RESEARCH

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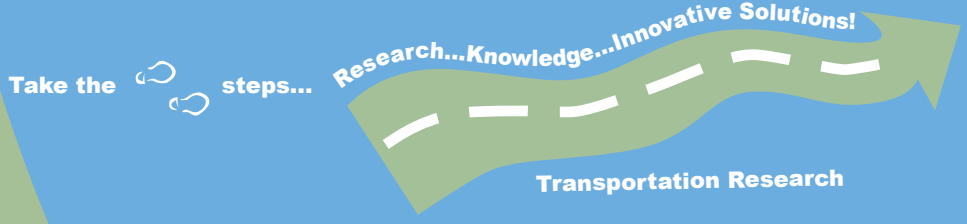
North/West Passage
ITS Integrated Corridor Strategic Plan



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The vision of the North/West Passage Corridor is to immediately influence ongoing standards development and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders. While travel information reflects the initial destiny, maintenance and operations and planning and programming are long-term visions. The vision provides a framework to guide the states' future projects in the corridor. Conversely, a set of near-term goals and objectives are also identified in the plan and are based on the issues and needs currently faced in the corridor.

Building upon the high-level architecture and assessment, a series of projects were then identified in the strategic plan. Projects were selected based on their ability to achieve the traveler information and maintenance operations goals identified earlier in the strategic plan. The projects are presented in a recommended sequence and contain details on approach, potential benefits, affected stakeholders, and estimated costs.

With this strategic plan, the North/West Passage states have developed a set of recommended projects geared toward achieving their near-term goals. These projects may be folded into annual work plans or used to secure future funding for the corridor. The plan also establishes a process for future project development that will enhance deployment efforts in the corridor. Ultimately, this plan will help the North/West Passage achieve their vision to influence ongoing standards development and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders.

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ITS Integrated Corridor Strategic Plan

Final Report

Prepared by:

Ginny Crowson
Minnesota Department of Transportation
Office of Traffic, Safety and Operations
1500 W. County Road B2, MS 725
Roseville, MN 55113

Jeffrey L. Lutz
SEH Inc.
Butler Square Building, Suite 710C
100 North 6th Street
Minneapolis, MN 55403-1515

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Executive Summary

Interstates 90 and 94 between Wisconsin and Washington function as major corridors for commercial and recreational travel. Extreme winter weather conditions, prevalent in the northern states within this corridor, pose significant operational and travel-related challenges. Idaho, Minnesota, Montana, North Dakota, South Dakota, Washington, Wisconsin, and Wyoming are predominantly rural and face similar transportation issues related to traffic management, traveler information, and commercial vehicle operations.

Recognizing the value of coordinated, cross-border collaboration for ITS deployment to address these issues, Minnesota initiated a meeting in 2002 with representatives from each of the states within the corridor. The group established itself as a Transportation Pooled Fund in 2003 through the Federal Highway Administration (FHWA).

The states have completed several projects in the years since their establishment as a pooled fund. Some Phase I projects involved significant construction or equipment purchases, and the North/West Passage pooled fund served as project initiator. This concept of project initiation was a success in Phase I. In Phase II, the states identified the need for a strategic plan. The ITS Integrated Corridor Strategic Plan was developed to guide future collaboration in the corridor. The plan focuses on center-to-center information sharing opportunities, includes a high-level architecture for the corridor, presents an inventory of existing systems, and identifies a coordinated deployment and operational concept for traveler information systems across state borders.

The vision of the North/West Passage Corridor is to immediately influence ongoing standards development and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders. While travel information reflects the initial destiny, maintenance and operations and planning and programming are long-term visions. The vision provides a framework to guide the states' future projects in the corridor. Conversely, a set of near-term goals and objectives are also identified in the plan and are based on the issues and needs currently faced in the corridor. The plan has three overall goals and associated objectives:

1. Integrate traveler information systems that can provide information appropriate to the location and need of the traveler.

    a. Understand the common and unique information needs of the corridor's diverse travelers. This includes the type of information, as well as the mechanism for delivering the information.

    b. Provide integrated traveler information systems – gathering and distributing – along the entire length of the corridor.

2. Develop and promote cross-border jurisdictional cooperation and coordination in the planning, deployment, operations, and maintenance of ITS infrastructure.

    a. Develop compatible and reliable communication systems among the states to support the operation of current and future ITS technology in the corridor.

b. Establish shared procedures for using dynamic message signs among the states.

3. Integrate ITS projects for the North/West Passage Corridor into the state, regional, and local planning and programming processes.

   a. Develop a 1- to 3-year ITS project plan for the corridor, identified by state.

   b. Identify and resolve legal or institutional issues related to funding project deployment and ongoing operations.

   c. Document and share lessons learned from integration of ITS projects into state, regional, and local planning and programming processes.

In addition to providing a vision and goals for the North/West Passage Corridor, the strategic plan also provides an overview of existing ITS deployments in the corridor. Existing ITS devices, such as Road Weather Information Systems (RWIS) provide a basis for the states to identify what's working well today, where gaps exist, and what their needs may be in the future. Once the deployments were inventoried and needs were identified, the states participated in a workshop that was designed to gain further understanding of the stakeholders' needs and objectives regarding traveler information and maintenance operations. Two scenario-based exercises were conducted during the workshop to set the stage for identifying potential solutions, desired functions, partnerships, and information flows in each of these areas.

Following the workshop, a series of proposed concepts and potential solutions were assessed to identify, at a high-level, the issues and implications that affect their deployment. To further facilitate how potential solutions may work across state borders in the corridor, a high-level architecture was also created. The architecture focuses on the immediate needs of the corridor, and where applicable, the future needs mutually agreed upon by member states. Specifically, the architecture has been developed to satisfy stakeholder defined goals and objectives that can be addressed through ITS.

Building upon the high-level architecture and assessment, a series of projects were then identified in the strategic plan. Projects were selected based on their ability to achieve the traveler information and maintenance operations goals identified earlier in the strategic plan. The projects are presented in a recommended sequence and contain details on approach, potential benefits, affected stakeholders, and estimated costs.

Traveler Information
1. Corridor-wide Consistent Major Event Descriptions
2. Clarus Regional Demonstration Concept of Operations
3. CAD to Reporting System Integration – Lessons Learned Workshop
4. North/West Passage Traveler Information Web Site
5. 511 Call Forwarding and Evaluation of Cross Border Information Requests
6. North/West Passage Traveler Information Kiosks
7. Corridor-wide Marketing and Outreach to CVOs
8. Information Systems Network (ISN)

9. Route Selection Information Support Tool
10. North/West Passage Traveler Information for ISPs

Maintenance and Operations
1. Cross-Border O&M Collaboration Workshop
2. Center-to-Center Communications Concept of Operations
3. Camera Image and RWIS Sensor Data Sharing
4. Develop Agreements with CVOs to Deploy Vehicle Probes

The final chapter of the strategic plan presents an approach for ITS deployment projects and a timeline illustrating the benefits that may be achieved as projects are completed over the next 3 to 5 years. To better understand how future North/West Passage deployment projects should be approached, the states modified the strategic planning process to initiate the preliminary design of a corridor-wide travel information web site (as proposed in Chapter 7). By initiating the corridor-wide web site during the planning process, the states have set the stage for an "early winner" project and have gained the experiences of a real-world deployment project to assist in developing guidelines for future deployment projects.

With this strategic plan, the North/West Passage states have developed a set of recommended projects geared toward achieving their near-term goals. These projects may be folded into annual work plans or used to secure future funding for the corridor. The plan also establishes a process for future project development that will enhance deployment efforts in the corridor. Ultimately, this plan will help the North/West Passage achieve their vision to influence ongoing standards development and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders.

Chapter 1: Introduction and Technology Inventory

Interstates 90 and 94 between Wisconsin and Washington are major corridors for commercial and recreational travel. Extreme winter weather conditions pose significant operational and travel-related challenges, especially in the northern states within this corridor. Because Idaho, Minnesota, Montana, North Dakota, South Dakota, Washington, Wisconsin, and Wyoming are predominantly rural, they each face transportation issues related to traffic management, traveler information, and commercial vehicle operations.

Recognizing the value of cross-border collaboration, Minnesota initiated a meeting in 2002 with representatives from each of the states within the corridor to address these issues through coordinated ITS deployment. The group established itself as a Transportation Pooled Fund in 2003 through the Federal Highway Administration (FHWA).

Since then, the states have completed several projects. Some Phase I projects involved significant construction or equipment purchases, and the North/West Passage pooled fund served as project initiator. This concept of project initiation was a success in Phase I. In Phase II, the states identified the need for a strategic plan. The ITS Integrated Corridor Strategic Plan was developed to guide future collaboration in the corridor. The plan focuses on center-to-center information sharing opportunities, includes a high-level architecture for the corridor, presents an inventory of existing systems, and identifies a coordinated deployment and operational concept for traveler information systems across state borders.

The foundation of this strategic plan is the ITS technology currently deployed along I-90/I-94 within each of the North/West Passage Corridor states. Understanding what is currently deployed in the corridor will provide insight into what technology has and has not worked well, states' experiences with various technologies, technology preferences, and more. This chapter presents a "snapshot" of the following ITS technology components:

- Transportation Operations Centers/Traffic Management Centers (TOC/TMC)
- Reporting Systems
- 511
- Kiosks
- Dynamic Message Signs (DMS)
- Highway Advisory Radio (HAR)
- Closed Circuit Television (CCTV)
- Road Weather Information Systems (RWIS)
- Data Collection
- Automatic Vehicle Location (AVL)
- Communication
- Miscellaneous Technologies

The components are first described according to their position within the National ITS architecture. Each component is then described according to its overall deployment and typical use within the states. A table summarizing the number and nature of the components follows the descriptions. The locations of individual components are illustrated in a series of maps in

Appendix A. Finally, because center-to-center data-sharing is the primary focus of this strategic plan, the latter part of this chapter describes the current practices for data-sharing among the states.

The information presented in this chapter was obtained through a series of interviews with representatives from each state, in addition to a cursory review of select documents, including, regional and state-wide ITS architecture and deployment plans. A complete list of references is included in Appendix B.

1.1 Technologies within the National ITS Architecture

To present a high-level overview of how the ITS technology components currently deployed in the corridor fit within the National ITS architecture, the components are grouped into four classes – Center, Roadside, Vehicle, and Traveler. Each class is briefly described below in relation to the ITS technology components deployed in the North/West Passage Corridor. The classes are further subdivided into 22 different areas of functionality or subsystems. The ITS technology components deployed within the North/West Passage Corridor are specifically related to six subsystems that are highlighted in Table 1-1.

Table 1-1: National ITS Architecture Classes and Subsystems

Center
1. Traffic Management
2. Information Service Provider
Traveler
3. Remote Traveler Support
Field
4. Roadway
5. Commercial Vehicle Check
Vehicle
6. Maintenance and Construction Vehicle

- Center Subsystems – Center subsystems provide management, administrative, and support functions for the transportation system. Traffic Management subsystems, in particular, typically communicate with the Field and Traveler subsystems to monitor traffic flow or road surface conditions to convey information to travelers via services like 511. The Information Service Provider (ISP) subsystem collects, processes, stores, and disseminates transportation information to system operators and the traveling public. Information provided includes basic advisories, traffic and road conditions, transit schedule information, yellow pages information, ride matching information, and parking information.

- Traveler Subsystems – Traveler subsystems provide travelers with formatted traffic advisories over multiple types of electronic media, from their homes, workplaces, major trip generation sites, and personal portable devices. Personal Information Access subsystems provide travelers to receive basic routing information over multiple types of electronic media, formatted traffic advisories from their homes, workplaces, major trip

generation sites, and personal portable devices. This subsystem can initiate a distress signal and cancel a prior-issued manual request for help.

- Field Subsystems – Field subsystems consist of components distributed along the transportation network that perform surveillance, information provision, and plan execution control functions and whose operation is governed by Center subsystems. The Roadway subsystem includes the equipment distributed on and along the roadway that monitors and controls traffic or monitors and manages the roadway itself. Equipment may include traffic detectors, environmental sensors, traffic signals, HAR, DMSs, CCTV cameras and video image processing systems, grade crossing warning systems, and freeway ramp metering systems. The Commercial Vehicle Check subsystem supports automated vehicle identification at mainline speeds for credential checking, roadside safety inspections, and weigh-in-motion (WIM) using two-way data exchange to provide warnings to commercial vehicle drivers, their fleet managers, and proper authorities of safety problems. The subsystem also can access and examine historical safety data and automatically decide whether to allow a vehicle to pass or require it to stop with operator manual override.

- Vehicle Subsystems – Vehicle subsystems cover ITS related elements on vehicle platforms. Vehicle subsystems include general driver information and safety systems applicable to all vehicle types. Four fleet vehicle subsystems – Transit, Emergency, Commercial and Maintenance, and Construction Vehicles – add ITS capabilities unique to these special vehicle types.

1.2 ITS Technology Components

The following section consists of the ITS technology components currently deployed in the North/West Passage Corridor. A brief description is provided of the overall deployment and its typical use within the states followed by a table summarizing the number and nature of the components by state.

1.2.1 Transportation Operations Centers/Traffic Management Centers (TOC/TMC)

The TOC/TMC is the nerve center of most freeway management systems. The TOC/ TMC falls under Traffic Management subsystem, which in its most basic form, monitors and controls traffic and the road network. The TOC/TMC collects and processes freeway system data, combines it with other operational and control data, synthesizes it to produce “information,” which is distributed to stakeholders such as the media, other agencies and traveling public. TOC/TMC staff uses the information to monitor freeway operations and to initiate control strategies that affect operational changes. Agencies also coordinate their responses to traffic conditions and incidents through the TOC/TMC.

Within the larger urbanized areas of the North/West Passage – Milwaukee, Minneapolis/St. Paul, Spokane and Seattle – there are organized regional TOC/TMCs. These facilities monitor and control freeway traffic control systems including ramp metering, CCTV cameras, traffic recording devices, DMS, and HAR.

On a much smaller scale, but no less important are a series of rural TOC/TMCs operating in the North/West Passage Corridor. The Minnesota Department of Transportation (Mn/DOT) operates

nine such centers. The St. Cloud facility monitors and collects data for the St. Cloud metropolitan area including I-94. It is integrated with the Regional Transportation Management Center (RTMC) in the Twin Cities to provide a wider area of capability for traffic management and traveler information. Within the Fargo-Moorhead area, a TOC/TMC operated by the North Dakota Department of Transportation (NDDOT) serves as the focal point for collecting information about system operations, actively managing the system, and coordinating traffic operations. The Fargo-Moorhead facility monitors a CCTV camera from I-94/I-29, ramp operations, DMS, and a traveler information web page. The Washington Department of Transportation's (WSDOT) regional TOC/TMCs in Seattle and Spokane work with other city and county TOC/TMCs to coordinate traffic management activities relating to I-90. Status of TOC/TMC deployments in all of the states is summarized in Table 1-3, and the locations of existing TOC/TMCs are illustrated in Appendix A.

1.2.2 Reporting Systems

Reporting systems fall under the ISP subsystem and are defined as systems for facilitating the real-time electronic reporting of surface transportation incidents to a central location for use in monitoring the event, providing accurate traveler information, and developing an appropriate response. The importance of reporting systems has been emphasized in Section 1201 of SAFETEA-LU. The federal legislation requires the Secretary of Transportation to establish data exchange formats to ensure that the data provided by highway and transit monitoring systems, including reporting systems, can be readily exchanged to facilitate nationwide availability of information.

There are currently two reporting systems used by states within the North/West Passage Corridor. The Condition Acquisition Reporting Systems (CARS) is a non-proprietary, standards-based reporting system that allows authorized users to enter, view, and disseminate critical road, travel, weather, and traffic information. CARS users access the system from any location using a standard web browser, which allows them to enter or view reports throughout the state. Washington, Idaho, Wyoming, and Minnesota all currently use CARS as their state-wide reporting system. South Dakota uses the Road Condition and Reporting System (RCRS) to perform similar functions, and North Dakota is considering using RCRS in their state. In an earlier project for the North/West Passage Corridor, an interface control document was developed to define the specific use of an XML message based on the Traffic Management Data Dictionary Full Event Update draft standard for these systems to exchange data.

1.2.3 511

The nation's traveler information number – 511 – is an ISP subsystem and was designated by the Federal Communications Commission in July 2000. Since its designation, over 23 states have deployed 511 telephone and, in many cases, companion web sites to provide travelers with construction, congestion, transit, and a variety of other information. Except for Wyoming and Wisconsin, all of the North/West Passage states have launched 511 telephone services. Refer to Table 1-2 for access numbers and web sites. Wyoming launched their 511 in September 2006, and Wisconsin is in the planning/funding stage for their service. All of the 511 services within the North/West Passage Corridor provide construction and road condition information. Some states provide transit, tourism, incident, and congestion information. Because of its status as the

nation's traveler information number, 511 represents one of the most consistently deployed ITS technology in the North/West Passage Corridor.

Table 1-2: North/West Passage States with Access Numbers and Web Sites

North/West Passage State	Access Number	Web Site
Idaho	(888) IDA-ROAD	511.idaho.gov
Minnesota	(800) 542-0220	www.511mn.org
Montana	(800) 226-7623	www.mdt511.com
North Dakota	(866) MY ND 511	www.state.nd.us.gov/dot/divisions/maintenance/511_nd.html
South Dakota	(866) MY SD 511	www.sddot.com/511.asp
Washington State	(800) 695-ROAD	www.wsdot.wa.gov/traffic/511
Wyoming	(888) WYO ROAD	www.wyoroad.info

1.2.4 Kiosks

Within the North/West Passage Corridor, traveler information kiosks are primarily located at rest areas and travel information centers in North Dakota and South Dakota. Kiosks are classified in the Remote Traveler subsystem. The kiosks provide travelers with readily accessible, useful, and timely information obtained from a variety of sources.

Kiosks in North Dakota provide access to state web pages, with the DOT traveler information and tourism information up front. They also allow access to the web via a sophisticated filter system. This allows travelers to access their email and other information on the internet.

By using password-supplied web access, NDDOT can add alerts, including: Amber Alerts, Homeland Security and transportation alerts (road closures, etc.).

In South Dakota, rest areas in South Dakota provide access to 511 via Safe Travel USA. The kiosks provide road weather information; construction and maintenance activities; incidents/accidents; traffic conditions; disturbances/disasters; obstructions and scheduled events. This information is provided on Interstates 29 and 90, and all U.S. and state highways.

1.2.5 Wireless Hot Spots

Wireless access is a relatively new technology, classified in the Remote Traveler subsystem, that is helping travelers stay connected to their home and office via the wireless internet access. This component falls under the Remote Traveler Support subsystem. In general, wireless internet access points will offer travelers links to information regarding:

- Winter road conditions
- Road construction
- Vehicle width and width restrictions
- National Weather Service forecasts and alerts
- Traffic incidents
- Amber Alerts

- Food and lodging
- Fuel locations
- Tourism attractions and events.

Within the North/West Passage states, North Dakota and Washington have wireless access points at their rest areas.

1.2.6 Dynamic Message Signs (DMS)

DMS are another widely deployed technology in the North/West Passage Corridor. For the purposes of this plan, the term DMS will encompass Variable Message Signs (VMS), Changeable Message Signs (CMS), and Variable Speed Limit (VSL) signs. DMS falls under the Roadway subsystem and in part includes equipment distributed on and along the roadway that monitors and controls traffic. DMS are primarily used for traveler information along the corridor. They project information, such as roadway conditions, dynamic travel times, road closures and special event details. There are 121 existing permanent and semi-permanent (portable parked in fixed locations) DMS along the North/West Passage Corridor. Appendix A illustrates specific locations of existing DMS by state.

1.2.7 Highway Advisory Radio (HAR)

HAR is a Roadway subsystem and consists of a low-power radio transmitter licensed for state use in the AM frequency. Signs along the North/West Passage direct travelers to dial particular AM stations to hear short, pre-recorded messages that alert drivers of severe weather conditions, construction, incidents, or congestion. HAR is used in varying degrees only within the states of Wisconsin, Minnesota, Wyoming, Montana, and Washington. Locations of the HAR transmitters within the North/West Passage Corridor are shown in Appendix A.

1.2.8 Closed Circuit Television (CCTV)

CCTV cameras are classified under the Roadway subsystem and are distributed along the roadway to monitor and control traffic, and are also used by maintenance and law enforcement personnel to assess roadway conditions on the roadway without physically being at the location. CCTV cameras are most prevalent within the large urban areas of Milwaukee, Minneapolis/St. Paul, Spokane, and Seattle to monitor congestion and incidents. However, Washington and Wyoming have also strategically placed CCTV cameras on I-90 to assist in monitoring incidents related to severe weather in mountainous and remote areas. Appendix A shows camera are location in each state.

1.2.9 Road Weather Information Systems (RWIS)

RWIS are meteorological stations consisting of sensors, CCTV, and communication devices. RWIS is classified under the Roadway subsystem because specialized equipment and computer programs monitor air and pavement temperature to forecast how the weather may affect road surface conditions. Strategically located alongside the highway, RWIS data is frequently used in the North/West Passage states for traveler information, such as looking for CCTV information from RWIS raw data. However, from a DOT perspective, RWIS is more valuable for maintenance and operations to make maintenance decisions regarding anti-icing and deicing, as well as optimizing materials and staff. As illustrated in Appendix A, all the North/West Passage Corridor states have RWIS located along I-90/I-94.

1.2.10 Data Collection Stations

This section encompasses data collection stations (ESS, ATR, or similar device), as well as weigh in motion systems used in the North/West Passage Corridor. Because both are primarily used for collecting raw data about vehicle traffic, they are combined as one ITS technology component.

- Roadway Traffic Detection/Sensors – The traffic detection equipment or sensors located along the North/West Passage Corridor are in the Roadway subsystem category. Traffic detection equipment or sensors are typically used to collect traffic volume, occupancy, vehicle classification or speed information. These sites provide a detailed estimate of volumes throughout the entire year and provide reliable estimates of Annual Average Daily Traffic (AADT). Detection is more widely deployed in the larger urban areas. Within the Milwaukee metro area, on the all the major roadway systems including I-94, Wisconsin Department of Transportation (WisDOT) used primarily embedded pavement detectors that are located approximately every half mile. Speed and vehicle count data are collected and sent to a nearby roadside controller, which then sends the information to a local TOC/TMC via fiber or leased line communication. In the Minneapolis/St. Paul metro area, there are approximately 4,000 inductive loop detectors on the freeway system and over 800 loop detectors on I-94 alone. Loop detectors are located on the mainline of freeways approximately every half mile and on entrance and exit ramps. Loop detectors collect information about volume and occupancy and report the data back to the RTMC every 30 seconds via fiber. Sensors are also located within the North/West Corridor in some rural areas of Minnesota, Idaho, and Washington. Sensor locations are shown by state in Appendix A.

- Weigh-in-Motion Systems –WIM systems fall into the Commercial Vehicle Check subsystem. WIM systems are designed to capture and record truck axle weights and gross vehicle weights as they drive over a sensor. Unlike static weigh stations, WIM systems do not require commercial trucks to stop as long as they comply with posted weight restrictions. Appendix A illustrates where WIM sites are located within the North/West Passage Corridor.

1.2.11 Automatic Vehicle Location (AVL)

AVL systems are included in the Construction and Maintenance Vehicle subsystem. AVL systems are fleet management tools that integrate several technologies to relay vehicle location and, in many cases, other vehicle activities including plow status, chemical application rate, or vehicle speed. Many AVL applications incorporate Mobile Data Terminals (MDT) to allow users to wirelessly access information or send and receive text messages. The combination of AVL and MDTs provide a central control system with immediate contact to vehicles. This helps reduce radio communication between drivers and dispatchers and automates some recordkeeping functions. Wisconsin, Minnesota, and Washington have deployed AVL on their segments of snowplow and highway patrol fleets.

1.2.12 Miscellaneous Technologies

This section of ITS components deployed in the corridor consists of miscellaneous technology including automated gate closure and anti-icing/deicing systems.

- Automated Gate Closure – Road closure gates, a Roadway subsystem, located along the North/West Passage Corridor are primarily used to restrict vehicle access during severe weather conditions, hazardous material spills, or major crashes. As depicted in Appendix A, automated gate closure systems are located in Minnesota. Mn/DOT's automated gate system located at the I-90 and US 71 interchange is controlled from the Mn/DOT District 7 Office in Windom, Minnesota. Deployment of the automated gate closure system in Minnesota has been primarily driven by blizzards and extreme high winds causing drifting conditions common along I-90 in this area.

- Anti-Icing/Deicing Systems – Anti-icing/deicing systems are categorized in Roadway subsystems. In cold weather conditions, specifically snow and freezing rain, moisture on bridge decks and underpasses may freeze while adjacent roadways remain unaffected. To address this problem, automated ant-icing and deicing systems have been deployed. Wisconsin, Minnesota, North Dakota, Montana, and Washington have all deployed anti-icing/deicing systems. Locations of individual systems are shown in Appendix A.

1.2.13 Communication

There are four different categories of communication currently utilized within the North/West Passage Corridor. These categories are fiber, radio, cellular, and copper. Extensive fiber networks are mostly found in the larger urban areas within the corridor. Idaho, Minnesota, North Dakota, South Dakota, Washington, and Wisconsin have fiber conduit throughout I-90 corridor in various stages. Idaho has fiber conduit implemented along I-90, either owned or leased. However, at present, the company in ownership of the leased fiber went bankrupt, and because their assets were not bought out, there is a question whether Idaho has access to it. Minnesota has fiber backbone in the Twin Cities metro area on Interstate 94 to St. Cloud. North Dakota has implemented fiber from the I-94 bridge to I-29, an approximate four-mile stretch of roadway. South Dakota has minimal fiber located in urban areas, such as Sioux Falls and Rapid City. Wisconsin has fiber backbone along I-94 from the Twin Cities to the Illinois border. Wyoming has limited fiber located at the Wyoming/Montana point of entry; Washington has fiber coverage in Seattle and Spokane.

Radio, cellular, and copper communication are utilized throughout the corridor where conditions warrant or make them available. In many rural areas, commercial cellular service is unavailable or spotty at best. All of the states have radio communication utilizing a variety of frequencies including 150, 960 and 800 MHz. Because of the rapid evolution of communication technology and deployments, a specific inventory for the corridor was not developed. As such, a current assessment of communication service should be conducted at the time that individual projects are programmed.

Table 1-3 provides a summary of the ITS technology components located or associated with North/West Passage Corridor.

Table 1-3: Technology Components Summarized by State

	TOC/TMC	Reporting Systems	511	Kiosks	Dynamic Message Signs (DMS)	Highway Advisory Radio (HAR)	Closed Circuit Television (CCTV)	Road Weather Information Systems (RWIS)	Data Collection Stations[c]	Weigh-in-Motion	Automatic Vehicle Locators (AVL)	Miscellaneous
Wisconsin	Yes	Plan	Plan	0	16	2	27	15	0	1	Yes	0
Minnesota	Yes	Yes	Yes	0	29	2	86	9	8	0	Yes	1[a,b]
North Dakota	Yes	No	Yes	7	8	0	4	7	0	1	Yes	1[b]
South Dakota	Plan	No	Yes	10	18	0	0	7	5	2	No	0
Wyoming	No	Plan	Yes	0	0	0	7	3	0	0	No	0
Montana	No	No	Yes	1	2	3	3	12	5	10	No	0
Idaho	Plan	Yes	No	0	5	0	0	4	4	0	No	0
Washington	Yes	Yes	Yes	0	43	6	128	24	19	0	Yes	0

a. Automated Gate Closure System
b. Automated Anti-Icing System (Minnesota/North Dakota joint project on I-94 Red River Bridge)
c. Numbers exclude Data Collection within the Milwaukee, Minneapolis/St. Paul, Spokane and Seattle metro areas

1.3 Data-sharing

Sharing data among the states in the North/West Passage is the primary focus of this strategic plan. Sharing data may take many forms, but initially, it will be for the purpose of providing traveler information. Minnesota, North Dakota, and South Dakota have limited experience with exchanging data among their 511 telephone services. Although it is outside of the North/West Passage Corridor and they do not exchange data among systems, Idaho has agreements with Utah and Oregon to operate DMS on I-84. Wisconsin also has experience sharing data with Illinois and Indiana through the Gary-Chicago-Milwaukee (GCM) Corridor effort. The North/West Passage states will capitalize on their previous data-sharing experiences, and using the technology inventoried in this chapter, develop a plan for future data-sharing.

Chapter 2: Issues, Problems, and Needs

Identifying and addressing the predominant issues, problems, and needs for the North/West Passage states is essential to setting the strategic direction and opportunities for future ITS efforts in the corridor and for developing a coordinated traveler information network that integrates data across state borders. This section explains the identification process and presents the issues, problems, and needs grouped into three broader categories.

2.1 Identification Process

The process of identifying issues, problems, and needs consisted of obtaining and synthesizing information from interviews, strategic planning meetings, and document review. Issues, problems, and needs may relate to weather, safety, technology, or institutional matters. For example, all of the states in the corridor experience severe winter weather conditions. During severe weather, each of the states struggle with similar issues related to providing traveler information or maintaining road conditions.

Interviews were conducted with representatives from each of the North/West Passage states. The interviews included questions about institutional or legal barriers to sharing data or infrastructure, technology that may have been unsuccessfully used in the past or technology that cannot be used because of limitations. A complete list of the interview questions is included as Appendix B to this plan.

Feedback from the state representatives then was further refined through discussions at the early strategic planning meetings and document review. Select documents from several of the states were reviewed for additional issues, problems, and needs in the corridor. Documents generally consisted of state-wide and regional ITS architectures and deployment plans. Some of those that were reviewed included Wisconsin's 2005 state-wide Turbo Architecture database, North Dakota's 2005 State-wide ITS Architecture Final Report, and 2004 deployment statistics published by the United State Department of Transportation (USDOT) ITS Joint Program Office. A complete list of document references may be found in Appendix C.

2.2 Categorization

As they are presented in this chapter, the issues, problems, and needs have no particular ranking for the corridor as a whole, and their impact may vary within each of the states. They have, however, been grouped into three categories to facilitate further discussion and development of goals and objectives. The three categories include Traveler Information, Maintenance and Operations, and Planning and Program Management. These categories were chosen because they align with more traditional practices within the state departments of transportation.

- Traveler Information – There is a wide variety of commuter, recreational, and commercial vehicle travelers who use the North/West Passage Corridor. A common theme among the issues, problems, and needs in this category is making information readily available to these diverse travelers. For example, travel is naturally heavier in urbanized areas, such as Milwaukee, Minneapolis/St. Paul, and Seattle where daily commuter traffic impacts are stronger and congestion related information is needed. Conversely, travel is lighter in rural parts of the corridor, and there are greater needs for

weather and road condition information. The states currently have numerous systems for collecting, processing, and integrating data and for delivering information to travelers. However, these systems are not integrated across state borders and the issues, problems, and needs in Table 2-1 reflect this.

- Maintenance and Operations – There are maintenance and operation activities associated with the ITS systems deployed now and in the future along the North/West Passage Corridor. Key activities as they pertain to this plan include monitoring, operating, and maintaining ITS systems and infrastructure along the corridor. Currently, responsibilities for maintenance and operations are segregated among regional or district offices within the departments of transportation and sometimes among various local levels of government. For example, State A may have staff specifically dedicated to operating DMS 1, while State B may not have staff readily available to DMS from their location if a cross-border operating agreement is developed. It is important to recognize that hours of operation may vary between states and will need to be addressed in any operating agreement.
- Planning and Program Management – The North/West Passage is in essence a collection of regional ITS systems and initiatives. As such, should be consistency not only in how systems are maintained and operated, but also in how they are planned and programmed across state borders. Presently, the North/West Passage primarily focuses on planning and programming for traveler information and operations. As such, in the near term, those planning and programming efforts will focus on integrating traveler information across state borders. In the long term, that paradigm could extend to planning and programming on a broader scale. The issues, problems, and needs identified in this category illustrate the current lack of coordination among states' planning and programming efforts.

Table 2-1: Issues, Problems, and Needs Grouped by Category

Category	Issues, Problems Or Needs
Traveler Information	4. Lack of consistent and adequate traveler information. 5. Ongoing demand to update and maintain traveler information. 6. Misunderstanding that good traveler information is not an end unto itself, but involves ongoing improvement. 7. Provide more information in regard to work zones to improve safety. 8. Incident management, 511, and operational needs to take on a greater significance in the future. 9. Lack of consistent and adequate real-time information that would enhance corridor-wide travel. 10. Inconsistent and unreliable information for commercial vehicle travelers. 11. Commercial vehicle traveler frustration with rest area restrictions, multiple and uncoordinated points for getting

Category	Issues, Problems Or Needs
	permits, etc.
Maintenance and Operations	12. Inconsistent management of weather-related incidents and traffic management. 13. There are large gaps in communication because fiber and commercial wireless services are not consistently available throughout the corridor. 14. Need to share information among local and regional management centers to include crossing state borders. 15. Common reporting systems are needed among states, including guidelines for frequency, accuracy, reliability, etc. 16. Lack of agency and management coordination at borders. 17. Gathering reliable, accurate and timely information on work zones and how best to navigate them is challenging. 18. Legal issues dealing with data transmission and firewall/system security are always present when sharing data with law enforcement.
Planning and Program Management	1. Need for improved regional coordination among the states for planning and programming ITS projects. 2. Need for development of unified and coordinated response procedures throughout the North/West Passage Corridor. 3. Differences in the way states govern themselves and the laws relating to the departments of transportation. 4. Differences in the management of ITS projects and funding among the states.

These issues, problems and needs represent areas of opportunity on which the North/West Passage states can focus their efforts for improved cross-border data-sharing. Using these issues, problems, and needs, a series of goals and objectives for the North/West Passage Corridor will be presented in the next chapter. Ultimately, these issues, problems, and needs will set the strategic direction for the North/West Passage effort. They will be carried forward in this plan to develop concepts, potential solutions, and desired functions for the corridor, which will translate into future projects for the states to pursue.

Chapter 3: Vision, Goals, and Objectives

Building from the issues, problems, and needs categorized in Chapter 2, this chapter presents a vision and series of goals and objectives for the North/West Passage Corridor. The scope of this plan is strategic in nature, and, therefore, the plan reflects a long-term timeframe, with short and medium-term objectives. The vision provides a framework to guide the states' future projects in the corridor. It is designed to be flexible enough to accommodate regional differences, but still relate to state-wide plans and the plans of other adjoining jurisdictions. Additionally, political and financial constraints have put pressure on all proposed transportation projects, and ITS projects must compete for increasingly limited resources. This is reflected in the fact that ITS deployments on a national level are increasingly funded through the use of funding sources not specific to ITS. This transition to a mainstream funding mechanism necessitates the integration of ITS into the established planning process where it can be evaluated both against and in combination with conventional transportation components. Therefore, the goals and objectives must relate to other transportation priorities in the states, but still reflect the unique features and needs of the North/West Passage Corridor.

3.1 Vision

The states within the North/West Passage Corridor are predominately rural and face similar transportation issues related to traffic management, traveler information, and commercial vehicle operations. Within the corridor states, there are numerous systems for collecting, processing, and integrating traveler and road maintenance information. At present, this information is not readily shared across state borders. Recognizing the value of coordinated, cross-border collaboration for ITS deployment to address these issues, the following vision has been developed to focus and guide future North/West Passage efforts:

> *The vision of the North/West Passage Corridor is to immediately influence ongoing standards development and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders. While travel information reflects the initial destiny, maintenance and operations and planning and programming are long-term visions.*

3.2 Goals and Objectives

The following goals and corresponding objectives have been developed in keeping with the corridor vision. They also reflect the categories of issues, problems, and needs identified in the previous chapter. These goals and objectives will be used in conjunction with the vision to identify and guide future ITS projects in the corridor.

1. Integrate traveler information systems that can provide information appropriate to the location and need of the traveler.

    a. Understand the common and unique information needs of the corridor's diverse travelers. This includes the type of information, as well as the mechanism for delivering the information.

b. Provide integrated traveler information systems – gathering and distributing – along the entire corridor.

2. Develop and promote cross-border jurisdictional cooperation and coordination in the planning, deployment, operations, and maintenance of ITS infrastructure.

   a. Develop compatible and reliable communication systems among the states to support the operation of current and future ITS technology in the corridor.

   b. Establish shared procedures for using dynamic message signs among the states.

3. Integrate ITS projects for the North/West Passage Corridor into the state, regional, and local planning and programming processes.

   a. Develop a one to three-year ITS project plan for the corridor, identified by state.

   b. Identify and resolve legal or institutional issues related to funding project deployment and ongoing operations.

   c. Document and share lessons learned from integration of ITS projects into state, regional, and local planning and programming processes.

Chapter 4: Concepts, Potential Solutions, and Desired Functions

Reviewing the information gathered during previous tasks is essential for developing concepts, potential solutions, and desired functions discussed in this chapter. Chapter 1, Technology Inventory, provided ITS technology currently deployed along the I-90/I-94 within each of the North/West Passage Corridor states and provided insight from stakeholder interviews into which technology has and has not worked well. Chapter 2, Issues, Problems, and Needs, identified predominant issues, problems, and needs that will be essential to setting the strategic direction and opportunities for future ITS efforts in the North/West Passage Corridor states. Chapter 3, Visions, Goals, and Objectives, presents a framework to guide the North/West Passage Corridor states' future projects within the corridor. Those chapters laid the directional foundation for development of the strategic plan.

A workshop was held in Minneapolis, Minnesota on April 19 and 20, 2006 with the North/West Passage Corridor stakeholders to provide a general overview of coordinated efforts to develop an integrated traveler information and maintenance operations network for the eight North/West Passage Corridor states. The workshop was used as a tool to guide development of the strategic plan by encouraging stakeholder involvement in order to determine user needs and identify the roles and responsibilities of operating and maintaining traveler information on I-90 and I-94. This section responds to questions and provides input from stakeholders to continue towards developing a strategic approach to traveler information in the North/West Passage Corridor.

Additionally, this workshop was designed to gain further understanding of the stakeholders' issues, problems, needs, and objectives regarding present and future traveler information and maintenance operations network along the North/West Passage Corridor. In summary, stakeholder input provides valuable information regarding how ITS along the North/West Passage Corridor should work and how it can improve the effectiveness and efficiency of the highway system throughout the eight states.

The two scenario-based exercises conducted during the two-day workshop were used in a real-world approach to document the users and technology, and to set the stage for identifying potential solutions, desired functions, partnerships, and information flows.

The first scenario-based exercise follows the progress of three cousins as they travel from different points of the North/West Passage Corridor to a ski resort in Montana. The second scenario-based exercise follows the operations and maintenance process from a DOT TMC perspective. In general, the scenarios encouraged participants to explore the following questions:

1. What traveler information do traffic management operators and travelers need, and is it available now?

2. Where does the traveler information reside?

3. Who provides the information?

4. Based on the information obtained from items 1 through 3, is this the way traveler information will be provided in the future?

Each of the scenario-based exercises was broken down into the following three sessions:

1. Brainstorming Sessions – The brainstorming sessions provided the stakeholders the opportunity to identify potential solutions to develop coordinated traveler information network, maintenance and operations.

2. Scenario-Based Exercise Work Session – The purpose of the two work sessions was to identify potential solutions in enough detail to allow for the technology assessment. Stakeholders at the workshop were provided the "story line" to set up the scenario.

3. Prioritization of Solutions – Based on the previously identified potential solutions and following the work sessions, the stakeholders prioritized the potential solutions.

4.1 Traveler Information

The purpose of this section was to document the Traveler Information scenario-based exercise and to identify potential solutions that were ranked by the attending workshop stakeholders. Based on the prioritized potential solutions, the desired function and partnerships were identified in implementing and operating the solutions.

4.1.1 Potential Solutions and Stakeholders

- Stakeholders were asked to provide input on potential solutions related to a coordinated traveler information network

The following prioritized potential solution list for the Traveler Information scenario is outlined below.

1. Develop a consistent information format and content (e.g., road conditions); minimum set of data that all states can/will provide

   Members of North/West Passage Corridor states agree that agencies receiving information from other 511 deployers should have the final decision as to what information is made available to their users. As such, 511 deployers should make all, or as much as possible, of their data and information available in electronic form to other agencies for inclusion in the receiving agency's 511system, although the final decision on what data to provide resides with the 511 service agency.

   The choice between call transfer and data-sharing is a local implementation issue. 511 deployers within the North/West Passage Corridor states need to be aware that a nationally interoperable 511 system is included in the vision for 511. The North/West Passage Corridor states have taken the following recommendations developed by the 511 Deployment Coalition Interoperability Task Force under consideration:

   - Identify travel corridors, other regions, and neighboring states and consider how to include their information for callers to your system either through data-sharing or call transfer.

   - Recognize that your neighbors are also dealing with this issue and engage them in dialogue.

- Use the SAE Advanced Traveler Information Systems (ATIS) (J2354) standard when developing and upgrading information databases and system communications to facilitate the exchange of information.

- Examine wireless calling areas at the boundaries of your system and develop a plan for dealing with misrouted calls. Be especially be mindful of the placement of signage near a border that may lead to someone calling 511 and not getting through because they are being handled by a switch where 511 is inactive or are routed to another state's 511 system.

The following factors relating to call transfers and data-sharing need to be considered:

- Arrangements for handling requests for your information from a neighbor system – data or call transfer.

- The estimated number of callers to need "outside" information and the nature of that information.

- The number of "outside" information sources to be incorporated based on logical travel patterns in the region.

- Availability of data from these "outside sources" to be incorporated into your own system.

- Effort required integrating data from "outside sources" into your system.

- Existence of 511 and other telephone "outside" systems for calls to be transferred to and the suitability of those systems to accept and handle transfers.

- The cost of call transfers to the outside sources in terms of the number of calls and cost per call.

- Likelihood and acceptability of "dead-end" calls that result from call transfers.

If a 511 deployer determines data-sharing is preferred, then the following items need to be considered:

- Use the SAE ATIS (J2354) standard.
- Recognize the need to parse and size information to match your system.
- Be careful in menu design not to overload your system with "outside" focus.

The goal of a delivering or receiving agency should be to allow the information to be presented in both their region and other regions without requiring numerous additional, and often manual, steps to create a separate data stream to or from another agency. The SAE ATIS (J2354) standard has been specifically developed to eliminate these problems. Regardless of the internal computer programs, an ATIS may use the output in a SAE ATIS (J2354) standard database feed that will allow traffic reporters, broadcasters, and other ATIS/511 systems to receive and parse the messages for further distribution through their systems.

2. Identify a mechanism (e.g., interface between systems, call transfers, etc) for providing seamless 511 in corridor

An increasing number of 511 systems share boundaries and/or have significant travel between them. This also is true along major travel corridors throughout the country. Callers in one metropolitan area may want to dial 511 to find information not just for their local travels, but for their entire trip, which might include regions and crossing state borders. The North/West Passage Corridor states understand that as users become more familiar with 511, demand for seamless use between systems will increase.

The Interoperability Task Force of the 511 Deployment Coalition in June 2005 completed a "quick tips" report that has defined interoperability into two categories:

- A consistent user interface
- Appropriate methodology for sharing (transferring) information between adjacent systems or along a corridor

As the North/West Passage Corridor states move forward with providing seamless 511, the approach to 511 should incorporate the following perspectives:

- Operator perspective: System interfaces
- User perspective: Similar experiences across the system

Incorporating operator and user those perspectives will allow the North/West Passage Corridor states using 511 a more straightforward interface for those who use multiple systems and allow access to neighboring traveler information systems in a seamless manner. The 511 Deployment Coalition has set a goal "to make 511 functions with interoperability even though 511 systems are individually operated." The North/West Passage Corridor states understand that currently, each system that is or will be developed, designed, and operated will reflect local preferences. As the national interoperability goal of seamless 511 is achieved, the North/West Passage states should focus on developing a consistent user interface across 511 systems, and a reliance on industry standards for data-sharing.

3. Provide safety related traveler information

While 511 is useful on a daily basis to travelers seeking regular traveler information, 511 has proven to be invaluable method getting critical information to the public. In the previous decade, strides have been made to improve the completeness and quality of safety and incident related incidents reporting. Further, technological advances, including the internet, have made it possible for safety-related reports coming from an array of sources to be integrated in a single "picture" of travel conditions. These advances also have made it possible to provide safety-related information to 511 callers by predefined road segments.

For each road segment, in all areas, information should include:

- Construction/Maintenance Projects – Current information on active projects along the route segment that may affect traffic flow and/or restrict lanes.

- Road Closures and Major Delays – Unplanned events, major incidents, or congestion that shut down or significantly restricts traffic for an extended period. In urban areas, information on all incidents and accidents, both major and minor, and congestion information along each route should also be provided.

- Major Special Events – Transportation-related information associated with significant special events (fairs, sporting events, etc.).

- Weather and Road Surface Conditions – Weather or road surface conditions that could affect travel along the route segment.

For each of these safety and incidents, it is necessary to provide details that enable callers to assess travel conditions and make travel decisions associated with a route segment.

- Location – The location or portion of route segment where a reported item is occurring, related to mileposts, interchange(s), and/or common landmark(s).

- Direction of Travel – The direction of travel in which a reported item is occurring.

- General Description and Impact – A brief account and impact of the reported item.

- Days/Hours and/or Duration – The period in which the reported item is "active" and possibly affecting travel.

- Detours/Restrictions/Routing Advice – As appropriate, summaries of required detours, suggested alternate routes, or modes and restrictions associated with a reported item.

- General Forecasted Weather and Road Surface Conditions – Near-term forecasted weather and pavement conditions along the route segment.

A more recent 511 enhancement is the ability to assist in managing and sharing information with the public about work zones by warning travelers of expected and real-time delays. 511 can also provide callers with notice of work zones on their route. However, experience has demonstrated that to be effective, involved agencies must commit to real-time management of work zone status information.

4. Provide information to in-vehicle navigation systems

Current traveler information is limited to data collected primarily by loop detectors and video cameras along limited access highways in major metropolitan areas. The most effective real-time traffic information service provides traffic conditions on both primary and alternate routes so drivers can make informed decisions, but this requires complete and accurate data for all major routes. However, in recent years, innovative techniques for data collection continue to emerge that may provide the level of coverage necessary for traveler information. One technique is to use mobile communications devices to gather information on traffic for the entire transportation network. Mobile communication devices are installed in vehicles that include wireless communications devices to determine the location of the vehicle. Monitoring a vehicle's position as a function of time also reveals the velocity of the vehicle. Position and speed is periodically broadcast by the vehicles to a central monitoring station and to other similar equipped vehicles.

Private firms can collect the data and make them available to operating agencies, ISPs, and others.

5. Vehicle Infrastructure Integration (VII) Initiative

The Vehicle Infrastructure Integration (VII) Initiative - cosponsored by USDOT, the American Association of State Highway and Transportation Officials (AASHTO), and several major automobile manufacturers - is exploring the concept of communication and data exchange between vehicles and the roadside. Relevant data that could be collected and transmitted by vehicles include speed, windshield conditions, air temperature, sudden braking, and more than a dozen other indicators. The use of wireless communications to provide location-based services in vehicles is a growing technology with the potential to meet travelers' demands for traffic information delivery. Primarily used for navigation and emergency services, this technology is often included in luxury vehicles or as an option in midlevel vehicles. It is anticipated that as the prices fall over the next few years, the demand for both in vehicle devices and aftermarket units to increase.

6. Develop corridor web-site (e.g., I-5)

Highway agencies in conjunction with private companies provide traveler information to nearly 300 web sites in the U.S. The web sites update travelers about weather, road conditions, construction, road closures, major incidents, and road restrictions.

As 511 services continue to mature, gathering more users and greater awareness among the nation's travelers, there is an increasing need for co-branded web sites that not only have same or similar information as the 511 service, but that have "511" as part of their address. As a coalition, the North/West Passage Corridor states would benefit from the use of a co-branded web site to provide traveler information along the I-90/I-94 corridor.

The GCM Corridor is a cooperative effort among the Indiana, Illinois, and Wisconsin DOTs to address traffic in the GCM areas. In 2003, Federal Highway Administration (FHWA) honored the GCM Corridor for developing a GCM Travel Site. The state DOTs developed a data-sharing system that allows users to link information across the tri-state area, including cameras, traffic maps, and messages posted on DMS signs. The GCM Corridor is geographically smaller compared to the North/West Passage Corridor, but the North/West Passage Corridor state partners have an opportunity to look at the this existing system and determine whether a cross-border web site is an option to continue to pursue.

7. Integrate law enforcement CAD with reporting systems to capture incidents

CAD systems used by law enforcement agencies provide dispatchers and response units with real-time information about road incidents. These public safety systems typically track data on assignments to response units, locations of crashes, equipment locations, and statuses, utility locations, and special hazards. In recent years, CAD systems used by law enforcement and ITS have worked together to provide instant access to real-time information on traffic and road conditions. This has allowed emergency responders to reach incident scenes more quickly and manage the responses more efficiently. Conversely, transportation agencies have used real-time information from CAD systems to manage the traffic-related effects of emergencies more efficiently.

As the North/West Passage Corridor states contemplate moving forward with reporting system improvements, it needs to be understood that many existing CAD systems are proprietary and are not designed to exchange information with CAD systems offered by other vendors, let alone with ITS technologies. Variations in formats and protocols for data exchange and messaging pose additional challenges, as do different system standards in the transportation and public safety communities.

8. Deploy automated data collection on fleet (e.g., maintenance vehicles)

AVL has been used extensively for almost 20 years. AVL was introduced in 1988. The service at that time primarily targeted the long-haul trucking industry. Since then, both public and private agencies, including the aforementioned trucking companies, transit, and EMS, have taken advantage of AVL to enhance the efficiency and effectiveness of their operations.

Within the last 10 years, the use of AVL in highway maintenance activities has been increasing as a fleet management tool that integrates several technologies. For example, a truck can automatically report if a snowplow is up or down and when it is spreading sand or salt. However, use by DOTs and highway departments has been sparse, which has been attributed to benefits being less obvious than in the trucking industry, transit, and EMS. However, even without the availability of quantitative data, the benefits of AVL show there are cost benefits large enough to justify deployment.

9. Franchise/privatize traveler information beyond basic information provided by states in the North/West Passage Corridor (e.g., Air Sage, traffic control)

To date, DOTs have contracted with private industry to provide traveler information. For example, the Georgia Department of Transportation contracted with a private firm to add new software to an already existing cell tower to figure how fast cars are going and where congestion is located.

10. Provide convenience related traveler information

Traveler information services, such as 511, have developed from the bottom up. State and local transportation agencies, in collaboration with the private sector, determine where to establish services and when. The benefits of this approach are that deployers are free to provide innovative 511 services specifically tailored to the needs of the users. Ultimately, the success and convenience of the service depends on the customer. The North/West Passage Corridor states have access to a downloadable Usage and Evaluation section found on the National 511 web page.

11. Provide corridor-wide e-mail/phone alerts

Traditionally, traffic information has been delivered via the media, primarily radio reports during morning and evening peak drive times. The disadvantage to this type of information is that the information may be provided on routes that may or may not affect the specific driver. Personalized traffic information has been provided by private sector companies for a number of years. However, DOTs are increasingly taking up the challenge of providing this service for free, but users must register. Real-time traffic information is sent to the user via text message, e-mail, cell phone, or email address chosen by the users.

12. Use DMS to deliver information to more passive audiences

DMS is a highly visible way to disseminate traveler information. The North/West Passage Corridor states contain over 100 permanent and portable DMS on the I-90 and I-94 corridors, and on a national level, there are approximately 3,500. These signs primarily relay real-time traveler information in the form of travel time or delay messages. Despite the number of signs deployed nationwide, there are only a handful of areas that post messages about their travel times on their signs. Although travel times may not be appropriate for every city, they have proven to be successful in regions or corridors that experience periods of recurring congestion resulting from traffic demand caused by an event, such as weather, traffic incident, road construction, or a lane closure.

FHWA encourages state and local agencies to put travel times on DMS and has developed guidance toward that end. In metropolitan areas and in regions prone to recurring congestion, the goal of the FHWA is to make it unacceptable to have "dark" DMS. At any given time, they would provide travel times and ensure that travelers everywhere can access 511 for real-time traffic, transit, and weather.

13. Use HAR to deliver information to more passive audiences

The HAR broadcast range usually falls within one to six miles, and nearly all HAR systems use the AM band. HAR is often used in conjunction with DMS, which will tell drivers where or when to tune in. Advantages of HAR broadcasts inform travelers of:

- Detours
- Operating restrictions, such as requirements to put on snow tires, or chains.
- Warnings about hazards, such as forest fires, floods, mudslides, or highway closures
- Traffic conditions along short segments of specific routes, especially work zones
- Directions to tourist attraction
- Parking availability
- Public transit alternatives
- Notices of events

Additionally, HAR broadcasts can include more specific information than a commercial traffic report or a variable message sign, it can be available 24 hours a day. No additional equipment is needed to receive HAR broadcasts since most cars have AM radios.

However, HAR is not without its disadvantages. Keeping the information current is labor-intensive. Under some conditions, placing, installing, and maintaining antennas can be costly, as can be staffing and equipping a central control facility to coordinate information from multiple agencies. It is difficult to make travelers aware of the service because frequencies change and cover small territories, and lastly, designing a message that is succinct and yet comprehensive is challenging.

14. Identify information to transfer center-to-center (via TOCs or reporting systems)

Center-to-center application area covers the interfaces between a traveler ISP and other centers that provide transportation data to the ISP or support traveler services. ISPs generally collect transportation data from a variety of sources, integrate the information, and disseminate the information through many types of resources (e.g., internet, PDA, kiosks, DMS, etc.).

Within the North/West Passage Corridor, there are a wide range of systems for collecting incident data, for supporting incident and emergency management, and for providing traveler information. These systems cover roadways within as well as outside the geographic area of the corridor. Ultimately, the North/West Passage Corridor states will have related systems to provide information relevant to other system and receive information that will have a positive impact on its users.

15. Provide relevant regional information to regional travelers

The accuracy, timeliness and reliability of traveler information is an important issue for the North/West Passage Corridor states and information quality should be the foremost concern. The quality of basic traveler information will in most cases determine the success of traveler information services, such as 511. Traveler information is recommended to be tailored to the traveler's needs along their route. Further, it is recommended that traveler information give the callers the ability to gauge the quality of the reported information to enable them to properly weigh the information in their decision-making.

4.1.2 Desired Functions and Information Flows

The traveler information scenario-based exercise follows the progress of three cousins, Tim, Zack, and Eric, who will meet at Big Mountain, Montana for a snowboarding trip, each cousin traveling on the North/West Passage Corridor from the following three different locations:

- Bellevue, Washington
- Sioux Falls, South Dakota
- Madison, Wisconsin

Throughout this scenario-based exercise, the stakeholders were asked to provide input on the following questions:

- What information does the traveler need? Is it available now?
  - Forecast weather and surface information
  - Road pavement issues or current surface conditions
  - Construction issues (current and planned)
  - Incidents
  - Maintenance information (lane closures [current and planned])
  - Camera images
  - Congestion (travel times)
  - Alternate routes (information only – not trip planning)
  - Information between other states that includes "major incidents", such as closures, major delays, etc.
- Where does the traveler information reside?
  - TOC/TMC
  - 511 (web)
  - 511 (telephone)

  - Media
  - Information Display (Point Source)

- Who or what provides the information?

  - TOC/TOC
  - Media
  - HAR
  - DMS

- Is this the way it is likely to be done?

  - Point Source Information Displays (kiosks) have the ability and do provide traveler information in North Dakota and South Dakota, and Montana. Use is being considered in Idaho and Wisconsin.

  - There was general consensus among the stakeholders that 511 information categorized as urgent should be available across state lines via call transfer. It was suggested that 511information be sent via e-mail. However, it is believed that there may be procedural issues (e.g., staffing) and would cause the process to breakdown.

  - HAR provides more detailed information than DMS. However, there is the need to provide cross-border agreements. The question that needs to be answered is how this will be accomplished on the North/West Passage Corridor.

In summary, the Traveler Information scenario-based exercise identified the following ITS components as key to an integrated traveler information network:

- Web site systems (e.g., pre-trip information)
- DMS as a key messaging device
- HAR, though at this time not as widespread
- Point Source Information Displays, which are able to provide various forms of traveler information
- 511 information

4.2 Maintenance and Operations

This purpose of this section was to document the Maintenance scenario-based exercise and identify potential solutions that then were ranked by the attending workshop stakeholders. Based on the prioritized potential solutions, the desired function and partnerships were identified in implementing and operating the solutions.

4.2.1 Potential Solutions and Stakeholders

Mirroring the task in the first scenario-based exercise, stakeholders again were asked to provide input on potential solutions; however, in this case, in regard to maintenance and operations activities. The following prioritized potential solution list, explanation, and stakeholders for the Maintenance and Operations scenario-based exercise is outlined below:

1. Provide camera views for neighboring states

Provision of camera views, as well as other ITS devices across state borders has the opportunity to help with communication, coordination, and cooperation among local and state stakeholders within the North/West Passage Corridor. The primary objective would improve local incident management by reducing detection, notification, and response times and further improve communication among affected agencies charged with maintaining and providing services at that particular location. Also, two other objectives would be achieved:

- Improvement of traveler information services by increasing traveler awareness to certain situations, (e.g., inclement weather)
- Enhance traveler mobility

2. Provide access to sensor (e.g., RWIS, loops/data stations)

Sensors in various forms along the North/West Passage Corridor states collect and disseminate atmospheric conditions, pavement temperature, vehicle speed, and visual monitoring. This information is valuable to the DOTs, travelers, law enforcement, commercial vehicle operators (CVOs), etc. Accessing road weather data available via a web site or telephone allows users to be aware of and avoid hazardous conditions, modify driving, and reduce crash risk.

3. Understand states' standards for road clearance (e.g., snow removal)

Most, if not all of the North/West Passage Corridor states have some sort of road clearance and/or quick clearance procedures in place. At this time, nearly half of the states in the U.S. have move-it laws that encourage or require drivers to move their vehicle out of the roadway. All of the North/West Passage Corridor states have procedures for road clearance for snow events, hazardous and non-hazardous materials incidents, and infrastructure damage. In short, road clearance and quick clearance procedures go hand in hand to assist overall incident management, but there are many obstacles to effective and uniform application procedures. Within state boundaries, DOTs have road clearance plans and procedures in place, but these may vary from between states along the corridor.

As a coalition of states, local governments, and private entities from Maine to Florida the I-95 Corridor Coalition realized the need to address cross-border issues to develop more consistent applications of road clearance practices corridor-wide. To achieve this, the I-95 Corridor Coalition reviewed policies and procedures in the corridor in coordination with a National Cooperative Highway Research Program (NCHRP) study.

The study provided an overview of recommended administrative, regulatory, and statutory best practices, as well as a broad set of institutional recommendations to help focus continued member efforts towards more consistent incident management practices. The study noted an important point:

"While road clearance programs must be established at the state level, at the request of its members, the I-95 Coalition will continue to facilitate interstate collaboration – including policies, regulations, and laws – to encourage uniformity to the extent possible throughout the Corridor."

4. Identify if or how state resources maybe shared across borders. (e.g., plows, DMS, cameras)

Working partnerships are an integral component in successfully managing major traffic incidents, traveler information, weather, and providing real-time information across borders. Some opportunities for collaboration come with local weather emergencies and the multitude of one-time and planned events that take place along the North/West Passage Corridor. Perhaps equally important is the ongoing cooperation among the eight North/West Passage Corridor states that meet regularly for the purpose of comparing information, solving common problems, and sharing best practices.

The coalition of North/West Passage Corridor states provides a forum for key decision makers to address transportation management and operations issues of common interest. The mission is to influence ongoing standards development and utilize effective methods for sharing, coordinating, and integrating traveler information across state borders.

5. Improve communication infrastructure (fiber, radio wireless, etc.) in corridor

The North/West Passage Corridor states are in different stages of developing their communication infrastructures whether it be through fiber, microwave, wireless, etc. As an organized coalition, the North/West Passage Corridor states have a regional, institutional, and organizational framework to work together to continue to provide ITS communications development and interoperability throughout the corridor. As such, the North/West Passage Corridor states have an opportunity to take a leadership role in fostering development of communications infrastructures.

Similar to other interstate and intrastate regional and corridor organizations, the North/West Passage Corridor states should develop corridor-wide policy to develop communication infrastructure in an integrated fashion to optimize traveler satisfaction and system performance. Each of the state DOTs in the North/West Passage Corridor would have the opportunity to discuss with local governments, agencies, and MPOs how best to develop a plan to develop communication infrastructure and to manage and operate that infrastructure once implemented. This would include determining the needs, required resources, and level of funding to support communications infrastructure development.

6. Understand how states will or are responding through maintenance

Maintenance needs for ITS devices are very diverse. Because the range of potential maintenance actions is broad, a wide variety of expertise and skills are needed. Most DOTs and/or their district or regional areas with ITS devices have developed maintenance programs that provide a plan for:

- What maintenance will be conducted
- How maintenance is performed
- How it is budgeted
- How/why it is needed

Maintenance plans similar to the one described above would be useful tools to share across state borders along the North/West Passage Corridor. This would allow feedback on improvements, issues, and assessment of maintenance operations, and provide guidance to those representatives involved with overall corridor activities.

7. Develop interagency agreements to guide operations

Developing cooperation and data exchange across the North/West Passage Corridor is critical to continued development. A key to this success will be to develop operations and maintenance agreements with DOT districts and regions on border-states to cover CCTV, DMS, RWIS, and other roadside equipment.

8. Develop arrangement with CVOs to serve as mobile sensors (e.g., temp., surface conditions, speed) in exchange for custom traveler information

Recent feasibility studies determined that with widespread deployment of fleet management systems for commercial vehicles, it may be possible to employ vehicle location and speed data from these systems for use in developing accumulated representations of traffic conditions nationwide. However, when contacted, one of the CVO industry's largest suppliers of long-haul fleet tracking services was not interested in utilizing their data for traffic monitoring purposes for the following reasons:

- All data collected for fleet management purposes belongs to the customer rather than the industry supplier.
- Their core business competency and revenue source is fleet management, not traffic data management, which is not perceived as profitable.

Perhaps, rather as acting as traffic data (e.g., speed and location) collectors, commercial vehicles should be equipped with sensors that record temperature, surface conditions, etc. Industry suppliers might have more interest.

9. Develop guidelines for coordinating emergency response across borders

Guidelines dealing with interoperability are the key real-time, mobile, cross-agency, cross-border voice, and data networks that will allow emergency responders from different agencies and states to locate incidents, to navigate traffic congestion, and to work together more effectively. In the past 10 years, many metropolitan and rural transportation management centers are, in many cases, co-located with state police or other highway patrol operations. This allows for effective highway and law enforcement cooperation focusing on real-time traffic management. The North/West Passage Corridor states have the opportunity to develop guidelines for coordinating emergency response with existing and planned cross border TOC/TMCs.

10. Custom information CVOs (e.g., livestock/perishable haulers)

Commercial vehicle operations will benefit from continued ATIS developed for public and private vehicle transportation, in that specialized services for CVO have and will continue to emerge. Examples of those services include parking information and queue lengths. Questions being addressed about ATIS and CVOs include:

- What is the perceived usefulness of these services?

- What is the role of the public sector in development and delivery of information systems?
- What benefits to the public experience because of CVO ITS?
- Will third party logistics providers get into the market of developing and providing ATIS to their partners or customers?

Previous studies have identified that the impact on the overall highway system of ongoing technology-driven changes in a manufacturing and distribution systems are not well understood. In many cases, CVO traveler information systems in place often fail to identify key issues of particular carriers. However, studies have shown CVO surveys can provide information that will help highway authorities, corridor coalitions, identify transit time, reliability of transit time, scheduling accuracy, scheduling timeliness, scheduling flexibility, load security, and other factors. In short, order to identify guidelines or policies related to CVO on the North/West Passage Corridor is important to understand the needs of the shippers that use the corridor.

11. Understanding what resources are available (e.g., how much information can be provided, hours of operation)

Minnesota and Washington DOTs currently have numerous TOC/TMCs in operation to manage traffic operations in urban and outlying areas in their respective states. The TOC/TMC facilities act as regional centers for 24-hour incident and emergency response, multi-agency dispatching, interagency communications, collection of and dissemination of road conditions closures, and traffic management.

TOC/TMCs across the United States continue to be equipped with new tools to improve operator effectiveness and service to travelers. As TOC/TMCs are developed in the other North/West Passage Corridor states and improved upon in the existing participating states, consideration to address the establishment of an integrated corridor-wide communication and network is encouraged.

12. Develop guidelines for coordinating closures

For the North/West Passage Corridor states, development of guidelines for coordinating road closures would mean coordinating with TOC/TMCs, and in those states where TOC/TMCs are planned, but not yet deployed, with law enforcement and/or DOT dispatch centers. The type of roadway closure information collected includes weather-related road closures, traffic-related maintenance activities, and major traffic incidents.

13. Share extended construction information (e.g., 10-mile projects)

In the event that multiple construction projects or a single, multi-mile construction project availability to some project construction plan, transportation management plan, etc., such a plan would provide guidelines or methods for minimizing construction-related traffic delay and accidents. During construction activities, one or more TOC/TMCs serve as information clearinghouses and coordinates operations. The TOC/TMC helps to identify conflicts and recommends appropriate action. For example, the TOC/TMC, when provided with up-to-date closure information, has the ability to provide information via DMS and HAR.

4.2.2 Desired Functions and Information Flows

Three TMC operators, each in different states (Idaho, Montana, Washington), track a severe winter weather warning in Northern Idaho and Western Montana. This scenario-based exercise also follows the travel of a CVO from Moses Lake, Washington to Butte, Montana. This is how they coordinate and provide information regarding alternate routes.

Throughout this scenario-based exercise, the stakeholders were asked to provide input on the following questions:

- What information do the operators need? Is it available now?
  - Is response information important (e.g., plows/blowers are on-site, location of resources)?
  - Notification of end of maintenance operations
  - Forecast treatment (snow/ice) information
  - Treatment status
- What information does the CVO operator need? Is it available now?
  - CVO restrictions (weight, heights, chains)
  - Truck detours different than regular vehicle
- Where does the information reside?
  - TOC/TMC (C2C)
  - DOT web site
  - RWIS
  - CARS/RCRS
  - DOT Maintenance
  - Are/should all data sources be stationary?
  - Web site 511
- What information should the operators provide?
  - General Snow Plans (start of season)
  - Ongoing construction activity (start of season)
  - Communication and equipment exercise control (start of season)
  - Specific event information coordination
  - Exceptions to snow plans
  - Operations plans/incident management plans
  - Closure information (include all states)
  - RWIS information
  - Weather event validation (via e-mail/call)
  - Vehicle operating requirements (chains)
  - Vehicle restrictions/travel advisories
  - Probe/AVL weather information
  - Subscription services

- What other mechanisms should be used?
  - Probe data/AVL data
- What should the operators do with the information? Who is the audience for the information?
  - Maintenance operators in the field to maintenance dispatch (C2C)
  - Private weather predictor (state B private ISP)

In summary, the Maintenance and Operations scenario-based exercise identified the following ITS components key to an integrated maintenance and operations network:

- Web site systems (e.g., pre-trip information)
- TOC/TMC
- ITS field devices
- Maintenance Decision Support System (MDSS)
- EMS CAD

Chapter 5: Technology Assessment Outline

5.1 Introduction

The concepts and potential solutions presented in the Chapter 4 represent an initial step to defining specific projects that improve traveler information and maintenance operations along I-90/I-94 at or near state borders. Up to this point, the prioritized list of concepts and potential solutions have not been analyzed in detail, making it difficult to determine if they are feasible given current agency directives, constraints, and funding allocations. This chapter begins the process of analyzing proposed solutions so states can begin to make decisions regarding deployment of each. Specifically, this chapter presents a high-level analysis of selected solutions and provides the foundation for detailed analysis that occurs in Chapters 7 and 8.

This chapter will assess proposed concepts and potential solutions to identify, at a high level, the issues and implications that affect their deployment. The results of this assessment will be used in later chapters to narrow the list to only those that, in whole or in part, deliver the most benefits, with the least costs and within desired timeframes. The results of this chapter will be the basis for Chapter 6, Corridor ITS Architecture, which will serve as the blue print for system development and deployment within the corridor for the next 10 years.

5.2 Summary of Prioritized Concepts and Proposed Solutions

The purpose of this section is to summarize the potential solutions proposed by the North/West Passage Steering Committee and documented in Chapter 4. This summary will provide a starting point from which further analysis will take place. Further analysis will not only determine which solutions are most desired, but also to determine which solutions satisfy the unique needs and requirements of the corridor.

The potential solutions for traveler information and maintenance operations are listed in Tables 5-1 and 5-2, respectively. A total of 27 solutions were suggested by the Steering Committee of which 15 related to improving cross-border issues related to traveler information and the remaining 12 related to maintenance operations.

Table 5-1: Prioritized List of Potential Concepts/Solutions (Traveler Information)

Goal	Description	Votes	Rank
1	Develop a consistent information format and content (e.g., road conditions); minimum set of data that all states can/will provide.	9	1
2	Identify a mechanism (e.g., interface between systems, call transfers, etc.) for providing seamless 511 in corridor	6	2
3	Provide safety related traveler information	3	3
4	Provide information to in-vehicle navigation systems	2	4
5	Develop corridor web site (e.g., I-5)	1	5
6	Integrate law enforcement CAD with reporting systems to capture incidents	1	5
7	Deploy automated data collection on fleet (e.g., maintenance vehicles)	1	5
8	Franchise/privatize traveler information beyond basic information provided by states in the North/West Passage Corridor (e.g., Air Sage, traffic control)	1	5
9	Provide convenience related traveler information	0	9
10	Provide corridor-wide e-mail/phone alerts	0	9
11	Use DMS to deliver information to more passive audiences	0	9
12	Use HAR to deliver information to more passive audiences	0	9
13	Use media to deliver information to more passive audiences	0	9
14	Identify information to transfer C2C (bldg/TOC or reporting system)	0	9
15	Provide relevant regional information to regional travelers	0	9

Table 5-2: Prioritized List of Potential Concepts/Solutions (Maintenance Operations)

Goal	Description	Votes	Rank
1	Provide camera views and access to sensor data for neighboring states	6	1
2	Understand state standards for road clearance (e.g., snow removal)	2	2
3	Identify if or how state resources maybe shared across borders. (e.g., plows, DMS, cameras)	2	2
4	Improve communication infrastructure (fiber, radio wireless, etc.) in corridor (agricultural money for cell)	2	2
5	Understand how states will or are responding through maintenance	1	5
6	Develop interagency agreements to guide operations	1	5
7	Develop arrangement with CVOs to serve as mobile sensors (e.g., temp., surface conditions, speed) in exchange for custom traveler information	1	5
8	Develop guidelines for coordinating emergency response across borders	1	5
9	Custom information CVOs (e.g., livestock/perishable haulers)	1	5
10	Understanding what resources are available (e.g., how much information can be provided; hours of operation)	0	10
11	Develop guidelines for coordinating closures	0	10
12	Share extended construction information (e.g., 10-mile projects)	0	10

Analysis of the proposed concepts/solutions in Tables 5-1 and 5-2 show balance between technical solutions involving to some degree, systems, software, or other devices, while the

remaining concepts/solutions are non-technical. The original purpose of this chapter was to assess the technical implications of proposed concepts/solutions, but due to the number of non-technical solutions, this effort included these as well.

5.3 Filtering Concepts/Solutions for Further Analysis

The purpose of this section is to further refine the initial list of concepts/solutions proposed by stakeholders at the April 2006 workshop to arrive at a set of targeted concepts/solutions that address critical needs (for traveler information and maintenance operations) for the corridor. A refined list of concepts/solutions will narrow the focus of detailed analysis by eliminating less desirable concept/solutions from further consideration. A refined list of projects is also appropriate given the limited financial resources of the North/West Passage Coalition.

Of the 15 proposed concepts/solutions that address traveler information presented in Table 5-1, only eight received one or more votes. Similarly, of the 12 proposed concepts/solutions that address maintenance operations presented in Table 5-2, only nine received votes. In both cases, the remaining concepts/solutions received no votes, suggesting that there is little to no near-term support for these projects when compared against the other proposed concepts/solutions (solutions that did not receive any votes are shaded light gray in Tables 5-1 and 5-2). Therefore, the concepts/solutions that received no votes for both traveler information and maintenance operations were not included as part of the assessment undertaken in this chapter. However, it should be noted that although these concepts/solutions did not receive any votes they may be viable for future deployment and should be reconsidered when this strategic plan is updated.

5.3.1 Communications Implications

To a large part, communications is not an issue for the potential solutions identified in Tables 5-1 and 5-2 because they either do not include a technology component, and therefore, do not require communications, or they can be adequately implemented with communications networks currently deployed. There are some exceptions that will be discussed within the analysis of targeted concepts/solutions in the following section.

5.4 Analysis of Targeted Concepts/Solutions

The purpose of this section is to analyze, in greater depth, the targeted concepts/solutions that address cross-border issues affecting traveler information and maintenance operations across state borders. Specifically, the intent of this analysis is to prioritize targeted concepts/solutions for implementation based on their potential benefits, potential costs, their ease of implementation, and potential institutional issues.

5.4.1 Traveler Information

The proposed concepts and solutions for traveler information that have been further refined and summarized below represent a targeted list of concepts/solutions that are viable for improving traveler information along the North/West Passage. The list of potential concepts and solutions includes non-technical, lower cost solutions, as well as advanced technology solutions with greater cost/benefit implications.

Solution #1: Develop a consistent information format and content (e.g., road conditions); minimum set of data that all states can/will provide

A common data format and standardized content is seen by member states as a means to improve communication between agencies across state borders by reducing the time needed to request, analyze, and interpret data from outside agencies. This project would not involve providing additional types of data beyond what are currently provided by the states, but rather would seek to establish common data collection techniques and terminology so a standardized level of content can be provided in a common format. Currently, agencies responsible for operations along I-90/I-94 collect data in a variety of formats, and in different quantities. These formats and quantities may differ from those desired by outside agencies. Therefore, the outside agency that has requested information often has to fill in the gaps in collected data before it can be analyzed. In addition, the outside agency often has to convert data into formats that comply with the software they use in their daily operations. All these activities require significant amounts of time and resources to complete. A common data format and standardized content will improve agency operations by reducing the time and resources needed to request, analyze, and interpret data from agencies across state borders. This will speed delivery of traveler information to the public and improve the accuracy of data provided.

What's in Place

Currently, transportation, maintenance, and emergency response agencies responsible for activities along I-90/I-94 collect and use various types of data in their everyday operations. The types of data used vary from agency to agency, thus there may be gaps in terms of data that is desired and data that is readily available. This concept/solution can be achieved using the data currently being collected by agencies; however, this would involve multiple agency to agency agreements and may include smaller sets of data than are desired. If this concept/solution were implemented corridor-wide, agencies operating on similar levels would need to coordinate to develop a minimum set of data that can be shared. This coordination would have to include the specific types each agency would be responsible for collecting and the software formats in which this data will be collected/stored.

High-level Benefits/Costs

The primary benefits of this concept/solution would be: 1) improved coordination between state DOTs and with other agencies that operate, maintain, and respond to incidents on I-90/I-94; and 2) improved consistency of information provided to travelers. With a standardized data format, agencies that operate on similar levels that share data would be able to send/receive common sets of data reducing the need to fill in gaps in data that are readily available today.

High-level benefits of this solution, as well as the other solutions are provided in Table 5-4, at the end of this section. Within Table 5-4, benefits are broken down into four general categories:

- Improved information consistency
- Improved information quality
- Improved safety
- Improved coordination

The high-level benefits of Solution #1 pertain primarily to improved information consistency and improved coordination.

At a minimum, this solution would require funding for additional staff hours for meetings, coordination, and communication. The cost to complete these activities is considered low (less than $100,000), as indicated in Table 5-5 provided at the end of this section. The estimate does not assume costs for the purchase of additional software or equipment or for the design of new systems. Additional costs would be incurred for each agency system that is updated or redesigned as required to establish a common data format.

Implementation Gaps, Issues, and Concerns

The primary issue affecting this concept/solution is the institutional issues that surround the decision-making process needed to collectively define the content and format of data to be shared. Typically, agencies collect only the data needed for their operations, and in only the formats that are associated with the software used to collect, process, and analyze these data. States would have to collectively decide on a specific set of data that will be shared, and if needed, implement appropriate software/hardware to ensure that these data can be used and interpreted by all agencies. New systems may be needed only if the states are looking to define a common set of data to be used on a corridor-wide basis. Otherwise, instead of securing new systems, states can identify subsets of data that are common between two or more states.

Participating agencies must determine a minimum set of data that will be shared. This may be a small set of data or more robust sets of data depending on the similarities that exist in agency operations and thus data needs. If agencies' operations vary widely, participating agencies may initially want to think small and define a smaller set of data that is deemed beneficial to all participating agencies. As agencies adjust to the common data content and format, interagency agreements can be developed between specific agencies that have a need for larger set of data. This would represent a subset of the larger group.

<u>Solution #2: Identify a mechanism (e.g., interface between systems, call transfers, etc.) for providing seamless 511 in corridor.</u>

An integrated 511 system is seen by member states as a viable and effective mechanism to improve the delivery of traveler information to the public. For instance, an integrated 511 system will allow travelers the ability to access traveler information not only in the state in which they currently reside, but also for neighboring states they soon will enter. Travelers who use an integrated system like this, therefore, have the opportunity to adjust travel plans to avoid travel-related problems that occur or are scheduled to occur in areas between their origin and destination.

What's in Place

511 systems have been deployed and are operational in seven of the eight corridor states. It is expected that all states will have an operational 511 system within the next year or two. With that said, efforts and resources will not be needed to establish 511 systems along the North/West Passage. Instead, efforts to implement a seamless 511 system will be focused on system design and configuration to make 511 systems interoperable.

High-level Benefits/Costs

The primary benefit would be the enhanced level of traveler information provided to the general public. Currently, travelers who call 511 are capable only of receiving traveler information from the state in which they reside. This is often problematic for travelers near state borders, seeking information about a state in which they are about to enter. An integrated network of 511 systems will effectively make 511 systems seamless from the public's perspective, making it easier for callers to obtain the information they desire.

Implementation Gaps, Issues, and Concerns

There are several issues and concerns that correspond to integrating 511 systems across state borders. Some of these issues are bulleted below.

- Approach to developing a consistent interface and menu structure. Currently, the type and extent of traveler information provided by state 511 systems varies. To reduce confusion and to promote use of an integrated 511 system, state 511 systems should have a similar look and feel so that the system appears seamless to users.

- Coordination with land-line and wireless telecommunications providers to assess the feasibility and financial implications of establishing an integrated 511 service along the corridor.

- Marketing – Significant funding is needed not only to plan, design, and develop an interoperable 511 system, but also to market the system.

At the stakeholder workshop held in April 2006, member states discussed at a high-level potential methods in which 511 information can be shared across state borders. From this discussion, two methods of exchanging data emerged. The first and perhaps most straightforward method to exchange 511 information was via call transfers. The second, more technical integration option was data transfers. In order for 511 system interoperability to appear seamless to the user, member states should select one of these options. The pros and cons of each interoperability design are presented in Table 5-3.

Table 5-3: Pros and Cons of 511 Interoperability Design Options

	Pro	Con
Call Transfers	▪ Much less effort required to modify system software and prompts (the wording the system uses to "prompt" the caller to select the desired option) ▪ More practical and easier to implement at this time versus data transfers ▪ Easier to expand an existing 511 system to include surrounding states' 511 systems	▪ Recurring costs associated with each transferred call ▪ Must be able to reasonably predict number and duration of transferred calls so as not to incur unexpected costs ▪ Problems with receiving information from another 511 system once the caller has been connected to an outside agency
Data Transfers	▪ No recurring costs ▪ Promotes communication and information sharing between states	▪ System for bordering states that are either forced to conform to the same design or systems that must replicate the menu structure and prompts of the neighboring states ▪ Longer implementation time versus the call transfer alternative ▪ Larger and more complex databases ▪ More difficult to expand the 511 system to include future surrounding states' 511 systems

Questions that need to be considered to achieve a seamless, multi-state 511 systems include:

- Does current/anticipated funding support work to develop an interoperable 511 system for the corridor?
- How will the individual state 511 systems be redesigned to be made interoperable (e.g., will call transfers be used or will data be transferred between states?).

- Will the menu structure and content of individual state 511 systems be modified to create a consistent user interface? What types of information will be provided (weather, transit, services, etc.)? What types of roads will be included (freeways, arterials, etc.)?

- How will system performance be monitored? Which agency will be responsible for tracking, reporting performance?

To a large extent, the cost of developing an interoperable 511 system has already been incurred by individual states. This stems primarily from the fact that 511 systems currently exist and only need to be modified to meet needs and expectations. With this said, however, significant costs remain to plan, redesign, test, and market a network of interoperable 511 systems. These costs will vary with respect to the method in which systems are made to be interoperable. The costs are expected to be less with call transfers and greater with data transfers.

It is also reasonably expected that existing costs to operate systems may increase as their potential use has increased. In other words, now that systems are interoperable, users may access the system more often.

Despite the relatively high costs of developing interoperable 511 systems, the benefits of interoperability are significant and should prompt further analysis once detailed requirements are developed.

Solution #3: Provide safety related traveler information

Providing additional traveler information is seen by member states as a means to enhance a travelers' trip. Specifically, member states identified safety-related information as the type of information initial efforts should focus on. Efforts should focus on getting complete and accurate safety related traveler information (e.g., road and weather conditions, construction activities, road closures, and congestion) to motorists as quickly as possible to give them enough advanced warning to alter their trips. Strategies and technologies to be developed under this concept/solution should seek to improve the accuracy, timeliness, and scope of data collection and reporting.

What's in Place

Currently, member states rely on a variety of technologies to collect, process, and disseminate traveler information (see Chapter 1 – Technology Inventory). Efforts to improve traveler information need not focus on the type of equipment being used, but rather on the extent to which this equipment covers the transportation network and the quality of information this equipment provides. For instance, the RWIS located on I-90/I-94 can be expanded to include additional systems at locations where there is a need for additional data. The additional data collected by these sensors can provide a more complete, real-time picture of weather conditions occurring over the corridor. Additionally, these data can serve as input into developing climate profiles and historical weather patterns that help determine appropriate response when specific conditions occur.

High-level Benefits/Costs

This solution would involve bringing together safety related information from the states to form a "single picture" of travel conditions on the corridor. Expected benefits of this concept/solution

not only include improvements to safety, but also improved public perception and use of mechanisms that disseminate this information (e.g., 511, DMS, and HAR). Other possible benefits include:

- More accurate and detailed weather reports and forecasts
- Reduced costs to deploy monitoring equipment
- More appropriate treatment of roadway surfaces based on more accurate pavement forecasts
- Improved level of service (e.g., reduced delay)
- Better informed travelers

Depending on the extent to which new field equipment is installed, the cost of enhancing safety related traveler information may range from $100,000 for a small-scale deployment (e.g., three to four RWIS at $20,000 each plus installation) to upwards of $1,000,000 for a large scale deployment (e.g., 40 RWIS plus installation). These costs do not include annual maintenance costs estimated at about $2,000 per year per device.

Implementation Gaps, Issues and Concerns

Since corridor states currently provide safety related traveler information, this solution focuses on equipment needs that either improve or enhance systems that provide traveler information or that serve as input into providing these services. States should identify locations where either additional data need to be collected (e.g., curves, bridges, low lying roadway segments, areas of frequent fog, etc.) or where information should be provided to motorists (e.g., locations immediately before decision points where motorists can alter their trips).

Communications similar to those used to support existing field devices would be adequate to support any new field devices to be deployed as part of this concept/solution. Where possible, it would be advantageous to tie into existing communication networks with available capacity.

Solution #4: Provide information to in-vehicle navigation systems

Providing information to in-vehicle navigation systems is seen by member states as a means to improve the dissemination of traveler information. By providing information via in-vehicle systems, travelers en route can gain access to information in real-time, rather than waiting to see information posted on DMS, transmitted through HAR, or communicated through other means.

What's in Place

Currently, in-vehicle navigation systems exist in only a small percentage of personal automobiles. However, the use of in-vehicle navigation systems is expected to increase.

States like Minnesota make traffic flow data and CARS logs available to third party service providers who in turn reformat the data and make it available to in-vehicle navigations systems.

High-level Benefits/Costs

This solution would involve providing for communication and data exchange between vehicles and the roadside. This exchange would allow for travelers to receive real-time location based traffic information on their in-vehicle devices. This increase in accurate traffic data would improve the quality of the traveler information provided to all travelers, agencies, and ISPs both pre-trip and en route.

Implementation Gaps, Issues, and Concerns

The ability to successfully implement this concept/solution will depend on the willingness of third party auto manufacturers to incorporate traveler information into the in-vehicle navigation systems they deploy in their vehicles. Currently, public sector transportation groups are working with auto manufactures to develop mechanisms to exchange data and information between roadside devices and devices installed on a vehicle. If the VII Initiative proves successful, the ability to share data with motorists via in-vehicle navigation systems will significantly improve. However, until the VII effort plays out, issues surrounding this solution will remain complex at best.

Another concern is the relative small percentage of vehicles on the road today that possess in-vehicle navigation systems. Adding to this concern is the even smaller percentage of in-vehicle navigation systems that are able to effectively incorporate additional types of data into their displays. For these purposes, this concept/solution is not practical for short-term deployment. However, states need to remain cognizant of the VII Initiative.

Solution #5: Develop corridor web site

Although not ranked as highly as the interoperable 511 phone system, stakeholders indicated that a corridor-based, co-branded web site may improve the dissemination of traveler information across state borders. Such a web site might be designed similarly to the GCM web site. A corridor web site might offer information similar to that provided by the 511 phone service; however, the final decision ultimately rests with the member states. Unlike the phone service though, the web site might show a map of the corridor and may contain information users can visually interpret quickly. Such information may include the location and status of incidents, scheduled construction activities, real-time congestion information (in the larger metropolitan regions), weather readings, and camera images.

What's in place

Corridor states currently disseminate web-based traveler information via their independently owned and operated web sites. This concept/solution would create a single web site for the North/West Passage. The North/West Passage web site might draw upon some of the information and data sources that feed individual state's web sites. The key is to establish a minimum set of data that all states are able to provide to ensure consistency in the data provided for each state. Solution #1 (Develop a consistent information format and content) lays the groundwork for establishing a corridor web site. With Solution #1 already in place, a corridor web site will present a seamless means to convey traveler information to motorists.

High-level Benefits/Costs

This solution would involve coordination between DOTs to develop a single traveler information web site for the corridor. The traveler information content provided would not be expanded beyond what is currently offered by the individual states, but the information would be integrated to allow travelers to view the corridor as a seamless unit. Potential benefits of a single corridor based web site may include:

- Easy, low cost access to information
- One stop shopping for traveler information
- Excellent means to extend the benefits of cameras and sensors

This solution would involve costs for coordination between agencies, web site design, data integration, and necessary updates to equipment and software.

Implementation Gaps, Issues, and Concerns

A corridor-wide traveler information web site would necessitate the use of a common set of data to present a consistent, easy to understand interface. Therefore, states will need to either agree to use a minimum set of data that each state currently collects and can disseminate, or states must agree to deploy additional technologies so that a larger set of consistent data can be disseminated. The selected approach will depend on dissemination needs of member states and feasibility of implementing new technologies. Also, the coalition must identify a champion to lead the development of a web site and must identify funding mechanisms to enable this effort.

Another concern associated with a web site is its continuous maintenance needs. Ongoing efforts are needed to keep information current. The inability to keep information current will ultimately dissolve user confidence of information displayed on the web site.

At a minimum, member states should address the following questions before implementing this concept/solution.

- Who will be responsible for developing, operating, maintaining the web site?
- How will the web site be funded? Will private ISPs be allowed to advertise for a fee?
- What type of information will be shared?
- What type of content will be provided on the web site?

A single web site for the North/West Passage Corridor will likely be a low cost, highly visible, and effective means to disseminate traveler information to travelers pre-trip; however, several activities need to be undertaken before a consistent user interface can be developed.

<u>Solution #6: Integrate law enforcement CAD with reporting systems to capture incidents</u>

Integrating CAD system data with data currently captured in the states various event reporting systems will enhance operations of law enforcement personnel, as well as traffic managers and operators. The addition of CAD data will allow operators to observe and implement a response to incidents more quickly than current methods of collecting from the enforcement community (e.g., phone calls, listening to scanners, e-mails).

What's in Place

Currently, CAD systems operated by the various law enforcement agencies within the corridor states are not integrated into event reporting systems like CARS and RCRS. If integrated into these systems, information reported by law enforcement personnel can be made available to other public agencies in real-time and may improve the everyday operations of these agencies. Similarly, law enforcement agencies will benefit from having access to maintenance and construction information, as well as incidents reported by traffic management agencies. Since law enforcement CAD systems are widely deployed, little additional capital is needed for system deployment. Most costs associated with this concept/solution would be tied to the integration of CAD and reporting systems.

High-level Benefits/Costs

This solution would involve coordination with law enforcement agencies to integrate data provided by CAD systems to capture incidents and to capture a more complete view of incidents affecting travel throughout the corridor. The integration of CAD systems with event reporting systems will also produce the following benefits:

- Improve both the level and accuracy of traveler information
- Decreases response times
- Allows response agencies to be adequately prepared before arriving at an incident
- Reduces the number of web sites travelers need to access to understand events affecting traffic

The cost for this solution would depend primarily on the compatibility of the output of the existing CAD systems. Additional design, equipment, and software costs may be required to integrate systems.

Implementation Gaps, Issues, and Concerns

Integrating CAD data with that already entered into event reporting systems will require a thorough review of CAD software platforms among agencies both within and across state lines to determine the extent these systems apply a standardized process for reporting, displaying, and disseminating information. National ITS standards should be used. Systems that do not fully align with National ITS standards should be updated to incorporate these standards.

Another concern with the integration of CAD data is the handling and protecting of sensitive information. Before integration occurs, data must be analyzed to determine which data can be integrated and which should not.

<u>Solution #7: Deploy automated data collection on fleet (e.g., maintenance vehicles)</u>

Deploying automated data collection systems on maintenance vehicles is seen by members of the Steering Committee as a means to automatically collect weather and pavement information from remote locations in the field. This information may be used by operators at TOC/TMC to monitor roadway conditions and implement an appropriate response when conditions are or may

affect the safety of travelers. Members also see automated data collection on fleet vehicles as a method to track and route vehicles in real-time to improve maintenance activities.

With real-time knowledge of maintenance vehicles including snow plows, states can easily determine the position of vehicles and deploy them to areas that have the most need. At state borders, states can work together to share resources located near state borders to provide better maintenance in these areas.

High-level Benefits/Costs

This solution would involve deploying automated data collection systems on highway maintenance fleet vehicles, such as snowplows, to collect weather and road condition information, as well as vehicle location. This additional data would be provided to general travelers, CVOs, ISPs, and to other agencies so users can make decisions regarding travel. The data provided would also allow for more efficient maintenance of the roads by DOT and other agency fleets. Other potential benefits of automated data collection on fleet vehicles include:

- Improved motorists and operator safety
- Allows equipment operations and fleet managers to make more informed and cost-effective decisions
- Better facilitation of the management of vehicle maintenance tasks
- Reduced snow and ice control costs
- Current road surface conditions available at control center
- Better able to respond to customer inquiries
- Improved customer service
- Provides continuous visibility of fleet operations
- Reduces vehicle life-cycle cost
- Better management of de-icing and anti-icing materials
- Provides better control of maintenance labor

This solution would include costs for the design of the system and for the software and equipment needed for data collection, communication, and integration. The level of cost would depend on the number of vehicles that would be equipped. Unit costs are estimated between $5,000 to $8,000.

Implementation Gaps, Issues, and Concerns

Issues and concerns that arise from deploying automated data collection systems on fleet vehicles include:

- Need to include maintenance personnel and vehicle operators from the onset of project planning to ensure end user acceptance of technology.

- Procedures need to be developed to ensure equipment is working properly and providing accurate data outputs.

- The complexity of technologies on-board fleet vehicles will require additional maintenance capabilities.

- The complexity of technologies on board fleet vehicles will require training programs to ensure correct use of equipment and reporting of meaningful data.

Solution #8: Franchise/privatize traveler information beyond basic information provided by states in the North/West Passage Corridor (e.g., Air Sage, traffic control)

Franchising/privatizing traveler information is viewed by members of the Steering Committee as a means to offset the costs of disseminating traveler information to the public, while at the same enhancing the content provided to travelers. Franchising/privatizing traveler information also offers the potential to develop public/private partnerships that allow two-way exchange of data – enhancing the operations of both public and private agencies.

What's in Place

Today, both public and private agencies collect and disseminate various types of traveler information to their respective end users. For the most part, the information and data collected by individual agencies is not shared with outside agencies. Therefore, traveler information is disseminated to the public from a variety of sources. This makes it somewhat cumbersome on the public's behalf to find the specific types of information they are looking for.

High-level Benefits/Costs

This solution would involve contracting with private industry to provide additional or improved traveler information content. The potential public/private agency relationships that are formed as a result of contracting may promote the exchange of data between agencies, ultimately improving the operations of each type of agency. Other potential benefits of franchising/ privatizing traveler information include:

- Offset public agency costs
- Improved coordination with regional/state transportation agencies

If information and data collected by public and private agencies were shared, the operations of both types of agencies may be improved.

The level of costs for this solution would be dependent on the scope of the services contracted. They would most likely include a start up fee and yearly license fee. Although, public/private partnerships have the potential to reduce overall costs, it might also increase costs if public agencies do not operate at levels require to support the operations of private agencies.

Implementation Gaps, Issues, and Concerns

Public and private agencies have different perspectives on and uses of traveler information and data. Public/private agencies need to establish upfront agreements and policies before data is shared. This will lead to a common understanding between agencies in an effort to minimize conflicts.

The coordination that needs to occur between public/private agencies is often cumbersome and requires significant periods of time to resolve issues that arise. One potential conflict is the private sector's desire for large amounts of public agency data. This desire may outpace the public agency's resources that are able to provide data. In other words, public agencies may not have enough resources (e.g., equipment and staff) to fulfill private sector data needs. In this case, the cost of doing business with the private sector may eventually dissolve the desire of public agencies to maintain public/private relationships.

The following tables, Tables 5-4 and 5-5, provide a snapshot of the high-level benefits/costs for each of the Traveler Information solutions 1 through 8.

Table 5-4: Traveler Information Concepts/Solutions and Associated High-level Benefits

		BENEFITS																					
		Improved Information Consistency								Improved Information Quality								Improved Safety			Improved Coordination	
		Pre-Trip				En route				Pre-Trip				En route								
	POTENTIAL SOLUTIONS	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	Agency- Agency	Public-Private
TRAVELER INFORMATION	Develop a consistent information format and content	■	■	■	■	■	■	■	■												■	
	Provide safety related traveler information	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	
	Provide information to in-vehicle navigation systems									■	■	■	■	■	■	■	■					
	Develop a corridor web-site	■	■	■	■																■	
	Integrate law enforcement CAD with reporting systems to capture incidents										■	■	■	■	■	■	■	■	■	■	■	
	Deploy automated data collection on fleet vehicles									■	■	■	■	■	■	■	■	■	■	■	■	
	Franchise/privatize traveler information									■	■	■	■	■	■	■	■					■

Table 5-5: Traveler Information Concepts/Solutions and Associated High-level Costs

	POTENTIAL SOLUTIONS	COST ELEMENTS				LEVEL OF COST *			
		Administrative & Coordination	Design	Franchise Fee	Software	Equipment	Capital	O & M	Overall
TRAVELER INFORMATION	Develop a consistent information format and content	■					L	L	L
	Provide safety related traveler information	■	■				M	L	M
	Provide information to in-vehicle navigation systems	■	■		■	■	H	M	H
	Develop a corridor web site	■	■		■		L	L	L
	Integrate law enforcement CAD with reporting systems to capture incidents	■	■		■	■	M	L	M
	Deploy automated data collection on fleet vehicles	■	■		■	■	H	M	H
	Franchise/privatize traveler information	■		■			M-H	L	M-H

5.4.2 Maintenance Operations

The proposed concepts and solutions for maintenance operations that have been further refined and summarized below represent a targeted list of concepts/solutions that are viable for improving maintenance activities and traffic operations along the North/West Passage. The list of potential concepts and solutions includes non-technical, lower cost solutions, as well as advanced technology solutions with greater cost/benefit implications. The emphasis of this assessment will be placed on the technical concepts/solutions.

Solution #1: Provide camera views and access to sensor data for neighboring states

Providing camera views and access to sensor data is viewed by members of the ITS Steering Committee as a means to improve coordination among the states, improve incident and emergency response, and provide more accurate and timely traveler information.

What's in Place

All state DOTs, with the exception of Idaho and South Dakota, operate CCTV along segments of I-90/I-94 within their state borders. CCTV cameras are most prevalent within the large urban areas of Milwaukee, Minneapolis/St. Paul, Spokane, and Seattle. CCTV are also present in more remote locations; however, there are less cameras deployed in these locations.

All state DOTs operate some form of sensor (e.g., RWIS, Traffic Detection, etc.) from which pertinent data can be collected and reported to neighboring states. Therefore, no additional in-field equipment is needed to implement this concept/solution. However, additional equipment and software is likely needed to allow an outside agency the ability to directly access traffic images and sensor data collected by a neighboring state.

High-level Benefits/Costs

High-level benefits and costs for maintenance operations solutions are provided in Tables 5-6 and 5-7 presented at the end of this section. As summarized in Table 5-6, this solution improves coordination between the states by providing access to camera images and data from sensors and RWIS stations across state borders. This access would improve coordination between states, traffic management agencies, tow trucks operators, and public works departments by providing additional data from which these agencies can make better operational decisions. The exchange of CCTV images between these agencies may also accomplish the following:

- Better identify the location of incidents
- Better assess the severity and magnitude of incidents
- Increase the efficiency of routing vehicles and equipment to incidents
- Decrease the time needed to identify incidents

This solution would involve costs for coordination between agencies for the provision of access to existing CCTV camera images and data sources. It is assumed that the purchase of new software and equipment would not be covered under this solution.

Implementation Gaps, Issues, and Concerns

CCTV may need to be expanded to areas where images are needed and where images can improve operations of agencies across state borders. Similarly, CCTV will need to tie into

existing communications infrastructure or new communication networks will need to be provided.

Corridor states need to decide how camera images and sensor data will be exchanged between the states. It is recommended that an institutional hierarchy be established that states how cameras will be operated and the conditions under which agencies can access images and sensor data. As part of this decision, states need to determine the amount, frequency, and quality of images/data to be shared. In addition, states must decide if video capture by CCTV will ever be shared. These decisions will impact communications requirements for effectively sharing image and sensor data, and/or video. Streaming video and data feeds will require higher bandwidth communications platforms than static images and packaged data sent in periodic intervals. The states also must decide if there is any sensitive data that cannot be exchanged and must set up security mechanisms that prevent its access.

Solution #2: Understand state standards for road clearance and maintenance (e.g., snow removal)

State standard procedures for road clearance and maintenance are viewed by members of the Steering Committee as a means to improve maintenance at and near state borders. Understanding standard procedures that neighboring states follow will help operators make better maintenance decisions. This understanding also is likely to promote and improve coordination among the states, which may lead to formal agreements to make future maintenance activities more effective and efficient. For example, neighboring states may enter into a partnership where either state may maintain I-90/I-94 when equipment is located near a border and the other state cannot respond in a timely manner, such as when state's snowplow may plow I-90/I-94 on both of sides of a state border until the neighboring state has time to reposition equipment to that location.

What's in Place

The proposed sharing of information does not require any systems, software, or other technologies to be implemented. Further coordination needs to occur between each state and their respective maintenance department to determine if and to what extent state standards for road clearance exist.

High-level Benefits/Costs

This solution would involve research into current state standard procedures for road clearance and increased coordination between states. Increased consistency and awareness of the standard procedures would reduce secondary crashes and improve safety of travelers and law enforcement personnel. In obtaining neighboring states' standard procedures, coordination between state DOTs and among other agencies, such as law enforcement, would increase, helping to break down institutional barriers in communication.

Implementation Gaps, Issues, and Concerns

It is not known whether each state's standards for road clearance are documented. Procedures for road clearance may exist loosely in portions of several documents or may not be documented at all. The costs of researching and reviewing state standards are lower if they simply could be copies to neighboring states. Otherwise, this concept/solution may be subject to additional costs

to research the documents in which these standards exist, or documenting these standards in a technical report in cases where these have not been previously documented.

Solution #3: Identify if or how state resources may be shared across borders. (e.g., plows, DMS, cameras)

Similar to Maintenance Operations Solution #2 above, members of the Steering Committee believe that there are efficiencies to be achieved if states partner to share resources across state borders. For instance, a DMS sign located in Wisconsin may be used to post messages for Mn/DOT regarding a full road closure. This will allow travelers in Wisconsin headed for Minnesota to make alternate travel plans, reducing congestion and improving safety near the incident. Other than DMS, other resources that might be shared include CCTV cameras and snowplows. Through resource sharing, states make better use of the resources that have been deployed. Therefore, the transportation agencies, as well as the general public would receive a greater return on their fixed investments.

What's in Place

This concept/solution would include the field equipment and other resources currently operated by the states. No additional equipment is required; however, additional equipment may be desired/implemented as a result of Memorandums of Understanding (MOUs) entered into by states seeking to implement this concept/solution.

High-level Benefits/Costs

This solution would involve increased coordination and cooperation between the states to identify how resources, such as plows, DMS, and cameras, could be shared across state borders. Sharing resources would allow for the provision of more consistent traveler information through camera images pre-trip and DMS messages en route. No additional traveler information content would be provided beyond what each state is currently providing.

Implementation Gaps, Issues, and Concerns

The concerns/issues that need to be resolved before this concept/solution is implemented depending on the types of resources being shared. Concerns/issues relevant to sharing of DMS, CCTV, and snowplows are described below.

The primary concern/issue that surrounds the sharing of DMS across state borders is establishing rules or guidelines that govern the use of DMS. Some questions that should be addressed before a neighboring state is allowed to share DMS include:

- Under which situations/conditions will a neighboring state be allowed to post a message on another state's DMS?
- Which agency will post DMS messages? In other words, will a neighboring state be allowed to control a DMS? There may be legal implications if a neighboring state is allowed to control another state's DMS.
- Who will have priority to use DMS and under which conditions?

Solution #4: Develop interagency agreements to guide operations

Developing interagency agreements is viewed by member states as a means to develop operational efficiencies and promote streamlined operations among participating agencies. Specifically, interagency agreements result in agencies sharing additional types and quantities of data that can be analyzed, filtered, and then disseminated to travelers pre-trip and en route. Shared data can also be used to make better operational decisions in a more timely fashion, reducing the time needed to implement a response to incidents or providing additional time to treat roadways or close lanes when severe weather is expected.

What's in Place

This concept/solution does not require any systems, software, or other technologies to be implemented. Coordination that occurs between agencies, if any coordination exists, is mostly in the form of informal, unwritten agreements between individuals. The concept/solution may draw upon the experience and knowledge of individuals to document formal, written guidelines.

High-level Benefits/Costs

This solution would involve the development of operations and maintenance agreements between DOT districts and regions in border states to cover CCTV, DMS, RWIS, and other roadside equipment. Cooperation and data exchange would allow for improved consistency of traveler information across state borders.

This solution would involve costs for additional staff hours for meetings and other activities involving coordination between the states and other agencies.

Implementation Gaps, Issues, and Concerns

None.

Solution #5: Develop arrangement with CVOs to serve as mobile sensors (e.g., temp., surface conditions, speed) in exchange for custom traveler information

Implementing sensors on commercial vehicles is viewed by members of the Steering Committee as a means to collect additional real-time data from various locations along the corridor. This additional data could give operators a better sense of traffic and weather conditions occurring at points along the roadway, and based on these conditions, operators could implement appropriate traffic management strategies. In exchange for commercial vehicles being equipped with mobile sensors, states would provide customized data to commercial vehicles to enhance their operations. Speed, vehicle location, and weather condition information may also be used by commercial vehicle dispatch operators to route commercial vehicles around areas thought to be impacted by congestion or weather. This may lead to reduced gas consumption, less vehicle wear and tear, and more prompt delivery of goods to market, which improves the profitability of commercial vehicle operations.

What's in Place

On-board sensors deployed on commercial vehicles, if they exist, are solely used by commercial vehicle agencies. This existing equipment may be supplemented with weather sensors to enhance remote data collection.

High-level Benefits/Costs

This solution provides customized traveler information to CVOs in exchange for their service as probe vehicles. The use of commercial vehicles as mobile sensors would increase the quantity and accuracy of the traffic data available along the corridor allowing for improved traveler information quality. The additional weather and pavement condition data gathered also would allow for the provision of improved information about road conditions to travelers and agencies, as well as to CVOs. This would improve safety by allowing travelers, CVOs, and agencies to respond more effectively to hazardous road or weather conditions.

This solution would involve costs for coordination between agencies and with the CVOs. There would also be significant system design costs and equipment and software costs. It is assumed that the system would be deployed on vehicles that are already equipped with GPS and other systems for tracking and routing. However, it is assumed that the cost of the communication and probe vehicle equipment and software would be the responsibility of the state DOTs.

Implementation Gaps, Issues, and Concerns

To this point, commercial vehicles agencies and the service providers that provide the communication systems for vehicle probes have been opposed to working with traffic management agencies to share probe data (speeds and vehicle location). There are issues that need to be addressed including: 1) who owns vehicle probe data; 2) what actions can be taken to access this data; 3) and what needs of the commercial vehicle industry can the traffic management industry fill to gain the cooperation of the commercial vehicle industry.

The barriers between the traffic management and commercial vehicle industries make it difficult to implement vehicle probes on commercial vehicles at this time. With that said, the participation of the commercial vehicle industry may not be needed if vehicle probes can be collected from standard automobiles, as being suggested in the VII Initiative being developed by transportation agencies and vehicle manufacturers.

As envisioned, the VII Initiative would consist of a nation-wide system in which vehicles routinely will communicate with transportation infrastructure in real-time to improve vehicle and roadway safety, and to support a wide range of commercial activities. Therefore, any vehicle that is equipped or contains equipment capable of providing real-time location information may automatically transmit various types of data collected by on-vehicle systems.

<u>Solution #6: Develop guidelines for coordinating emergency response across borders</u>

Guidelines for coordinating emergency response across state borders may reduce the time needed to provide treatment to injured persons involved in incidents near state borders. Specific guidelines for emergency response may reduce the time needed to coordinate activities among the various emergency response agencies when incidents are identified.

What's in Place

This concept/solution does not require any systems, software, or other technologies to be implemented. Coordination that currently occurs between emergency responses agencies, if any exists, is mostly in the form of informal, unwritten agreements between individuals. This

concept/solution may draw upon the experience and knowledge of individuals to document formal, written guidelines.

High-level Benefits/Costs

This solution would develop guidelines for coordinating emergency response across state borders. Such guidelines may improve emergency response to incidents near state borders by enabling emergency responders to perform in-field emergency services across state lines. Establishing guidelines for coordinating emergency response also may act as an initial exercise from which partnerships among emergency responders may grow. Lastly, documented guidelines will preserve existing, informal agreements between agencies so that information is not lost when staff retire, quit, or are released.

Costs to implement this concept/solution would be tied primarily to staff time, meetings, and direct expenses that enable coordination to occur between emergency management agencies that provide services near state borders.

Implementation Gaps, Issues, and Concerns

A major challenge to this concept/solution may be the legal implications of responding to incidents across state borders. For this concept/solution to work, emergency response agencies would have to be free from any legal claims or responsibility when providing services in another state. If not, legal implications will likely pose a challenge that will impede coordination.

Further analysis of the legal implications of this concept/solution needs to be investigated to determine if this concept/solution is feasible. The following tables, Tables 5-4 and 5-5, provide a snapshot of the high-level benefits/costs for each of the Maintenance Operations solutions 1 through 6.

Table 5-6: Maintenance Operations Concepts/Solutions and Associated High-level Benefits

POTENTIAL SOLUTIONS	BENEFITS																					
	Improved Information Consistency								Improved Information Quality								Improved Safety			Improved Coordination	
	Pre-Trip				En route				Pre-Trip				En route								
	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	ISP	Agency	Traveler	CVO	Agency- Agency	Public-Private
Provide access to camera views, sensors, and RWIS to neighboring states	■	■	■																	■	
Understand state standards for road clearance																	■	■	■	■	
Identify if/or how state resources may be shared across borders. (e.g., plows, DMS, cameras).	■	■	■	■	■	■	■	■												■	
Develop interagency agreements to guide operations	■	■	■	■	■	■	■	■												■	
Develop arrangement with CVO to serve as mobile sensors in exchange for custom traveler information									■	■	■	■	■	■	■	■		■	■	■	■
Develop guidelines for coordinating emergency response across borders																	■	■	■	■	
Custom information for CVOs (e.g., livestock/perishable haulers)			■				■				■				■						

Table 5-7: Maintenance Operations Concepts/Solution and Associated High-level Costs

	POTENTIAL SOLUTIONS	COST ELEMENTS				LEVEL OF COST *			
		Administrative & Coordination	Design	Franchise Fee	Software	Equipment	CAPITAL	O & M	OVERALL
MAINTENANCE OPERATIONS	Provide access to camera views, sensors, and RWIS to neighboring states	■					L	L	L
	Understand state standards for road clearance	■					L	L	L
	Identify if/or how state resources may be shared across borders. (e.g., plows, DMS, cameras).	■					L	L	L
	Develop interagency agreements to guide operations	■					L	L	L
	Develop arrangement with CVO to serve as mobile sensors in exchange for custom traveler information	■	■		■	■	M-H	M	M-H
	Develop guidelines for coordinating emergency response across borders	■					L	L	L
	Custom information for CVOs (e.g., livestock/perishable haulers)	■	■				M	L	L

Chapter 6: High-Level Architecture

6.1 Introduction

This chapter presents an initial, high-level ITS architecture for the North/West Passage Corridor. The North/West Passage Corridor ITS architecture was developed to guide member states and their associated partner agencies in implementing and integrating ITS throughout the corridor. The focus of the architecture is on how to integrate ITS systems and coordinate ITS activities across state borders. The architecture will not provide detail or direction on how ITS works within any given state, except as it relates to integrating systems or coordinating activities across state borders.

The North/West Passage Corridor ITS architecture represents an initial attempt to integrate technologies across state borders within the corridor. To this extent, the architecture focuses on the immediate needs of the corridor and, where applicable, the future needs mutually agreed to by member states. Specifically, the architecture has been developed to satisfy stakeholder defined goals and objectives that can be addressed through ITS. These goals and objectives focus on improving the cross-border exchange of information among member states to enhance traveler information, and operations and maintenance activities along the corridor.

The North/West Passage Corridor ITS architecture was developed using the National ITS Architecture, Version 5.1, as a guide to for establishing a common framework for planning, defining, and integrating intelligent transportation systems. In this regard, the North/West Passage Corridor ITS architecture represents a tailored version of the National ITS architecture, and includes only the existing and planned subsystems and functions that are relevant to the corridor. Use of a common framework will enable agencies across state borders to more easily integrate their ITS-related technologies as they are deployed in the future.

The North/West Passage Corridor ITS architecture builds upon the Technology Inventory presented in Chapter 1, and furthers it by identifying the ITS-related technologies proposed and desired for the corridor. The North/West Corridor ITS architecture also identifies the specific functions that ITS technologies are expected to perform and the information flows that occur between them.

Member agencies of the North/West Passage should periodically update the corridor architecture presented in this chapter as needs and priorities evolve and as funding becomes available to support related activity.

6.2 Background

6.2.1 What is an ITS Architecture?

An ITS architecture is a high-level planning framework that defines how various agencies and systems interconnect to share information and data in an overall effort to deliver transportation goals and objectives. Specifically, an ITS architecture identifies the individual pieces that comprise an ITS, the functions these pieces will perform, and the information and data that will be exchanged. The intent of an architecture is not to define “how” pieces of the system will be implemented, but rather it defines “what” the pieces must do. This provides the flexibility to easily incorporate new systems into the ITS framework as they are identified. In terms of the

North/West Passage Corridor, the ITS architecture can be compared to a "blueprint" that presents how ITS in the corridor looks today and defines desired options for future system implementation and integration that support cross border ITS activities. A full set of integration options will allow system deployment and integration to occur in an effective and efficient manner, reducing the need to acquire additional funding and resources to reverse engineer systems to their desired state.

6.2.2 Why is an ITS Architecture Needed?

The North/West Passage Corridor ITS architecture will help agencies across state borders coordinate to determine how best to integrate their existing and planned systems to improve safety, mobility, and convenience of travel for users traveling between states on I-90 and I-94. The North/West Passage Corridor Architecture also will help agencies foster better understanding of ITS-related elements of other bordering states, which, over the course of time, will strengthen working relationships and lead to the effective integration of systems across state borders.

6.2.3 FHWA Rule and Policy on Architecture Conformity

In early 2001, the USDOT announced the release of FHWA's final rule and Federal Transit Administration's (FTA) policy for applying the National ITS architecture. The rule/policy requires states that fund ITS projects through the National Highway Trust Fund to develop a regional ITS architecture that conforms with the National ITS architecture. Jurisdictions that had developed an ITS project prior to April 8, 2001 are required to develop a regional ITS architecture within four years, or by April 8, 2005. Areas yet to deploy an ITS project within the timeframe are required to have an ITS architecture developed within fours years of the first ITS deployment. ITS projects that are not funded through the National Highway Trust Fund are exempt from the rule/policy.

If a region has not developed an ITS architecture before the April 8, 2005 deadline, or four years after the first deployment, no new ITS project can advance if they are funded through the National Highway Trust Fund. Projects can advance only when the ITS architecture is finished, and if ITS projects can show conformance with it.

Section 940.9D of the rule/policy states that an "…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 ITS architecture

4. Any agreements (existing or new) required for operation including, at a minimum, those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the ITS architecture System functional requirements

5. 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)

6. Identification of ITS standards supporting regional and national interoperability

7. The sequence of projects required for implementation"

In addition to the above requirements, the rule/policy also requires regions to develop ITS projects using a systems engineering approach. This will ensure that various aspects of the project (e.g., system planning, design, procurement, deployment, operations, maintenance, expansion, and retirement) are considered to ensure successful deployment.

6.2.4 Summary of Project Goals and Purpose

The North/West Passage ITS architecture was developed according to the goals and objectives collectively agreed to by the North/West Passage ITS Steering Committee.

Goal #1: Establish a network of integrated traveler information systems that can provide information appropriate to the location and need of the traveler.

Goal #2: Develop and promote cross-border jurisdictional cooperation and coordination in the planning, deployment, operations, and maintenance of ITS infrastructure.

Goal #3: Integrate ITS projects for the North/West Passage Corridor into the state, regional, and local planning and programming processes.

Goal #3, which is primarily a process/procedure improvement, does not apply to the Corridor Architecture development effort.

6.2.5 Scope

The North/West Passage Corridor ITS architecture represents an initial attempt to integrate ITS across state borders with the specific goals of improving traveler information and enhancing agency operations. Therefore, activities leading up to architecture development were focused primarily on cost effective projects than can be implemented easily in the near-term (one to three years). It is anticipated that the initial architecture presented in this document will serve as the foundation for future efforts leading to the development of a robust architecture.

6.2.6 Geographic Extent

An architecture's geographic extent defines the physical boundaries in which an ITS will be developed and for which the architecture applies. The geographic extent of an architecture helps focus efforts to develop it as well as the ITS plan by assessing the needs of the stakeholders that have a role in ITS architecture development and integration.

The geographic extent of the North/West Passage Corridor extends the entire length of I-90 and I-94 from Seattle, Washington to the Wisconsin/Illinois state line. North/West Passage Corridor states include:

- Washington
- Idaho
- Montana
- Wyoming
- North Dakota
- South Dakota
- Minnesota
- Wisconsin

The North/West Passage Corridor ITS architecture is intended to serve only the needs of travelers and stakeholders along I-90 and I-94. In this regard, the architecture does not address ITS elements/needs pertaining to other locations within North/West Passage Corridor states.

A map of the North/West Passage Corridor is shown in Figure 6-1.

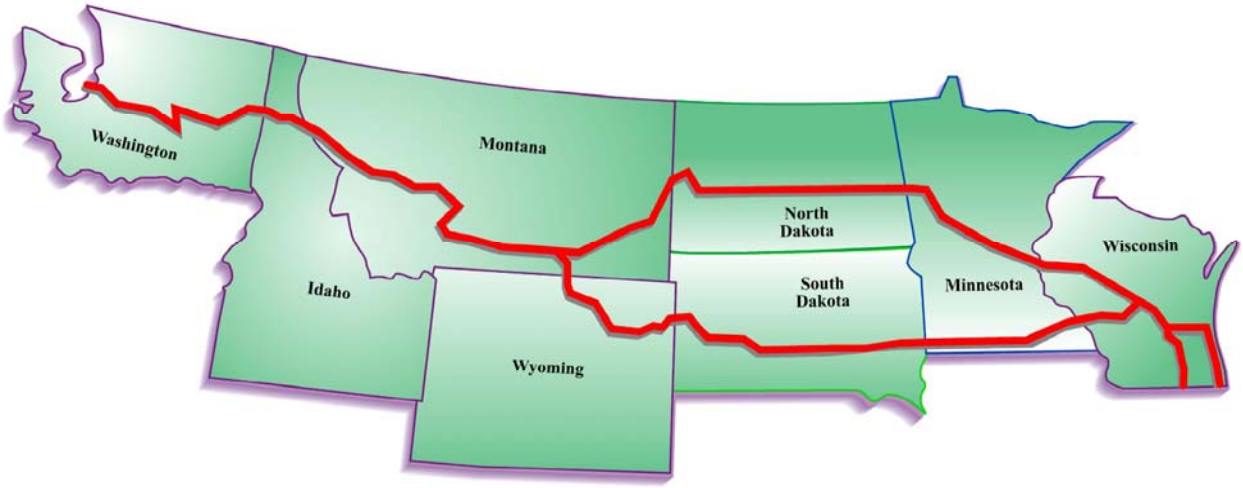


Figure 6-1: Map of the North/West Passage Corridor

6.2.7 Timeframe

Due to rapid evolution of technology, the North/West Passage Corridor ITS architecture was developed using a 10-year planning horizon. As with any high-level planning document, the architecture allows ITS implementation to occur incrementally in an effort to maximize benefits with anticipated funding. To allow for system implementation in the short-term, the architecture is focused on the near-term (one to three years); however, the architecture includes desired system functionally and integration options up to 10 years in the future.

6.2.8 Architecture Development and Inventory

The North/West Passage Corridor ITS architecture was developed in part through use of the Turbo Architecture Version 3.1 software. The Turbo Architecture software electronic database file contains attributes of the corridor architecture, including stakeholders, existing and planned ITS elements, high-level functions, system-to-system interconnects and information flows, and applicable standards. The Turbo Architecture electronic database file has been made available

and should be used as a means to easily and effectively update the North/West Passage ITS architecture in the future.

6.3 Stakeholder and System Identification

The Northwest/Passage ITS architecture was developed under the direct guidance and supervision of the North/West Passage ITS Steering Committee.

6.3.1 Primary Stakeholders

Primary stakeholders are the agencies primarily responsible for the development, deployment, operation, and integration of ITS located along the North/West Passage Corridor. In terms of this architecture, the primary stakeholders include:

- Washington Department of Transportation (WSDOT)
- Idaho Transportation Department (ITD)
- Montana Department of Transportation (MTDOT)
- Wyoming Department of Transportation (WYDOT)
- North Dakota Department of Transportation (NDDOT)
- South Dakota Department of Transportation (SDDOT)
- Minnesota Department of Transportation (Mn/DOT)
- Wisconsin Department of Transportation (WisDOT)

Representatives from each of the agencies listed above were invited to participate in a two-day workshop conducted in Minneapolis on April 19 and 20, 2006. Information pertinent to the development of the corridor architecture was collected at this workshop and synthesized with information collected from previous efforts undertaken to develop the North/West Passage Corridor ITS architecture and plan. Outcomes of the workshop are documented in Chapter 4 (Concepts, Potential Solutions, and Desired Functions) and summarized at various points in this chapter.

6.3.2 Secondary Stakeholders

Secondary stakeholders are those with whom the primary stakeholders exchange information, but do not have a major role in the North/West Passage Corridor ITS architecture. These stakeholders include:

- National Weather Service
- Public Users of the Transportation Network
- Media
- Public and Private ISPs
- Local Emergency Response Agencies

Table 6-1 identifies stakeholders included in the North/West Passage Corridor ITS architecture, their applicable systems, the status of system deployment, and a brief description.

Table 6-1: North/West Passage Corridor Stakeholders and ITS Elements

Stakeholder	Associated Element	Status	Description
All State DOTs	Integrated Corridor Web Site	Planned	This stakeholder represents collective body of all state DOTs within the North/West Passage Corridor. For the purpose of the North/West Passage Architecture, this stakeholder represents a partnership that assigns responsibilities equally among all state DOTs.
Private Commercial Vehicle Agencies and Individuals	Commercial Vehicle Drivers	Existing	This stakeholder represents commercial vehicle agencies and individuals that operate vehicles along I-90 and I-94.
Emergency Response Agencies	Local Emergency Response Agencies	Existing	This stakeholder represents any agency that provides emergency response services to areas along I-90 and I-94.
Traveler Services Providers	Service Providers	Existing	This stakeholder represents all third-party public and private agencies and organizations that provide services to travelers. Agencies that fall under this stakeholder classification include, but are not limited to, hotels, gas stations, restaurants, tourist facilities, and repair facilities.
Media	Media	Existing	This stakeholder represents various media outlets located within state borders.
National Weather Service	National Weather Service	Existing	This stakeholder represents local and regional affiliates of the National Weather Service.

Stakeholder	Associated Element	Status	Description
Neighboring State DOTs (within corridor)	Other 511 (Telephone) Other 511 (Web) Other Automated De-icing System Other Automated Gates Other Maintenance and Construction Vehicles Other CCTV Other DMS Other DOT Web Site Other HAR Other Point Source Information Display Other Pavement Detection/Sensors Other RWIS Other TOC/TMCs	Existing – All States Existing – All States Existing – Some States Existing – Some States Existing – Some States Existing – Some States Existing – All States Existing – Some States Existing – Some States Existing – Some States Existing – All States Existing – All States Existing – All States	This stakeholder represents a placeholder for individual neighboring state DOTs that own/operate ITS within the North/West Passage Corridor. In other words, this stakeholder represents the one or more DOTs the resident state DOT may interface with to exchange data.
Public	Personal Communication and Computing Devices Public Vehicles Traveler – En route Traveler – Pre-trip	Existing Existing Existing Existing	This stakeholder represents individual users of the transportation network, including their vehicles and devices that exchange data with, or receive data from ITS elements.

Stakeholder	Associated Element	Status	Description
State DOT	511 (Telephone) 511 (Web) Automated De-icing System Automated Gates CCTV DMS DOT Web Site HAR Point Source Information Display Maintenance and Construction Vehicles Pavement Detection/Sensors RWIS TOC/TMCs	Existing – All States Existing – All States Existing – Some States Existing – Some States Existing – Some States Existing – Some States Existing – All States Existing – Some States Existing – Some States Existing – All States Existing – Some States Existing – All States Existing – All States	This stakeholder represents any one of the eight DOTs that owns/operates ITS along the corridor. It represents the primary agency the user is affiliated with.

6.4 Mapping Corridor Goals and Objectives to National ITS Architecture Service Areas and Market Packages (e.g., Functions)

The National ITS architecture defines eight general service areas in which ITS can be used to improve the efficiency, safety, and convenience of travel. The National ITS architecture service areas are:

- Archived Data Management
- Public Transportation
- Traveler Information
- Traffic Management
- Vehicle Safety
- Commercial Vehicle Operations
- Emergency Management
- Maintenance and Control Management

For each general service area listed above, the National ITS architecture defines specific services or functions that work separately, or in combination, to address real-world transportation problems and needs. The National ITS architecture refers to these services as ITS Market Packages. National ITS Market Packages are identified by their general service area in Table 6-2.

6.4.1 Applicable National ITS Architecture Market Packages

Market Packages that are applicable to the North/West Passage Corridor are highlighted within Table 6-2 and marked with a (■). The Market Packages that are highlighted support traveler information, and maintenance and operations activities along the I-90/I-94, within and across states borders.

Descriptions of each Market Package are provided after the table and have been tailored to address the specific needs of the North/West Passage Corridor.

Table 6-2: National ITS Architecture Service Areas and Market Packages with Market Packages Applicable to the North/West Passage Highlighted

	Archived Data Management Service Area
	ITS Data Mart
	ITS Data Warehouse
	ITS Virtual Data Warehouse
	Public Transportation Service Area
	Transit Vehicle Tracking
	Transit Fixed-Route Operations
	Demand Response Transit Operations
	Transit Passenger and Fare Management
	Transit Security
	Transit Maintenance
	Multi-modal Coordination
	Transit Traveler Information
	Traveler Information Service Area
■	Broadcast Traveler Information
■	Interactive Traveler Information
	Autonomous Route Guidance
	Dynamic Route Guidance
■	ISP Based Trip Planning and Route Guidance
	Integrated Transportation Management/Route Guidance
■	Yellow Pages and Reservation
	Dynamic Ridesharing
	In-Vehicle Signing
	Traffic Management Service Area
■	Network Surveillance
	Probe Surveillance
	Surface Street Control
	Freeway Control
	HOV Lane Management
■	Traffic Information Dissemination
■	Regional Traffic Control
■	Traffic Incident Management System
	Traffic Forecast and Demand Management
	Electronic Toll Collection
	Emissions Monitoring and Management
	Virtual TMC and Smart Probe Data
	Standard Railroad Grade Crossing
	Advanced Railroad Grade Crossing
	Railroad Operations Coordination
	Parking Facility Management
	Regional Parking Management
	Reversible Lane Management
	Speed Monitoring
	Drawbridge Management
■	Roadway Closure Management

	Vehicle Safety Service Area
	Vehicle Safety Monitoring
	Driver Safety Monitoring
	Longitudinal Safety Warning
	Lateral Safety Warning
	Intersection Safety Warning
	Pre-Crash Restraint Deployment
	Driver Visibility Improvement
	Advanced Vehicle Longitudinal Control
	Advanced Vehicle Lateral Control
	Intersection Collision Avoidance
	Automated Highway System
	Commercial Vehicle Operations Service Area
	Fleet Administration
	Freight Administration
■	Electronic Clearance
	CV Administrative Processes
	International Border Electronic Clearance
■	WIM
	Roadside CVO Safety
	On-board CVO and Freight Safety & Security
	CVO Fleet Maintenance
	HAZMAT Management
	Roadside HAZMAT Security Detection and Mitigation
	CV Driver Security Authentication
	Freight Assignment Tracking
	Emergency Management Service Area
	Emergency Call-Taking and Dispatch
	Emergency Routing
	Mayday and Alarms Support
	Roadway Service Patrols
	Transportation Infrastructure Protection
	Wide-Area Alert
	Early Warning System
	Disaster Response and Recovery
	Evacuation and Reentry Management
■	Disaster Traveler Information
	Maintenance and Construction Management Service Area
■	Maintenance and Construction Vehicle and Equipment Tracking
	Maintenance and Construction Vehicle Maintenance
■	Road Weather Data Collection
■	Weather Information Processing and Distribution
■	Roadway Automated Treatment
■	Winter Maintenance
■	Roadway Maintenance and Construction
	Work Zone Management

			Work Zone Safety Monitoring
		■	Maintenance and Construction Activity Coordination

6.4.2 Traveler Information

Market Packages that fall under the National ITS Architecture Traveler Information Service Area that are applicable to the North/West Passage Corridor ITS architecture are described below.

Broadcast Traveler Information (ATIS1)

In terms of the North/West Corridor ITS architecture, this service collects traffic conditions, advisories, incident information, roadway maintenance and construction information, and weather information, and broadly disseminates this information through existing infrastructures and low cost user equipment (e.g., FM subcarrier, cellular data broadcast). The information may be provided directly to travelers or provided to merchants and other traveler service providers so that they can better inform their customers of travel conditions.

Interactive Traveler Information (ATIS2)

This Market Package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. In terms of the North/Passage ITS architecture, this Market Package allows the traveler to obtain current information regarding traffic conditions, roadway maintenance and construction, and detours. A range of two-way wide-area wireless and fixed-point-to-fixed-point communications systems may be used to support the required data communications between the traveler and ISP. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal, kiosk, Personal Digital Assistant, personal computer, and a variety of in-vehicle devices. This Market Package also allows value-added resellers to collect transportation information that can be aggregated and be available to their personal devices or remote traveler systems to better inform their customers of transportation conditions.

ISP Based Trip Planning and Route Guidance (ATIS5)

This Market Package offers the user trip planning and en route guidance services. It generates a trip plan, including a multi-modal route and associated service information (e.g., parking information), based on traveler preferences and constraints. Routes may be based on static information or reflect real-time network conditions. Unlike ATIS3 and ATIS4, where the user equipment determines the route, the route determination functions are performed in the ISP subsystem in this Market Package. The trip plan may be confirmed by the traveler and advanced payment and reservations for transit and alternate mode (e.g., airline, rail, and ferry) trip segments, and ancillary services (e.g., parking reservations) are accepted and processed. The confirmed trip plan may include specific routing information that can be supplied to the traveler as general directions or as turn-by-turn route guidance depending on the level of user equipment.

Yellow Pages and Reservation (ATIS7)

This Market Package offers the user trip planning and en route guidance services. It generates a trip plan, including a multi-modal route and associated service information (e.g., parking information), based on traveler preferences and constraints. Routes may be based on static

information or reflect real-time network conditions. Route determination functions are performed in the ISP subsystem in this Market Package. The trip plan may be confirmed by the traveler and advanced payment and reservations for transit and alternate mode (e.g., airline, rail, and ferry) trip segments, and ancillary services (e.g., parking reservations) are accepted and processed. The confirmed trip plan may include specific routing information that can be supplied to the traveler as general directions or as turn-by-turn route guidance depending on the level of user equipment.

6.4.3 Traffic Management

Market Packages that fall under the National ITS Architecture Traffic Management Service Area that are applicable to the North/West Passage Corridor ITS architecture are described below.

Network Surveillance (ATMS01)

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 as 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 ISP subsystem.

Traffic Information Dissemination (ATMS06)

This Market Package provides driver information using roadway equipment, such as dynamic message signs or HAR. 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 ISPs. 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.

Roadway Closure Management (ATMS21)

This Market Package closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited. The Market Package includes automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes. Remote control systems allow the gates to be controlled from a central location or from a vehicle at the gate/barrier location, improving system efficiency, and reducing personnel exposure to unsafe conditions during severe weather and other situations where roads must be closed. Surveillance systems allow operating personnel to visually verify the safe activation of the closure system and driver information systems (e.g., DMS) provide closure information to motorists in the vicinity of the

closure. The equipment managed by this Market Package includes the control and monitoring systems, the field devices (e.g., gates, warning lights, DMS, CCTV cameras) at the closure location(s), and the information systems that notify other systems of a closure. This Market Package covers general road closure applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other ATMS Market Packages.

6.4.4 Emergency Management

The Disaster Traveler Information Market Package is the only package that falls under the Emergency Management Service area that is applicable to the North/West Passage Corridor ITS architecture. This Market Package is described below.

Disaster Traveler Information (EM10)

This Market Package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This Market Package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed, and the public is provided with real-time disaster and evacuation information using ITS traveler information systems. This Market Package augments the ATIS Market Packages that provide traveler information on a day-to-day basis for the surface transportation system.

6.4.5 Commercial Vehicle Operations

Market packages that fall under the National ITS Architecture Commercial Vehicle Operations Service Area that are applicable to the North/West Passage Corridor ITS architecture are described below.

Electronic Clearance (CVO03)

This Market Package provides for automated clearance at roadside check facilities. The market package provides the short-range communications to allow weigh stations operators to communicate with commercial vehicle operators to obtain information on the vehicle and driver. This communication between the weigh station operator and the commercial vehicle typically occurs through use of automated vehicle identification transponders installed on the commercial vehicle, short range communications installed at the roadside, weighing sensors, and computer workstations. Based on the information obtained from approaching commercial vehicles, operators can sort commercial vehicle and allow those meeting requirements to pass by the weigh station at highway speeds.

Weigh in Motion (CVO07)

This market package provides for high speed weigh-in-motion with or without Automated Vehicle Identification (AVI) capabilities indicated in the electronic clearance market package noted above. Therefore this market package could be used as a stand-alone system or to augment the Electronic Clearance market package.

6.4.6 Maintenance and Construction Management

Market packages that fall under the National ITS Architecture Maintenance and Construction Management Service Area that are applicable to the North/West Passage Corridor ITS architecture are described below.

Maintenance and Construction Vehicle and Equipment Tracking (MC01)

This Market Package tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

Road Weather Data Collection (MC03)

This Market Package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway. 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 and on-board sensors provided by auto manufacturers. The collected environmental data is used by the Weather Information Processing and Distribution Market Package to process the information and make decisions on operations.

Weather Information Processing and Distribution (MC04)

This market package processes the weather information collected by the Road Weather Data Collection market package to detect segments of roadway where weather (e.g., ice, snow, winds, dense fog) presents a potential hazard to drivers. This information can be used by operators to issue warnings and implement a response to improve roadway conditions.

Roadway Automated Treatment (MC05)

This Market Package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The Market Package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated.

Winter Maintenance (MC06)

This Market Package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.

Roadway Maintenance and Construction (MC07)

This market package supports scheduled and unscheduled maintenance and construction on the right-of-way on a roadway. Maintenance services would include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.).

Maintenance and Construction Activity Coordination (MC10)

This Market Package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to the ISPs who can provide the information to travelers.

Table 6-3: ITS Element to Applicable Market Package Comparison

ITS Element	Broadcast Traveler Information ATIS 1	Interactive Traveler Information ATIS 2	ISP Based Trip Planning and Route Guidance ATIS 5	Yellow Pages and Reservation ATIS 7	Network Surveillance ATMS01	Traffic Information Dissemination ATMS06	Regional Traffic Control ATMS07	Traffic Incident Management System ATMS08	Roadway Closure Management ATMS21	Electronic Clearance CVO03	Weigh in Motion CVO07	Maintenance and Construction Vehicle and Equipment Tracking MC01	Road Weather Data Collection MC03	Weather Information Processing and Distribution MC04	Roadway Automated Treatment MC05	Winter Maintenance MC06	Roadway Maintenance and Construction MC07	Maintenance and Construction Activity Coordination MC10
511 (Telephone)	■	■	■	■	■	■		■						■				■
Point Source Information Display	■	■	■	■														
DMS						■												
HAR						■												
RWIS													■	■				
CCTV					■		■	■										
Pavement Detection/Sensors					■		■	■										
Automated Gates									■									
Automated De-icing System															■			
TOC/TMCs	■	■	■	■	■	■	■	■	■			■	■		■	■	■	■
DOT Web Site	■	■	■	■	■	■		■						■				■
Traveler – En route	■	■	■	■		■			■					■	■			
Traveler – Pre-trip	■	■	■	■										■				
Media	■	■				■								■				■
Personal Communication and Computing Devices	■	■	■	■										■				
National Weather Service	■	■											■	■		■		
Other 511 (Telephone)	■	■	■	■	■	■		■						■				
Other DOT Web Site	■	■	■	■	■	■		■						■				■
Other Automated De-Icing System															■			
Other Automated Gates									■									
Other Maintenance and Construction Vehicles												■				■	■	
Other CCTV					■		■	■										
Other DMS						■												
Other HAR						■												
Other Point Source Information Display	■	■	■	■														

ITS Element	Broadcast Traveler Information ATIS 1	Interactive Traveler Information ATIS 2	ISP Based Trip Planning and Route Guidance ATIS 5	Yellow Pages and Reservation ATIS 7	Network Surveillance ATMS01	Traffic Information Dissemination ATMS06	Regional Traffic Control ATMS07	Traffic Incident Management System ATMS08	Roadway Closure Management ATMS21	Electronic Clearance CVO03	Weigh in Motion CVO07	Maintenance and Construction Vehicle and Equipment Tracking MC01	Road Weather Data Collection MC03	Weather Information Processing and Distribution MC04	Roadway Automated Treatment MC05	Winter Maintenance MC06	Roadway Maintenance and Construction MC07	Maintenance and Construction Activity Coordination MC10
Other RWIS													■	■				
Other TOC/TMCs	■	■	■	■	■	■	■	■	■			■	■	■	■	■	■	■
Other Pavement Detection/Sensors					■		■	■										
Service Providers	■	■	■	■		■												
Public Vehicles					■	■												
Integrated Corridor Web Site	■	■			■	■		■						■				■
Maintenance and Construction Vehicles												■					■	
Local Emergency Response Agencies	■	■				■		■						■				
CVOs	■	■	■	■		■				■	■							
Weigh Stations										■	■							
Weigh Station Equipment										■	■							
Commercial Vehicle On-Board Equipment										■								

6.5 Physical ITS Architecture

The physical ITS architecture summarizes the existing and planned system-to-system interconnects and information flows that will occur between ITS elements.

6.5.1 High-Level Subsystem Interconnects

Figure 6-2 shows the high-level mapping of North/West Corridor ITS subsystems to National ITS architecture subsystems. The shaded (grayed-out) subsystems are not included in the existing or planned ITS deployment for the corridor. This is not to say that these systems do not exist or are planned for the corridor, but rather that current efforts have yet to identify possibilities for these systems to be integrated within existing ITS framework. The active subsystems (colored white) may be represented by one or more ITS elements within the corridor. For instance, in terms of the North/West Passage Corridor ITS architecture, the Roadway subsystem is represented by various ITS field elements located at or near the roadway, including DMS, HAR, CCTV, automated gates, and automated de-icing systems.

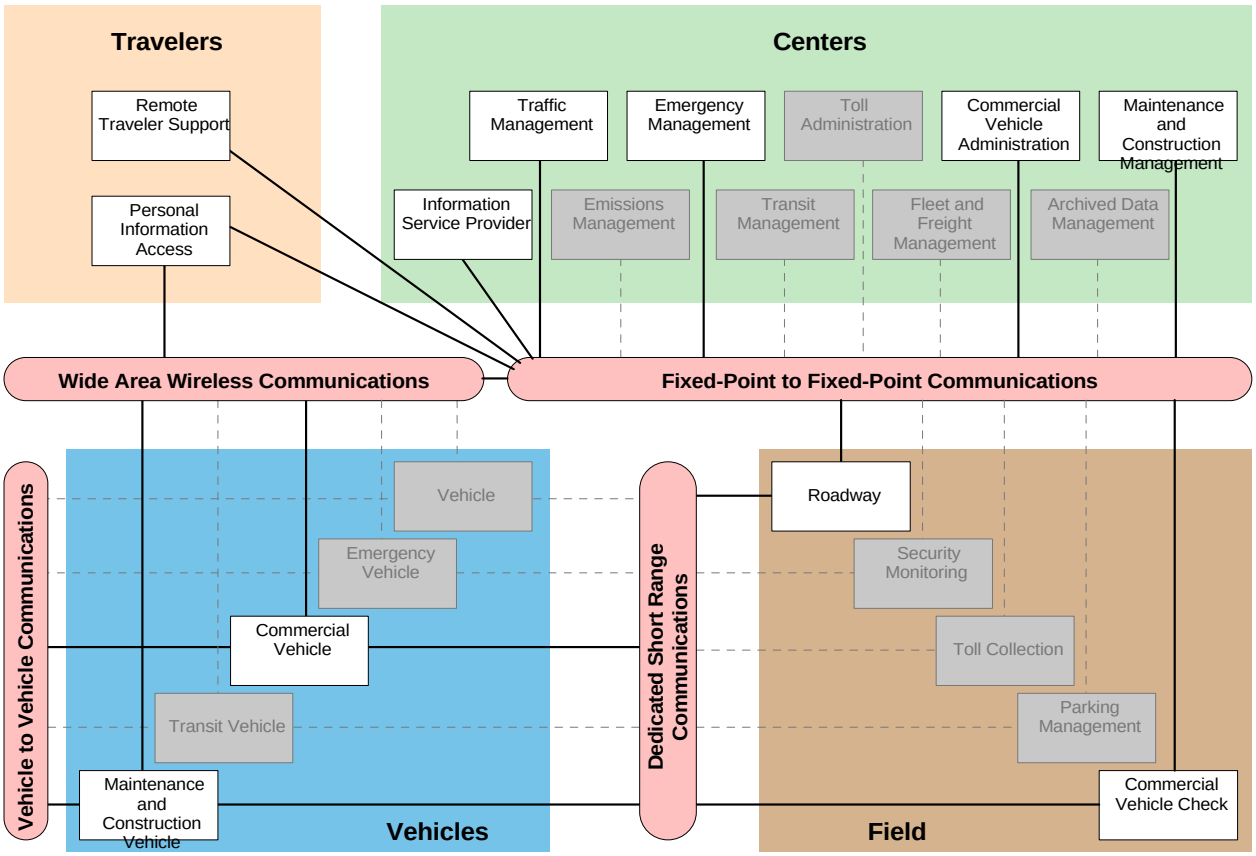


Figure 6-2: Subsystem Interconnect Diagram

6.5.2 System-to-System Architecture Interconnects

System-to-System Architecture interconnects give a high-level representation of the physical connections that occur between ITS elements. A system-to-system interconnect may occur via one or the following types of communication as shown in Figure 6-2.

- Wide area wireless communications
- Fixed-point to fixed-point communications
- Dedicated short range communications (DSRC)
- Vehicle-to-vehicle communications

North/West Passage Corridor System-to-System interconnects are listed in Table 6-4.

Table 6-4: North/West Passage System-to-System Interconnects

ITS Element 1	ITS Element 2	Status
511 (Telephone)	Other 511 (Telephone)	Planned
	Personal Communication and Computing Devices	Existing – All States
	Service Providers	Existing – Some States
	TOC/TMCs	Existing – All States
Automated De-icing System	DMS	Existing – Some States
	Pavement Detection/Sensors	Existing – Some States
	TOC/TMCs	Existing – Some States
Automated Gates	DMS	Existing – Some States
	TOC/TMCs	Existing – Some States
CCTV	TOC/TMCs	Existing – Some States
CVOs	DMS	Existing – Some States
	HAR	Existing – Some States
	Other DMS	Existing – Some States
	Other HAR	Existing – Some States
	Other Point Source Information Display	Existing
	Personal Communication and Computing Devices	Existing
	Point Source Information Display	Existing
DMS	TOC/TMCs	Existing – Some States
	Traveler - En route	Existing – Some States
DOT Web Site	Integrated Corridor Web Site	Planned
	Media	Existing – All States
	Other DOT Web Site	Existing – Some States
	Personal Communication and Computing Devices	Existing – All States
	TOC/TMCs	Existing – All States
HAR	Public Vehicles	Existing – Some States
	TOC/TMCs	Existing – Some States
Integrated Corridor Web Site	Other DOT Web Site	Planned
	Other TOC/TMCs	Planned
	Personal Communication and Computing Devices	Planned
	TOC/TMCs	Planned
Local Emergency Response Agencies	Other TOC/TMCs	Existing – All States
	TOC/TMCs	Existing – All States
Maintenance and Construction Vehicles	TOC/TMCs	Existing – Some States

ITS Element 1	ITS Element 2	Status
Media	Other TOC/TMCs	Existing – All States
	TOC/TMCs	Existing – All States
National Weather Service	Other Pavement Detection/Sensors	Existing – Some States
	Other RWIS	Existing – Some States
	Other TOC/TMCs	Existing – Some States
	Pavement Detection/Sensors	Existing – Some States
	RWIS	Existing – Some States
	TOC/TMCs	Existing – Some States
Other 511 (Telephone)	Other TOC/TMCs	Existing – All States
	Personal Communication and Computing Devices	Existing – All States
	Service Providers	Existing – Some States
Other Automated Gates	Other DMS	Existing – Some States
	Other TOC/TMCs	Existing – Some States
Other Automated De-Icing System	Other DMS	Existing – Some States
	Other Pavement Detection/Sensors	Existing – Some States
	Other TOC/TMCs	Existing – Some States
	Pavement Detection/Sensors	Planned
Other CCTV	Other TOC/TMCs	Existing – Some States
Other DMS	Other TOC/TMCs	Existing – Some States
	Traveler - En route	Existing – Some States
Other DOT Web Site	Other TOC/TMCs	Existing – All States
	Personal Communication and Computing Devices	Existing – All States
Other HAR	Other TOC/TMCs	Existing – Some States
	Public Vehicles	Existing – Some States
Other Maintenance and Construction Vehicles	Other TOC/TMCs	Existing – Some States
Other Pavement Detection/Sensors	Other TOC/TMCs	Existing – Some States
	Public Vehicles	Existing – Some States
Other Point Source Information Display	Other TOC/TMCs	Existing – Some States
	Traveler – En route	Existing – Some States
	Traveler – Pre-trip	Existing – Some States
Other RWIS	Other TOC/TMCs	Existing – All States
Other TOC/TMCs	Service Providers	Existing – Some States
	TOC/TMCs	Existing – Some States
Pavement Detection/Sensors	Public Vehicles	Existing – Some States
	TOC/TMCs	Existing – Some States
Personal Communication and Computing Devices	Traveler – En route	Existing
	Traveler – Pre-trip	Existing

ITS Element 1	ITS Element 2	Status
Point Source Information Display	TOC/TMCs	Existing – Some States
	Traveler – En route	Existing – Some States
	Traveler – Pre-trip	Existing – Some States
RWIS	TOC/TMCs	Existing – All States
Service Providers	TOC/TMCs	Existing – Some States

6.5.3 System-to-System Architecture Information Flows

In terms of the North/West Passage ITS architecture, the exchange of information will naturally flow across state borders from center-to-center, unless current agency agreements state otherwise or until new agreements have been reached. Currently, a few inter-agency agreements exist between agencies. For example, the NDDOT and Mn/DOT have an existing agreement to share information between their event reporting systems. Similarly, WYDOT and the ITD have a verbal agreement to control DMS located on the opposite side of their respective border.

It is anticipated that this architecture will help agencies uncover potential areas where ITS can be integrated to better serve the needs of stakeholder and travelers along the corridor. As such, it is expected that agencies will enter into new agreements to better integrate their systems over time. If, and when such agreements have been reached, the North/West Passage ITS architecture will need to be updated to incorporate new interconnects and information flows.

Figure 6-3 illustrates the high-level information flows that occur between the various Transportation Management Centers located within North/West Passage Corridor states. In terms of this Architecture, a Transportation Management Center represents a placeholder entity that corresponds to any center that provides transportation management functions. This includes maintenance activities.

Table 6-5 provides all the system-to-system information flows from the National ITS architecture that is applicable to the North/West Passage Corridor. The majority of information flows in Table 6-5 occur between systems located within state borders. Table 6-5 shows the type of information exchanged between systems, the system where the information originates, the system that receives the information, and the status of the information flow. Depending on the information flow, the status may be shown as: Existing, Existing – Some States, Existing – All States, or Planned. The distinction is made for existing flows to address unique aspects of state DOT ITS inventories.

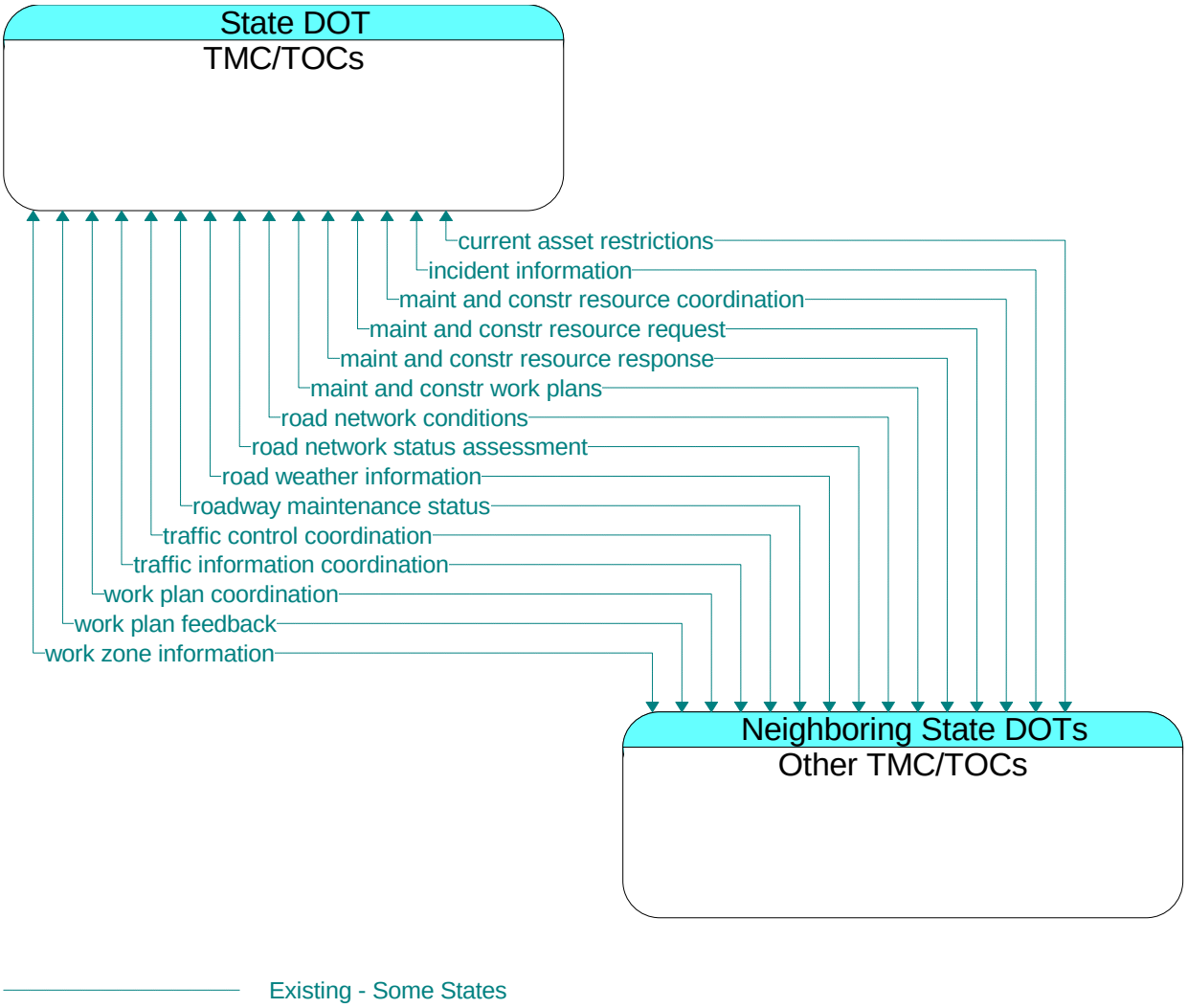


Figure 6-3: North/West Passage TOC/TMC-to-TOC/TMC Information Flow

Table 6-5: North/West Passage System-to-System Information Flows

Source Element	Destination Element	Flow Name	Flow Status
511 (Telephone)	Other 511 (Telephone)	ISP coordination	Planned
		voice-based traveler information	Planned
		voice-based traveler request	Planned
	Personal Communication and Computing Devices	broadcast information	Existing – All States
		emergency traveler information	Existing – All States
		traveler information	Existing – All States
		trip plan	Existing – All States
		yellow pages information	Existing – All States
	Service Providers	travel service information request	Existing – Some States
		travel service reservation request	Existing – Some States
		voice-based traveler request	Existing – Some States
Automated De-icing System	DMS	roadway equipment coordination	Existing – Some States
	Pavement Detection/Sensors	roadway equipment coordination	Existing – Some States
	TOC/TMCs	roadway treatment system status	Existing – Some States
Automated Gates	DMS	roadway equipment coordination	Existing – Some States
	TOC/TMCs	barrier system status	Existing – Some States
CCTV	TOC/TMCs	field device status	Existing – Some States
		traffic images	Existing – Some States
CVOs	Other Point Source Information Display	traveler inputs	Existing
	Personal Communication and Computing Devices	traveler inputs	Existing
	Point Source Information Display	traveler inputs	Existing
DMS	CVOs	driver information	Existing – Some States
	TOC/TMCs	roadway information system status	Existing – Some States
	Traveler – En route	driver information	Existing – Some States
DOT Web Site	Integrated Corridor Web Site	ISP coordination	Planned
	Media	traveler information for media	Existing – All States
	Other DOT Web Site	ISP coordination	Existing – Some States
	Personal Communication and Computing Devices	broadcast information	Existing – All States
		emergency traveler information	Existing – All States
		traveler information	Existing – All States
		trip plan	Existing – All States
		yellow pages information	Existing – All States

Source Element	Destination Element	Flow Name	Flow Status
HAR	CVOs	driver information	Existing – Some States
	Public Vehicles	broadcast advisories	Existing – Some States
	TOC/TMCs	roadway information system status	Existing – Some States
Integrated Corridor Web Site	DOT Web Site	ISP coordination	Planned
	Other DOT Web Site	ISP coordination	Planned
	Personal Communication and Computing Devices	broadcast information	Planned
		emergency traveler information	Planned
		traveler information	Planned
		trip plan	Planned
		yellow pages information	Planned
Local Emergency Response Agencies	Other TOC/TMCs	incident information	Existing – All States
		incident response status	Existing – All States
		maint and constr resource request	Existing – All States
		resource request	Existing – All States
		work plan feedback	Existing – All States
	TOC/TMCs	emergency traffic control request	Existing – All States
		incident information	Existing – All States
		incident response status	Existing – All States
		maint and constr resource request	Existing – All States
		resource request	Existing – All States
		road network probe information	Existing – All States
		work plan feedback	Existing – All States
Maintenance and Construction Vehicles	TOC/TMCs	maint and constr vehicle location data	Existing – Some States
Media	Other TOC/TMCs	external reports	Existing – All States
		media information request	Existing – All States
	TOC/TMCs	external reports	Existing – All States
		media information request	Existing – All States
National Weather Service	Other TOC/TMCs	environmental conditions data	Existing – Some States
		weather information	Existing – Some States
	TOC/TMCs	environmental conditions data	Existing – Some States
		weather information	Existing – Some States

Source Element	Destination Element	Flow Name	Flow Status
Other 511 (Telephone)	511 (Telephone)	ISP coordination	Planned
		voice-based traveler information	Planned
		voice-based traveler request	Planned
	Personal Communication and Computing Devices	broadcast information	Existing – All States
		emergency traveler information	Existing – All States
		traveler information	Existing – All States
		trip plan	Existing – All States
		yellow pages information	Existing – All States
	Service Providers	travel service information request	Existing – Some States
		travel service reservation request	Existing – Some States
		Voice-based traveler request	Existing – Some States
Other Automated Gates	Other DMS	roadway equipment coordination	Existing – Some States
	Other TOC/TMCs	barrier system status	Existing – Some States
Other Automated De-Icing System	Other DMS	roadway equipment coordination	Existing – Some States
	Other Pavement Detection/Sensors	roadway equipment coordination	Existing – Some States
	Other TOC/TMCs	roadway treatment system status	Existing – Some States
Other CCTV	Other TOC/TMCs	field device status	Existing – Some States
		traffic images	Existing – Some States
Other DMS	CVOs	driver information	Existing – Some States
	Other TOC/TMCs	roadway information system status	Existing – Some States
	Traveler – En route	driver information	Existing – Some States
Other DOT Web Site	DOT Web Site	ISP coordination	Existing – Some States
	Integrated Corridor Web Site	ISP coordination	Planned
	Media	traveler information for media	Existing – All States
	Personal Communication and Computing Devices	broadcast information	Existing – All States
		emergency traveler information	Existing – All States
		traveler information	Existing – All States
		trip plan	Existing – All States
		yellow pages information	Existing – All States
Other HAR	CVOs	driver information	Existing – Some States
	Other TOC/TMCs	roadway information system status	Existing – Some States
	Public Vehicles	broadcast advisories	Existing – Some States
Other Maintenance and Construction Vehicles	Other TOC/TMCs	maint and constr vehicle location data	Existing – Some States

Source Element	Destination Element	Flow Name	Flow Status
Other Pavement Detection/Sensors	National Weather Service	environmental conditions data	Existing – Some States
	Other Automated De-Icing System	roadway equipment coordination	Existing – Some States
	Other TOC/TMCs	environmental conditions data	Existing – Some States
		field device status	Existing – Some States
		traffic flow	Existing – Some States
Other Point Source Information Display	Traveler – En route	traveler interface updates	Existing – Some States
	Traveler – Pre-trip	traveler interface updates	Existing – Some States
Other RWIS	National Weather Service	environmental conditions data	Existing – Some States
	Other TOC/TMCs	environmental conditions data	Existing – All States
		field device status	Existing – All States
Other TOC/TMCs	Integrated Corridor Web Site	current asset restrictions	Planned
		maint and constr work plans	Planned
		road network conditions	Planned
		road weather information	Planned
		roadway maintenance status	Planned
		work zone information	Planned
	Local Emergency Response Agencies	current asset restrictions	Existing – All States
		incident information	Existing – All States
		maint and constr resource response	Existing – All States
		maint and constr work plans	Existing – All States
		resource deployment status	Existing – All States
		road network conditions	Existing – All States
		roadway maintenance status	Existing – All States
		traffic images	Existing – All States
	Media	maint and constr work plans	Existing – All States
		road network conditions	Existing – All States
		road weather information	Existing – All States
		roadway maintenance status	Existing – All States
		traveler information for media	Existing – All States
	National Weather Service	environmental conditions data	Existing – Some States
		road weather information	Existing – Some States
	Other 511 (Telephone)	current asset restrictions	Existing – All States
		maint and constr work plans	Existing – All States
		road network conditions	Existing – All States
		road weather information	Existing – All States
		roadway maintenance status	Existing – All States

Source Element	Destination Element	Flow Name	Flow Status
		voice-based traveler information	Existing – All States
		work zone information	Existing – All States
	Other Automated Gates	barrier system control	Existing – Some States
	Other Automated De-Icing System	roadway treatment system control	Existing – Some States
	Other CCTV	video surveillance control	Existing – Some States
	Other DMS	roadway information system data	Existing – Some States
	Other DOT Web Site	current asset restrictions	Existing – All States
		maint and constr work plans	Existing – All States
		road network conditions	Existing – All States
		road weather information	Existing – All States
		roadway maintenance status	Existing – All States
		work zone information	Existing – All States
	Other HAR	roadway information system data	Existing – Some States
	Other Maintenance and Construction Vehicles	maint and constr dispatch information	Existing – Some States
	Other Pavement Detection/Sensors	environmental sensors control	Existing – Some States
		traffic sensor control	Existing – Some States
	Other Point Source Information Display	broadcast information	Existing – Some States
		traveler information	Existing – Some States
	Other RWIS	environmental sensors control	Existing – All States
	Service Providers	road network conditions	Existing – Some States
	TOC/TMCs	current asset restrictions	Existing – Some States
		incident information	Existing – Some States
		maint and constr resource coordination	Existing – Some States
		maint and constr resource request	Existing – Some States
		maint and constr resource response	Existing – Some States
		maint and constr work plans	Existing – Some States
		road network conditions	Existing – Some States
		road network status assessment	Existing – Some States
		road weather information	Existing – Some States
		roadway maintenance status	Existing – Some States
		traffic control coordination	Existing – Some States
		traffic information coordination	Existing – Some States
		work plan coordination	Existing – Some States
		work plan feedback	Existing – Some States

Source Element	Destination Element	Flow Name	Flow Status
		work zone information	Existing – Some States
Pavement Detection/Sensors	Automated De-icing System	roadway equipment coordination	Existing – Some States
	National Weather Service	environmental conditions data	Existing – Some States
	Other Automated De-Icing System	roadway equipment coordination	Planned
	TOC/TMCs	environmental conditions data	Existing – Some States
		field device status	Existing – Some States
		traffic flow	Existing – Some States
Personal Communication and Computing Devices	511 (Telephone)	emergency traveler information request	Existing – All States
		traveler profile	Existing – All States
		traveler request	Existing – All States
		trip confirmation	Existing – All States
		trip request	Existing – All States
		yellow pages request	Existing – All States
	DOT Web Site	emergency traveler information request	Existing – All States
		traveler profile	Existing – All States
		traveler request	Existing – All States
		trip confirmation	Existing – All States
		trip request	Existing – All States
		yellow pages request	Existing – All States
	Integrated Corridor Web Site	emergency traveler information request	Planned
		traveler profile	Planned
		traveler request	Planned
		trip confirmation	Planned
		trip request	Planned
		yellow pages request	Planned
	Other 511 (Telephone)	emergency traveler information request	Existing – All States
		traveler profile	Existing – All States
		traveler request	Existing – All States
		trip confirmation	Existing – All States
		trip request	Existing – All States
		yellow pages request	Existing – All States

Source Element	Destination Element	Flow Name	Flow Status
	Other DOT Web Site	emergency traveler information request	Existing – All States
		traveler profile	Existing – All States
		traveler request	Existing – All States
		trip confirmation	Existing – All States
		trip request	Existing – All States
		yellow pages request	Existing – All States
	Traveler – En route	traveler interface updates	Existing
	Traveler – Pre-trip	traveler interface updates	Existing
Point Source Information Display	Traveler – En route	traveler interface updates	Existing – Some States
	Traveler – Pre-trip	traveler interface updates	Existing – Some States
Public Vehicles	Other Pavement Detection/Sensors	traffic characteristics	Existing – Some States
	Pavement Detection/Sensors	traffic characteristics	Existing – Some States
RWIS	National Weather Service	environmental conditions data	Existing – Some States
	TOC/TMCs	environmental conditions data	Existing – All States
		field device status	Existing – All States
Service Providers	511 (Telephone)	travel service information	Existing – Some States
		travel service reservations	Existing – Some States
		voice-based traveler information	Existing – Some States
	Other 511 (Telephone)	travel service information	Existing – Some States
		travel service reservations	Existing – Some States
		voice-based traveler information	Existing – Some States
	Other TOC/TMCs	fare and price information	Existing – Some States
		travel service information	Existing – Some States
		travel service reservations	Existing – Some States
	TOC/TMCs	fare and price information	Existing – Some States
		travel service information	Existing – Some States
		travel service reservations	Existing – Some States
TOC/TMCs	511 (Telephone)	current asset restrictions	Existing – All States
		maint and constr work plans	Existing – All States
		road network conditions	Existing – All States
		road weather information	Existing – All States
		roadway maintenance status	Existing – All States
		voice-based traveler information	Existing – All States
		work zone information	Existing – All States
	Automated De-icing System	roadway treatment system control	Existing – Some States

Source Element	Destination Element	Flow Name	Flow Status
	Automated Gates	barrier system control	Existing – Some States
	CCTV	video surveillance control	Existing – Some States
	DMS	roadway information system data	Existing – Some States
	DOT Web Site	current asset restrictions	Existing – All States
		maint and constr work plans	Existing – All States
		road network conditions	Existing – All States
		road weather information	Existing – All States
		roadway maintenance status	Existing – All States
		work zone information	Existing – All States
	HAR	roadway information system data	Existing – Some States
	Integrated Corridor Web Site	current asset restrictions	Planned
		maint and constr work plans	Planned
		road network conditions	Planned
		road weather information	Planned
		roadway maintenance status	Planned
		work zone information	Planned
	Local Emergency Response Agencies	current asset restrictions	Existing – All States
		emergency traffic control information	Existing – All States
		incident information	Existing – All States
		maint and constr resource response	Existing – All States
		maint and constr work plans	Existing – All States
		resource deployment status	Existing – All States
		road network conditions	Existing – All States
		roadway maintenance status	Existing – All States
		traffic images	Existing – All States
	Maintenance and Construction Vehicles	maint and constr dispatch information	Existing – Some States
	Media	maint and constr work plans	Existing – All States
		road network conditions	Existing – All States
		road weather information	Existing – All States
		roadway maintenance status	Existing – All States
		traveler information for media	Existing – All States
	National Weather Service	environmental conditions data	Existing – Some States
		road weather information	Existing – Some States
	Other TOC/TMCs	current asset restrictions	Existing – Some States

Source Element	Destination Element	Flow Name	Flow Status
		incident information	Existing – Some States
		maint and constr resource coordination	Existing – Some States
		maint and constr resource request	Existing – Some States
		maint and constr resource response	Existing – Some States
		maint and constr work plans	Existing – Some States
		road network conditions	Existing – Some States
		road network status assessment	Existing – Some States
		road weather information	Existing – Some States
		roadway maintenance status	Existing – Some States
		traffic control coordination	Existing – Some States
		traffic information coordination	Existing – Some States
		work plan coordination	Existing – Some States
		work plan feedback	Existing – Some States
		work zone information	Existing – Some States
	Pavement Detection/Sensors	environmental sensors control	Existing – Some States
		traffic sensor control	Existing – Some States
	Point Source Information Display	broadcast information	Existing – Some States
		traveler information	Existing – Some States
	RWIS	environmental sensors control	Existing – All States
	Service Providers	road network conditions	Existing – Some States
Traveler – En route	Personal Communication and Computing Devices	traveler inputs	Existing
Traveler – Pre-trip	Personal Communication and Computing Devices	traveler inputs	Existing

6.6 Applicable Standards

ITS standards define how system components interconnect and interact with other systems and specifically state the requirements each system must have in order for systems to deliver desired functions. Documenting applicable standards ensures that system deployment occurs in an effective and efficient fashion throughout the corridor and with local and national ITS deployments. The use of standards among corridor states will ensure that different ITS devices manufactured by various vendors will be interoperable.

As standards are added to the National ITS architecture, regular updates to the North/West Passage ITS architecture will be required.

Table 6-6: North/West Passage Corridor ITS Architecture Supporting Standards

Group/Doc ID	Title	Description
ATIS General Use	ATIS General Use Standards Group	The ATIS General Use family of standards, created by the SAE standards development organization, is for general exchange of data independent of bandwidth limitations. This standards group addresses primarily the interfaces between the ISP and other ITS centers, such as TMCs, transit management centers, etc., and is, therefore, mapped to the relevant architecture flows in the National ITS architecture. This group provides the vocabulary (called data elements and messages) necessary to exchange information between these ITS systems. We have created this summary entry – ATIS General Use Group of standards – to identify the main standards applicable to this interface.
ATIS Low Bandwidth	ATIS Bandwidth Limited Standards Group	The ATIS Bandwidth Limited family of standards, created by the SAE standards development organization, applies to reduced bandwidth interfaces (such as wide-area-wireless interfaces). This standards group addresses primarily the interfaces between the ISP and the PIAS (personal), RTS (public), and Vehicle subsystems and is, therefore, mapped to the relevant architecture flows in the National ITS architecture. This group provides the vocabulary (called data elements and messages) necessary to exchange information between these ITS systems. We have created this summary entry – ATIS Bandwidth Limited Group of standards – to identify the main standards applicable to this interface.

Group/Doc ID	Title	Description
DSRC 5GHz	Dedicated Short Range Communication at 5.9 GHz Standards Group	DSRC is a general purpose radio frequency (RF) communications link between the vehicle and the roadside, or between two vehicles. The set of standards developed to support this interface provide a short to medium range communications service for a variety of applications, including public safety (obstacle detection, collision avoidance), commercial vehicle applications (WIM/inspection clearances, border crossing), electronic toll collection, parking lot payment, and many others.
IEEE IM	Incident Management Standards Group	The Incident Management family of standards, created primarily by the IEEE standards development organization, addresses the interfaces between an emergency management center and other centers. They provide the vocabulary (called data elements and messages) necessary to exchange information between ITS systems. Together, the ITS standards in this group apply to emergency management center interfaces (such as with a traffic management center, an emergency management center, or other centers). There is also a significant amount of reuse of data elements and messages across multiple interfaces; rather than repeat the entire list of standards for each architecture flow, we have created this summary entry – the Incident Management (IEEE IM) Group of standards.
ITE TM 1.03 Approved – Not Published	Standard for Functional Level Traffic Management Data Dictionary (TMDD)	
ITE TM 2.01 Approved – Not Published	Message Sets for External TMC Communication (MS/ETMCC)	
NTCIP 1201 Approved – Published	Global Object Definitions	
NTCIP 1203 Approved – Published	Object Definitions for DMS	
NTCIP 1204 Approved – Published	Environmental Sensor Station (ESS) Interface Standard	
NTCIP 1205 Approved – Published	Object Definitions for CCTV Camera Control	
NTCIP 1208 Approved – Not Published	Object Definitions for CCTV Switching	
NTCIP 1209 Approved – Not Published	Data Element Definitions for Transportation Sensor Systems (TSS)	
NTCIP 1210 Under Development	Field Management Stations – Part 1: Object Definitions for Signal System Masters	

Group/Doc ID	Title	Description
NTCIP C2C	National Transportation Communications for ITS Protocol (NTCIP) Center-to-Center Standards Group	The NTCIP family of standards, created jointly by AASHTO, Institute of Transportation Engineering (ITE) and National Electrical Manufacturers Association (NEMA), address primarily the interfaces between a transportation management center, the ITS field devices it manages, and other centers. They provide both the rules for communicating (called protocols) and the vocabulary (called objects, data elements, and messages) necessary to exchange information between ITS systems.
NTCIP C2F	NTCIP Center-to-Field Standards Group	The NTCIP family of standards, created jointly by AASHTO, ITE and NEMA, address primarily the interfaces between a transportation management center, the ITS field devices it manages, and other centers. They provide both the rules for communicating (called protocols) and the vocabulary (called objects, data elements, and messages) necessary to exchange information between ITS systems.

6.7 Updating the Architecture

The North/West Passage Corridor ITS architecture should be viewed as a living document that needs periodic updates. As a general rule, the architecture should be updated every three years. However, if resources are available, it is recommended that the architecture be updated every time a change is identified (e.g., a new system is proposed for implementation). Updating the architecture as changes are identified will ensure that the North/West Passage Corridor ITS architecture remains an up-to-date, valid document. This preserves the initial investment used to develop the architecture and reduces the need to develop a new architecture before the end of it useful life (e.g., 10-year planning timeframe). Additionally, updating the architecture on a frequent basis will reduce the level of effort required to update the architecture at the time such work is undertaken since text can be updated in manageable, bite-sized pieces.

6.8 Information Flow Definitions

The National ITS architecture provides a comprehensive listing of high-level information flows that are commonly exchanged between various types of ITS technologies. This listing is not intended to represent all the possible types of information that can be exchanged, but rather it is intended to provide a high-level representation of the types of data in which specific information may fall. Therefore, information flows from the National ITS architecture help further define the framework in which system development and integration will occur. In this regard, it helps identify specific standards that may be used to ensure that systems can be easily integrated and remain interoperable well into the future. National ITS architecture information flows applicable to the North/West Passage Corridor ITS architecture are listed and defined below.

Barrier System Control

Information used to configure and control barrier systems that are represented by gates, barriers, and other automated or remotely controlled systems used to manage entry to roadways.

Barrier System Status

Current operating status of barrier systems. Barrier systems represent gates, barriers, and other automated or remotely controlled systems used to manage entry to roadways. Status of the systems includes operating condition and current operational state.

Broadcast Advisories

General broadcast advisories that are provided over wide-area wireless communications direct to the vehicle radio. These analog advisory messages may provide similar content to ITS broadcast information flows, but include no digital data component. Existing Highway-Advisory Radio (HAR) advisory messages are a prime example of this flow.

Broadcast Information

General broadcast information that contains link travel times, incidents, advisories, transit services, and myriad other traveler information.

Current Asset Restrictions

Restrictions levied on transportation asset usage based on infrastructure design, surveys, tests, or analyses. This includes standard facility design height, width, and weight restrictions, special restrictions, such as spring weight restrictions, and temporary facility restrictions that are imposed during maintenance and construction.

Driver Information

General advisory and traffic control information provided to the driver while en route.

Emergency Traffic Control Information

Status of a special traffic control strategy or system activation implemented in response to an emergency traffic control request, a request for emergency access routes, a request for evacuation, a request to activate closure systems, a request to employ driver information systems to support public safety objectives, or other special requests. Identifies the selected traffic control strategy and system control status.

Emergency Traffic Control Request

Special request to preempt the current traffic control strategy in effect at one or more signalized intersections or highway segments, activate traffic control and closure systems (such as gates and barriers) activate safeguard systems, or use driver information systems. For example, this flow can request all signals to red-flash, request a progression of traffic control preemptions along an emergency vehicle route, request a specific evacuation traffic control plan, request activation of a road closure barrier system, or place a public safety or emergency-related message on a dynamic message sign.

Emergency Traveler Information

Public notification of an emergency, such as a natural or man-made disaster, civil emergency, or child abduction. This flow also includes evacuation information including evacuation instructions, evacuation zones, recommended evacuation times, tailored evacuation routes and destinations, traffic and road conditions along the evacuation routes, traveler services and shelter information, and reentry times and instructions.

Emergency Traveler Information Request

Request for alerts, evacuation information, and other emergency information provided to the traveling public.

Environmental Conditions Data

Current road conditions (e.g., surface temperature, subsurface temperature, moisture, icing, treatment status) and surface weather conditions (e.g., air temperature, wind speed, precipitation, visibility) as measured and reported by environmental sensors. Operational status of the sensors is also included.

Environmental Sensors Control

Data used to configure and control environmental sensors.

External Reports

Traffic and incident information that is collected by the media through a variety of mechanisms (e.g., radio station call-in programs, air surveillance).

Fare and Price Information

Current transit, parking, and toll fee schedule information.

Field Device Status

Reports from field equipment (sensors, signals, signs, controllers, etc.) that indicate current operational status.

Incident Information

Notification of existence of incident and expected severity, location, time, and nature of incident. As additional information is gathered and the incident evolves, updated incident information is provided. Incidents include any event that impacts transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) through large-scale natural or human-caused disasters that involve loss of life, injuries, extensive property damage, and multi-jurisdictional response.

Incident Response Status

Status of the current incident response including a summary of incident status and its impact on the transportation system, traffic management strategies implemented at the site (e.g., closures, diversions, traffic signal control overrides), and current and planned response activities.

ISP Coordination

Coordination and exchange of transportation information between centers. This flow allows a broad range of transportation information collected by one ISP to be redistributed to many other ISPs and their clients.

Maintenance and Construction Dispatch Information

Information used to dispatch maintenance and construction vehicles, equipment, and crews and information used to keep work zone crews informed. This information includes routing information, traffic information, road restrictions, incident information, environmental information, decision support information, maintenance schedule data, dispatch instructions, personnel assignments, alert notifications, and corrective actions.

Maintenance and Construction Resource Coordination

Request for road maintenance and construction resources that can be used in the diversion of traffic (cones, portable signs, etc.), clearance of a road hazard, repair of ancillary damage, or any other incident response.

Maintenance and Construction Resource Request

Request for road maintenance and construction resources that can be used in the diversion of traffic (cones, portable signs, etc.), clearance of a road hazard, repair of ancillary damage, or any other incident response. The request may poll for resource availability or request pre-staging, staging, or immediate dispatch of resources.

Maintenance and Construction Resource Response

Current status of maintenance and construction resources including availability and deployment status. General resource inventory information covering vehicles, equipment, materials, and people and specific resource deployment status may be included.

Maintenance and Construction Vehicle Location Data

The current location and related status (e.g., direction and speed) of the maintenance/ construction vehicle.

Maintenance and Construction Work Plans

Future construction and maintenance work schedules and activities including anticipated closures with anticipated impact to the roadway, alternate routes, anticipated delays, closure times, and durations.

Media Information Request

Request from the media for current transportation information.

Resource Deployment Status

Status of traffic management resource deployment identifying the resources (vehicles, equipment, materials, and personnel) available and their current status. General resource inventory information and specific status of deployed resources may be included.

Resource Request

A request for traffic management resources to implement special traffic control measures, assist in clean up, verify an incident, etc. The request may poll for resource availability or request pre-staging, staging, or immediate deployment of resources.

Road Network Conditions

Current and forecasted traffic information, road and weather conditions, traffic incident information, and other road network status. Either raw data, processed data, or some combination of both may be provided by this architecture flow. Information is also included regarding diversions and alternate routes, closures, and special traffic restrictions in effect (lane/shoulder use, weight restrictions, width restrictions, HOV requirements).

Road Network Probe Information

Aggregated route usage, travel times, environmental conditions, and other aggregated data collected from probe vehicles.

Road Network Status Assessment

Assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.

Road Weather Information

Road conditions and weather information that are made available by road maintenance operations to other transportation system operators.

Roadway Equipment Coordination

The direct flow of information between field equipment. This includes transfer of information between sensors and driver information systems or control devices (traffic signals, ramp meters, etc.), direct coordination between adjacent control devices, interfaces between detection and warning or alarm systems, and any other direct communications between field equipment. Both peer-to-peer and master-slave communications between field devices are covered by this flow.

Roadway Information System Data

Information used to initialize, configure, and control roadside systems that provide driver information (e.g., dynamic message signs, HAR, beacon systems). This flow can provide message content and delivery attributes, local message store maintenance requests, control mode commands, status queries, and all other commands and associated parameters that support remote management of these systems.

Roadway Information System Status

Current operating status of dynamic message signs, HARs, beacon systems, or other configurable field equipment that provides dynamic information to the driver.

Roadway Maintenance Status

Summary of maintenance fleet operations affecting the road network. This includes the status of winter maintenance (snow plow schedule and current status).

Roadway Treatment System Control

Control data for remotely located, automated devices that affect the roadway surface (e.g., de-icing applications).

Roadway Treatment System Status

Current operational status of automated roadway treatment devices (e.g., anti-icing systems).

Traffic Characteristics

Physical traffic characteristics that are monitored and translated into macroscopic measures like occupancy, volume, density, and average speed. Point measures support presence detection and individual vehicle measures like speed.

Traffic Control Coordination

Information transfers that enable remote monitoring and control of traffic management devices. This flow is intended to allow cooperative access to, and control of, field equipment during incidents and special events and during day-to-day operations. This flow also allows 24-hour centers to monitor and control assets of other centers during off-hours, allows system redundancies and fail-over capabilities to be established, and otherwise enables integrated traffic control strategies in a region.

Traffic Flow

Raw and/or processed traffic detector data that allows derivation of traffic flow variables (e.g., speed, volume, and density measures) and associated information (e.g., congestion, potential incidents). This flow includes the traffic data and the operational status of the traffic detectors.

Traffic Images

High fidelity, real-time traffic images suitable for surveillance monitoring by the operator or for use in machine vision applications. This flow includes the images and the operational status of the surveillance system.

Traffic Information Coordination

Traffic information exchanged between TMCs. Normally would include incidents, congestion data, traffic data, signal timing plans, and real-time signal control information.

Traffic Sensor Control

Information used to configure and control traffic sensor systems.

Travel Service Information

Information supplied by a service provider (e.g., a hotel or restaurant) that identifies the service provider and provides details of the service offering. This flow covers initial registration of a service provider and subsequent submittal of new information and status updates so that data currency is maintained.

Travel Service Information Request

Requests for travel service information. This flow supports initial registration of service providers and requests for additional traveler service information from registered providers.

Travel Service Reservation Request

Reservation request for traveler services (e.g., for a hotel or restaurant) including billing information when applicable.

Travel Service Reservations

Traveler service (e.g., for a hotel or restaurant) reservation information and status, including information on associated billing transactions, when applicable.

Traveler Information

Traveler information comprised of traffic and road conditions, advisories, incidents, payment information, transit services, and many other travel-related data updates and confirmations. For the North/West Passage, the flow traveler information may be customized to provide specific types of information for the sole use and benefit of CVOs. This information may include truck stops, chain requirements, truck detours, and truck restrictions.

Traveler Information for Media

General traveler information regarding incidents, unusual traffic conditions, transit issues, or other advisory information that has been desensitized and provided to the media.

Traveler Inputs

User input from a traveler to summon assistance, request travel information, make a reservation, or request any other traveler service.

Traveler Interfaces Updates

Visual or audio information (e.g., routes, messages, guidance, emergency information) that is provided to the traveler.

Traveler Profile

Information about a traveler including equipment capabilities, personal preferences, and recurring trip characteristics.

Traveler Request

Request by a traveler to summon assistance, request information, make a reservation, or initiate any other traveler service.

Trip Confirmation

Acknowledgement by the driver/traveler of acceptance of a route.

Trip Plan

A sequence of links and special instructions comprising of a trip plan indicating efficient routes for navigating the links. Normally coordinated with traffic conditions, other incidents, preemption and prioritization plans.

Trip Request

Request by a driver/traveler for special routing.

Video Surveillance Control

Information used to configure and control video surveillance systems.

Voice-Based Traveler Information

Traveler information sent to the telecommunications systems for traveler information terminator. This flow may represent the bulk transfer of traveler information, including traffic conditions, incident information, transit information, and weather and road condition information. It may be specially formatted for voice-based traveler information.

Voice-Based Traveler Request

The electronic traveler information request from the telecommunications systems for traveler information terminator. It may be specifically formatted for voice-based traveler requests. The request can be a general subscription intended to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.

Weather Information

Accumulated forecasted and current weather data (e.g., temperature, pressure, wind speed, wind direction, humidity, precipitation, visibility, light conditions, etc.).

Work Plan Coordination

Coordination of work plan schedules and activities between maintenance and construction organizations or systems. This information includes the work plan schedules and comments and suggested changes that are exchanged as work plans are coordinated and finalized.

Work Plan Feedback

Comments and suggested changes to proposed construction and maintenance work schedules and activities. This information influences work plan schedules so that they minimize impact to other system operations and the overall transportation system.

Work Zone Information

Summary of maintenance and construction work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.

Yellow Pages Information

Travel service information covering tourist attractions, lodging, restaurants, service stations, emergency services, and other services and businesses of interest to the traveler.

Yellow Pages Request

Request for information (RFI) through a yellow pages type service.

Chapter 7: Traveler Information and 511 Systems Integration

The North/West Passage states have identified traveler information as a priority ITS service for the corridor. The goal for traveler information is to integrate systems that can provide information appropriate to the location and need of the traveler. In doing this, the states need to understand the common and unique information needs of the corridor's diverse travelers. Some may travel daily among the states, others may frequently travel the length of the corridor for commercial purposes, while others still may be first-time or infrequent travelers of the corridor. As such, their needs vary dramatically in terms of type of information and level of detail needed, as well as the most effective mechanism for delivering the information. To achieve their goal, the states also must provide integrated traveler information systems, both for gathering and distributing data and information, along the entire length of the corridor. Planning for such integration must assess the volume, format, and frequency of information transferred among the states' various systems used to gather information.

This chapter will present a sequence of recommended projects geared toward achieving the traveler information goals and objectives identified for the North/West Passage Corridor over the next three to five years. For each project, a title, description, and timeframe will be provided in addition to potential stakeholders/partners, related initiatives (state and federal), architecture and standards considerations, and estimated cost.

7.1 Traveler Information Projects

For traveler information, the goal of the e North/West Passage Corridor coalition is to efficiently provide information appropriate to the location and need of the traveler. This requires an understanding of the common and unique information needs of the corridor's diverse travelers. There are commercial vehicle, recreational/tourist, and commute-oriented travelers who use the corridor. The type of information they need and their preferences for receiving it may vary significantly. Understanding those needs is essential to identifying what systems need to be integrated for gathering and distributing information. Projects were selected to address the greatest common needs.

As the corridor moves toward system development and deployment projects, the States within the Corridor must consider the ongoing financial obligations and contractual requirements of joint operations. For example, if software or hardware purchases are made jointly for long-term deployment, having a process in place to identify ownership, as well as ongoing operations, and maintenance responsibilities will be critical. Because of this, the scope of early development/deployment projects will be limited, allowing for a measured and incremental approach to joint system ownership and operations. The recommended projects also emphasize the core benefit of a pooled fund effort – information sharing. Sharing information on similar experiences – good and bad – is a proven benefit for states involved in pooled fund efforts. One of the projects focuses on simply offering a structured information sharing opportunity related to a topic that one state has experienced and other states have expressed interest in pursuing. Specifically, Washington recently completed a project to integrate the State Police CAD system with the DOT reporting system. Before proceeding with a corridor-wide project of this nature, there were many valuable lessons learned in Washington that could be shared with the other

states to help them understand the challenges and implications of pursuing such a project collectively or individually.

The short-term traveler information projects recommended for the North/West Passage are listed below. Complete details on each of the projects follow the summary list.

Project Title	
Corridor-wide Consistent Major Event Descriptions	
Clarus Regional Demonstration Concept of Operations	
CAD to Reporting System Integration – Lessons Learned Workshop	
North/West Passage Traveler Information Web Site	
511 Call Forwarding and Evaluation of Cross Border Information Requests	
North/West Passage Traveler Information Kiosks	
Corridor-wide Marketing and Outreach to CVOs	
Information Systems Network (ISN)	
Route Selection Information Support Tool	
North/West Passage Traveler Information for ISPs	

Table 7-1: Traveler Information Projects

Project Title	1. Corridor-wide Consistent Major Event Descriptions
Project Champion	Bill Legg, Washington DOT [or Bob Koeberlein, Idaho DOT]
Project Purpose	The purpose of this project is to establish an agreeable set of nomenclature and related definitions for how events are described throughout the corridor. It is recommended that this project be completed before any others directed at standardizing the data exchange of event information. It will focus on the basics of how events are described to the traveling public, both on the internet and 511 phone systems. This project will also identify a minimum, core set of events to be exchanged in a consistent manner.
Current Status	Currently, most of the North/West Passage states operate and maintain traveler information systems to disseminate information over 511 phone systems and internet pages. While these states all report events, such as weather, delays, roadwork, and road closures, the event descriptions often vary from state to state. For example, exact same weather and road conditions may be reported differently among North/West Passage states. If snow is falling at a rate of one inch per hour, one state may report "difficult driving conditions, heavy snowfall", another state may report "blizzard conditions", while a third might report "moderate snowfall". This can lead to confusion as travelers hear or read reports from adjacent states. Therefore, prior to the North/West Passage Corridor beginning the process of exchanging data, it is critical that the states come to an agreement on shared terminology at least for those events that generate multi-state dissemination. This would ensure that a traveler driving the entire corridor would get consistent reports.

Project Title	1. Corridor-wide Consistent Major Event Descriptions
Approach	The project team will begin by focusing on defining (and reaching group consensus on) a small set of events that are critical to the North/West Passage Corridor. These may be six to ten event descriptions, reporting such things as road closures or situations that seriously impact safety or result in long delays. Additionally, North/West Passage members may reach consensus on key locations where consistent reports and reporting procedures are agreed upon. By only limiting this consistent reporting to a limited set of event types or locations, the intent is to avoid extensive debate over the many other events that may describe local situations. Once this project is successful, it is envisioned that the number of event types that are described in a consistent manner may be expanded to include additional (or perhaps all) types of events as a future project. Other factors that will be addressed in this project include: ▪ Whether condition reports are provided all the time during the winter months (e.g., if the pavement is dry and clear, reporting "good driving conditions" or "dry pavement") or whether only exception reporting is performed. If a traveler of the corridor hears "good driving conditions" for I-94 throughout Minnesota and then hears nothing about the road in Wisconsin, it may be confusing to travelers as they might assume that the report is delayed or non-existent ▪ Whether future roadwork is included in descriptions or only current roadwork ▪ Whether forecasted weather conditions are reported, or only current conditions
Benefits	The benefits of this project will be realized every time events are exchanged among North/West Passage members and disseminated to travelers throughout the corridor. Without this project, there would be a lack of consistency at the core definition of events disseminated to travelers, and therefore, the potential for confusion and misunderstanding with every event disseminated to travelers along the corridor. This project will indirectly address all of the eight traveler information related needs defined in Chapter 2. However, it will most directly address the following needs: ▪ Lack of consistent and adequate traveler information ▪ Lack of consistent and adequate real-time information that would enhance corridor-wide travel ▪ Inconsistent and unreliable information for commercial vehicle travelers

Project Title	1. Corridor-wide Consistent Major Event Descriptions
Participants	It is important that all North/West Passage states participate in this project. It also may be important to consider (at some level) neighboring states to the North/West Passage states. For example, Wisconsin is part of the GCM Corridor and therefore would not want to agree to any definitions that present a potential conflict with the information exchanges among GCM states.
Duration/Timing	This project should be completed before any projects that focus on exchanging event information between states. As such, it is suggested that the project be scheduled for early 2007, and the estimated duration is four to six months.
Costs	The estimated cost for identifying the common set of nomenclature and related definitions, and then preparing a summary document may be feasible for $20,000 to $25,000. This cost does not include any modifications to the states' reporting systems to comply with the agreed upon nomenclature and definitions.
Deliverables	1. Clear definitions of agreed-upon nomenclature and 'semantics' for describing major incidents and events along the corridor, that are consistent with the ITS standards, but include enough detail to ensure consistent information delivery. 2. North/West Passage states would individually use these definitions within their own operational procedures and state reporting systems to report and disseminate consistent event summaries.

Project Title	2. Clarus Regional Demonstration Concept of Operations
Project Champion	Dave Huft, South Dakota DOT
Project Purpose	Contingent upon selection by FHWA, the North/West Passage states will develop a concept of operations for Clarus using the corridor as a demonstration site. As stated in the August 30, 2005 synopsis published by FHWA, "Clarus is a FHWA initiative designed to collect, quality check, and make available via the internet, this nation's public investments in atmospheric and pavement observations which support surface transportation operations. The progress of the Clarus Initiative has advanced to a stage in which the FHWA is seeking to conduct one or more Clarus Multi-state Regional Demonstrations. Through the Clarus Multi-state Regional Demonstrations, the FHWA aims to achieve the following objectives: (1) Demonstrate that the Clarus System functions as designed by incentivizing a large number of state and local agencies to contribute data from their Environmental Sensor Stations (ESS); (2) Enable proactive transportation system management through utilization of the Clarus System; and (3) Provide an environment so that private sector service providers can innovate and create new and improved products that will benefit the public, academia and other private industries. Emphasis will be on demonstrating new and innovative uses of Clarus-based technologies and information. It is anticipated that the demonstrations will span multiple procurements over a three-year period."
Current Status	FHWA issued a synopsis (http://www.grants.gov/search/search.do?oppId=10797&mode=VIEW) of the grant notice on August 30, and the full request for applications will be issued on October 1. Applications will be due to FHWA by November 15. A total of $675,000 is available for the grant program with a maximum of $135,000 per grant. Minnesota, North Dakota, South Dakota, Washington and Wisconsin have been actively involved in the Clarus Initiative Coordinating Committee (ICC). To date, the ICC has completed an overall concept of operations, system requirements, architectural description, gap analysis, and preliminary design for a Clarus system. The purpose of the next phase of demonstration is to develop concepts of operation based on actual corridors and then select a demonstration site to evaluate the full potential for a more broadly deployed Clarus effort.

Project Title	2. Clarus Regional Demonstration Concept of Operations
Approach	The North/West Passage states will identify an external party to support their Clarus Initiative efforts. With input from the states, this party will prepare an application to FHWA's RFA on behalf of the North/West Passage states. Upon FHWA selection of the North/West Passage as a demonstration corridor, the external party will provide program support for the states' charge to develop a concept of operations for Clarus along I-90/I-94.
Benefits	This project presents a rare opportunity for the North/West Passage states to visibly establish their identity as a corridor in the industry and more broadly address the traveler information and maintenance and operations goals identified for the corridor. As identified in Chapter 2, the issues and needs that this project would allow the states to address include: ▪ Lack of consistent and adequate traveler information ▪ Lack of consistent and adequate real-time information that would enhance corridor-wide travel ▪ Inconsistent and unreliable information for commercial vehicle travelers ▪ Inconsistent management of weather-related incidents and traffic management ▪ Need to share information among local and regional management centers to include crossing state borders ▪ Lack of agency and management coordination at state borders In turn, the corridor also offers a broad range of surface weather challenges that present an ideal environment for evaluating the effectiveness and potential of Clarus.
Participants	All states
Duration/Timing	The estimated duration for this project is 9 to 12 months, and it is recommended that is be scheduled for early 2007.
Costs	FHWA grant awards will not exceed $150,000 Local Match: $37,500 (Cost to Pooled Fund)
Deliverables	1. Concept of Operations describing the approach to and benefits of Clarus throughout the corridor, and the roles of each agency. 2. Each participating North/West Passage state will establish a connection to Clarus in order to upload the states' weather data. 3. Each North/West Passage state will have access to the Clarus database of weather data.

Project Title	3. CAD to Reporting System Integration-Lessons Learned Workshop
Project Champion	Bill Legg, Washington DOT
Project Purpose	Based on Washington's recent experience with this type of integration, the purpose of this project is to develop and present a workshop for the states to evaluate the effectiveness of and process followed to integrate Computer Aided Dispatching (CAD) with a reporting system. The purpose of this workshop is to determine the value of proceeding with further CAD to reporting system integration in other states within the corridor as a mechanism for gathering incident (e.g., crash) related information. Additionally, the workshop will concentrate on how each of the states collect data, as well as take a higher level look at how North/West Passage members share information and with whom. The Washington experience will serve as a case study to identify the technical and institutional process used to complete the integration and further evaluate the benefit of receiving the additional information from CAD in a reporting system.
Current Status	Washington completed a CAD-to-reporting-system integration project within the past two years. The integration was between the Motorola Printrak system used by the Washington State Patrol and the Condition Acquisition and Reporting System (CARS) operated by Washington DOT. Although the integration effort was initially considered an operational test, it is still operational and used daily. All of the North/West Passage states use CAD for highway patrol dispatching purposes on I-90/I-94 and other roadways. However, they use a variety of CAD software programs – none of which are standardized and as such would require case-by-case integration approaches. Furthermore, there are at least two different reporting systems used by the states – CARS and the Road Condition Reporting System (RCRS) – and three of the states do not yet operate state-wide reporting systems. This further compounds the complexity of defining a consistent integration path for all the states to follow.
Approach	Emphasis will be placed on reviewing the Washington project, highlighting challenges and benefits recognized to date, and discussing potential benefits for a corridor-wide effort for further integration. In addition, ideally additional representatives from each North/West Passage state would attend the workshop, allowing law enforcement and emergency responders (who may operate the CAD systems) to benefit as well.

Project Title	3. CAD to Reporting System Integration-Lessons Learned Workshop
Benefits	The perceived benefit of integrating CAD with reporting systems is faster, more comprehensive reporting on incidents (e.g., crashes) managed by law enforcement, particularly in rural areas. If successful, this automated transfer of information from CAD to reporting systems could facilitate more consistent, reliable information for travelers using services like 511 in the North/West Passage Corridor. The specific issues and needs identified in Chapter 2 that this project may indirectly address are: ▪ Lack of consistent and adequate traveler information. ▪ Ongoing demand to update and maintain traveler information. ▪ Lack of consistent and adequate real-time information that would enhance corridor-wide travel.
Participants	DOT, state patrol, and IT staff from each state.
Duration/Timing	Estimated project duration is one to three months, allowing for workshop preparation, the actual workshop, and a summary document to be prepared following the workshop. It is suggested that this project be scheduled for early to mid-2007 in conjunction with a regularly scheduled in-person meeting for the states.
Costs	Estimated project cost is $5,000 to $10,000 and is based on an external party preparing, delivering, and summarizing the workshop. There are no operational costs associated with this project.
Deliverables	1. Meeting material will be developed for the workshop and also will be circulated to all members for use in further presentations. 2. Facilitated workshop allowing corridor representatives to understand the issues, setbacks, and expected path to be followed should they decide to implement CAD to reporting system integration. Discussions will focus on helping each state understand if CAD to reporting system integration is appropriate for their state. 3. Meeting summary documenting the meeting process, the feedback of attendees, and a perspective for each state moving forward with CAD to reporting system integration.

Project Title	4. North/West Passage Traveler Information Web Site
Project Champion	Mark Nelson, Minnesota DOT
Project Purpose	Develop a corridor based web site focused on presenting travel information related to I-90/I-94. The inspiration for this idea was based on the I-5 corridor web site on which Washington participates with California and Oregon. The initial information presented for the North/West Passage web site would focus on major events as defined in Project 1 – Corridor-wide Consistent Major Event Descriptions. The North/West Passage site would be linked to/from each of the individual state 511 (or related state-wide traveler information) web sites to encourage use. The site also could be developed to serve as a foundation for providing similar information at kiosks in rest areas, restaurants or other venues along the corridor.
Current Status	All of the North/West Passage states have state-wide road condition and construction related web sites. All, except Wisconsin and Wyoming, also co-brand their web sites with state-wide 511 telephone services. Five of the eight states also use a centralized reporting system to populate their web sites. The other three – Wisconsin, North Dakota, and Wyoming – pull their data from separate databases to publish state-wide travel information. Finally, it also is important to note that not all of the states report the same type of information. All of them provide construction and winter road condition information, but they do not all provide incident (e.g., crashes), congestion or commercial vehicle (e.g., weight/height restrictions) related information. Therefore, the definition of "major events" and what is displayed on a corridor web site must be carefully considered to ensure quality and manage traveler expectations.

Project Title	4. North/West Passage Traveler Information Web Site
Approach	Project 1 – Corridor-wide Consistent Major Event Descriptions should be completed prior to this project to ensure a consistent definition for "major events" and how those events will be described to travelers on a web site or via any other medium (e.g., 511 telephone). With this foundation established, the states could develop one common technical approach for a North/West Passage web site to collect information from each state's individual reporting system or systems. For example, all states could be required to develop an XML stream of their data that the North/West Passage web site could then parse for relevant information to post. The benefits of this approach would be minimal administration for the state assigned responsibility for the web site, and a process for future travel information distribution (e.g., via kiosks) would be established. Potential costs to this approach could be the need for one state to be responsible for administering the web site for quality and availability, and the broader exchange of information among TOCs could be limited. A further simplified approach may be to develop a web site with links to the individual states' camera views and a list of links to the individual existing state web site. Regardless of the approach ultimately selected, it is recommended that the web site be used as an evaluation mechanism for further, more complex integration efforts among the states. For example, hits to the site could reflect a general level of interest among corridor travelers in using a web site as a tool to receive such information. Hits also could reflect the value of the actual information contained on the site. Random surveys also could be developed for the site to get more direct feedback from visitors.
Benefits	This approach offers a simpler, less expensive and potentially shorter duration project to achieve the overall desire for a corridor web site. If evaluation is incorporated into the project, it may also serve as a tool for gauging the value of more complex integration among traveler information systems in the corridor. Finally, this project presents an opportunity to provide consistent, real-time information aimed at enhancing travel in the corridor. The specific issues and needs identified in Chapter 2 that this project could address are: ▪ Lack of consistent and adequate traveler information ▪ Ongoing demand to update and maintain traveler information ▪ Lack of consistent and adequate real-time information that would enhance corridor-wide travel ▪ Inconsistent and unreliable information for commercial vehicle travelers
Participants	All states
Duration/Timing	The estimated duration to complete this project is 9 to 12 months, and the suggested timeframe for scheduling this project is mid-2007.

Project Title	4. North/West Passage Traveler Information Web Site
Costs	The estimated cost to complete this project is $30,000, and the estimated operational costs for the web site are $1,500 to $2,000.
Deliverable	1. Concept of Operations and Preliminary Design Document for corridor-wide ATIS website. 2. Operational website supporting travelers of the corridor with camera images, links to weather reports, and links to state operated traveler information. 3. Usage feedback on the level of public use of the corridor-wide website.

Project Title	5. 511 Call Forwarding and Evaluation of Cross Border Information Requests
Project Champion	Bob Koeberlein, Idaho DOT
Project Purpose	The purpose of this project is to offer a short-term, easily deployed solution for making corridor-wide 511 traveler information available to callers at any location along the corridor using call forwarding options among member states. The second goal of this project is to evaluate the demand for corridor-wide information by tracking the number of requests from callers to be transferred to neighboring North/West Passage states. The evaluation is expected to gain insight about the actual demand from callers for information on neighboring states along the corridor. While it is generally agreed that it will be beneficial to offer information on other states along the corridor (either through call forwarding or event description exchange), this will provide real-world numbers on the actual volume of requests for information on conditions in other states.
Current Status	Currently, 511 phone systems are operational in seven of the eight North/West Passage states. Wisconsin is currently researching and planning for a 511 system. Each system offers the ability to perform call forwarding to other phone systems, and each system allows for tracking of call forwarding activities. The 511 systems in the North/West Passage states are operated through a variety of approaches that include internal operations and outsourcing of operations. Therefore, modifications to the 511 systems would best be performed by each North/West Passage member state.
Approach	The proposed approach to this project is to develop and agree to a consistent approach for forwarding callers from one state 511 system to another. This approach might include common recordings/menu options for offering callers the option to be transferred to other North/West Passage states (e.g., "For call transfer to neighboring states, press or say 9"). Then, each state will be asked to implement the call forwarding option to at least the neighboring North/West Passage states, ideally allowing callers to request any North/West Passage state. In addition, each state will be asked to modify their 511 phone system to track the number of requests for transfers to the other member states. Additional tracking (if possible) also would be useful. For example, some 511 systems may be able to track if the call came in to their system by being forwarded from another state, and it might be of value to report and evaluate the time callers spend after arriving at another state's 511 system. The evaluation can serve two key purposes: The evaluation can assess the demand for information in surrounding states. 1. If little or no demand exists, this will be valuable information for future project considerations, such as event sharing among states. 2. The evaluation can assess the likely long-term costs of call forwarding fees and other costs associated with this approach operating over the long term.

Project Title	5. 511 Call Forwarding and Evaluation of Cross Border Information Requests
Benefits	The benefits of this project are that travelers would (in the near term) have the ability to be forwarded to any North/West Passage state's 511 phone system to address: ▪ Lack of consistent and adequate traveler information ▪ Lack of consistent and adequate real-time information that would enhance corridor-wide travel ▪ Inconsistent and unreliable information for commercial vehicle travelers The initial stage of this project should involve assessing those North/West Passage states that currently offer call forwarding to other states to better understand the projected number of calls that may be forwarded. Each North/West Passage state will have a different cost structure for each forwarded call (depending upon their approach to long distance and call transfers). This will further enable projection of the operational costs associated with offering call forwarding throughout the corridor. North/West Passage members should accept that the common marketing and promotion of the availability of 511 will likely increase the call forward requests.
Participants	This project would ideally involve all North/West Passage member states. However, the participation of states could begin with one or two member states deciding to implement the call forwarding option. Therefore, it is recommended that all North/West Passage states participate in the initial planning of options for forwarding, to ensure there is agreement about how the call-forwarding is offered. Then, individual member states may decide to implement the call forwarding as desired.
Duration/Timing	In addition, the evaluation portion of the project will provide valuable insight to guide other proposed projects. The estimated duration is three to six months for the initial configuration planning. Timelines for implementing the call forwarding will depend on each state's schedule for changes to their 511 system.
Costs	$10,000 is estimated for the initial configuration planning. However, each state will bear their respective costs for implementing the call forwarding. The call forwarding also will have some operational cost impacts for the additional calls placed. Again, the operational cost impacts will vary according to the telephone service operated for each state's 511 system and call volumes.
Deliverables	1. Operational call forwarding between all North/West Passage states (exact parameters of forwarding to be determined) 2. Evaluation feedback on the demand for (and usage of) call forwarding to access neighboring states' travel information.

Project Title	6. North/West Passage Traveler Information Kiosks
Project Champion	Ed Ryen, North Dakota DOT
Project Purpose	This project will build upon the framework established by Project 1 – Corridor-wide Consistent Major Event Descriptions, Project 4 – North/West Passage Traveler Information Web Site, and Project 5 – 511 Call Forwarding and Evaluation of Cross Border Information Requests. This framework allows for the provision of information via other mediums such as HAR, DMSs, kiosks, and Wi-Fi. In recent years, some state DOTs, for example the Iowa DOT, have tested and are now providing free Wi-Fi access to travelers at rest areas throughout the state. The purpose of this project is to further expand the mediums that deliver information to travelers in the corridor.
Current Status	North Dakota, South Dakota, and Montana currently offer kiosk services at rest areas and other locations along I-90 and I-94. The kiosks offer access to an array of travel-related information on tourism, road information, and so forth. Although relatively unsuccessful several years ago, when they were first conceived as a tool for distribution, traveler information kiosks have since undergone dramatic transformations in functionality, style, and acceptance.
Approach	For this project, kiosks would be targeted for deployment in key rest area locations along the corridor to deliver information to targeted audiences traveling I-90 or I-94. The kiosks should offer a version of the web site created earlier for the corridor with emphasis on major events. This will streamline and ensure more consistent provision of information to travelers. There are a variety of kiosk styles available, and this project should include a task to identify the desired functions to evaluate potential kiosk styles against. For example, the states should consider whether touch screens or printing capabilities are essential for the kiosks.
Benefits	The primary benefit of this project is its ability to directly target travelers using the corridor in a real-time fashion. It also does not require the traveler to have electronic equipment (e.g., cell phone or PDA) of their own to access the information. Roadside advertising (e.g., service signs) also could be incorporated into this project to make travelers aware that information is available at the selected locations.
Participants	All states
Duration/Timing	The estimated duration for this project is 9 to 12 months, and it is suggested that it be scheduled for initiation in 2008.
Costs	The estimated deployment cost per kiosk is $29,000 to $72,000.[1] If two kiosks were deployed in each state at the point of entry and mid-point, 16 kiosks would be needed and the estimated deployment cost would be $464,000 to $1,152,000. The estimated annual operating cost for an individual kiosk is $1,700 to $5,800.[2]
Deliverables	1. Review and comparison of kiosk approaches 2. Deployment of operational kiosks allowing travelers to access the North/West Passage corridor-wide ATIS website.

[1] ITS Benefits, Costs and Lessons Learned (2005), Appendix A.1, Remote Location, Interactive Kiosks
[2] ITS Benefits, Costs and Lessons Learned (2005), Appendix A.1, Remote Location, Interactive Kiosks

Project Title	7. Corridor-wide Marketing and Outreach to CVOs
Project Champion	To Be Determined.
Project Purpose	The purpose of this project is to establish brand recognition for the North/West Passage Corridor and to initiate outreach and education to the CVOs that travel the corridor regularly. While the North/West Passage Corridor will be used by commuters, vacationers, and leisure travelers, the CVOs who regularly drive long routes along the corridor will likely be the biggest benefactors of the coordinated information available for the entire corridor. CVOs also are most likely repeat drivers of the corridor and, therefore, may quickly build habits of regular use of traveler information systems offered along the corridor. A secondary purpose to this project will be to work with a qualified marketing team to establish a "brand" image for the North/West Passage Corridor. This image will consist of the nomenclature to be used when announcing the corridor to the traveling public (e.g., this may be "The I-90/I-94 Corridor" or "The Corridor between Seattle and Milwaukee"). In addition, common graphics, images, and other materials will be developed for use in press releases, public statements, and the promotion of services to the traveling public. As one example, the North/West Passage states might consider that each member state's 511 system contain an option "9" on the menu that allows for call forwarding to other North/West Passage states or allows for corridor-wide information reports. Regular travelers of the corridor would then come to remember, "For information on other states along the I-90 or I-94 corridor, press 9 or say corridor" and be comfortable requesting this information regardless of their location.
Current Status	There currently are a number of established communication channels to reach CVOs. Member state agencies may support commercial vehicle web pages displaying permitting information or may perform regular mailings to carriers. In addition, many carriers regularly purchase permits at DOT facilities. The first task of this project would be to assess the current communication channels that exist with commercial vehicle carriers (both real-time and periodic communication) in an effort to develop a market outreach plan. In addition, the public affairs coordinators in each member state likely will have established procedures and processes that must be respected, and in many cases, can be leveraged to accomplish this project.

Project Title	7. Corridor-wide Marketing and Outreach to CVOs
Approach	The approach to performing marketing and outreach to CVOs along the corridor should begin with an initial stage to develop a marketing plan for outreach to commercial vehicle customers along the corridor. This plan should consist of defining "who" the primary target audience is. Then the North/West Passage members should develop and reach consensus on "what" messages are to be conveyed to the primary audience (e.g., one option might be that the message is to inform them of the North/West Passage web site and the ability to call transfer to any North/West Passage state by calling 511). Then the market outreach effort should define "how" the communication will be performed. This is where the existing communication channels (and use of flyers, web announcements, press releases, or media outlets) also will be utilized. The second phase of the project should focus on performing the outreach to commercial vehicle carriers by executing the marketing plan.
Benefits	Increased awareness by CVOs and dispatchers of the traveler information available along the corridor and especially about the coordinated manner in which information is offered on the North/West Passage web site and coordinated 511 systems. A secondary benefit will be the establishment of a "brand" image for the corridor that member states can use in press releases, informational flyers, and other outreach to travelers. This will help ensure that the corridor is presented in a common format throughout the states. This project will specifically address the following traveler information needs identified in Chapter 2: ▪ Commercial vehicle traveler frustration with rest area restrictions, multiple and uncoordinated points for getting permits, etc.
Participants	All states
Duration/Timing	It is suggested that this project be targeted for 2008 after the corridor web sites, kiosks, and 511 options have been established for travelers to use.
Costs	$55,000 ($35,000 for Phase 1, $20,000 for Phase 2). It would also be expected that member states might utilize their public affairs personnel and/or resources to produce marketing materials such as graphics, mailings, news releases, etc.
Deliverables	1. Corridor-wide outreach and brand recognition Marketing Plan. 2. Outreach effort to introduce and promote the corridor-wide ATIS website and other operational systems to commercial vehicle operators.

Project Title	8. Information Systems Network
Project Champion	Vince Garcia, Wyoming DOT
Project Purpose	Several of the North/West Passage states are exchanging various levels of information, but they are doing so from individual system to individual system. This project presents a new cohesive system for all states. The new system would then represent one source from which other systems may draw information – for traveler information or maintenance and operations use. One challenge for this project will be to develop a system that functions seamlessly with the individual reporting systems that the states may operate (e.g., CARS, RCRS, etc.). Another significant challenge lies in determining which state(s) will own and operate a new system such as the one identified for this project.
Current Status	The majority of North/West Passage states currently operate some form of a condition reporting system and/or information assembly and data archiving tool, or will likely be deploying one shortly. However, the sharing of event reports between these systems (inter state information exchange) does not happen. There has been considerable development of ITS standards for data exchange, and these standards as well as common internet exchange standards and the common event descriptions developed in project #1 should be capable of supporting the development of an information systems network throughout the corridor.
Approach	Develop one common information network that individual reporting systems could push/pull data to/from. This approach could allow for more extensive information sharing among TOCs. This approach is similar to the ISN concept developed by the I-95 Corridor Coalition. As in the ISN Concept of Operations (September 2005), "The express purpose of the ISN is to provide the ability to share event information between systems across all transportation agencies operating along the corridor. The ISN will fundamentally be a network of transportation information services with new standardized interfaces, and of new management components, administrative interfaces, and policies needed to make it coherent and cohesive."
Benefits	Implementation would allow North/West Passage states to openly exchange event information among member states. Therefore, one state could assimilate all the crash, roadwork and weather events, for example, from another state and offer a high-level report on the 511 phone or web system about the travel conditions as travelers move into other states. The largest benefit would be in allowing travelers to access travel information for neighboring states without the need to perform call forwarding or internet page links.
Participants	All states; however, the project could initially involve a subset of states to demonstrate the technology and assess the value.
Duration/Timing	The estimated duration for this project is one to three years, with a 2009 initiation.

Project Title	8. Information Systems Network
Costs	The costs are estimated in two phases: Phase 1: Concept of Operations definition and consensus building: $45,000 Phase 2: Software development of exchange network: $100,000-$200,000 (depending upon exact features and complexity of information exchange network)
Deliverables	1. Concept of Operations for an information exchange network (defining what events are uploaded to the network, the format and process for both uploading, updating, and removing events, and also the processes for accessing and downloading event information). 2. Operational information exchange network, where each state DOT sends data and has the option to download other states' data and information for dissemination to travelers within their state.

Project Title	9. Route Selection Information Support Tool
Project Champion	To be determined
Project Purpose	The purpose of this project is to develop a multi-state process and related system to provide information on optional routes along the corridor. Existing condition reporting weather and traffic monitoring, and the use of Maintenance Decision Support System (MDSS) and Clarus technologies along the corridor would be used collectively to formulate reports on the alternate routes.
Current Status	The traveler information systems in place or in development are capable of reporting events along the corridor. In many situations, the reporting systems, sensors, and forecast systems produce the data and information needed for alternate routes. The missing component is the process of building a report that compares and contrasts the current conditions along two routes in order to provide a "snapshot" of useful information that commercial and leisure travelers could use in their decision-making process. Given that the corridors in question may cover many states, this is an opportunity to add value to traveler information through collaboration.
Approach	The proposed project would include two distinct phases. Phase 1 will be development of a detailed operational concept and system design. Phase 2 would be the development and implementation of the software and/or systems needed to execute and operate the set of procedures and processes.
Benefits	The benefits of this system would be realized primarily by CVOs. In addition to receiving a comparison of the alternate routes, travelers also would receive a high level summary of the corridor.
Participants	All states
Duration/Timing	Phase 1: 12 months Phase 2: 18-24 months The suggested timing for this project is 2011.
Costs	Phase 1: $100,000 Phase 2: $250,000-350,000
Deliverables	1. A Concept of Operations and detailed system design. 2. An Operational system delivering a set of alternate route summaries that may be used by any North/West Passage state to disseminate within their own traveler information system (web, phone, DMS, etc.).

Project Title	10. North/West Passage Traveler Information for Internet Service Providers (ISPs)
Project Champion	Brandi Hamilton, Montana DOT
Project Purpose	The intent of this project is to better understand the date requirements of for-profit third party traveler information service providers.
Current Status	Several of the states who operate state-wide reporting systems freely provide their data to any interested party. For example, Minnesota publishes an XML stream of content from the Condition Acquisition and Reporting System (CARS). The data is used by a variety of ISPs to deliver value-added services to consumers.
Approach	This project proposes to develop a North/West Passage Corridor RFI targeting ISPs, automobile manufacturers, and after-market device manufacturers requesting information on the availability of information delivery in any city along the corridor, and to assess interest from the responders in receiving additional data from North/West Passage member states. The RFI is envisioned to achieve the following benefits: ▪ Better understand how public agency traveler information data is being used and by whom. ▪ Promote the North/West Passage states and their cooperation to establish the existence of the group ▪ Potentially initiate relationships with private or public entities that could lead to VII or Clarus related partnerships.
Benefits	The primary benefit associated with this project is in understanding if the states can significantly expand the availability of traveler information throughout the North/West Passage Corridor by partnering with ISPs. The project could address all of the issues and needs identified for traveler information in Chapter 2. In particular, it would significantly improve the level of information available for CVOs, many of whom are already using ISPs for travel related information.
Participants	All states
Duration/Timing	The estimated duration for this project 6 to 12 months, and it is suggested that it be scheduled for 2012.
Costs	The estimated cost for this project is $5,000 to $10,000 based on the time and effort required to prepare, solicit, review, and summarize the RFI and resulting responses.
Deliverables	1. Responses to RFI from information service providers, documenting the current state of the art in in-vehicle Information service delivery and expressions of interest in delivering information throughout the North/West Passage corridor.

In addition to traveler information and the projects presented in this chapter, Maintenance and Operations within the corridor were also identified as priority issues for the states to collaborate on. Chapter 8 will present another series of projects around the theme of Maintenance and Operations in the North/West Passage.

Chapter 8: Maintenance and Operations

Similar to traveler information, the North/West Passage states have identified maintenance and operations as another priority ITS service for the I-90/I-94 corridors. The goal for maintenance and operations is to integrate systems and control philosophies so that states can initiate an appropriate and timely response to maintenance needs near state borders, particularly in response to weather-related events. To collaborate effectively, the states must understand the maintenance and operational procedures of their neighboring states and be willing to establish shared operational procedures in the border regions. This chapter will present a sequence of recommended projects geared toward achieving the maintenance and operations goals and objectives identified for the North/West Passage Corridor For each project, a title, description, and timeframe will be provided in addition to potential stakeholders/partners, related initiatives (state and federal), architecture and standards considerations, and estimated cost.

8.1 Maintenance and Operations Projects

The goal established for maintenance and operations along the North/West Passage Corridor is to integrate systems to improve the exchange of information between corridor states in an effort to improve the reliability and safety of travel along I-90/I-94. This effort includes an improved understanding the resources available to, and the control philosophies undertaken by the individual states to maintain the corridor, especially along the stretches of roadway near state borders. The integration of systems, the sharing of the information, and the improved understanding of agency responsibilities and control philosophies will help maintenance and operations appear seamless to the traveler.

The recommended projects for the North/West Passage are a series of low cost projects that lay the groundwork for fostering coordination among the states and promoting common understanding of the procedures each state follows when maintaining roadways at or near state borders.

The maintenance and operations projects recommended for the North/West Passage are listed chronologically below followed by brief summaries of each project concept.

Project Title	
1. Focused Workshops	
2. Center-to-Center Communications for Concept of Operations	
3. Camera Image and RWIS Sensor Data-sharing	
4. Develop Agreements with CVOs to Deploy Vehicle Probes	

Table 8-1: Maintenance and Operations Projects

Project Title	**1. Cross Border O&M Collaboration Workshop**
Project Champion	To be determined
Project Purpose	This workshop will focus on four major topics related to collaborating operations and maintenance across borders throughout the corridor. <u>Topic #1 – Maintenance Operations (Lessons Learned)</u> This topic will allow participants to understand other states' standards for maintenance in the corridor with emphasis on operations at or near state borders. With this understanding, states can identify areas where maintenance operations may be insufficient, but improved through improved coordination with neighboring states. Issues that should be addressed under this topic include: ▪ The types of events each state responds to. ▪ The level of urgency each type of event is given. ▪ The existing and planned resources that are typically applied to each event. ▪ Needs each state has that may be addressed through coordination with other states. <u>Topic #2 – Equipment and Resource Sharing</u> This topic will include discussion of how states can share equipment and resources when maintenance needs arise at or near state borders. Maintenance needs for corridors like I-90 and I-94 do not end at state borders, but rather transverse them. More often than not, institutional responsibilities and boundaries prevent states from performing services within another state. For example, equipment, such as snowplows, traditionally clear roadways up to the state border, but not beyond. Maintenance equipment positioned near state borders may be used more effectively if used to clear roadways on each side of the border. <u>Topic #3 – Camera and Sensor Data-sharing</u> This topic will involve discussion of how states can share camera images and provide access to RWIS sensor data. States will consider what data is available, how it might be used, how it might be shared (technically), and what agreements may need to be in place to facilitate sharing.

Project Title	1. Cross Border O&M Collaboration Workshop
Project Purpose	Topic #4 – Incident/Construction/Event Information Data-sharing As with the previous topic, this topic explores further information sharing among other data sources. Again, the states will consider what data is available, how it might be used, how it might be shared (technically), and what agreements may need to be in place to facilitate sharing. The anticipated benefit of this type of information sharing is improved freeway operations near state borders by quickly identifying incidents, construction activities and events beyond state borders, and rerouting traffic as needed.
Current Status	The procedures for maintaining roadways and the desire/ability to share resources across state borders vary between states. There may be individual agreements (informal and formal) between two or more states, but to date there has been no coordination on a corridor-wide basis.
Approach	This project should start with an investigation that looks into if and how other states currently share data, equipment, and resources. This investigation should focus on topic areas 2, 3, and 4. In doing so, the investigation should provide case studies to serve as the foundation from which further collaboration could be identified and consensus achieved. This workshop would devote a half day to each topic identified above in the project purpose section. Ideally, all four topics would be discussed over a two-day period, reducing the expense of multiple trips. The states' maintenance personnel will be asked to participate and provide their lessons learned for providing maintenance operations within their respective states. Appropriate points of contact knowledgeable in daily maintenance activities along the corridor need to be identified by the states and then asked to participate in the workshops. An appropriate amount of time between when invitations are sent and when the workshop will be held should be accounted for to allow as much participation as possible. The pertinent findings of the workshop should be documented in a summary report and distributed to each state. During the workshop, the applicable results of the investigation should be presented to facilitate discussion and to obtain consensus on whether specific agreements should be developed. The states should investigate using an external party to conduct the investigation, coordinate workshop logistics, facilitate the workshop, and develop the summary report.
Benefits	This project will allow states to share the procedures they follow to maintain their roadways. Based on this understanding, states can begin to identify gaps in their existing operations and take steps toward improvement. Resulting agreements will strengthen the working relationships between states.
Participants	All states.

Project Title	1. Cross Border O&M Collaboration Workshop
Duration/Timing	The estimated project duration is 6 to 9 months, allowing for individuals' schedules, workshop preparation including initial investigation into state's operating procedures, the actual workshop, and a technical memorandum summarizing the pertinent findings of the workshop.
Costs	The estimated project cost includes $10,000 for an external party to prepare, deliver, and summarize the workshop. An additional $30,000 is expected for meeting facilities and travel for 24 (three from each of the eight states) participants at approximately $1,000 each. There are no operational costs associated with this project.
Deliverables	▪ Four (4) One half day workshops ▪ Workshop materials (e.g., presentations and meeting summaries corresponding to each workshop) ▪ Three (3) Technical Memos summarizing the results of the investigation in the states' procedures for sharing data, resources and equipment. One technical memo for each topic addressed by workshops 2, 3, and 4.

Project Title	2. Center-to-Center Communications Concept of Operations
Project Champion	To be determined
Project Purpose	This project will develop a detailed concept of operations that specifies the states' approach to sharing information between states' operations and maintenance centers (e.g., state-to-state). The concept of operations will bring together the findings of the workshops outlined in project #1 and will use these findings to develop a methodology to share the pertinent information discussed in these projects. The project should define agency roles and responsibilities, systems to be used, general types of information/data to be exchanged, the format that the information/data will be stored, the periods/timeframes that data will be exchanged, and other processes that should be followed when exchanging data.
Current Status	At the April 2006 stakeholder workshop, the states collectively agreed that center-to-center communications would be the sole method by which electronic data will be exchanged across state borders. Although center-to-center communication currently occurs between several states via non-automated means (e.g., e-mails, fax, phone calls) and, to a somewhat limited degree, more efficient and automated means to collect and receive neighboring state data is desired.
Approach	The concept of operations, which likely would be facilitated by a third party, will document the state-of-the-practice in center-to-center communications; identify barriers to integration, and strategies for addressing these barriers. To date, part of the difficultly that has prevented neighboring states from implementing projects like this is that communications platforms vary from state to state and much of the data that is collected by individual states is in a proprietary format that cannot easily be shared or integrated into systems owned and operated by neighboring states. The concept of operations will serve as the basis for detailed system design The concept of operations will be prepared and documented in a final report and disseminated to each participating state upon completion of the project.
Benefits	This project will provide an open forum in which individual needs can be stated and a corridor-wide consensus regarding the exchange of information/data can be achieved. Furthermore, the high-level concept of operations will promote the design of systems that complete the corridor vision for exchanging information/data.
Participants	All states
Duration/Timing	The project is anticipated to take 9 to 12 months. Anticipated timing for this project is 2009
Costs	$200,000 to $250,000. This estimate includes travel to/from 2 workshops for 2 representatives from each state for a period of 2 days/1 night each.
Deliverables	1 Draft Concept of Operations Document 1 Final Concept of Operation Document

Project Title	3. Camera Image and RWIS Sensor Data-sharing
Project Champion	To be determined.
Project Purpose	The purpose of this project is to allow states to access camera images and RWIS sensor data (pavement and roadside) from bordering states. Of primary interest are systems located near state borders that may benefit the operations of the neighboring state. By providing access to data and images, neighboring states will have the ability to make more informed operational decisions during weather-related events. Specifically, this integrates the RWIS hardware currently owned and operated by the various states within the corridor and will feed the data collected by these systems into one standardized system that can account for the variances in data and make the data to each state.
Current Status	Camera images and RWIS data are available, but are not shared among the states. All state DOTs, with the exception of Idaho and South Dakota, operate CCTV along segments of I-90/I-94 within their state borders. CCTV cameras are most prevalent within the large urban areas of Milwaukee, Minneapolis/St. Paul, Spokane, and Seattle. CCTV also are present in more remote locations; however, there are less cameras deployed in these locations.
Approach	In order to integrate camera images and RWIS data (e.g., pavement and environmental conditions), it is necessary to develop/deploy software that can translate the data formats of several vendors into one "universal" format.
Benefits	Sharing camera images and RWIS sensor data will help streamline agency maintenance operations, reducing the cost to agencies for maintaining their respective segments of I-90/I-94. ▪ Improved weather forecasting along the corridor ▪ Allows effective planning of maintenance routes ▪ Reduce wear on vehicle fleet ▪ Reduce chemical, salt, and sand usage ▪ Improved level of service
Participants	All states
Duration/Timing	This project should follow the Traveler Information Project #2 (Clarus Regional Demonstration Concept of Operations), Maintenance Operations Project #1 (Camera and Sensor Data-sharing MOU Agreements), and Maintenance Operations Project #2 (Center-to-Center Communications Concept of Operations).
Costs	$250,000 to $500,000
Deliverables	Software development and license for eight states

Project Title	4. Develop Agreements with CVOs to Deploy Vehicle Probes
Project Champion	To be determined
Project Purpose	The purpose of this project is to develop an agreement with CVOs to deploy sensors on commercial vehicles for the purpose of collecting data (vehicle position, air temperature, precipitation, etc.) in real-time across the I-90/I-94 corridor. These data may serve as inputs into models that identify areas affected by incidents or weather events.
Current Status	Currently, an agreement to share vehicle or probe data does not exist between any CVOs and the northwest passage states.
Approach	<u>Phase 1 – Preliminary Design Requirements</u> Before reaching out to CVOs, the North/West Passage states must have a preliminary sense for the outcomes that are to be achieved in deploying probes on commercial vehicles. In this regard, the states must collectively decide on the number of vehicles that need to be equipped to provide sufficient travel characteristics along the corridor. States must also determine the types of probes that can be used to collect desired information. <u>Phase 2 – CVO Outreach</u> Phase 2 will involve efforts to reach out to the commercial vehicle industry and explain the types of information that are desired and how these data may be collected. Outreach to CVOs should emphasize the benefits of vehicle probes in general and how data collected can be used to benefit the commercial vehicle industry. Due to the relatively large number of commercial vehicles that travel the I-90/I-94 corridor, only a small percentage of commercial vehicles need to be equipped (perhaps 5% of vehicles or less).
Benefits	The benefits of this project include: ▪ Continuous data collection ▪ Low data collection costs ▪ Automated Data collection ▪ Reduced data processing time ▪ No disruption to traffic
Participants	All states
Duration/Timing	The anticipated timeframe for this project is four to six months. It is suggested that this project be scheduled for 2009, soon after Traveler Information Project #7 (Corridor-wide Marketing and Outreach to CVOs) is completed. Implementing this project in this fashion will give this project the best chance to succeed
Costs	Phase 1: $75,000 to $100,000 Phase 2: $50,000 to $75,000
Deliverables	Draft Detailed Design Requirements Document Final Detailed Design Requirements Document Outreach to CVO community

Chapter 9: Deployment and Concept of Operations Plan

9.1 Introduction

Chapter 9 presents an approach for ITS deployment projects and a timeline illustrating the benefits that may be achieved as projects are completed over the next three to five years. To better understand how future North/West Passage deployment projects should be approached, the states modified the strategic planning process to initiate the preliminary design of a corridor-wide travel information web site (as proposed in Chapter 7). By initiating the corridor-wide web site during the planning process, the states have set the stage for an "early winner" project, and have gained the experiences of a real-world deployment project to assist in developing guidelines for future deployment projects.

The vision and near-term goals of the North/West Passage Corridor will be achieved through the development and execution of annual work plans based on the projects recommended in Chapters 7 and 8, and alternative projects when appropriate. Each annual work plan will identify the activities to be performed in order to advance the corridor toward its vision.

Chapter 9 has two distinct sections; the first describes a four stage project development process recommended to be performed as part of each ITS deployment project in the corridor. The description of each stage includes the activities/tasks to be performed. The content and recommendations in this section are based on the experiences of advancing the corridor-wide web site from concept through preliminary design and reflect real-world lessons learned about the states working together to deploy ITS projects. The second section of this chapter presents a potential deployment timeline including all the projects presented in Chapters 7 and 8. The intent of this timeline is to illustrate the expected outcomes and benefits should each of the projects be delivered. This deployment timeline is also presented as a guideline to support the annual work plan development and execution process.

9.2 North/West Passage Corridor Deployment Procedures and Policies

Based on initiation of the corridor-wide traveler information web site project, this section recommends a project development process for deployment projects. As the web site project moves from preliminary design to development, the process can be further tested and proven. The initial one to three months of the corridor-wide web site project will be the time when major decisions, deployment procedures, and policies are finalized. This section defines a process that the states can follow to complete the critical stages of project development and operations.

9.2.1 North/West Passage Project Development Process

North/West Passage deployment oriented projects will differ from the consulting and planning projects performed previously for the corridor. For example, the deployment projects will require ongoing operations and maintenance, and most often will require some form of long-term agreement among those agencies impacted. Based on the experiences of the North/West Passage states working together on the corridor-wide web site, the following stages are recommended for all North/West Passage deployment projects:

- Stage 1: Project Selection and Funding Commitments
- Stage 2: Preliminary Design

- Stage 3: Development
- Stage 4: Operations and Maintenance

9.2.2 Description of Each Project Development Stage

This section is intended to include direction on the processes and procedures that North/West Passage members will perform during each stage of deployment project development.

Stage 1: Project Selection and Funding Commitments

The North/West Passage Deployment Plan outlines a roadmap of deployment activities directed towards achieving a corridor-wide vision. This vision will be achieved through the development and implementation of annual work plans that best allocate the resources available for each year. The selection and funding of deployment projects along the corridor for each year's work plan development is different than earlier experiences selecting research or consulting projects, given the long-term commitment to operations and maintenance. Therefore, it is recommended that a formal selection process be followed to select projects and commit funding.

The North/West Passage Organizational Charter describes the annual preparation of a program work plan to be approved by the Steering Committee. In order to complete this annual work plan, the North/West Passage Steering Committee will need to identify projects, prioritize, and select those projects to fund each year. This section presents guidelines for project identification, prioritization, and selection to be approved by the Steering Committee prior to completion of the Deployment Plan.

Project Identification

The North/West Passage Deployment Planning process has identified a number of deployment projects that may be implemented over the next five to seven years. This "pool" of projects is an excellent source to ensure that annual work plan developments are working towards the ultimate vision outlined in this plan. In fact, this deployment plan has outlined a schedule for project deployments. Ideally, the annual work plans would reflect this schedule, and all projects agreed to be critical would be deployed over the coming years. However, funding and resource limitations create an environment within multi-state programs, such as this, where each year's deployment commitments must be taken one step at a time.

Additionally, individual states may have opportunities for leveraging other deployments within their state and, therefore, may suggest a North/West Passage project (outside of those presented in this plan) that they feel would be timely and opportunistic for deployment.

Finally, federal funding opportunities might present themselves at times, and the corridor states might be able to receive one-time or ongoing federal grants for deployments if solicitations are pursued.

The annual work plan process should involve the assembly of all the candidate deployment projects and circulation to member states at least one week in advance of any prioritization or voting efforts.

Project Selection and Funding Commitments

It is anticipated that North/West Passage Steering Committee members will vote and rank deployment projects during the work plan development process, and it is important to consider the following elements in deployment plan selection:

- The anticipated benefits to the overall corridor
- The funding availability for development and deployment
- The extent to which the project is compatible with the corridor vision and concept of operations
- The timeliness of the project (is it timely for deployment immediately).

Another factor that should be considered in the deployment selection process is any additional funds that member states would be willing to commit to the project, above and beyond the annual contribution to the North/West Passage Program that will enable project completion.

Given the above considerations, it is recommended that Steering Committee members complete a project ranking and voting sheet similar to the table below when selecting deployment projects for inclusion in the annual work plan.

Table 9-1: Sample Project Ranking/Voting Spreadsheet

Project	Voting Criteria	Possible Points	Awarded Points
Project A	Anticipated Benefits to corridor	10	
	Funding availability	40	
	Compatibility with vision and ConOps	40	
	Timeliness of Project	10	
	Total Points	100	
	Additional Funding Commitment		$_____
Project B	Anticipated Benefits to corridor	10	
	Funding availability	40	
	Compatibility with vision and ConOps	40	
	Timeliness of Project	10	
	Total Points	100	
	Additional Funding Commitment		$_____

Resource Commitments

The nature of multi-state ITS deployment projects most likely will require both development and operational/maintenance resources. These resources may be funding requirements or staff time for such things as information management, equipment maintenance, or quality control.

Because of the critical factor that resource commitments will play in North/West Passage deployment projects, it is recommended that each project selected include a funding and resource allocation plan when documented in the annual work plan. This plan should identify the

anticipated resource needs, define the approach for meeting the resource needs, and describe the commitment (either formal or informal) from each member state to address the resource needs.

Stage 2: Preliminary Design

For those deployment projects approved and funded by the North/West Passage Corridor Steering Committee, it is recommended that a second stage of project development be performed to develop a preliminary design for the project. The need for a preliminary design phase was evident during the initial call to begin the corridor-wide web site development. Key decisions, such as who would host the site and who would manage ongoing operations, were decided to be too difficult to answer responsibly without further information about the preliminary design of the project. Therefore, based on this experience, a formal preliminary design phase is recommended as Stage 2 for every corridor deployment project.

The preliminary design phase shall:

- Define the system development needs and specific tasks to be performed
- Estimate costs of development, equipment purchases, and operations
- Establish the needed interagency agreements to support the longevity of the deployed system or systems, including ownership of hardware and/or software
- Define cost sharing commitments from participating states and describe the mechanism for sharing costs and paying contractors or vendors
- Define preliminary estimates for the information technology (IT) or maintenance support needs for ongoing operations performed by the hosting state(s)
- Define the role of the North/West Passage Board in the project, as well as a role of a project team (if needed) and assemble the project team
- Confirm a project champion for the project development period (to follow the design phase)
- Confirm a project champion for the ongoing operations phase beyond the initial development and testing (Note: it is critical that the IT and maintenance needs be defined in enough detail such that member states can confidently commit to championing the ongoing operations.)
- Management of the preliminary design phase may be by the North/West Passage board, the administrative state, or a subgroup appointed to manage the design. Once a project development champion is selected, they shall take over the management of the design phase.

The preliminary design phase will typically involve the North/West Passage Board member representatives from one or more states, contributing to (or reacting to) the design as it develops.

Stage 3: Development Stage

The development stage shall:

- Perform the necessary administrative activities to establish agreements with public, private, or university contractors to perform the system development
- Develop the system(s) following the established systems engineering process whenever applicable
- Perform the needed testing, installation, and training to bring the deployment to reality
- Hand the ongoing operations of the system off to the operations champion, together with the needed supporting materials and documentation to support operations

The development stage of project development may either involve the North/West Passage Board members from each state, or in many situations, it may be more appropriate to involve representatives from the member states who work more closely with maintenance activities or traveler information activities or other technical roles.

Stage 4: Operations and Maintenance Stage

The operations stage of the project shall:

- Perform any needed external contracting or internal resource allocation to commit to the level of needed operation defined in the preliminary design phase
- Perform ongoing operations of the system(s) in a manner that meets the operational needs defined in the preliminary design stage
- Maintain and regularly review the ongoing agreements among participating agencies to ensure continued successful operations

The operations stage of project development will almost certainly rely heavily on other individuals inside participating North/West Passage state beyond the Board members. For example, if one state were to host a web page, it likely would be IT staff performing the daily hosting of the environment. As another example, if an ongoing operation involves in-field equipment maintenance, maintenance likely will be performed by the maintenance crew of the state hosting the equipment. However, the funding for such operations support may come from the North/West Passage Group, as defined in the interagency agreements developed in the preliminary design phase.

9.3 Project Descriptions and Impacts

9.3.1 Summary of Projects/Outcomes/Benefits

This section presents a summary of the anticipated benefits and/or outcomes of the projects defined in Chapter 7 and Chapter 8. It is unlikely that all the projects described in Chapter 7 and Chapter 8 will be funded and delivered as described; however, this section presents the benefits and outcomes of each to assist in future prioritization and the annual work plan processes.

Types of Benefits

The various projects included in the North/West Passage Deployment Plan for consideration in each year's annual work plan offer various benefits and outcomes. These are summarized into one of three categories:

- Benefits to Member States' DOTs – Many of the proposed projects are aimed to benefit the DOTs by increasing knowledge, establishing relationships with neighboring states, and generally supporting the operations and maintenance staff within the member states. Projects targeting these benefits may not result in outcomes that are directly observed by travelers; however, the service provided to travelers is expected to improve indirectly.

- Systems Deployed – A number of the North/West Passage projects will deploy systems, resulting in physical tools supporting either the DOTs or the travelers. These will most often require ongoing operations and maintenance support.

- Traveler Impacts – A number of the proposed projects have very tangible impacts that will be experienced by travelers upon deployment. These may be either through systems deployed or procedural changes within the DOTs.

The remainder of Section 3.1 presents the outcomes, benefits, and costs of the candidate projects in two different formats, with the intention of allowing member representatives to gain a perspective of what will be accomplished by the completion of the projects. Again, it is anticipated that these projects will be committed and executed as part of the annual work plan development process; however, these presentation of the outcomes, benefits, and costs of the projects is intended to allow each year's work plan development process to consider the larger corridor vision.

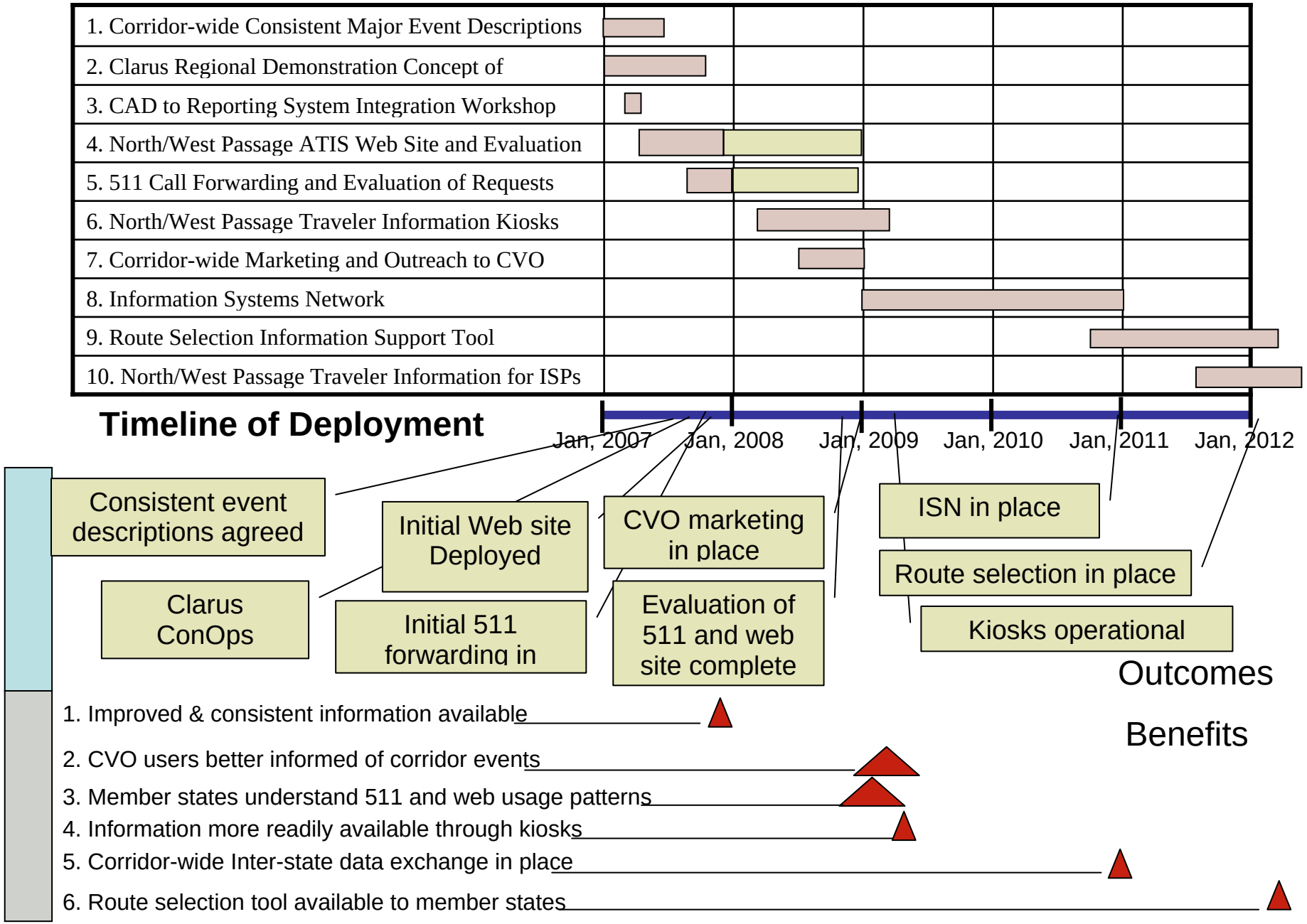
Table 9-2: Presentation of Candidate North/West Passage Projects' Costs, Benefits, and Outcomes

Year	Project and Estimated Costs	Benefits to Member States' DOTS	Systems Deployed	Traveler Impacts
2007	North/West Passage Traveler Information Web Site $30,000 ($1,500 to $2,000 annual)	Experience gained from first corridor-wide deployment project	24/7 operational corridor-wide ATIS web site	Access to all camera images, weather, traffic, and condition reports along corridor from one location
	Maintenance Operations – Lessons Learned Workshop $15,000 to $35,000	Understanding of neighboring states' standards for maintenance performance, and identification of shortfalls		
	Center-to-Center Communications Concept of Operations $150,000 to $200,000	The concept of operations will promote the design of systems that complete the corridor vision for exchanging information/data.		
	Corridor-wide Consistent Major Event Descriptions $20,000 to $25,000	Consistent naming and definition of limited event descriptions. Corridor positioned to perform cross border ATIS projects.		
	Clarus Regional Demonstration Concept of Operations (FHWA grant + local match)	Clear concept defined for the corridor's use of Clarus weather information.	Corridor states' weather data connected to Clarus	Improved weather information exchange and response.
	CAD to Reporting System Integration-Lessons Learned Workshop ($5,000 to $10,000)	Knowledge transfer of lessons learned to help states develop CAD-ATIS interfaces.		
	511 Call Forwarding and Evaluation of Cross Border Information Requests ($10,000)	Understanding of the perceived value by travelers of cross border 511 call forwarding.	Modifications (if needed) to individual states' 511 systems.	Access to neighboring states 511 systems.

Year	Project and Estimated Costs	Benefits to Member States' DOTS	Systems Deployed	Traveler Impacts
2008	Develop Equipment and Resource Sharing MOU Agreements ($50,000 to $75,000)	Closer ties (between corridor states) that over time will improve coordination of resources for such things as construction or incident response.		
	Camera and Sensor Data-sharing MOU Agreements ($50,000 to $75,000)	Closer ties (between corridor states) that over time will improve coordination and exchange of data and information between the states.		
	North/West Passage Traveler Information Kiosks ($29,000 to $72,000 per kiosk) ($1,700 to $5,800 per kiosk annual operations)	Allows corridor states to directly target en route travelers along the corridor (without any need for traveler-owned equipment (e.g., cell phones, pages, etc.)	In-field kiosks disseminating real-time travel information at selected locations.	Travel information available at key locations along the corridor.
	Corridor-wide Marketing and Outreach to CVOs ($55,000)	Outreach to the CVO community about available information and established a branding "image" of the North/West Passage Corridor, including a naming convention for describing the corridor		The CVO community is informed of the collaboration among North/West Passage states and aware of the travel information available.

Year	Project and Estimated Costs	Benefits to Member States' DOTS	Systems Deployed	Traveler Impacts
2009	Camera Image and RWIS Sensor Data-sharing ($250,000 to $500,000)	Intended to streamline agency maintenance operations, reducing the cost to agencies for maintaining their portions of the corridor.	Systems deployed to facilitate the exchange of multiple vendor equipment and systems.	
	ISN (Costs to be determined)	Interstate exchange of events stored in each states' condition reporting system.	May involve a new system deployment or may develop links between existing systems	Ability to be alerted to corridor-wide events by any states' ATIS system.
	Develop Agreements with CVOs to Deploy Vehicle Probes ($100,000 to $250,000)	Access to mobile probes of data along the corridor (reporting may include temperature, precipitation, position, wind speed, etc.)	Mobile probes located on commercial vehicles that travel the corridor	Increased content to North/West Passage corridor-wide ATIS web site
	Incident/Construction/Event Information/Data-sharing MOU ($50,000 to $75,000)	Allow states to gain awareness of event information outside their state and define data-sharing agreements		Increased ATIS dissemination about corridor-wide events
2011	Route Selection Information Support Tool ($350,000 to $700,000)	Ability to present alternate route comparisons at key locations.	Existing data collection combined with additional data processing systems to deliver increased information	Travelers receive high level summary of alternate corridor routes at key decision locations
2012	North/West Passage Traveler Information for ISPs ($5,000 to $10,000)	Increased understanding of the role private ISPs could play on the corridor.		May lead to corridor-wide real-time information dissemination over in-vehicle navigation systems, for example

Figure 9-1 Timeline of Projects, Expected Outcomes, and Benefits



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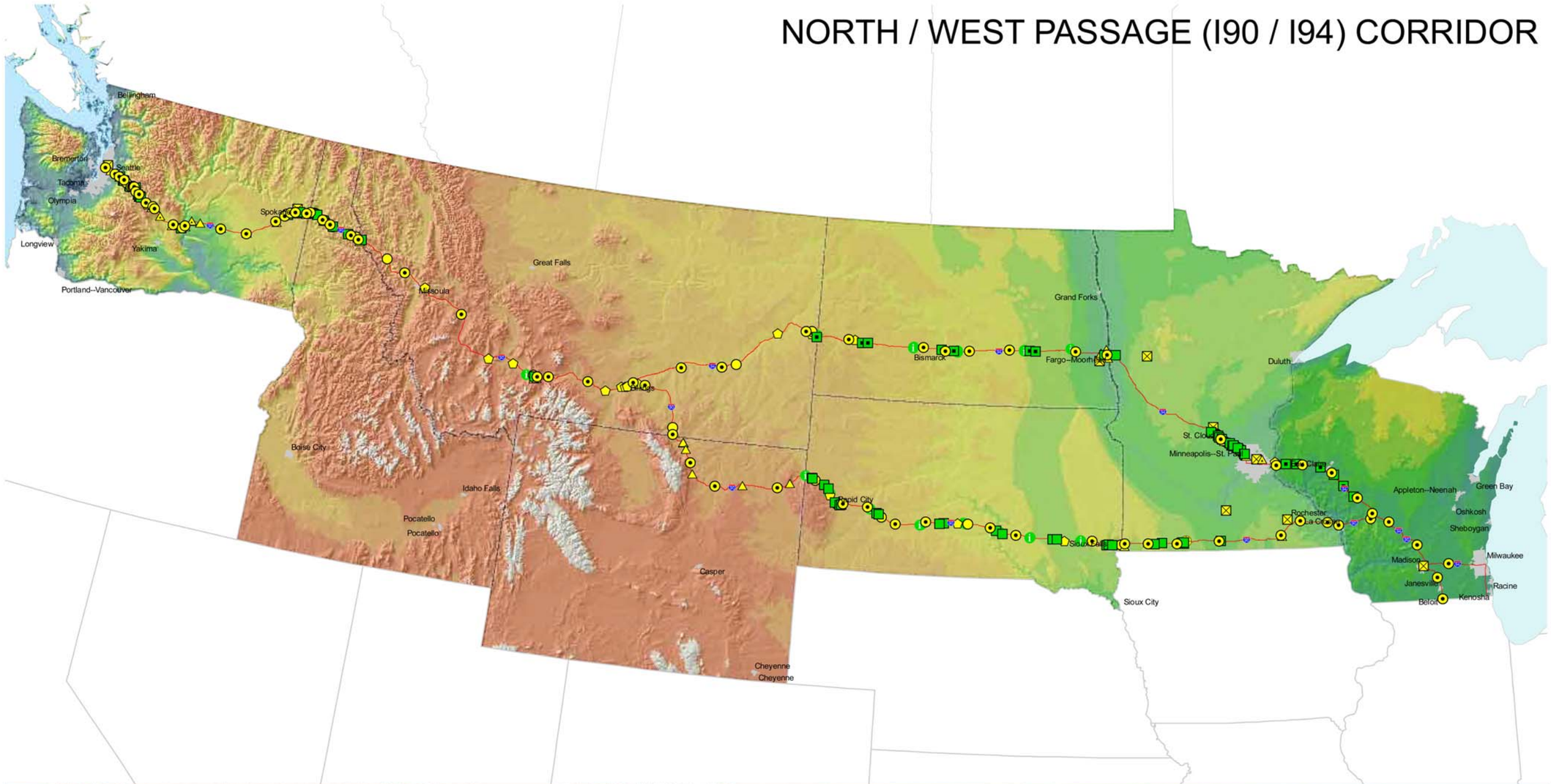
North/West Passage Stakeholder Interviews, 01/06.

Appendix A

North/West Passage ITS Inventory Maps

NORTH / WEST PASSAGE (I90 / I94) CORRIDOR



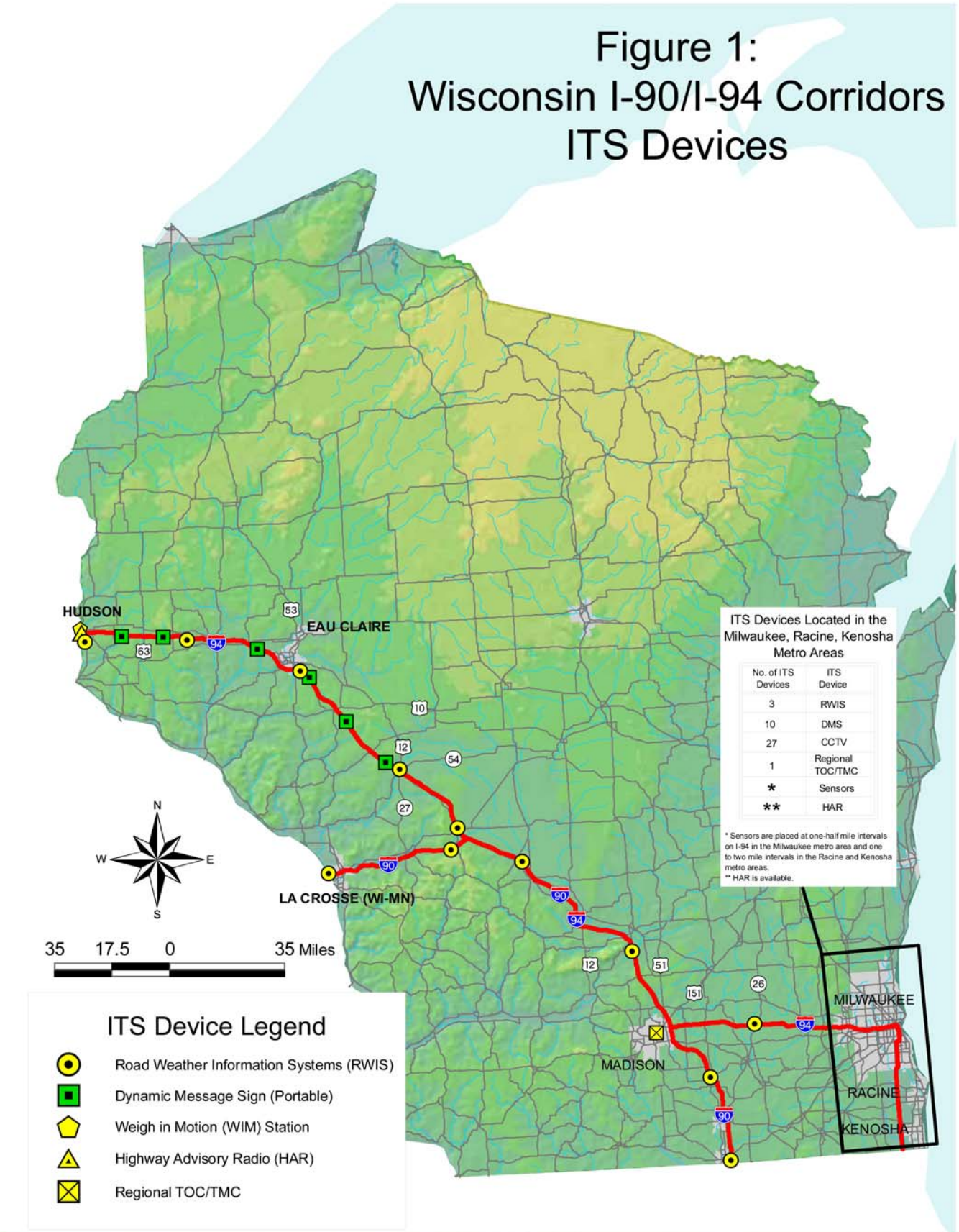
ITS Device Legend

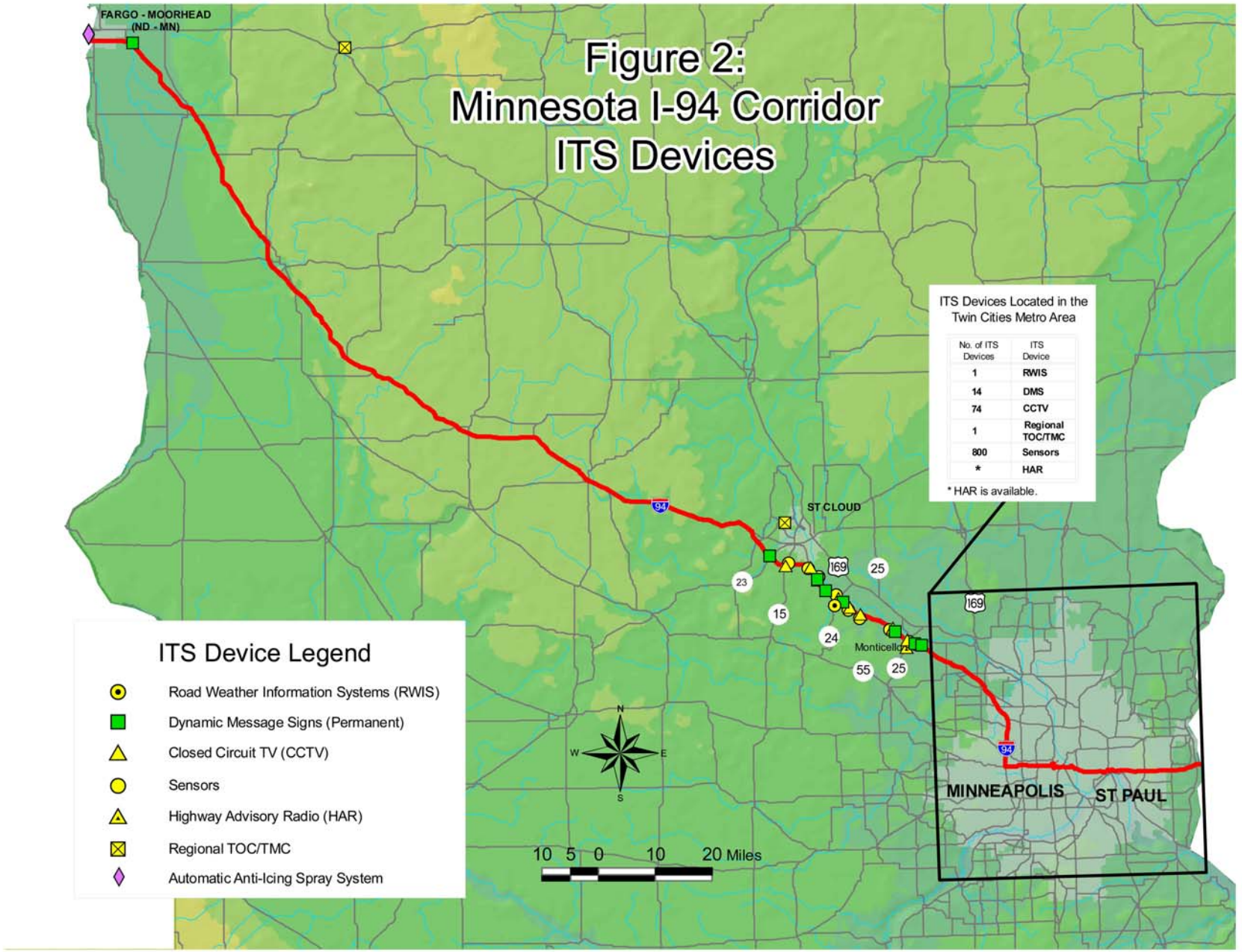
- Road Weather Information Systems (RWIS)
- Dynamic Message Sign (Portable)
- Dynamic Message Sign (Permanent)
- Closed Circuit TV (CCTV)
- Sensors
- Weight in Motion (WIM) Station
- Highway Advisory Radio (HAR)
- Rest Area Kiosks
- Regional TOC/TMC
- Variable Speed Limit (VSL) Sign
- Automated Gate Closure

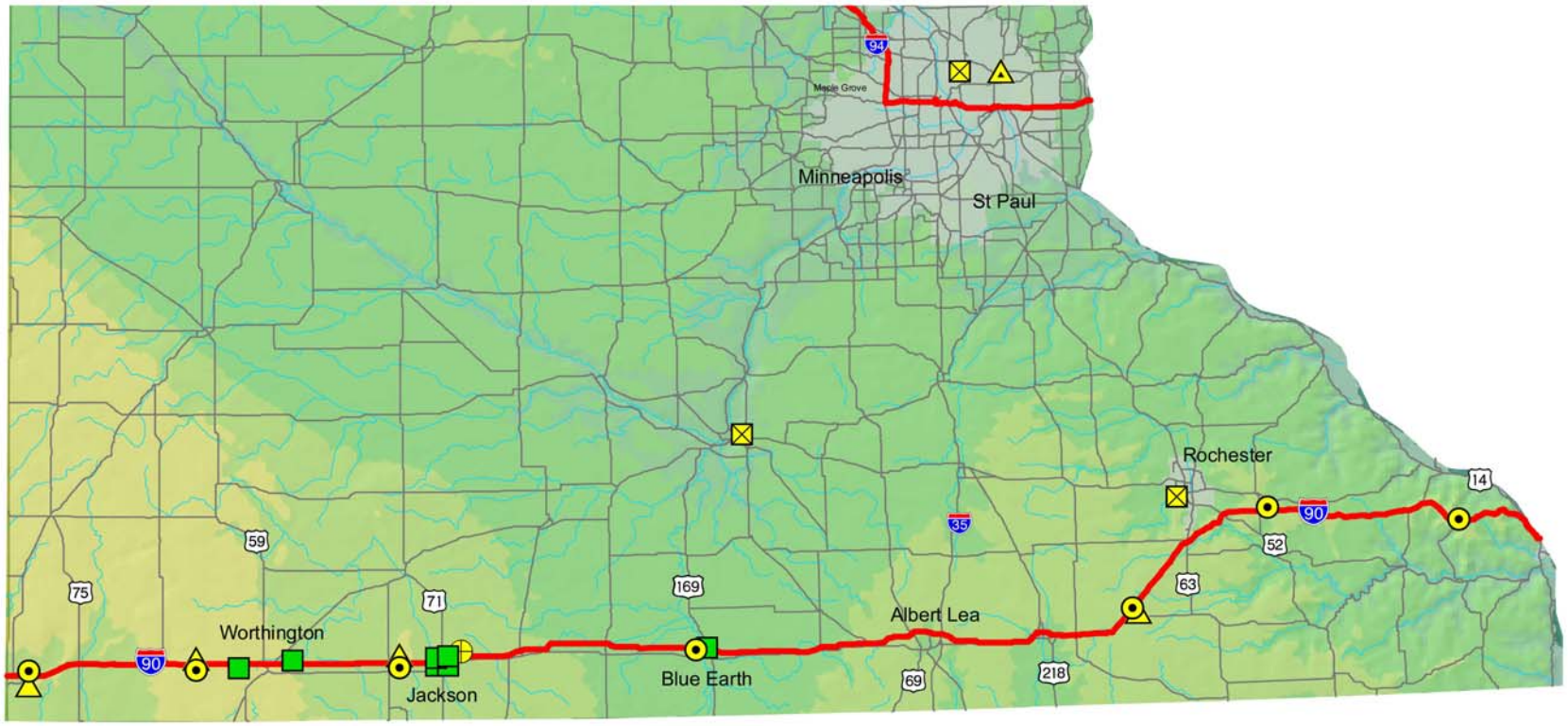
N W E S

110 55 0 110 220 Miles

Figure 1:
Wisconsin I-90/I-94 Corridors
ITS Devices




FARGO - MOORHEAD
(ND - MN)
Figure 2:
Minnesota I-94 Corridor
ITS Devices
ITS Devices Located in the Twin Cities Metro Area
No. of ITS Devices
ITS Device
1
RWIS
14
DMS
74
CCTV
1
Regional TOC/TMC
800
Sensors
*
HAR
* HAR is available.
ST CLOUD
Monticello
MINNEAPOLIS
ST PAUL
ITS Device Legend
Road Weather Information Systems (RWIS)
Dynamic Message Signs (Permanent)
Closed Circuit TV (CCTV)
Sensors
Highway Advisory Radio (HAR)
Regional TOC/TMC
Automatic Anti-Icing Spray System
10 5 0 10 20 Miles



ITS Device Legend

- Road Weather Information Systems (RWIS)
- Dynamic Message Signs (Permanent)
- Closed Circuit TV (CCTV)
- Highway Advisory Radio (HAR)
- Regional TOC/TMC
- Automated Gate Closure

N W E S

25 12.5 0 25 Miles

Figure 3: Minnesota I-90 Corridor ITS Devices

Figure 4:
North Dakota I-94 Corridor ITS Devices

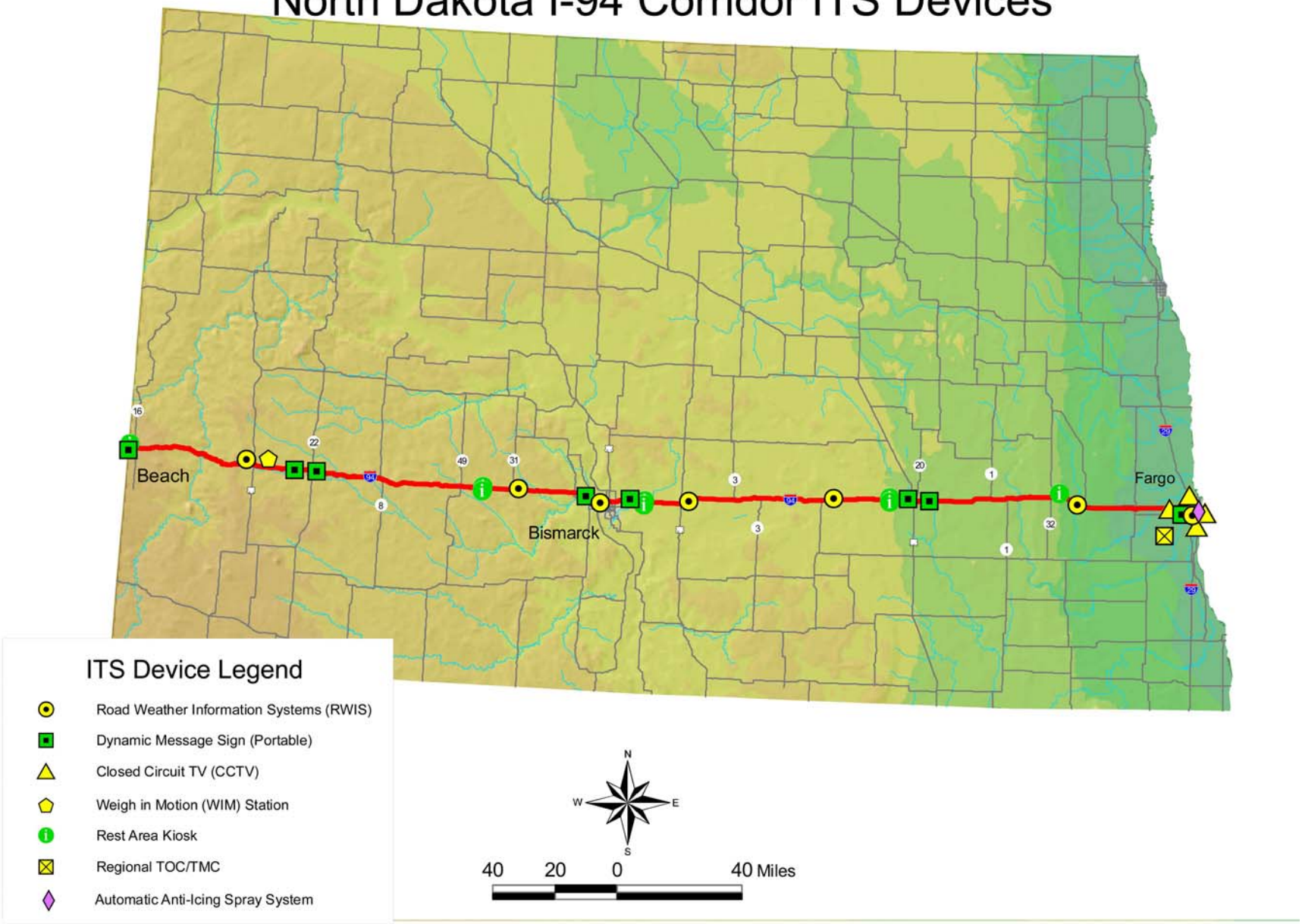


Figure 5:
South Dakota I-90 Corridor ITS Devices

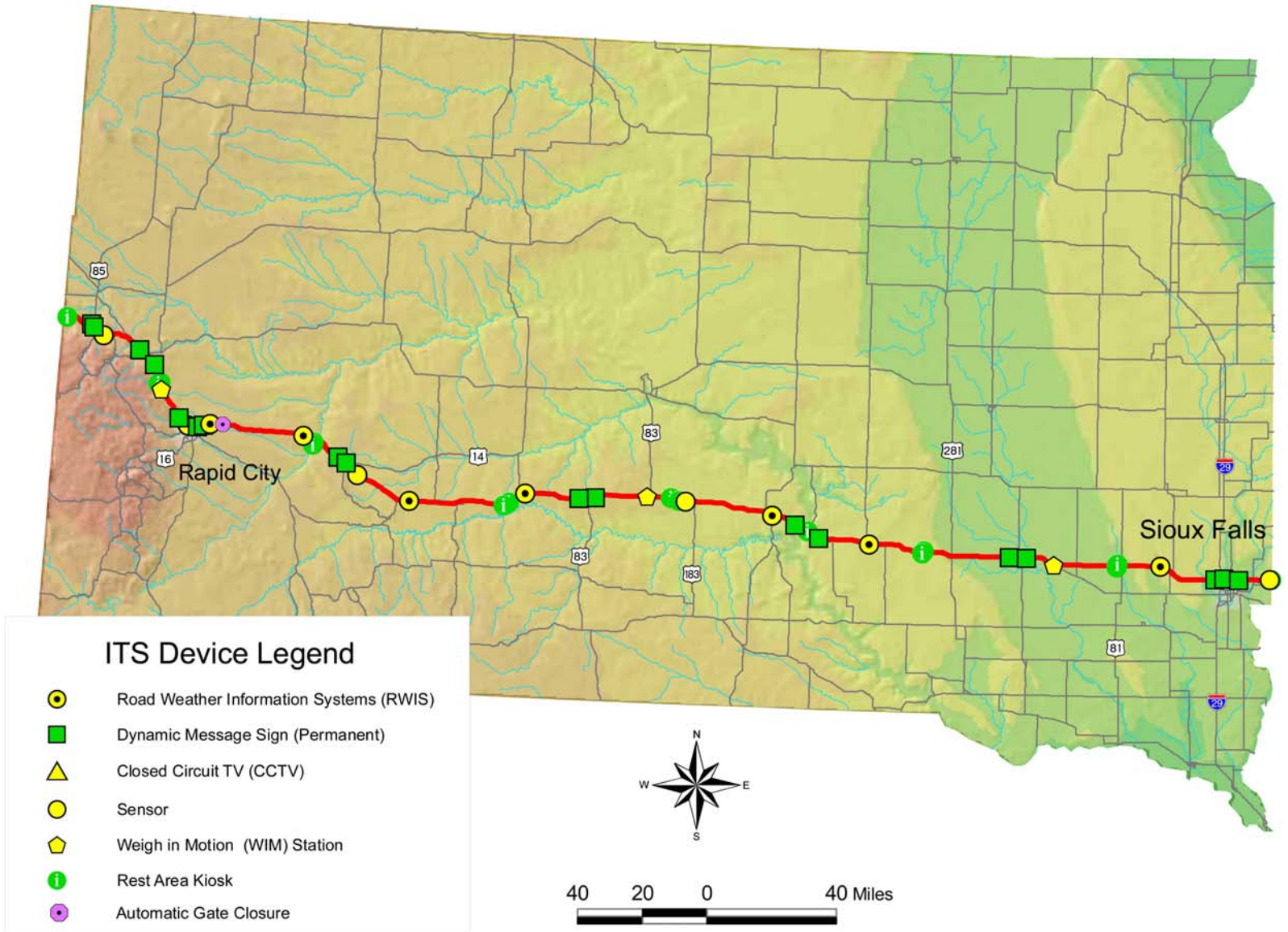


Figure 6:
Wyoming I-90 Corridor ITS Devices

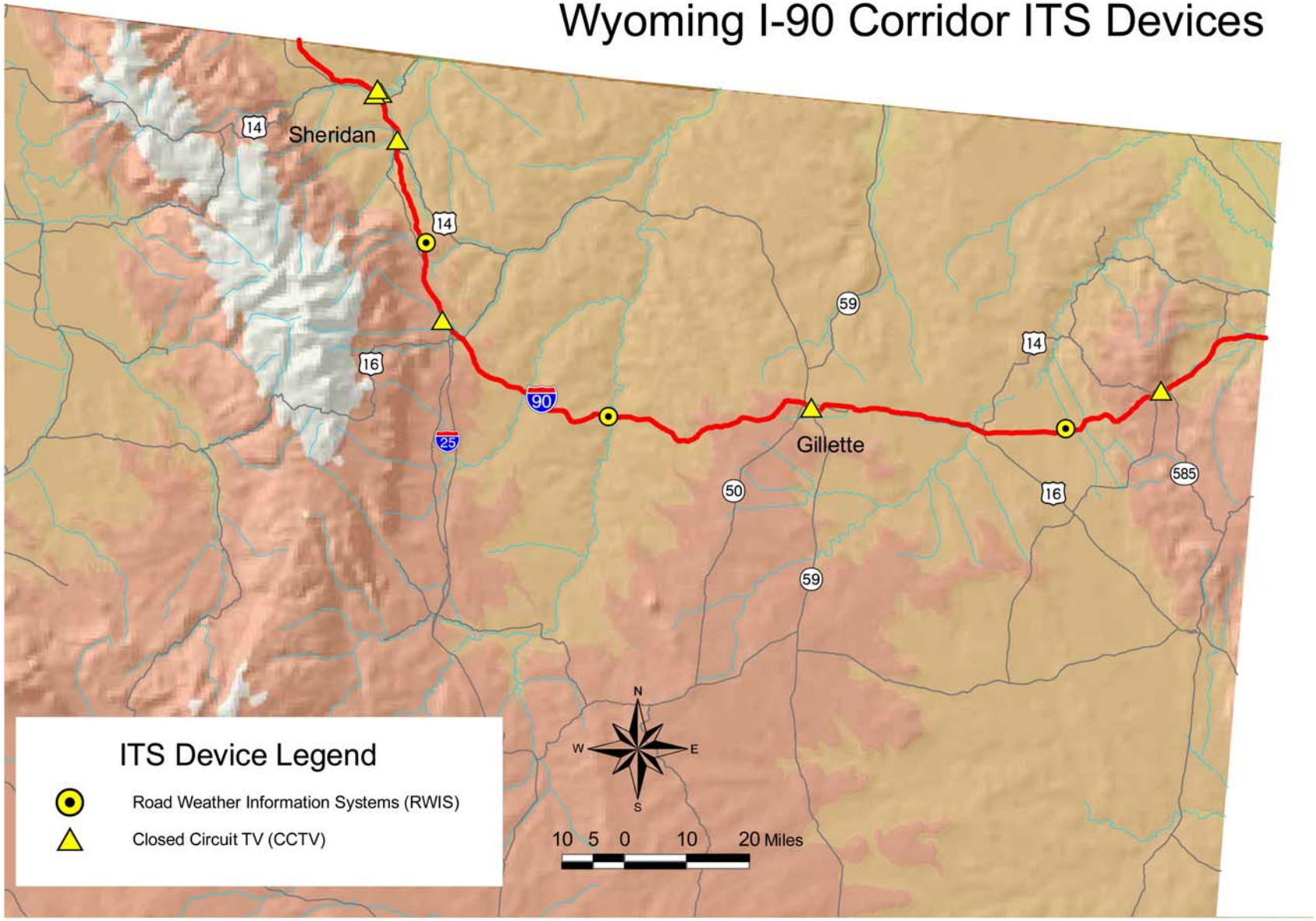


Figure 7:
Montana I-90/I-94 Corridors
ITS Devices

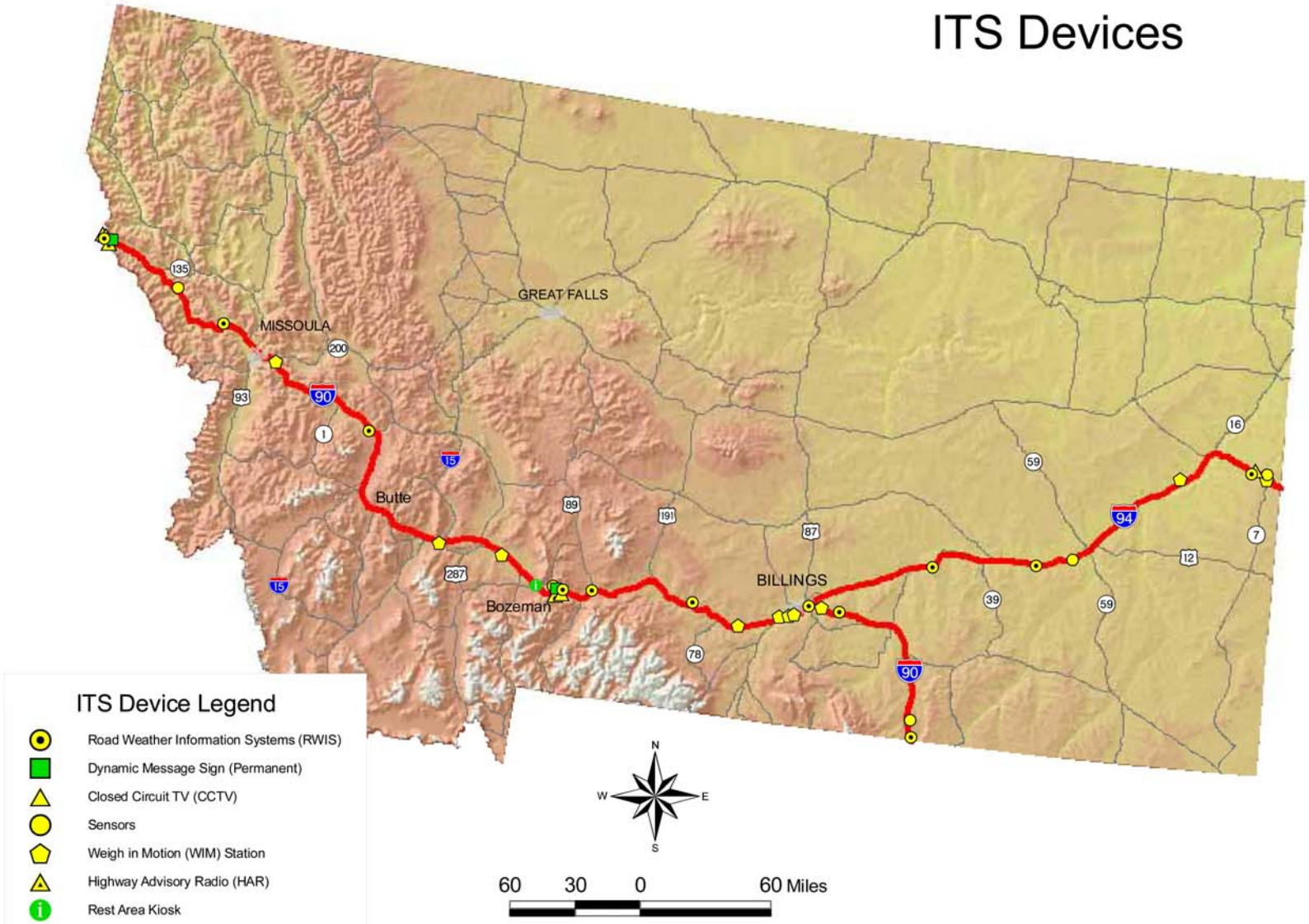
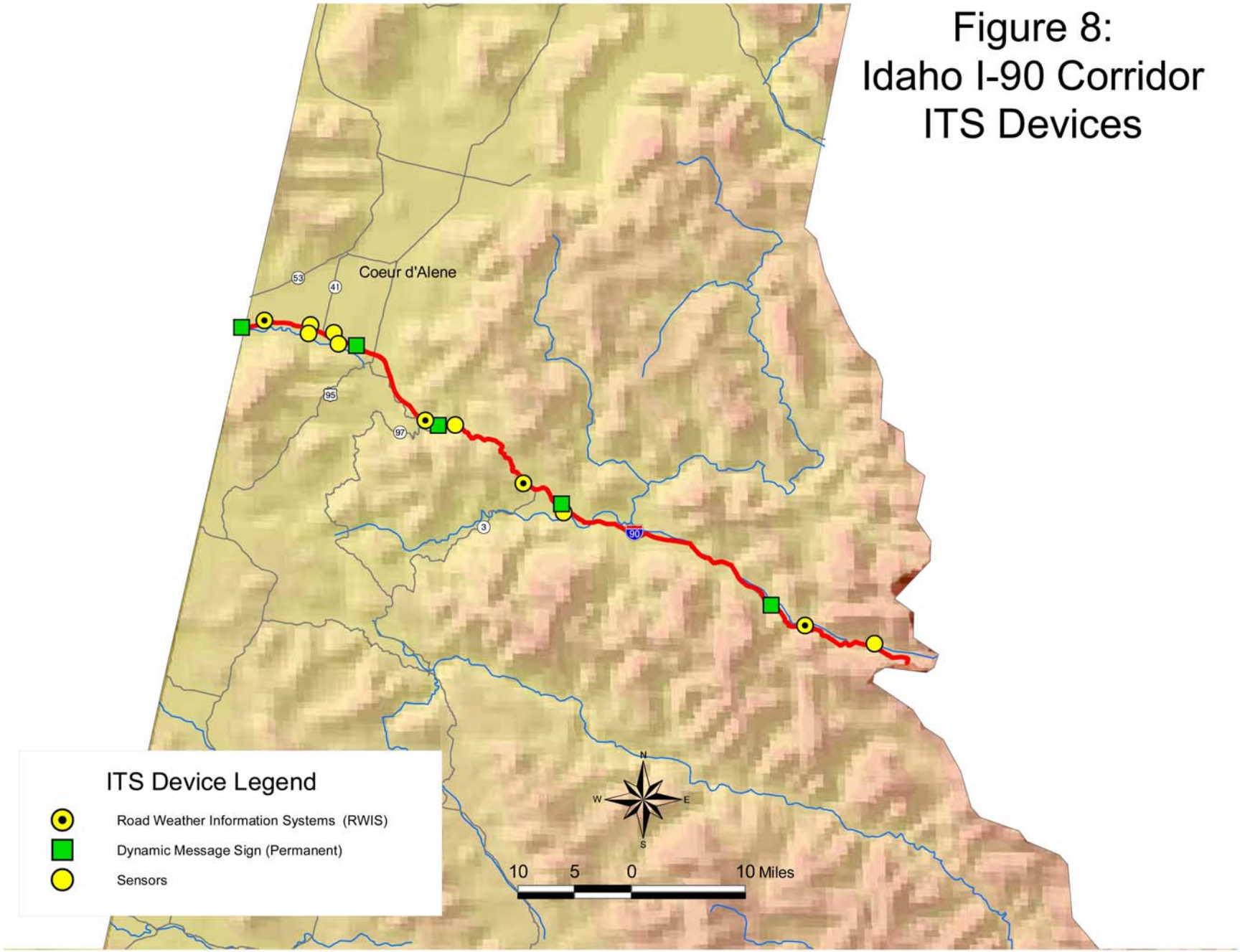


Figure 8:
Idaho I-90 Corridor
ITS Devices



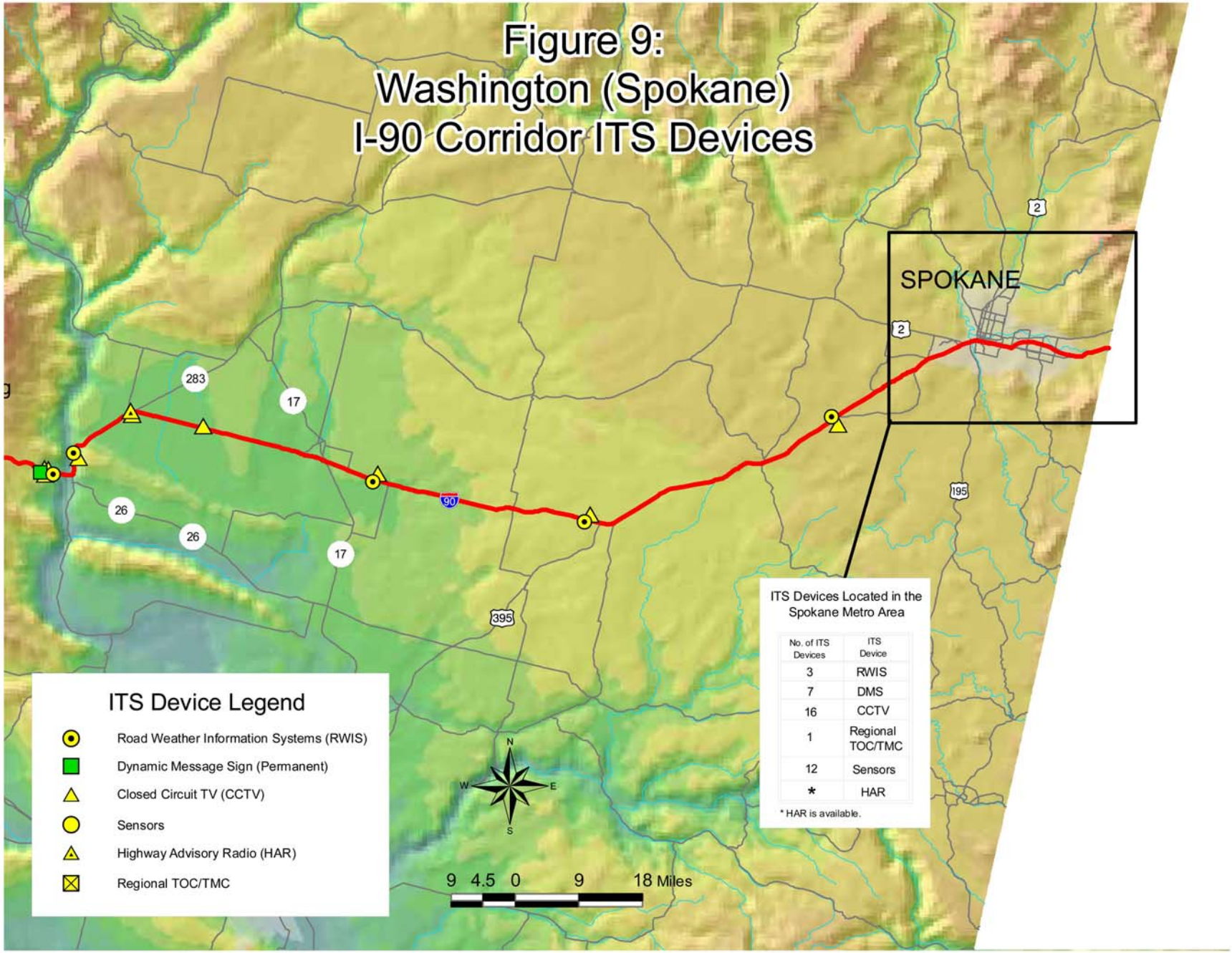


Figure 9:
Washington (Spokane)
I-90 Corridor ITS Devices
SPOKANE
2
2
283
17
90
26
26
17
195
395
ITS Device Legend
Road Weather Information Systems (RWIS)
Dynamic Message Sign (Permanent)
Closed Circuit TV (CCTV)
Sensors
Highway Advisory Radio (HAR)
Regional TOC/TMC
ITS Devices Located in the Spokane Metro Area
No. of ITS Devices
ITS Device
3
RWIS
7
DMS
16
CCTV
1
Regional TOC/TMC
12
Sensors
*
HAR
* HAR is available.
N
W
E
S
9 4.5 0 9 18 Miles

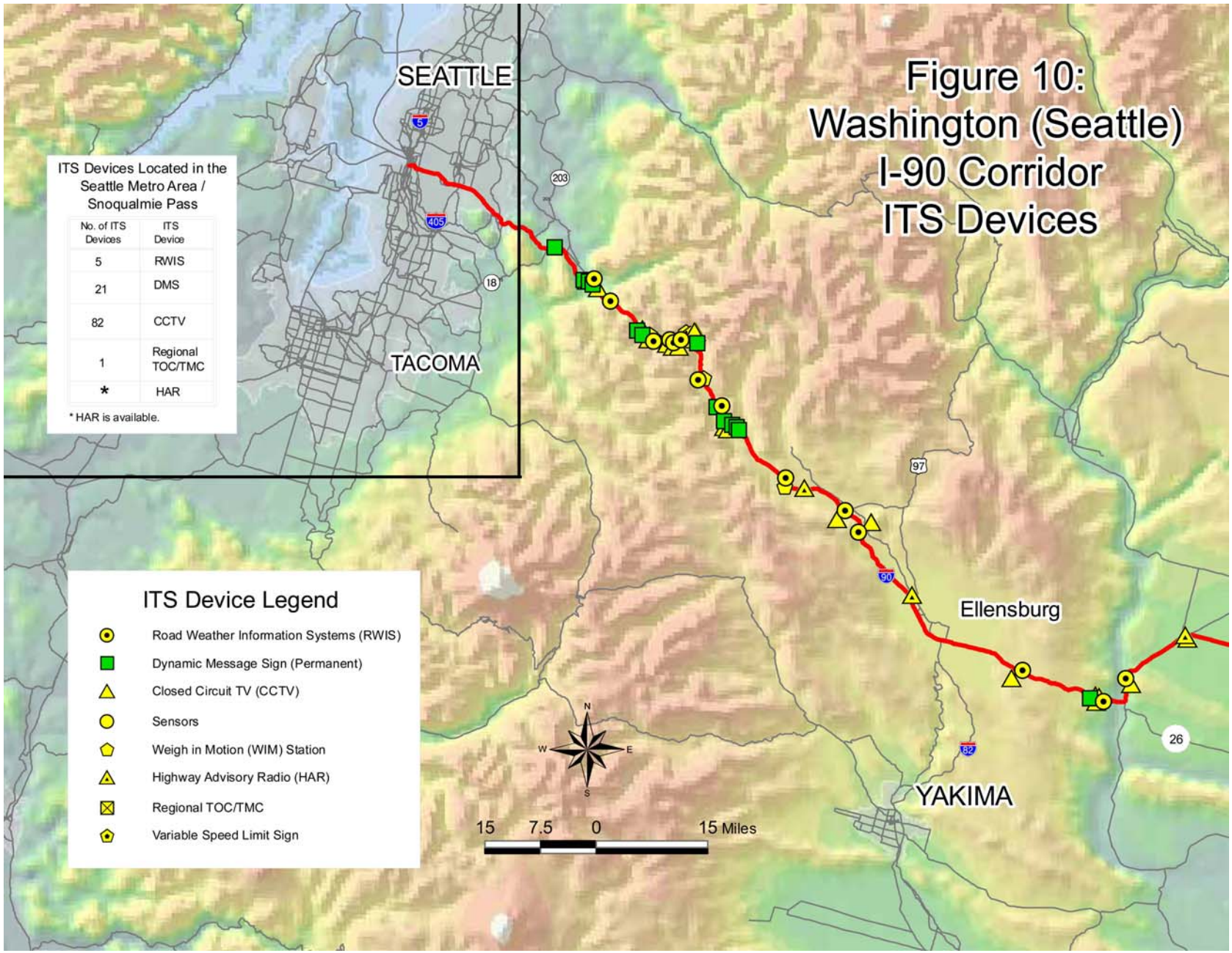


Figure 10:
Washington (Seattle)
I-90 Corridor
ITS Devices
SEATTLE
TACOMA
Ellensburg
YAKIMA
ITS Devices Located in the Seattle Metro Area / Snoqualmie Pass
No. of ITS Devices
ITS Device
5
RWIS
21
DMS
82
CCTV
1
Regional TOC/TMC
*
HAR
* HAR is available.
ITS Device Legend
Road Weather Information Systems (RWIS)
Dynamic Message Sign (Permanent)
Closed Circuit TV (CCTV)
Sensors
Weigh in Motion (WIM) Station
Highway Advisory Radio (HAR)
Regional TOC/TMC
Variable Speed Limit Sign
N
W
E
S
15 7.5 0 15 Miles