North/West Passage Transportation Pooled Fund Study

Phase I

Project 1.6

Preliminary Design for DMS Deployment at the I-94 and I-90 Split in Tomah, Wisconsin

Project Summary

March 17, 2005

North/West Passage

NORTH/WEST PASSAGE TRANSPORTATION POOLED FUND STUDY: PROJECT 1.6 – PRELIMINARY DESIGN FOR DMS DEPLOYMENT AT THE I-94 AND I-90 SPLIT IN TOMAH, WISCONSIN

Introduction

The purpose of the North/West Passage Project 1.6 – *Preliminary Design for Dynamic Message Sign (DMS) Deployment at the I-94 and I-90 Split in Tomah, Wisconsin* was to supply westbound travelers with en-route road weather condition information to Minnesota, North Dakota, and South Dakota in order to make early and safer travel decisions. Currently, travelers receive only limited information via weather broadcasts.

The initial focus of Project 1.6 was to focus on developing a preliminary design for deploying a DMS on I-90 and I-94 southeast of Tomah, Wisconsin including communication links to stakeholders responsible for system operation, in order for road weather condition information on I-94 and I-90 to be communicated early to travelers on these routes.

After considerable discussion at the Project 1.6 Work Team Kick-Off Meeting in March 2004, it was agreed that the first step to achieving the goal of deploying a DMS was developing a Concept of Transportation Operations for the project. Concurrent with the development of Project 1.6, Wisconsin was developing a Traffic Operations Plan (TOP). There was a need to coordinate efforts between these projects due to their close relationship.

Therefore, the focus of Project 1.6 shifted to developing a Concept of Transportation Operations document. The group proceeded with the development of this document, focusing on providing traveler information at the Tomah split not specifically a DMS. However as the project progressed in December 2004 it was determined that the deliverable for this project would be this working document for Wisconsin to use as work continues on projects such as the TOP.

The following sections identify information presented and discussed at Project 1.6 Work Team meetings for inclusion in a Concept of Transportation Operations document.

1.0 Concept of Transportation Operations Purpose and Objective

The purpose of this Concept of Transportation Operations document is to provide a high level perspective of providing traveler information, including a definition of key elements and services of the system, and sample scenarios of how the system will work. A concept of operations is an iterative process of defining the system in non-technical terms so that multiple classes of stakeholders agree on the function and objectives of the system. This plays an invaluable role of accelerating buy-in among stakeholders. With this understanding as a baseline, engineering efforts for evolving to a design and implementation could commence.

The primary objectives for creating a Concept of Transportation Operations is to:

- To make a broad-brush attempt at defining goals and objectives
- To clearly describe a traveler information system and how it will be managed and operated
- To identify and address common institutional issues; and
- To advance communication and cooperation among the stakeholders.

The following sections address the information for Wisconsin to consider in providing traveler information to individuals traveling along the I-90/94 corridor in central and western Wisconsin, in particularly near the Tomah split.

2.0 Project/System Overview

2.1 Need

Although traffic delays are much more common in metropolitan areas, they can be more lengthy and disruptive in rural areas. Unlike metropolitan areas, obstructions to free flow of traffic on rural segments of highway are usually unexpected. When motorists come upon road construction, incidents, or deteriorating driving conditions in rural areas, their options are limited. With fewer exits, fewer alternative routes, and fewer lanes, motorists are less able to minimize delay.

Travelers on I-90/94 in central and western Wisconsin lack a reliable and effective method of obtaining real-time traveler information. Currently in Wisconsin, traveler information is available though the 1-800-ROADWIS telephone number. This number is Wisconsin specific and is not regional traveler information telephone number. This information is currently updated at a minimum of 4 times daily, limiting the accuracy of the information presented. This deficiency limits a drivers' ability to make informed route choice decisions as they approach major decision points along I-90 and I-94.

2.2 Project Purpose

The purpose of this project is to provide accurate and real-time traveler information for travelers on I-90/94 in central and western Wisconsin. Filling this void in traveler information will aid route choice decisions in Wisconsin and throughout the upper Midwest.

2.3 Stakeholders

In order for traveler information to be available to the public, primary stakeholders need to be identified that will have responsibility or shared responsibility to operate the traveler information system. Stakeholders would include Wisconsin Districts along with Minnesota's Regional Traffic Management Center.

Other stakeholders within the areas of operational impact (defined in Section 4.2) may have supporting roles in traveler information operations by means of providing information to and coordinating with the primary stakeholders. Those secondary stakeholders include county and city transportation agencies and emergency responders within the areas of operational impact

2.4 Project Concept

The concept of this project is to provide traveler information along I-90/94 in central and western Wisconsin. Particularly, this project focuses on providing real-time travel information to travelers on westbound I-90/94 at a location southeast of Tomah, Wisconsin prior to the split of the Interstates. The information would be used to provide travelers accurate and useful real-time information pertaining to road closures, incidents, construction, or weather related concerns within both the local area of influence itself and downstream locations throughout the corridors. This information would be available prior to the split between the two Interstates to provide adequate time for drivers to process the information and make their route choice decision.

In order to provide accurate traveler information various stakeholders mentioned in the previous section will share responsibility of providing information. The primary responsibility would lie in the district the traveler information component is placed during normal business hours. Other districts throughout the state and corridor would share control of providing the traveler information. Additional responsibilities would also be placed on the Wisconsin State Patrol during off hours. Local agencies including county sheriff's departments, local polices and fire, emergency management agencies, county highway departments, and city highway/public works departments, may coordinate with District 5 and the State Patrol during off hours.

3.0 Vision, Goals, and Objectives

3.1 Project Vision

The vision of Project 1.6 is to improve the quality of life for people living in or attending events within the city of Tomah, Wisconsin and surrounding areas or traveling through West-Central Wisconsin, and the upper Midwest on I-90/94 by providing safe, efficient movement of people, goods, and services.

3.2 Project Goals and Objectives

The overall goal of this project is to provide travelers with accurate, timely, and coordinated regional and local traffic and traveler information to enable informed route choice decisions before the split between I-90 and I-94. Specifically, the goals and objectives of this project are:

Goal	Objective
Enhance Mobility and Accessibility	▪ Improve accessibility and availability of travel information to the traveling public and other users
Enhance Productivity	▪ Reduce travel delay and increase the reliability and predictability of moving people and goods for transportation users ▪ Improve the ability of the traveling public and other users to perform travel planning and make route choice decisions using real-time travel information
Improve Safety	▪ To improve the ability to identify, respond, remove, and mitigate the effects of incidents
Increase Efficiency	▪ Reduce time delay and costs associated with congestion ▪ Improve the operational efficiency of goods and people movement

In addition, the project will promote the realization of the following benefits:

- Address and promote sharing of operations of ITS assets between WisDOT Districts and between WisDOT and MnDOT

- Capture the links between this Concept of Transportation Operations Document and other planning and operations documents within the State of Wisconsin
- Promote agency coordination and cooperation within Wisconsin, the Gary-Chicago-Milwaukee Corridor, and the North/West Passage Corridor
- Establish common vocabulary and terminology to be used across agencies and jurisdictions in the State of Wisconsin

4.0 System Architecture and Operational Capability

4.1 System Architecture

This project represents an application of the National ITS Architecture at a project level and implements the vision by providing the following user services:

- En-route Driver Information
- Traffic Control
- Incident Management

The following market packages are closely related to the system:

- ATMS06 – Traffic Information Dissemination
- ATMS07 – Regional Traffic Control

Brief descriptions of the associated with the system are provided in the following.

Traffic Information Dissemination: This market package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Information Service Providers. A link to the Maintenance and Construction Management subsystem allows real time information on road/bridge closures due to maintenance and construction activities to be disseminated.

Regional Traffic Control: This market package provides for the sharing of traffic information and control among traffic management centers to support a regional control strategy. This market package provides the communications links and integrated control strategies that enable integrated inter-jurisdictional traffic control. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation and adds hardware, software, and fixed-point to fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of control between traffic management centers.

4.2 Areas of Operational Impact

Four distinct areas of operational impact centered at the location of the I-90/04 split are defined as:

- The local area of operational impact is defined as the area generally within 10-mile radius of the Tomah Split. The operational authorities within this local area include WisDOT District 5 and WisDOT State Patrol District 5. Other agencies that may support traveler information include Monroe County Highway Department, Emergency Management Department, and Sheriff's Department, and public works, fire and policy departments of cities and local communities within the area.
- The extended local area of operational impact is defined generally as the area between 10 and 20 miles from the Tomah Split. The operational authorities within the area include WisDOT District 4, WisDOT District 5, and WisDOT State Patrol District 5. Other agencies within the area that may support the use of the DMS include Monroe County, Jackson County, Juneau County, and other cities within the area.
- The regional area of operational impact is generally defined as the area within 20 miles of the I-90 and I-94 west of the Tomah Split in Western Wisconsin. The operational authorities within this regional area include WisDOT Districts 5 and 6, and WisDOT State Patrol Districts 5 and 6. Other agencies that may support traveler information within this area include the highway, sheriff's, and emergency management departments of the following counties: Monroe, Jackson, Clark, Eau Claire, Chippewa, Pepin, Buffalo, Pierce, Dunn, St. Croix, Trempealeau, La Crosse, and Vernon.
- The multi-state area of operational impact is any location along the I-90 and I-94 Corridors outside of the regional area of operational impact in Wisconsin, Minnesota, and Eastern North Dakota.

The areas of operational impact include I-90 and/or I-94, and other routes within these four distinct regions. The traveler information provided will not be limited to events on the interstates only but will also include other traveler information deemed important to travelers at this location in central Wisconsin.

4.3 Operational Capability

Operational capabilities for this project should be considered based on the areas of operational impact as defined in the above, in conjunction with the consideration of areas of operational authority. Four operational capability categories are defined:

- Local Functions – Those functions are the responsibility of WisDOT District 2, WisDOT State Patrol District 5, and WisDOT District 5.
- Extended Local Functions – Those can be carried out by the WisDOT District 2, WisDOT District 5, and WisDOT State Patrol District 5 without interagency collaboration but would benefit the local agencies and the region if done with a regional perspective.
- Regional Functions – Those are performed for the regional and local benefit and should be performed with regional cooperation and collaboration between agencies.
- Multi-State Functions – Those functions are performed for the regional and multi-state benefit and regional and multi-state regional coordination and collaboration is required.

4.3.1 Local Functions

WisDOT District 2 Traffic Operations Center (TOC) will be responsible for disseminating traveler information during the regular operating hours. WisDOT District 2 TOC processes information related to any events taking place within this local area of operational impact. The information may be received internally from other divisions within WisDOT District 2 or from other agencies within the local area of operational impact. WisDOT District 5 analyzes the magnitude of the events and the area of influence, and determines appropriate actions for disseminating the information to travelers. If it is determined the traveler information systems are used, WisDOT District 2 TOC Operator then follows the WisDOT policy and disseminates appropriate information via roadway equipment (i.e, DMS and HAR) and/or other travel information systems (i.e. 511, internet website). For pre-scheduled events such as work zone activities and planned special events where the lengths of the events are known, the TOC Operator determines the length of the information that will be disseminated. WisDOT District 2 TOC continues monitoring the events and/or receiving updated information related to the events. Other agencies, that are responsible for or involved with the events and providing the information to WisDOT District 2 TOC for activation of the sign, continue providing updated information to the TOC throughout the length of the events. Upon receiving updated information, the Operator evaluates the scenario and alters or removes information content as appropriate.

4.3.2 Extended Local Functions

Similar to the local functions, agencies within the extended local area of operational impact inform WisDOT District 2 TOC with information significant to travelers on I-90/94. The TOC Operator analyzes the magnitude of the events and the impact area and determines appropriate actions. If traveler information systems are used, the Operator then follows the WisDOT policy and determines and disseminates appropriate information. WisDOT District 2 TOC continues monitoring the events and/or receiving updated information related to the events. Upon receiving updated information, the TOC Operator evaluates the scenario and alters or removes information content as appropriate.

4.3.3 Regional Functions

Coordination amongst WisDOT District 2 and agencies within the regional area of operational impact takes place to inform travelers of events further downstream along I-90 and I-94 Corridors. WisDOT District 2 TOC Operator analyzes and determines the events with regional significance based on the information related to the events. Such information is obtained either internally within the District or is provided by other WisDOT Districts or other agencies within the area of operational impact. The Operator then, based on the WisDOT policies and guidelines, determines if the events warrant the use of travel information systems. A contingency plan must be in place regarding traffic re-routing and suggested alternate routes if conditions require such an action.

4.3.4 Multi-State Functions

Coordination amongst WisDOT District 1, WisDOT District 2, WisDOT District 5, WisDOT State Patrol District 5, MnDOT Regional Transportation Management Center (RTMC), and/or North Dakota DOT, as well as other operational authorities within the multi-state area of operational impact takes place to inform travelers of events further downstream of the I-90 and I-94 Corridors. When an event occurs further downstream of the corridors that impact the normal operations, MnDOT RTMC may share the operation of the roadway traveler information equipment with WisDOT District 2 TOC and WisDOT District 5. Coordination and information sharing among the three agencies take place when shared control is required.

WisDOT District 2 TOC Operator analyzes and determines the events with greater regional or multi-state significance based on the information related to the events. Such information is obtained either internally within WisDOT or is provided by other agencies within the area of operational impact. The Operator then based on the WisDOT policies and guidelines, determines if the events warrant the use of traveler information systems.

The multi-state operational capabilities will function similarly to the regional capabilities. Agreements will need to be in place between states to facilitate the exchange of information between different state's agencies and provide protocols to create real-time information exchanges.

The vision for this project is to allow all travelers to make route choices based on accurate and real-time traveler information. Traveler information coordination within Wisconsin agencies and with other state agencies is an attainable goal to provide seamless, real-time information to all travelers. The performance of the system can be measured by a variety of sources. One method may include calculating the average time it takes to disseminate the traveler information after the authorities have been notified of the event. Another measure of performance could include calculating the amount of traffic diversion due to the information provided to the traveler.

5.0 Operational and Support Environment

As a traveler information component is identified, it is necessary to describe the facilities, equipment, technologies, computing hardware, software, services, personnel, operational procedures, and support that may be necessary to operate the system and to achieve the project/system performance goals and objectives.

The operational and support environment may include:

- Facilities: identify physical facilities necessary to meet the needs of the fully functional system through high-level descriptions.
- Equipment: High-level descriptions identify the equipment necessary for the system to be operational.
- Hardware: Typically, this refers to the physical information systems that the users of the system access.
- Software: A high-level description of the information system applications necessary for system operations.
- Personnel: Describes the personnel necessary to staff all facilities needed for the system to be operational. This typically includes a concise subset of the system users identified in the User-Oriented Operational Description.

- Operational Procedures: A description of what, and when, the users and system components are performing under specific conditions.
- Support Necessary to Operate the Deployed System: This includes all other supporting labor that is not specifically designated by the operations of the system. This support could include facility management, accounting/finance, human resources, etc.

6.0 Staffing and Training

After a system is defined for providing traveler information, staffing and hours of operations need to be defined. Another component would be to define training requirements in order to familiarize staff with the system.

7.0 Operational Scenarios

A main component in identifying how the system would work for providing information to travelers includes the development of operational scenarios. The following list highlights suggested scenarios to address as a component for providing traveler information is determined.

- Traffic Incident on Westbound I-90 West of Tomah
- Traffic Incident on US Highway 53 Near Bloomer, Wisconsin
- Road Closure at I-94 Bridge Over St. Croix River Near Hudson, Wisconsin
- Truck with Hazardous Material Overturn on I-94 Near Eau Claire
- A Major Winter Strom in Southeastern Minnesota
- Amber Alert

8.0 Roles and Responsibilities

Within each operation scenario suggested above, there is a need to identify the roles and responsibilities of staff within each identified stakeholder.

Conclusion

The goal of Project 1.6 is to provide information to travelers westbound on I-90 and I-94 before the Tomah split, so users can make informed route decisions based on the conditions. Although a preliminary design was not developed for a DMS, the project was successful in identifying that a Concept of Transportation Operations should first be developed to identify where a traveler information component should be placed in order to receive buy-in among stakeholders. Due to Wisconsin's TOP project occurring at the same time as Project 1.6, the group learned that the documents need to compliment each other by addressing the Concept of Operations. The information presented above identifies information to address as a Concept of Transportation Operations document is developed within in Wisconsin.

During the duration of this project the following stages were identified for developing a Concept of Operations for Wisconsin. Please note the stages were suggested and discussed with the Project 1.6 Work Team and were never formally approved.

Stage 1: Regional Concept of Transportation Operations

- This stage would not identify technology. It would look at what is needed from an operational perspective. The effort would consider various operational/ incident related scenarios (6 – 10). The effort would help answer questions about:
  - What do we do with traffic?
  - How do we manage it?
  - What do the travelers need to know?
  - Where do travelers need to know this information?

  Identify different locations. This effort is independent from what tools or technology will be used but you could identify strategic decision making points or different locations that are critical to the various scenarios.

Stage 2: Corridor Infrastructure Concept of Operations (ITS Plans/Architectures)

- This stage looks at what system capabilities and tools will need to be implemented throughout the corridor to meet the needs related to the scenarios identified in Stage 1. Technologies and tools such as DMS, communication systems, Public Safety Communication Centers, surveillance, detection, more intensive subsystems for weather information, etc. could be considered. This effort would identify site-specific locations to deploy the tools.

Stage 3: Corridor Operations Plan (Systems Engineering Concept of Operations)

- This stage takes the next step if you want to implement the infrastructure identified in Stage 2. Here is where you consider things like who operates the tools, who maintains, what information is shared, what gets integrated, on-going operations/maintenance, how the technology is administered institutionally, how does the system evolve over time, etc.

Concept of Corridor Operations Planning Guide (Template)

- The concept of corridor operations planning guide/template developed under the Wisconsin Transportation Operations Plan (TOP) would precede the three about stages. It would provide the framework to link the three stages together as well as help break the state into specific corridors. The guidelines would facilitate and help tell how you apply the three stages/ tools above.

In addition to discussing the stages for developing a Concept of Operations in Wisconsin, mapping the current Wisconsin efforts to the stages of Concept of Operations was developed as follows.

Concept of Corridor Operations Planning Guide
- Status: Developed under TOP

Stage 1: Regional Concept of Transportation Operations
- Apply Corridor Operations Planning Guide to IH94 Tomah Split
  - Status: To be determined

Stage 2: Corridor Infrastructure Concept of Operations (ITS Plans/Architecture)

- Completed efforts:
  - IH90/94 Intercity Corridor Study – Strategic Deployment Plan, Dec. 1996
  - IH90/94 ITS Corridor Program – Corridor ITS Architecture, March 2002
  - ITRAM (Madison and Surrounding Area Design Study Report) – established statewide vision for CCTV and DMS.
  - Statewide ITS Architecture – effort broke state into corridors and developed a statewide architecture utilizing Turbo.
  - TOC Focus Groups

Stage 3: Corridor Operations Plans (Systems Engineering Concept of Operations)

- Completed efforts:
  - ITRAM (Madison and Surrounding Area Design Study Report) – developed very high-level scenarios and concept of corridor centers.
  - Statewide ITS Architecture – effort created very high level concept of operations for corridors throughout the State.
- Other Efforts:
  - North/West Passage Corridor Project 1.6 – DMS Deployment at IH94 Split at Tomah, Wisconsin