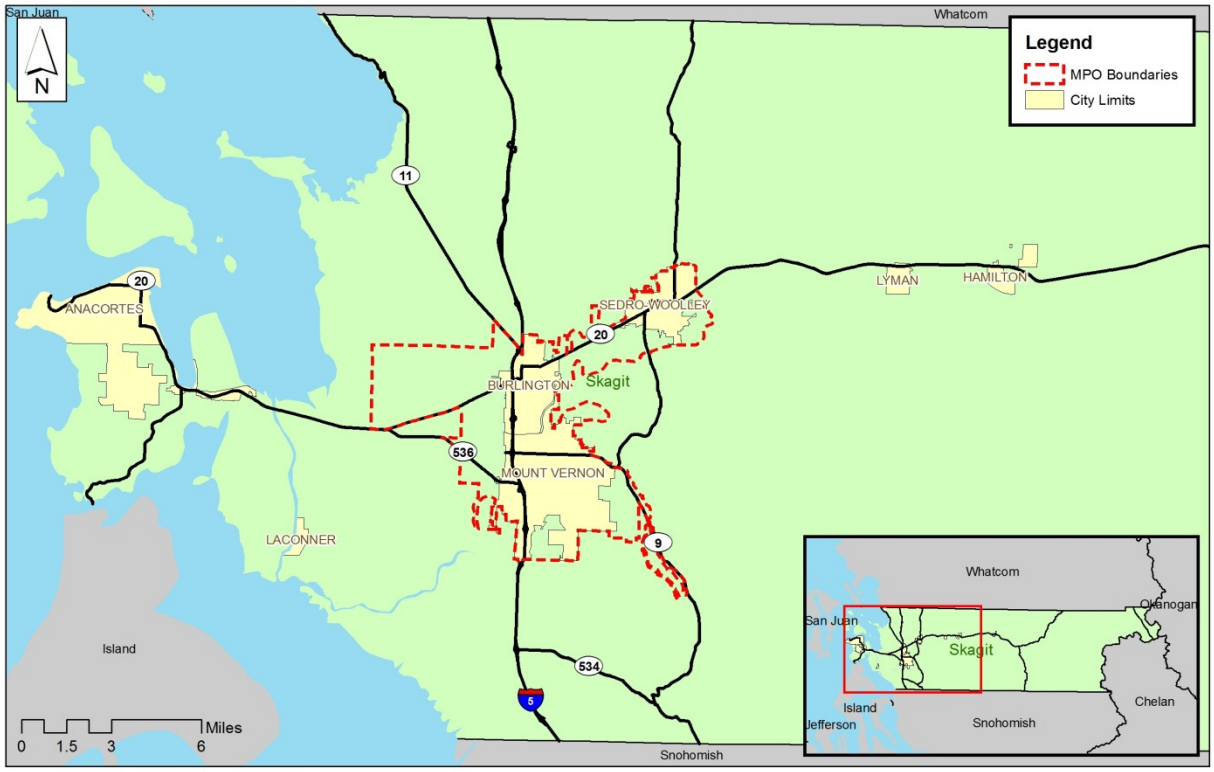
5. The architecture was submitted to the Skagit Metropolitan Planning Organization (MPO) Board on December 21, 2011 and was approved.

[1] January 8, 2001, U.S. Department of Transportation, Federal Highway Administration, 23 CFR Part 940, FHWA Docket No. FHWA-99-5899

2. Scope of the Architecture

The Skagit Regional ITS Architecture includes all ITS projects within the boundaries of the jurisdictions of Skagit's Metropolitan Planning region. Skagit County is bordered to the north by Whatcom County, to the west by Island and San Juan Counties, to the south by Snohomish County, and to the east by Okanogan and Chelan Counties. The population of Skagit is approximately 120,000 and the region is served by one interstate (I-5) and multiple state routes. Skagit County is also a hub for the Washington State Ferries (WSF) system between services to the San Juan Islands and the mainland through WSF's facility at Anacortes.

Exhibit 1: Map of Skagit County and MPO Boundaries



3. Stakeholders

Numerous stakeholder agencies are within the Skagit County MPO region:

- City of Burlington
- City of Mount Vernon
- City of Sedro-Woolley
- Port of Skagit
- Skagit Council of Governments (SCOG)
- Skagit County
- Skagit Transit
- WA State Department of Transportation (WSDOT)
- WA State Patrol (WSP)

There are agencies outside the Skagit MPO boundaries but within Skagit County itself (in the Skagit Sub-Region RTPO) that also have links to regional ITS networks and should be considered stakeholders as well:

- City of Anacortes
- Concrete
- Hamilton
- City of La Conner
- Lyman
- Port of Anacortes
- Samish Indian Tribe
- Sauk-Suiattle Indian Tribe
- Swinomish Indian Tribe
- Upper Skagit Indian Tribe
- WA State Ferries

4. Operational Concept

This section defines each stakeholder's current and future roles and responsibilities regarding any ITS systems they may operate or maintain.

WA State Department of Transportation (WSDOT)

WSDOT is responsible for operating and maintaining all ITS systems along Interstate 5, the State Routes within Washington State, and relating to their advanced traveler information systems (ATIS).

In addition, WSDOT has entered into maintenance agreements with the majority of jurisdictions in Skagit County and are responsible for operating all traffic signals and signal priorities in the county. A breakdown of specific roles and responsibilities is as follows:

- Operate traffic managements systems along I-5, SR20, SR9, SR11, SR530, and SR534.
- Operate traffic signalization for the City of Burlington.
- Operate traffic signalization for parts of the City of Mount Vernon.
- Operate traffic signalization for the City of Sedro-Woolley.
- Operate traffic signalization for Skagit County.
- Coordinate all advanced traffic management data through the traffic management centers (TMC) in Bellingham and Shoreline.
- Share information with WSP and local agencies.
- Maintain the remote weather information system (RWIS) currently in place.

Future roles and responsibilities may include:

- Develop an ATIS system through Skagit County (including traffic information, travel times, and feeds to applications for personal data devices).
- Add additional weather sensor data components along select routes in Skagit County.

- Install additional ITS components (including but not limited to fiber, detection, cameras, integrated signals) on SR20.
- Install additional ITS components (including but not limited to fiber, detection, VMS, cameras, integrated signals, HAR, RWIS, and ramp meters) on I-5 through Skagit County.

Skagit Transit

Skagit Transit operates county-wide public transportation systems which serve Skagit as well as Whatcom County residents. Skagit Transit has a variety of transit-related ITS solutions on board, in facilities, and plans for future deployment. A breakdown of specific roles and responsibilities is as follows:

- Maintain advanced vehicle location systems (AVL) for demand response vehicles.
- Maintain camera systems on all vehicles.
- Use monitoring systems for safety at the Skagit Station, South Mt. Vernon Park & Ride, and other locations.

Future roles and responsibilities may include:

- AVL for all routes.
- Monitoring abilities at all park and ride locations and stations.
- Monitoring for non-public transit areas.
- Dissemination of real time information about schedules and vehicle locations to the public.
- Coordinate trip planning and information with WA State Ferries, Whatcom Transportation Authority, and other regional agencies.
- Installation of information kiosks.
- Electronic information at transit stops and stations.
- Develop transit trip planning tools.
- Have the ability to collect electronic fare/passenger information.
- Develop transit signal priority systems with local jurisdictions.

City of Mount Vernon

The City of Mount Vernon has 30 traffic signals, controlling some but with the majority under the maintenance of WSDOT. Current roles and responsibilities include:

- Share control of traffic signals with WSDOT Traffic Management Center.

Future roles and responsibilities may include:

- Share control of cameras, variable message signs, or other information devices.
- Offer traffic signal prioritization to Skagit Transit.

City of Sedro-Woolley

The City of Sedro-Woolley's traffic signals are maintained by WSDOT. Current roles and responsibilities include:

- Share control of traffic signals with WSDOT Traffic Management Center.

Future roles and responsibilities may include:

- Share control of cameras, variable message signs, or other information devices.
- Offer traffic signal prioritization to Skagit Transit.

City of Burlington

The City of Burlington's traffic signals are maintained by WSDOT. Current roles and responsibilities include:

- Share control of traffic signals with WSDOT Traffic Management Center.

Future roles and responsibilities may include:

- Share control of cameras, variable message signs, or other information devices.
- Offer traffic signal prioritization to Skagit Transit.

5. Inventory

The following stakeholder agencies operate ITS systems within the geographic region of the architecture. Note that some stakeholders may have additional ITS systems within their inventory that are not listed here because they fall out of the geographic scope of this architecture.

Stakeholder	Element	Description	Status
City of Burlington	Burlington Surface Street Control	Burlington has signal control equipment that supports local surface street control and arterial traffic management in partnership with WSDOT.	Existing
City of Mount Vernon	Mount Vernon Surface Street Control	Mount Vernon has signal control equipment that supports local surface street control and arterial traffic management in partnership with WSDOT.	Existing
City of Sedro-Woolley	Sedro-Woolley Surface Street Control	Sedro-Woolley has signal control equipment that supports local surface street control and arterial traffic management in partnership with WSDOT.	Existing
Skagit Transit	Skagit Automatic Vehicle Location System	Skagit Transit has automatic vehicle location systems (AVL) operating on their demand response vehicles. They are planning to install AVL on fixed route vehicles as well.	Existing/ Planned
Skagit Transit	Skagit Fare Management	Skagit Transit may use electronic fare management tools in the future to assist passengers and monitor the use of services.	Planned

Skagit Transit	Skagit Station Monitoring	Skagit Transit has monitoring abilities at the Skagit Station and South Mount Vernon Park & Ride to maintain security. They plan to install cameras and expand the monitoring to the Chuckanut Park & Ride (with WSDOT partnering), March's Point Park & Ride, and a new Park & Ride at the Alger exit of I-5.	Existing/ Planned
Skagit Transit	Skagit Transit Information Displays	Skagit Transit would like to develop in the future a way to use the AVL system to display vehicle arrival times and locations at key stations, as well as to provide other real-time transit information to the traveling public.	Planned
Skagit Transit	Skagit Transit Signal Priority	Skagit Transit is planning to work with regional jurisdictions and WSDOT to consider transit signal prioritization in congested areas to reduce transit vehicle travel time.	Planned
Skagit Transit	Skagit Trip Planning Tool	Skagit Transit would like to develop a transit trip planning tool for the traveling public to allow users to better plan their transit trips.	Planned
WA State Department of Transportation (WSDOT)	Skagit I-5 ITS	This element represents all existing ITS systems on I-5 including fiber , CCTV camera images, and data centers.	Existing
WA State Department of Transportation (WSDOT)	I-5 Full Freeway ITS	This project will install full freeway Level 2 systems including fiber, detection, variable message signs, cameras, remote weather information systems, highway advisory radio, integrated signals, and some ramp meters. The project has three components between milepost 209 and 234.	Planned
WA State Department of Transportation (WSDOT)	SR20 Arterial ITS	This project will expand arterial ITS in both directions including fiber, detection, cameras, and integrated signals.	Existing/ Planned
WA State Department of Transportation (WSDOT)	WSDOT Traffic Management Center	WSDOT has a central traffic management center (TMC) in Shoreline. An additional TMC is located in Bellingham, WA.	Existing

6. Needs and Services

In the existing Skagit-Island Counties Metropolitan and Regional Transportation Plan for 2010-2035[2], six regional priorities were identified:

- **Economic vitality**: To promote and develop transportation systems that stimulate, support, and enhance the movement of people and goods to ensure a prosperous economy;

[2] Skagit-Island Counties Metropolitan & Regional Plan for 2010-2035, Skagit Council of Governments, http://scog.net/wp-content/uploads/downloads/2011/05/S-I_MRTP_May-2011-FINAL.pdf

- **Preservation**: To maintain, preserve, and extend the life and utility of prior investments in transportation systems and services;
- **Safety**: To provide for and improve the safety and security of the transportation customer; and the transportation system;
- **Mobility**: To improve the predictable movement of goods and people throughout the region;
- **Environment**: To enhance regional quality of life through transportation investments that promote energy conservation, enhance healthy communities, and protect the environment;
- **Stewardship**: To continuously improve the quality, effectiveness, and efficiency of the transportation system.

ITS systems may help address these transportation priorities by providing cost-effective alternatives to physical infrastructure improvements that allow for greater mobility, safety, and preservation while minimizing environmental impacts.

To respond to these needs, the following service areas were either implemented or are planned for future implementation:

Market Package [3]	Description	Elements	Status
APTS01: Transit Vehicle Tracking	This market package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. 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 the Information Service Provider.	Skagit Automatic Vehicle Location System	Existing
APTS02: Transit Fixed-Route Operations	This market package performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service determines the transit vehicle trip performance against the schedule using AVL data and provides information displays at the Transit Management Subsystem. Static and real time transit data is exchanged with Information Service Providers where it is integrated with that from other transportation modes (e.g. rail, ferry, air) to provide the public with integrated and personalized dynamic schedules.	Skagit Transit Information Displays	Planned

[3] Abbreviations for the types of market packages are as follows: APTS = Advanced Public Transportation Systems; ATMS = Advanced Traffic Management Systems; MC = Maintenance and Construction.

APTS03: Demand Response Transit Operations	This market package performs automated dispatch and system monitoring for demand responsive transit services. This service performs scheduling activities as well as operator assignment. In addition, this market package performs similar functions to support dynamic features of flexible-route transit services. This package monitors the 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. This service includes the capability for a traveler request for personalized transit services to be made through the Information Service Provider (ISP) Subsystem. The ISP may either be operated by a transit management center or be independently owned and operated by a separate service provider. In the first scenario, the traveler makes a direct request to a specific paratransit service. In the second scenario, a third party service provider determines that the paratransit service is a viable means of satisfying a traveler request and makes a reservation for the traveler.		Existing
APTS04: Transit Fare Collection Management	This market package manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device. Readers located either in the infrastructure or on-board the transit vehicle allow electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem. Two other market packages, ATMS10: Electronic Toll Collection and ATMS16: Parking Facility Management also provide electronic payment services. These three market packages in combination provide an integrated electronic payment system for transportation services.	Skagit Fare Management	Planned

APTS05: Transit Security	This market package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment is deployed to perform surveillance and sensor monitoring in order to warn of potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this market package provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring). The surveillance and sensor information is transmitted to the Emergency Management Subsystem, as are transit user activated alarms in public secure areas. On-board alarms, activated by transit users or transit vehicle operators are transmitted to both the Emergency Management Subsystem and the Transit Management Subsystem, indicating two possible approaches to implementing this market package. In addition the market package supports remote transit vehicle disabling by the Transit Management Subsystem and transit vehicle operator authentication.	Skagit Station Monitoring	Existing/ Planned
APTS06: Transit Fleet Management	This market package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Subsystem. Hardware and software in the Transit Management Subsystem processes this data and schedules preventative and corrective maintenance. The market package also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks.	Skagit Automatic Vehicle Location System; Skagit Transit Information Displays	Planned
APTS08: 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 services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.	Skagit Transit Information Displays; Skagit Trip Planning Tool	Planned

APTS10: Transit Passenger Counting	This market package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.	Skagit Fare Management	Planned
ATMS01: Network Surveillance	This market package includes traffic detectors, other surveillance equipment, the supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to the Traffic Management Subsystem. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Subsystem). The data generated by this market package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Information Service Provider Subsystem.	I-5 Full Freeway ITS; SR20 Arterial ITS; WSDOT Traffic Management Center	Planned
ATMS03: Surface Street Control	This market package provides the central control and monitoring equipment, communication links, and the signal control equipment that support local surface street control and/or arterial traffic management. A range of traffic signal control systems are represented by this market package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This market package is generally an intra-jurisdictional package that does not rely on real-time communications between separate control systems to achieve area-wide traffic signal coordination. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would be represented by this package. This market package is consistent with typical urban traffic signal control systems.	Anacortes, Burlington, Mount Vernon, and Sedro-Woolley Surface Street Control; Skagit Surface Street Control; SR20 Arterial ITS; WSDOT Traffic Management Center	Existing

ATMS04: Freeway Control	This market package provides central monitoring and control, communications, and field equipment that support freeway management. It supports a range of freeway management control strategies including ramp metering, interchange metering, mainline lane controls, mainline metering, and other strategies including variable speed controls. This package incorporates the instrumentation included in the Network Surveillance Market Package to support freeway monitoring and adaptive strategies as an option. This market package also includes the capability to utilize surveillance information for detection of incidents. Typically, the processing would be performed at a traffic management center; however, developments might allow for point detection with roadway equipment. For example, a CCTV might include the capability to detect an incident based upon image changes. Additionally, this market package allows general advisory and traffic control information to be provided to the driver while en route.	I-5 Full Freeway ITS; Skagit I-5 ITS	Existing/ Planned
ATMS06: Traffic Information Dissemination	This market package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time information on road/bridge closures due to maintenance and construction activities to be disseminated.	I-5 Full Freeway ITS; WA State Ferries Traveler Information; WSDOT Traffic Management Center	Existing

ATMS07: Regional Traffic Management	This market package provides for the sharing of traffic information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include coordinated signal control in a metropolitan area and coordination between freeway operations and arterial signal control within a corridor. This market package advances the Surface Street Control and Freeway Control Market Packages by adding the communications links and integrated control strategies that enable integrated interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Surface Street Control and Freeway Control Market Packages and adds hardware, software, and fixed-point to fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.	Anacortes, Burlington, Mount Vernon, and Sedro-Woolley Surface Street Control; I-5 Full Freeway ITS; Sr20 Arterial ITS; WSDOT Traffic Management Center	Planned
ATMS13: Standard Railroad Grade Crossing	This market package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the roadway subsystem and the driver in the architecture definition.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification by interfaced wayside equipment of an approaching train. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the traffic management subsystem.	Burlington, Mount Vernon, and Sedro-Woolley Surface Street Control; WSDOT Traffic Management Center	Planned
MC03: Road Weather Data Collection	This market package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway (or guideway in the case of transit related rail systems). In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on Maintenance and Construction Vehicles. The collected environmental data is used by the Weather Information Processing and Distribution Market Package to process the information and make decisions on operations. The collected environmental data may be aggregated, combined with data attributes and sent to meteorological systems for data qualification and further data consolidation. The market package may also request and receive qualified data sets from meteorological systems.	I-5 Full Freeway ITS	Planned

7. Interfaces and Information Exchanges

Using the National ITS Architecture as a basis and the Turbo Architecture 5.0 software to map out information flows and interfaces between systems, several diagrams representing how the various ITS systems in Skagit County interact.

A basic diagram illustrating the connections between ITS subsystems is in **Appendix c: Subsystems Diagram**.

A diagram of the interconnects between systems is in **Appendix D: Interconnect Diagram**.

A more complex flow diagram showing what specific information is exchanged between systems is available in **Appendix E: Flow Diagram**.

8. Functional Requirements

Functional requirements describe the activities performed by each element within the region. Given that each deployment of ITS will have specific functional requirements, they are not listed here. However a set of generalized functional requirements have been included in the Turbo Architecture version of the architecture. More information can be found there.

9. Standards

ITS standards have been developed to allow for greater interoperability and integration of ITS components, increasing the cost-effectiveness of ITS system solutions and overall functionality. Within Skagit County, most ITS systems are owned and operated by WSDOT and therefore ascribe to WSDOT system standards. WSDOT standards include WAC 296-46A-104 and WAC 296-46B-040 for traffic management systems, and Section 2500,2600,2700 in the current Time Standards Manual M54-05.

Independent ITS solutions installed by regional stakeholders may use other internationally-developed standards for implementation.

The following standards and listed as suggestions for the deployment of ITS systems within Skagit's MPO boundaries. For more specifics, please contact each stakeholder agency's ITS contact person to confirm whether or not the standard of the project being implemented adheres to established standards.

Group or Doc ID	Title	SDO
ATIS General Use	Advanced Traveler Information Systems (ATIS) General Use Standards Group	SAE
DSRC 5GHz	Dedicated Short Range Communication at 5.9 GHz Standards Group	ASTMEEE/ SAE
DSRC 915MHz	Dedicated Short Range Communication at 915 MHz Standards Group	ASTM
APTA TCIP-S-001 3.0.3	Standard for Transit Communications Interface Profiles	APTA
NTCIP 1207	Object Definitions for Ramp Meter Control (RMC) Units	AASHTO/ITE/NEMA
NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control	AASHTO/ITE/NEMA
NTCIP 1204	Object Definitions for Environmental Sensor Stations (ESS)	AASHTO/ITE/NEMA
NTCIP 1208	Object Definitions for Closed Circuit Television (CCTV) Switching	AASHTO/ITE/NEMA
NTCIP 1210	Field Management Stations (FMS) – Part 1: Object Definitions for Signal System Masters	AASHTO/ITE/NEMA
NTCIP 1201	Global Object Definitions	AASHTO/ITE/NEMA
NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller (ASC) Units	AASHTO/ITE/NEMA
NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)	AASHTO/ITE/NEMA
NTCIP 1211	Object Definitions for Signal Control and Prioritization (SCP)	AASHTO/ITE/NEMA
NTCIP 1213	Object Definitions for Electrical and Lighting Management Systems (ELMS)	AASHTO/ITE/NEMA
NTCIP 1214	Object Definitions for Conflict Monitor Units (CMU)	AASHTO/ITE/NEMA
NTCIP C2C	NTCIP Center-to-Center Standards Group	AASHTO/ITE/NEMA
NTCIP C2F	NTCIP Center-to-Field Standards Group	AASHTO/ITE/NEMA
NTCIP 1209	Data Element Definitions for Transportation Sensor Systems (TSS)	AASHTO/ITE/NEMA

10. Project Sequencing

A project sequence defines the order in which ITS projects within a region should be implemented. This is especially important if there are interdependencies of systems being developed between multiple agencies.

Given that there are no interdependent projects listed for future deployment at this time, and that all projects described are planned within a short-term time frame (five years), projects have not been sequenced by priority. However the following are recommended early projects with higher values in terms of overall cost-effectiveness:

1. **Improvements to regional traveler information systems**: WSDOT's planned expansion of the information systems available in the Puget Sound region to areas north (Snohomish, Skagit, and Whatcom counties) provides an opportunity for both the state agency and regional jurisdictions to access valuable traffic data, including vehicle counts, real-time congestion status, and additional cameras for system management.
2. **Expanded transit vehicle location**: Skagit Transit has some AVL systems in place but not for the entire fleet or fixed routes. By expanding the AVL system this will lead the way to other future ITS solutions for greater system efficiencies, including real-time

station arrival/departure information, improved security on board buses, and other benefits.

11. Agreements

The following agreements current exist to allow for real-time data sharing between stakeholder agencies:

Agency	Agency	Agreements
WSDOT	City of Anacortes	Signal Maintenance Agreement GM 1391
WSDOT	City of Burlington	Signal Maintenance Agreement GM 1392
WSDOT	City of Mount Vernon	Traffic Signal Control Agreement?
WSDOT	City of Sedro-Woolley	Traffic Signal Control Agreement?
WSDOT	Skagit County	Signal Maintenance Agreement GM 1393
WSDOT	WA State Patrol	Joint Operating Agreement

12. Architecture Maintenance

This architecture was presented to the SCOG MPO Board in December, 2011 and approved. It will remain current until the next update of the Skagit-Island Counties Metropolitan and Regional Plan, which will incorporate an architecture component and all future architecture updates will be done as part of the plan update schedule.

Until then, this architecture will be checked annually for accuracy and any amendments will be determined by the SCOG board.

Appendix A: Background Information on the U.S. National ITS Architecture

Note: this material is taken from the U.S. Department of Transportation National ITS Architecture, Version 6.1.[4]

Introduction

The National ITS Architecture provides a common framework for planning, defining, and integrating ITS. Specifically it defines:

- The functions (e.g. gather traffic information or request a route) that are required for ITS applications.
- The physical entities or subsystems where these functions reside (e.g. the roadside or the vehicle).
- The information flows that connect these functions and physical subsystems together into an integrated system.

Regional Architectures are not intended to specify the particular technologies that will be used in ITS deployments; they are instead used to define the functions that technologies must perform. The architecture is therefore employed to provide structure to the defining of general ITS functional requirements during the planning and design process.

Architecture terminology

There are numerous terms within the National ITS Architecture that may need additional explaining and are included below. All efforts have been taken to minimize architecture-specific language in the Skagit Regional ITS Architecture, but for comparing to the national architecture the terms need to be defined:

User services – These describe what an ITS system will do (i.e. provide pre-trip traveler information). These have been selected based on the needs of the stakeholders in the region.

Logical architecture – This defines the processes (activities or functions) needed to satisfy the User Services. The logical architecture uses data flows to identify information that is shared between processes.

Physical architecture – This high level structure defines the physical entities (subsystems and terminators) that make up ITS. It uses architecture flows to connect subsystems and terminators together.

Equipment packages – These break up subsystems into deployment-sized pieces.

Market packages – These represent slices of the physical architecture that address specific services (e.g. surface street control). A market package collects together several different

[4] http://www.iteris.com/itsarch/index.htm

subsystems, equipment packages, terminators, and architecture flows that provide the desired service.

Standards – The National ITS Architecture is a reference framework for the development of standards. The logical and physical architecture provide a starting point for ITS standards development activities by identifying the applicable architecture flows and data flows to be standardized and the way that information is exchanged across those interfaces.

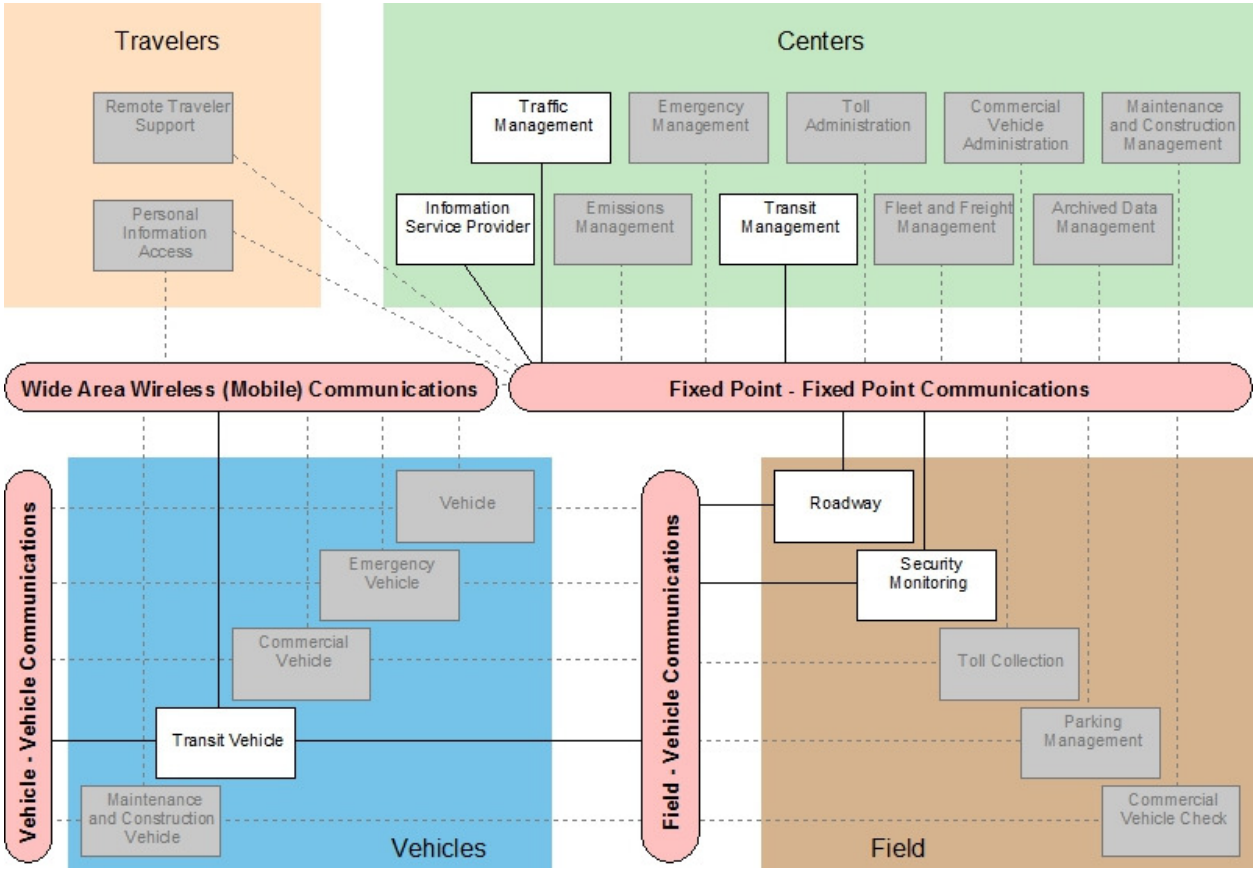
Appendix B: Summary of Feedback from Stakeholders

The following feedback was collected from regional stakeholders and used as a basis for this architecture.

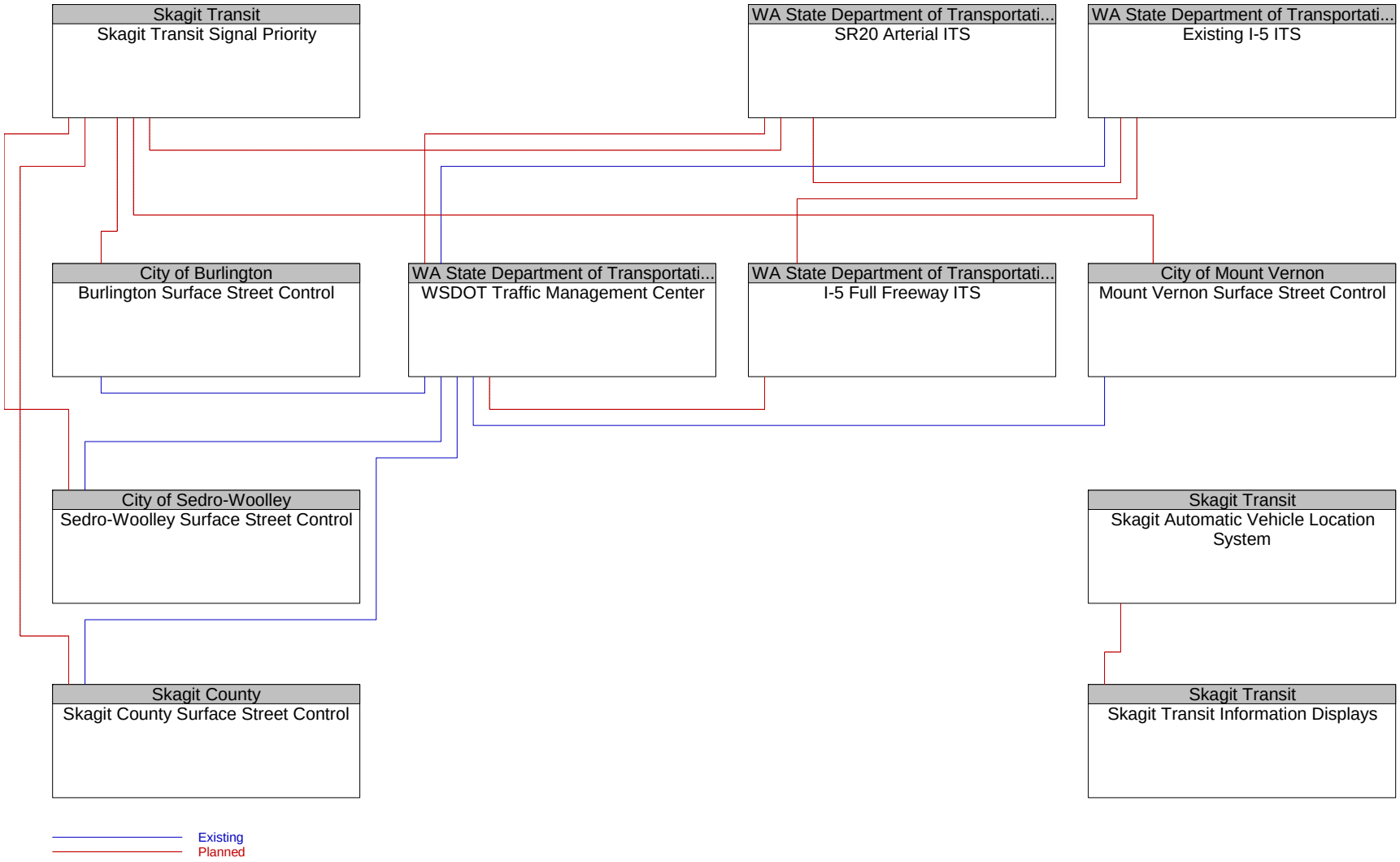
Stakeholder Agency	Existing ITS Systems	Planned ITS Systems	Future Needs
City of Anacortes	Anacortes has traffic signals controlled by WSDOT		
City of Burlington	Burlington uses WSDOT for fiber, detection, cameras, signals, railroad signals.	They have worked to link up all traffic signals to one fiber network.	Looking to add sensors, cameras, and hardware to improve current system.
City of Mount Vernon	City is responsible for 30 traffic signals. The city contracts with WSDOT signal operations.	City plans to include installing an interconnect system for signals on College Way and upgrade to 2070 signal controllers at certain locations.	
City of Sedro-Woolley	Sedro-Woolley has five signals on SR20 that are operated by WSDOT.		
Port of Skagit	No ITS		
Skagit Council of Governments	No ITS		
Skagit County			
Skagit Transit	AVL on demand response vehicles; cameras on all coaches; monitoring at some stations and park n rides	AVL for all vehicles; increased station and non-public areas monitoring; way to disseminate real-time information to public; transit trip planning tools; information kiosks; electronic fare tracking system; sharing of information	
WSDOT	WSDOT controls signals for all but the city of Mount Vernon; I-5 ITS includes fiber, detection, variable message signs, highway advisory radio, signals, and cameras; data transferred to traffic management centers in Bellingham and Shoreline; some data shared with WSP; RWIS	Possibly share cameras and data with local agencies in "trafficbusters" agreement; plans to expand ITS on I-5; advanced traveler information expansion, information to also go to VMS and personal devices; expand RWIS.	

Appendix C: Subsystems Diagram

The boxes in white show subsystems relevant to the Skagit MPO ITS Architecture.



Appendix D: Interconnect Diagram



Appendix E: Flow Diagram