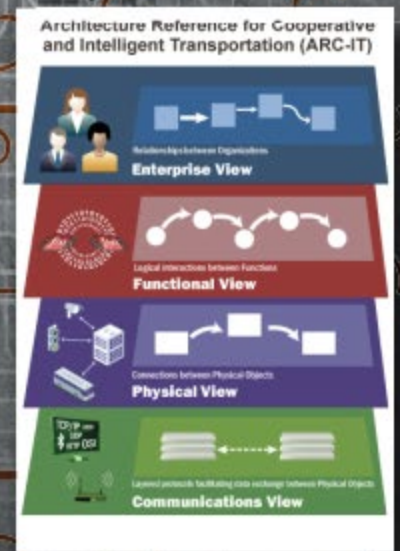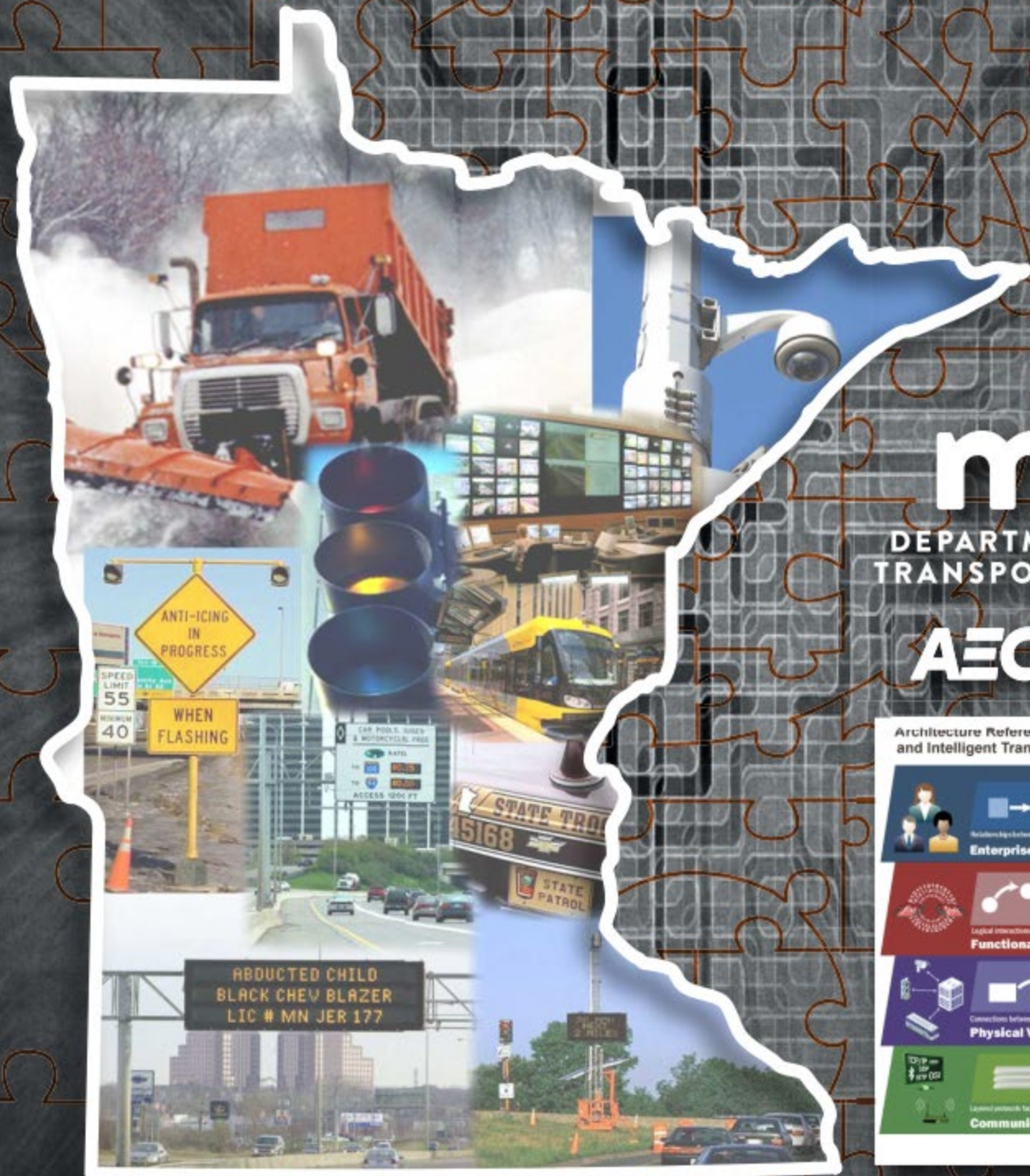# Minnesota Statewide Regional ITS Architecture

Version 2018

Implementation Volume – ITS Initiatives and Project Concepts for Implementation

m1
DEPARTMENT OF TRANSPORTATION

AECOM

Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)

Relationships between Organizations
Enterprise View

Logical interactions between Functions
Functional View

Connections between Physical Objects
Physical View

Layered protocols facilitating data exchange between Physical Objects
Communications View

Minnesota Statewide Regional ITS Architecture
Version 2018

Implementation Volume:
ITS Initiatives and Project Concepts for Implementation

DEPARTMENT OF TRANSPORTATION

Prepared by

AECOM

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Acronyms

AC	Advance Construction
AMBER	America's Missing: Broadcast Emergency Response
APTS	Advanced Public Transportation System
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ATIP	Area Transportation Improvement Program
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
ATP	Area Transportation Partnership
ATSPM	Automated Traffic Signal Performance Measure
AVL	Automatic Vehicle Location
AWOS	Automated Weather Observation System
BRT	Bus Rapid Transit
CAD	Computer Aided Dispatch
CARS	Condition Acquisition and Reporting System
CEA	Critical Emphasis Area
CMAQ	Congestion Mitigation and Air Quality
CSAH	County State Aid Highway
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Sign
DOT	Department of Transportation
DPS	Department of Public Safety
DVR	Digital Video Recorder
EASy	Enforcement Assistance System (for MnPASS)
EM	Emergency Management
EMS	Emergency Medical Services
EVP	Emergency Vehicle Preemption
FAST Act	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
FIRST	Freeway Incident Response Safety Team
FMS	Field Management Station
FTA	Federal Transit Administration
GIS	Geographic Information System
GPS	Global Positioning System
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HOT	High-Occupancy Toll
HOV	High-Occupancy Vehicle
HPDP	Highway Project Development Process
HRD	Highway Research and Development
HRI	Highway Rail Intersection
HSIP	Highway Safety Improvement Program
HUTD	Highway User Tax Distribution
ICM	Integrated Corridor Management
IEEE	Institute of Electrical and Electronics Engineers
IM	Interstate Maintenance
ITS	Intelligent Transportation Systems
IWZ	Intelligent Work Zone
LED	Light Emitting Diode
LRT	Light Rail Transit

MAP-21	Moving Ahead for Progress in the 21st Century Act
MCM	Maintenance and Construction Management
MCMIS	Motor Carrier Management Information System
MDSS	Maintenance Decision Support System
MnDOT	Minnesota Department of Transportation
MnPASS	An electronic toll collection system operated by MnDOT
MnSHIP	Minnesota State Highway Investment Plan
MPCA	Minnesota Pollution Control Agency
MPO	Metropolitan Planning Organization
MSAS	Municipal State Aid Streets
MSP	Minnesota State Patrol
MVLST	Motor Vehicle Leased Sales Tax
MVST	Motor Vehicle Sales Tax
MVTA	Minnesota Valley Transit Authority
NHFP	National Highway Freight Program
NHPP	National Highway Performance Program
NHS	National Highway System
NTCIP	National Transportation Communications for Intelligent Transportation System Protocol
OFCVO	Office of Freight and Commercial Vehicle Operations (MnDOT)
OS/OW	Oversize/Overweight
P3	Public-Private Partnership
PCMS	Portable Changeable Message Sign
PDA	Personal Digital Assistant
PDSL	Priced Dynamic Shoulder Lane
PRISM	Performance and Registration information Systems Management
PSAP	Public Safety Answering Point
RAD-IT	Regional Architecture Development for Intelligent Transportation
RDO	Regional Development Organization
RFID	Radio-Frequency Identification
RICWS	Rural Intersection Conflict Warning System
RTMC	Regional Transportation Management Center
RWIS	Road Weather Information System
SAFER	Safety and Fitness Electronic Records
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SALT	State Aid for Local Transportation
SEOC	State Emergency Operations Center
SHSP	Strategic Highway Safety Plan
SMTP	Statewide Multimodal Transportation Plan
SOV	Single Occupancy Vehicle
SPaT	Signal Phase and Timing
SSL	Signal System Local
SSM	Signal System Master
STBG	Surface Transportation Block Grant Program
STIP	State Transportation Improvement Program
STP	Surface Transportation Program
STRAHNET	Strategic Highway Network
TEA-21	Transportation Equity Act for the 21st Century
TH	Trunk Highway
TIGER	Traveler Information, Guidance, and Evacuation Routing

TIFIA	Transportation Infrastructure Finance and Innovation Act
TIP	Transportation Improvement Program
TPIMS	Truck Parking Information and Management System
TMC	Transportation/Traffic Management Center
TSP	Transit Signal Priority
TZD	Toward Zero Deaths
UPA	Urban Partnership Agreement
VMT	Vehicle Miles Traveled
VSL	Variable Speed Limit
WIM	Weigh-in-Motion

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1. Overview

1.1 Background

The Minnesota Statewide Regional Intelligent Transportation Systems (ITS) Architecture Version 2018 is an update of the previous version that was developed in 2014. It conforms with the National ITS Architecture (the Architecture Reference for Cooperative and Intelligent Transportation, or ARC-IT, Version 8.2) and the Federal Highway Administration (FHWA) Final Rule 940 and Federal Transit Administration (FTA) Final Policy on ITS Architecture and Standards. The Final Rule and the Final Policy ensure that ITS projects carried out using funds from the Highway Trust Fund including the Mass Transit Account conform to the National ITS Architecture and applicable ITS standards.

The Implementation Volume is one of a series of 15 reports that have been developed as part of the Minnesota Statewide Regional ITS Architecture Update effort. The Implementation Volume investigates and identifies opportunities to further integrate various ITS systems, and provide guidance for Minnesota state, regional and local agencies, and other involved transportation entities, to effectively apply the Minnesota Statewide Regional ITS Architecture in the planning, design, implementation, and operation stages of ITS systems and projects.

Fourteen other documents were developed as part of this architecture update effort and are listed below:

- **Overview:** The Overview document identifies the purpose/need, a general description of the region, development objectives, and performance measures for the Minnesota Statewide Regional ITS Architecture.

- **Volumes 1 thru 12 – Development and Documentation of Service Package Areas:** Each volume is specific to the corresponding Service Package Area and includes: a description of the Service Package Area, ITS development objectives, a summary of needs and services, and a detailed description of needs and services (consisting of the operational concept, inventory, specific service packages to address needs and services, interconnects and architecture flows, and research and development needs).

- **Volume 13 – RAD-IT Outputs of the Regional ITS Architecture:** Volume 13 consists of a report generated by the Regional Architecture Development for Intelligent Transportation (RAD-IT) software, formerly known as Turbo Architecture, for the Minnesota Statewide Regional ITS Architecture.

Volumes 1 through 12 were developed to identify and prioritize stakeholder needs; gather information on existing infrastructure, components and technology; and define stakeholder roles and responsibilities in planning, deploying, operating and maintaining existing and future ITS systems. The Implementation Volume was developed based on the information collected and summarized in these volumes.

1.2 Purpose

This document serves as long-range guidance to help affected agencies and stakeholders systematically and cost-effectively implement the ITS initiatives and project concepts for the next 15 to 20 years in Minnesota based on funding availability. It lists and defines specific ITS

needs that are further defined and prioritized into ITS initiatives and project concepts. Based on stakeholders' input on transportation issues and needs, the long-range project implementation document provides the corresponding details for each project concept or initiative which include project concept descriptions, agency involved, champion, implementation timeframe, technology readiness, dependencies, benefits, service packages, estimated costs, and agreements needed. The document identifies the approach for mainstreaming ITS into the Minnesota Transportation Investment Process and recommends the sequence and strategy for future project implementation.

1.3   Document Development Approach

The process for developing this document includes identification of stakeholder needs, investigation of existing capabilities and gaps related to the needs, development of appropriate ITS concept and initiatives to address needs, analysis of project dependencies, identification of implementation sequencing, investigation of technology and ITS standards maturity and readiness, and consideration of agency agreements and project funding requirements. Initiatives and project concepts identified in this document will accomplish the needs and services documented in the Statewide Regional ITS Architecture. Due to the complexity of the ITS systems and their dependencies, it is critical to develop a proper sequence to guide the deployment of all proposed ITS initiatives over time. Priority, desired timeframe and duration are examined and assigned to each ITS initiative, and an overall deployment schedule is compiled to ensure successful implementation.

The key in this planning process is to identify initiative definition and sequencing. An initiative definition outlines project concepts and the associated details including initiative title, stakeholder, scope, costs, benefits and the service packages defined in the ITS architecture. Implementation sequencing gives an approximate timeframe in which an ITS initiative should be implemented based on the understanding of the initiatives and the dependencies of the initiatives on other existing or planned ITS systems. Project dependencies show how successive ITS initiatives can build on one another. Typically, the first initiatives in the implementation sequence are already programmed and will simply be extracted from existing transportation plans. Successive initiatives will then be added to the sequence based on the project dependencies as well as technical, institutional and financial considerations.

An implementation sequence defines the order in which ITS initiatives may be implemented. A good sequence is based on a combination of two factors:

- Prioritization of initiatives based on existing conditions and stakeholder needs. The ITS initiatives were prioritized to reflect a deployment path (sequence) on stakeholder needs. Although the information collected through stakeholder surveys and meetings was the basis of the ITS architecture; technology, funding opportunities and requirements continue to evolve.
- Project dependencies, based on how successive ITS initiatives can build upon one another. Project dependencies influence the implementation sequencing. It is beneficial to identify the information and functional dependencies between initiatives.

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1.4   Document Organization

This document is organized into four sections:

- Section 1 provides a brief introduction to the document.
- Section 2 describes the approach and key process for ITS program development focusing on stakeholder needs, initiatives and project concepts identification, ITS architecture development, timeframe and sequencing. This section also identifies the role of ITS in the Minnesota Transportation Investment Process, which is the State's planning and programming process, funding needs and identification process.
- Section 3 describes the ITS project development process for generating specific ITS projects for incorporating into the Minnesota Transportation Investment Process. This section also provides an overview of the Systems Engineering Checklists for ITS Projects which are approval documents required to be completed prior to appropriating federal funding for ITS projects or projects with ITS components.
- Section 4 identifies the important implementation considerations including costs and short, medium and long term ITS initiatives and project concepts that may affect ITS implementation and integration.

In summary, the Implementation Volume describes the general approach and key process used to develop this document and how Minnesota ITS Goals, Objectives, and overall Statewide transportation strategic directions, goals and objectives are related to ITS project identification, selection and prioritization.

2.   ITS Program Development

2.1   Overview

This section provides an overview of the ITS project identification, selection and development process and the relationships of ITS projects with the transportation planning processes of transportation agencies and associated stakeholders throughout Minnesota

The Minnesota Statewide Regional ITS Architecture provides Minnesota state, regional and local agencies, and other involved transportation entities with a framework for planning, defining, and integrating the ITS systems in Minnesota. As part of the Architecture, the Implementation Volume identifies and defines specific ITS initiatives and project concepts planned to be implemented statewide and needed enhancements to existing ITS systems. The Implementation Volume documents the necessary information that will facilitate and prioritize the funding resources for future ITS deployments and enhancements statewide. The general approach for developing this document includes the following:

- Based on stakeholder needs, identify, categorize and prioritize ITS initiatives for implementation considerations for the next 15 to 20 years.
- Develop and utilize a process and a method for identifying, evaluating and prioritizing ITS initiatives based on needs, goals and objectives, investment priorities and benefits.
- Develop *project architectures* consistent with the Minnesota Statewide Regional ITS Architecture and in conformance with the National ITS Architecture.

- Define criteria, considerations and process for determining implementation timeline and sequences for future ITS initiative and project concepts.
- Describe Minnesota Department of Transportation's planning process and where the ITS project development process fits into the planning and programming process; defines the approach for mainstreaming ITS into the Minnesota Transportation Investment Process.
- Provide an overview of funding needs and sources to implement, operate, maintain and integrate ITS elements in Minnesota.
- Defines and illustrates a schedule summary for implementing ITS short, medium and long term initiatives and project concepts:
  - Short term initiatives (0-4 years) including a summary of: category; description; agency/stakeholder involved; champion; elements and interconnects; estimated costs; dependencies, and service packages.
  - Medium (5-8 years) and long term (>8 years) initiatives providing a high level summary for each initiative, including: category; description; agency/stakeholder, champion; dependencies and service packages.

Planned initiatives will accomplish the user services and system functions defined in Volume 13: RAD-IT Outputs of the Regional ITS Architecture. Due to the complexity of ITS systems and their dependencies, it is critical to develop a proper sequence to guide the deployment of proposed ITS initiatives over time. Priority, desired timeframe and duration are examined and assigned to each ITS initiative, and an overall deployment schedule is compiled to ensure successful implementation.

The key to the ITS planning process is to define the project/initiative definition and implementation sequencing process. The project/initiative definition outlines the initiatives and project concepts and the associated details including initiative title, stakeholder, scope, costs, benefits and service packages defined in Volume 13: RAD-IT Outputs of the Regional ITS Architecture. The implementation sequencing provides an approximate timeframe in which an ITS initiative may be implemented based on the understanding of the initiative and dependencies of the initiative with other existing or planned ITS systems.

2.2   Stakeholder Needs Identification and Prioritization

Stakeholder outreach has been a key component for updating the Minnesota Statewide Regional ITS Architecture. Because additional ITS needs and services have been identified and added since 2009, new technologies have come on-line, and new technologies have replaced out-of-date technology, a stakeholder survey was conducted in 2017. The survey asked each survey participant to review and provide priority ranking to each of the ITS functional and informational needs as well as research and technology development needs that were identified previously in the 2014 Minnesota Statewide Regional ITS Architecture. Survey participants were also asked to identify additional needs and provide information on the status of current projects/initiatives and plans for future projects/initiatives.

Between July 2017 and April 2018, a series of stakeholder workshops were conducted. The purpose of those workshops was to obtain feedback on the Minnesota ITS Goals and Objectives, discuss the results of the stakeholder survey, and gather additional feedback on needs and priority rankings. Based on those goals and objectives, stakeholders reviewed the ITS functional/informational needs and research and technology development needs and

participated in discussion to identify the highest priority needs that would benefit the traveling public.

Stakeholders also reviewed and updated the needs and services identified in the 2014 architecture update for each of the twelve Service Package Areas (Volumes 1 through 12). The stakeholders accomplished this by providing detailed feedback from Appendix C – Needs and Service Detail, in each Service Package Area document on the following categories:

- Need/Service
- Operational Concept
- Existing Capabilities
- Gaps/Planned Enhancements
- Roles/Responsibilities
- Interconnect
- Data Archive Needs
- Associated Service Package Areas

The stakeholder outreach and engagement resulted in an up-to-date list of ITS initiatives and project concepts to determine short (0-4 years), medium (5-8 years) and long term (>8 years) initiatives identified in this volume.

2.3   ITS Initiative Identification, Evaluation and Selection

As part of the Implementation Volume development process, the Project Team worked closely with participating stakeholders to identify, evaluate, select and prioritize ITS initiatives. Based on the previously identified needs and services, stakeholders identified and prioritized, in each of the service package areas, a list of initiatives and project concepts to address those needs and services. Specifically, detailed descriptions of operational concepts; existing capabilities; gaps and/or planned enhancements; stakeholder roles and responsibilities; interconnects; archive needs; specific and associated service packages were developed. ITS initiative selection included a detailed review of those needs and service details, keying in on operational concepts and gaps and/or planned enhancements to establish the list of initiatives.

Additional safety related initiatives with ITS components were identified in coordination and collaboration with the 2014 Minnesota Strategic Highway Safety Plan (SHSP) Update effort. Those ITS safety initiatives along with other ITS initiatives identified through the stakeholder outreach process are detailed in Section 4.

2.4   Implementation Timeframe and Sequencing

Implementation timeframe and sequencing explains the general criteria and process of defining the implementation sequence for future ITS initiatives and project concepts. Initiative timeframe represents the initiative status and defines the time window to implement the ITS initiative and associated services. Three timeframe categories are used and their definitions are described in Table 1.

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Table 1. Initiative Implementation Timeframes

Category	Timeframe	Year of Deployment
Short Term	0 – 4 years	2018 - 2022
Medium Term	5 – 8 years	2023 – 2027
Long Term	Beyond 8 years	2027 and beyond

Defining the timeframe and sequencing for initiative implementation is based on, stakeholder input; specific needs of the region (e.g. statewide, rural area, metropolitan planning organization [MPO], etc.) or local area (e.g. municipal or county jurisdiction etc.); and the readiness of each initiative. Other factors that will need to be considered in the implementation timeframe and sequencing process are:

- Funding availability
- Interdependency with current ITS capabilities and other initiatives
- Technology readiness
- Identification of estimated capital, operations and maintenance costs
- Agreements required for implementation and operations of ITS systems

2.5   Statewide Transportation Process for Investment Decisions

2.5.1 Transportation Planning and Program Process
Statewide transportation investment decision making relies on the transportation planning activities of Minnesota Department of Transportation (MnDOT), cities, counties, MPOs, Regional Development Organizations (RDOs), and other transportation agencies. This transportation planning and programming process is driven by statewide goals and transportation directions via the Minnesota Statewide Multimodal Transportation Plan (SMTP), which is supported by statewide, district, regional and local plans.

The statewide transportation planning and programming process encompasses planning, programming and project development. The following summarizes the planning framework which guides program and development process:

Transportation Planning Process
1. **Minnesota GO 50-Year Vision:** The Minnesota GO 50-year vision was adopted in November 2011 and is the first long-range transportation vision adopted for Minnesota. It establishes long-term goals for transportation in the state. The vision is for a multimodal transportation system that maximizes the health of people, the environment, and economy. It includes eight guiding principles to help inform future policy and investment decisions for all forms of transportation throughout Minnesota.

2. **MnDOT 20-Year Statewide Multimodal Transportation Plan:** The SMTP is Minnesota's highest level policy plan for transportation. It's a 20-year plan based on the Minnesota GO Vision. The SMTP is for all types of transportation an all transportation partners in the state. It includes broader multimodal objectives and strategies that directly affect the direction of modal investment plans. Additionally, the plan was developed to align with state legislative goals and federal guidance.

3. **MnDOT 20-Year Modal System Plans:** MnDOT currently has eight 20-year modal system plans: State Aviation System Plan, State Highway Investment Plan (MnSHIP), Greater Minnesota Transit Investment Plan, Statewide Bicycle System Plan, Statewide Freight System and Investment Plan, State Rail Plan, Statewide Ports and Waterways Plan, and Minnesota Walks. The modal system plans use the Minnesota GO Vision and guiding principles and the objectives and strategies identified in the SMTP as their framework for development. These plans draw on a broad array of other plans and studies to set out mode-specific objectives, strategies, and performance measures. For systems where MnDOT makes investments, the plans also include performance-based needs over upcoming years and risk-based investment trade-offs.

4. **Regional and Local Plans:** Regional and local plans include plans from MPOs; RDOs; Tribal governments; city; county; etc. MnDOT district representatives take into consideration developed metropolitan, regional and local plans that address transportation issues and needs, as well receive input and feedback from local agencies, interested transportation groups and the public.

Transportation Programming Process
1. **Metropolitan Planning Organizations (MPOs):** MPOs are entities designated by lay with the lead responsibility for the development of transportation plans for metropolitan areas and to coordinate the transportation planning process. There are eight MPOs in Minnesota: Metropolitan Interstate Council (Duluth/Superior), Grand Forks/East Grand Forks, Fargo-Moorhead Metropolitan Council of Governments, St. Cloud Area Planning Organization, Twin Cities Metropolitan Council, Rochester/Olmsted Council of Governments, La Crosse Area Planning Committee, and Mankato/North Mankato Area Planning Organization. The primary functions of an MPO include maintaining a Long Range Transportation Plan, developing a Transportation Improvement Program (TIP), and developing a Unified Planning Work Program.

2. **Regional Development Organizations (RDOs):** RDOs are key partners in statewide transportation planning and programming. There are twelve RDOs in Minnesota. Each RDO works with MnDOT through an annual work program framework to ensure statewide consistency while allow for unique differences in regional transportation issues around the state.

3. **Area Transportation Partnerships (ATPs):** ATPs generally align with MnDOT District boundaries but follow counties lines. Membership includes, but not limited to, MPOs, RDOs, Tribal Governments, local governments, and other transportation interests. The primary role of the ATPs is to bring together transportation improvement recommendations into a list of transportation investments – Area Transportation Improvement Program (ATIP).

4. **Area Transportation Improvement Program (ATIP):** The ATP develops an ATIP that covers a minimum of a four-year period. ATIPs include all projects seeking federal-aid highway, state trunk highway, and federal transit sources of funding. Each of the eight ATPs receives one or many prioritized lists of transportation projects through their solicitation process. The ATPs are responsible for integrating these priority lists into the ATIP. The ATIP prepared by each of the eight ATPs is submitted for inclusion in the draft State Transportation Improvement Program (STIP).

5. **State Transportation Improvement Program (STIP):** The ATIPs are analyzed and compared to statewide goals and objectives, and unique transportation needs. The ATIPs are also analyzed for completeness and fiscal constraint. From this process the draft STIP is developed. The draft STIP is circulated for review and comment before final adjustments are made. The STIP covers four state fiscal years and includes all state and local projects financed with federal highway or transit assistance. The STIP also includes other regionally significant projects, all projects on the state highway system and illustrative projects (i.e. projects that will be programmed should funding become available.

2.5.2 ITS Roles in STIP

ITS from a statewide perspective supports Minnesota's transportation planning and programming process in several ways:

- The Minnesota Statewide Regional ITS Architecture, incorporated with the MnDOT Statewide Multimodal Transportation Plan, aligns projects with the State or region's goals and flow into the STIP.
- The FHWA's, "Use of Regional ITS Architecture" manual lists several additional ways that a regional ITS architecture can support the transportation planning process:
  - o The services described in the ITS architecture can provide the basis for operational strategies to improve the transportation system and meet the state's or region's vision and goals.
  - o The ITS architecture can be used to support the evaluation and prioritization of strategies in two ways: 1) through the architecture's definition of archiving and data collection systems that support collecting the data needed for evaluation; and 2) through the detailed definition of ITS projects and their sequencing that can be used to support prioritization.
  - o The definition of an integrated transportation system described by the ITS architecture can support a key element of the transportation plan.
  - o The process of developing and maintaining a regional ITS architecture can help to enhance the linkage between operations and planning.

In summary, it is essential that overarching policies from statewide, regional and local plans provide direction to the architecture by establishing the state's/region's ITS needs and priorities to incorporate and plan improvements to address those identified needs and priorities. The Minnesota Statewide Regional ITS Architecture and associated ITS planning and deployment documents, were built upon a foundation provided by previous MnDOT transportation planning documents. These planning documents outline the agency's vision, goals, and priorities for the overall transportation system. These documents form the foundation for the ITS Architecture Update and guide the development of future ITS enhancements.

The basis for all MnDOT transportation planning documents is the Minnesota GO vision. This high-level plan defines MnDOT's principles to guide future policy and investment decisions for all forms of transportation throughout Minnesota. The 20-Year Statewide Multimodal Transportation Plan further clarifies these principles and lays out objectives and strategies to be used to implement the directions identified in the 50-year vision. These objectives and strategies are further developed in several different types of planning documents: Modal System Plans, Statewide ITS Plan, Highway Systems Operations Plan, SHSP, other investment plans, and local agency plans. These plans develop strategies, concepts, and projects to implement higher level policies. This Minnesota Statewide Regional ITS Architecture falls into this category.

Projects from this level of planning are selected for inclusion into 10-year programs of capital and service improvements and then a limited number are included into the 4-year STIP.

2.6 ITS Funding Sources

2.6.1 Federal Funding
Moving Ahead for Progress in the 21st Century Act (MAP-21) starts the transition to a performance-driven and outcome-based program. This transition is represented in many areas of MAP-21: formula highway programs, new performance management provisions, and planning provisions. It requires States and MPOs to establish and use a performance-based approach as part of the statewide and metropolitan transportation planning process. The Fixing America's Surface Transportation Act (FAST Act) builds on the changes made by MAP-21. The FAST Act establishes and funds new programs to support critical transportation projects to ease congestion and facilitate the movement of freight on the Interstate System and other major roads. Potential funding programs for ITS activities are summarized below:

- ITS Program
  - The FAST Act continues the ITS program, which provides for the research, development, and operational testing of ITS aimed at solving congestion and safety problems, improving operating efficiencies in transit and commercial vehicles, and reducing the environmental impact of growing travel demand.
  - Guided by the USDOT five-year ITS Strategic Plan, the ITS program is currently focused on significantly reducing crashes through advanced safety systems based on interoperable wireless communications among surface transportation vehicles of all types, traffic signals, other infrastructure systems, pedestrians, wireless devices, and automated vehicle systems.
  - A new goal, enhancement of the national freight system and support to national freight policy goals, is added to the ITS Program.
- National Highway Performance Program (NHPP)
  - NHPP funds an enhanced National Highway System, combining the functions of the existing National Highway System (NHS), Interstate Maintenance (IM) and Bridge Programs.
  - The enhanced NHS includes existing NHS, all principal arterials, STRAHNET, and intermodal connectors.
  - NHPP provides support for the condition and performance of the NHS, for the construction of new facilities on the NHS, and to ensure that Federal-aid investments in highway construction are directed to support progress toward achieving performance targets established in a State's asset management plan for the NHS.
  - NHPP funds capital and operating costs for traffic management and traveler information monitoring, management, and control facilities and programs.
  - NHPP also covers infrastructure-based ITS capital improvements, including installation of vehicle-to-infrastructure communication equipment.
- Surface Transportation Block Grant Program (STBG)
  - The FAST Act converts the long-standing Surface Transportation Program (STP) into the STBG Program.
  - The STBG program provides flexible funding that may be used for projects to preserve and improve conditions and performance on any Federal-aid highway, bridge and tunnel project on any public road, pedestrian or bicycle infrastructure, and on a capital transit project.

- o The STBG Program continues all prior STP eligibilities, including funding for projects and strategies designed to support congestion pricing, including electronic toll collection and travel demand management strategies.
- o The STBG Program also adds the following new eligibilities:
  - A State may use STBG funds to create and operate a State office to help design, implement, and oversee public-private partnerships (P3) eligible to receive Federal highway or transit funding, and to pay a stipend to unsuccessful P3 bidders in certain circumstances.
  - At a State's request, the USDOT may use the State's STBG funding to pay the subsidy and administrative costs for TIFIA credit assistance for an eligible STBG project or group of projects.
- o The FAST Act also adds specific mention of the eligibility of installation of vehicle-to-infrastructure communication equipment.
- Highway Safety Improvement Program (HSIP)
  - o The FAST Act continues the HSIP to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance.
  - o Under MAP-21, a State could use HSIP funds on any safety project (infrastructure-related or non-infrastructure) that met the overarching requirement. In contrast, the FAST Act limits HSIP eligibility to only the following activities:
    - Installation of vehicle-to-infrastructure communication equipment.
    - Pedestrian hybrid beacons.
    - Roadway improvements that provide separation between pedestrians and motor vehicles, including medians and pedestrian crossing islands.
    - Other physical infrastructure projects not specifically enumerated in the list of eligible projects.
  - o HSIP is available for local agencies to apply. Funding is completed through a solicitation and competitive process. Minnesota has historically shared about 50% of the available program funds with local agencies.
  - o The use of HSIP funds for the purchase, operation, or maintenance of an automated traffic enforcement system (except in a school zone) is prohibited.
- Congestion Mitigation and Air Quality (CMAQ)
  - o The FAST Act continues the CMAQ program in MAP-21. The program funds projects that help reduce emissions and traffic congestion in areas designated as nonattainment or maintenance areas for carbon monoxide, ozone or particulate matter.
  - o Eligible projects include projects to improve mobility such as through real-time traffic, transit and multimodal traveler information, or otherwise reduce demand for roads through means such as telecommuting, ridesharing, carsharing, and pricing.
  - o The FAST Act also specifically makes eligible the installation of vehicle-to-infrastructure communications equipment.
  - o The FAST Act continues eligibility for electric vehicle and natural gas vehicle infrastructure and adds priority for infrastructure located on the corridors designated under 23 U.S.C. 151.
- National Highway Freight Program (NHFP)
  - o The FAST Act establishes a new National Highway Freight Program (NHFP) to improve the efficient movement of freight on the National Highway Freight Network (NHFN).
  - o Eligible uses of NHFP funds for ITS include:
    - ITS and other technology to improve the flow of freight, including intelligent freight transportation systems
    - Efforts to reduce the environmental impacts of freight movement

- Railway-highway grade separation
- Real-time traffic, truck parking, roadway condition, and multimodal transportation information systems
- Electronic screening and credentialing systems for vehicles, including weigh-in-motion truck inspection technologies
- Traffic signal optimization, including synchronized and adaptive signals
- Work zone management and information systems
- Highway ramp metering
- Electronic cargo and border security technologies that improve truck freight movement
- ITS that would increase truck freight efficiencies inside the boundaries of intermodal facilities

- Motor Carrier Safety Assistance Program
  - The goal of the program is to improve motor carrier, commercial motor vehicle, and driver safety to support a safe and efficient surface transportation system. The program funds are eligible for deployment activities and activities to develop new and innovative advanced technology solutions that support commercial motor vehicle information systems and networks and for the operation and maintenance costs associated with innovative technology.
- Transit Program
  - Federal transit funding is appropriated annually. Programs include: Urbanized Area Formula Program, Rural Area Formula Program (includes rural, small urban, and intercity bus), Enhanced Mobility of Seniors and Individuals with Disabilities Formula Program, Metropolitan and Statewide Non-metropolitan Transportation Planning Formula Program, State of Good Repair Grants and Bus and Bus Facilities Formula Grants.
  - The FAST Act continues several important goals established in MAP-21, including safety, state of good repair, and performance.
  - It adds funding eligibility for the deployment of low or no emission vehicles, zero emission vehicles, or associated advanced technology.
  - It continues to fund BRT projects in defined corridors that demonstrate substantial investment in fixed transit facilities including transit stations, ITS technology, traffic signal priority, and off-bard fare collection.
- Highway Research and Development (HRD)
  - MAP-21 establishes a flexible, nationally-coordinated research and technology program. All research activities are to include a component of performance measurement and evaluation, should be outcome-based, and must be consistent with the USDOT Research, Development, and Technology Strategic Plan.
  - The FAST Act continues the HRD program, which funds strategic investment in research activities that address current and emerging highway transportation needs.
  - The FAST Act continues without change the broad range of activities eligible under HRD, including activities to improve highway safety and infrastructure integrity; activities to strengthen transportation planning and environmental decision-making; activities to reduce congestion, improve highway operations, and enhance freight productivity; and exploratory advanced research.
  - The Technology and Innovation Deployment Program funds efforts to accelerate the implementation and delivery of new innovations and technologies that result from highway research and development to benefit all aspects of highway transportation.

2.6.2 State and Local Funding

The State of Minnesota has a biennial budget. State agency programs and operating budgets are based on a balanced budget. The 2018-2021 STIP is based on one year of approved funding and three years of estimated funding. The funding level for the STIP is estimated to be approximately the same for all 4 years of the STIP.

- State Highway Funding
  - o MnDOT spends about $800 million per year for state highways, with $300 million per year from State Highway Funds based on the current revenue forecast and $500 million from Federal funds.
  - o The State Highway cash flow also permits advance construction of projects prior to actual federal dollars being available.
- State Transit Funding
  - o Transit assistance comes from three sources, the General Fund, Motor Vehicle Sales Tax (MVST) and Motor Vehicle Leased Sales Tax (MVLST). The transit appropriation from the State General Fund is expected to be about $0.5 million in 2018 and $17.4 million in 2019 and $17.2 million in the following years of the STIP for Greater Minnesota. For the Metropolitan area, the transit appropriation is and $121.0 million in 2018, 129.8 million in 2019, and $89.8 million in the following years of the STIP.
  - o Minnesota's 2007 Legislature statutorily dedicated 40 percent of the annual MVST collections for transit: 4 percent is dedicated for Greater Minnesota transit operations and 36 percent for Twin Cities Metropolitan Area transit operations.
  - o Greater Minnesota transit receives 38 percent of MVLST revenues.
- State Aid for Local Transportation (SALT)
  - o MnDOT distributes funds for highway maintenance and construction to counties, cities and townships based on a formula determined by the Legislature.
  - o Staff from SALT provides technical assistance in highway and bridge design, construction and maintenance, authorizes grants for bridge construction, coordinates local federally funded projects and provides overall management of the state aid system.
  - o The Minnesota Constitution provides that 95% of the Highway User Tax Distribution (HUTD) Fund revenues are distributed as follows: Trunk Highway (TH) fund - 62%; CSAH fund - 29%; and Municipal State Aid Streets (MSAS) fund - 9%. The remaining 5%, referred to as the five percent set-aside, is distributed in accordance with a formula established by the Legislature,
  - o Since July 1, 1999, the five percent set-aside revenues, $111 million in FY 2018, have been deposited in the CSAH Fund, where they have been further allocated to the Township Roads Account (30.5%), Township Bridges Account (16%), and Flexible Highway Account (53.5%).
- Flexible Highway Account
  - o The Flexible Highway Account was created by the 1998 Legislature by combining money from the five percent set-aside that was previously allocated to the Trunk Highway Fund, the county turnback account in the CSAH Fund, and the municipal turnback account in the MSAS Fund.
  - o The distribution of money in the Flexible Highway Account is subject to decisions made in the State's biennial budget process.
- Advance Construction
  - o Advance Construction (AC) is a federal law that allows states to request and receive approval to construct federal-aid projects prior to receiving apportionment or obligation authority.

- o Minnesota may commit future federal funds to a project as long as it goes through the normal FHWA approval and authorization process.
- o Projects using AC must be fully encumbered in the state MnDOT budget for the amount of state funds and the federal AC amount.
- o Advance Construction is available to local governments as well as MnDOT.
- o The agency using the AC procedure must "front end" the project with their own funds.

3.   ITS Project Development and Requirements

3.1   ITS Project Development Process

Throughout Minnesota ITS Program history the project development process encouraged ITS projects to be more cutting edge and experimental in their program development. This process required that the results and performance of the project or initiative be carefully analyzed and disseminated on a national level so as to allow future projects/initiatives to build on the successes of the original project/initiative.

The development of Minnesota ITS programs, initiatives, project concepts and projects lies in large part to documents such as the Minnesota Statewide Regional ITS Architecture and other plans with ITS components, which have laid the groundwork that will help set the new directions for ITS in Minnesota. Figure 1 provides a high level view of the ITS mainstreaming process into the Minnesota Investment Process.

Transportation Planning
- Minnesota GO 50-Year Vision
- 20-Year Statewide Multimodal Transportation Plan
- Modal Investment Plans (Highway, Aviation, Freight and Passenger Rail, Bicycle, Pedestrian, Greater Minnesota Transit Plan)
- Statewide ITS Plan
- Transportation System Management and Operations (TSMO) Plan
- Strategic Highway Safety Plan
- **Minnesota Statewide Regional ITS Architecture**
- MPO Long Range Transportation Plans
- Other Local/Regional Plans

District/ATP/MPO Planning
- Recommend Transportation Projects
- Evaluate, Identify and Integrate Transportation Priorities
- Congestion Management Process
- Recommend Investments – MPO & Area Transportation Improvement Program (ATIP)

District/ATP/MPO Programming
- Draft STIP (State Goals, Regional Priorities, Modal Balance, Equity Analysis)
- District/ATPs Review and Comment on Draft STIP
- STIP Finalized – Approved by MnDOT

Project Authorization
- MnDOT approved STIP is forwarded to FHWA/FTA for review and approval for funding allocation

Figure 1. ITS Mainstream Process

Two high-level diagrams of the MnDOT ITS project development process are presented in Figures 2 and 3. Typical ITS field equipment projects are similar to construction projects and can be implemented using the MnDOT Highway Project Development Process (HPDP), shown at a high level in Figure 2. This figure focuses specifically on the process steps and documentation that relate most directly to the systems engineering process. As shown the project scoping and detailed design steps include several documents that represent good systems engineering practice. Figure 3 aligns all three of these processes, a first step in mainstreaming ITS specific processed into the existing HPDP. The Rule 940 conformity process and the Systems Engineering process shown in Figure 3 are described in Sections 3.2 and 3.3, respectively.

MnDOT, in working with FHWA, is current exploring the relationship between the processes to facilitate integration of systems engineering activities with traditional MnDOT project development activities and the HPDP.
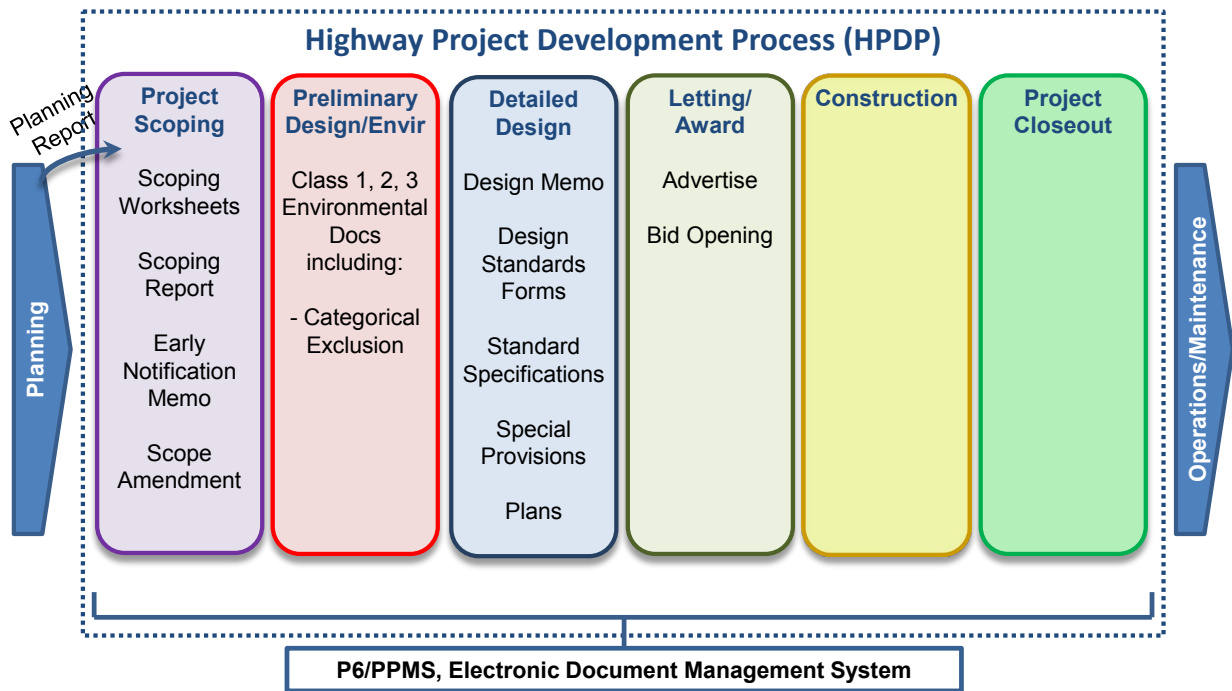
Figure 2. MnDOT Highway Project Development Process
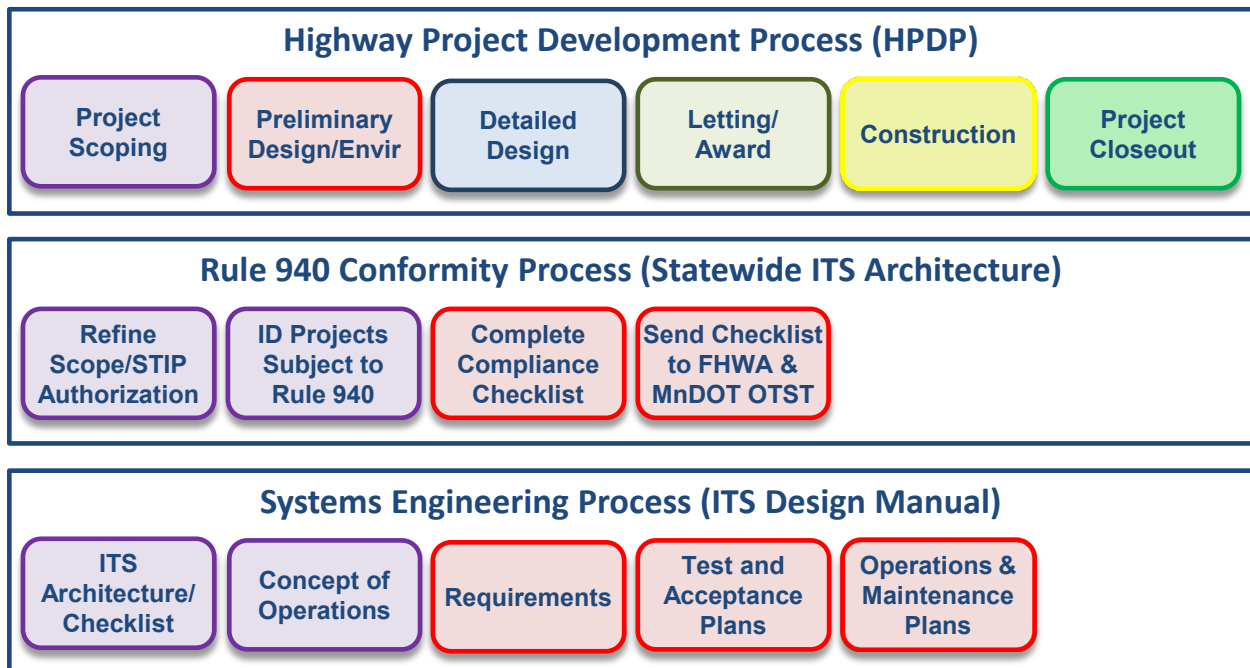
Figure 3. Aligning HPDP and ITS-Specific Processes

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3.2   Rule 940 Requirements and Conformity Process

FHWA Rule 940 (http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf) provides policies and procedures for implementing Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA–21), Public Law 105–178, 112 Stat. 457, pertaining to conformance with the National ITS Architecture and Standards. The rule states, in part, that the final design of all ITS projects funded with Highway Trust Funds must accommodate the interface requirements and information exchanges as specified in the regional ITS architecture. The Minnesota Statewide Regional ITS Architecture is a specific application of the framework specified in the National ITS Architecture, tailored to the needs of the transportation stakeholders statewide.

3.2.1   Project Initiation and Implementation

After funding has been programmed for a specified ITS project, or a transportation project incorporating ITS elements, the focus is on having the ITS project follow a sound systems engineering process. The following are activities after funding has been programmed into the STIP:

1) **Refine Scope/STIP Authorization:** The MnDOT Project Manager, or if a local project, the local Project Manager will work with partners to develop agreements, refine scopes, etc.

2) **ATIP/STIP Authorization:** If the project is federally funded projects must be entered on the ATIP/STIP before authorization can be obtained.

3) **Identification of Projects to Demonstrate Rule 940 Conformity:** For federally funded ITS projects, several steps need to be followed as part of the systems engineering analysis and Rule 940 requirements. Rule 940 states that the systems engineering analysis shall include, at a minimum:
    *   Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the National ITS architecture).
    *   Identification of participating agencies roles and responsibilities.
    *   Requirements definitions.
    *   Analysis of alternative system configurations and technology options to meet requirements.
    *   Procurement options.
    *   Identification of applicable ITS standards and testing procedures.
    *   Procedures and resources necessary for operations and management of the system.

    The rule requirements are applicable for all ITS projects funded through the Highway Trust Fund account. Conformity with the Rule 940 requirements is required for both routine and non-routine projects. However, with routine projects, the effort and the scope of systems engineering analysis should be minimal. For non-routine projects, the scale of the systems engineering analysis depends on the scope of the project.

    While the use of the architecture and the systems engineering approach is mandatory for federally funded projects, project developers are encouraged to use this approach for any ITS project using state or local funds, especially for projects that integrate with other systems in the region.

4) **Minnesota ITS Projects – Architecture Compliance (FHWA Final Rule 940 and FTA National ITS Architecture Policy) Checklist:** MnDOT has developed procedures and checklists for ITS projects for conformity with the FHWA Rule 940 and FTA National ITS Architecture Policy.[1] To facilitate the streamlined implementation of ITS systems engineering requirements, MnDOT has divided ITS projects into two categories: Standard ITS Applications and Large Scale/Complex ITS Applications. Standard ITS Applications include:

- Traffic Signal: including basic traffic signals, flashing yellow arrows, advanced warning flashers, railroad preemption, emergency vehicle preemption, transit signal priority, enforcement lights, and traffic signal interconnects.
- Road Weather Information System (RWIS): including RWIS sensors and stations.
- Railroad-Highway Grade Crossing: including flashing light signals, standard crossing gates, four quadrant gates, traffic signal preemption, etc.
- Weigh in Motion System: for CVO weight enforcement and inspection.

For Standard ITS Applications, a programmatic systems engineering analysis has been completed. This effort created a concept of operations, functional requirements document and systems engineering checklists for this type of ITS projects. The appropriate, pre-approved Systems Engineering Checklist should be completed by the project manager and/or District Traffic Engineer/State Aid Engineer.

Projects not covered by Standard ITS Applications are considered Large Scale/Complex ITS Applications and will require completion of a full systems engineering procedure and one of the following three Systems Engineering Checklists for ITS projects:

- Freeway Traffic Management Checklist
- Arterial Traffic Management Checklist
- General Large Scale/Complex ITS Application Checklist

These checklists are guides for project managers to determine what documents, steps and analyses need to be developed over the life of the project. The checklists are broken down into six and five sections for Standard ITS Applications and Large Scale/Complex ITS Applications, respectively. The sections of the checklist were adapted from federal guidance on using systems engineering in ITS projects, as well referencing other DOT's ITS compliance process. The checklists are available on the MnDOT Systems Engineering web page at https://www.dot.state.mn.us/its/systemsengineering.html. Project managers should complete the appropriate checklist based on information already available to them. Questions that arise pertaining to the checklists during the completion process should be directed to the MnDOT contact noted on the checklists.

For projects utilizing no federal or state funds or non-routine projects, it is recommended that a similar process be followed. Examples of such projects might include integration of computer-aided dispatch systems among law enforcement agencies and traffic management agencies, setting up a video clearing house, provision of regional traveler information, etc.

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[1] Similar to FHWA Rule 940, the FTA National Architecture Policy provides procedures for implementing section 5206(e) of the Transportation Equity Act for the 21st Century. All projects funded with mass transit funds from the highway trust fund will be based on a systems engineering process.

5) **Send Completed Checklist to MnDOT and FHWA:** Once the Rule 940 checklist is completed and signed by the District Traffic Engineer/State Aid Engineer, it should be submitted along with the project documentation package for federal authorization to MnDOT Pre-Letting Engineer or State Aid Office. MnDOT Office of Connected & Automated Vehicles (CAV-X) will provide guidance and technical assistance to properly use systems engineering and complete the checklist. FHWA staff will review checklist and supporting documentation and make a determination as to whether the proposed project demonstrates compliance with Rule 940.

3.3   Systems Engineering

Final Rule 940 requires that all ITS projects funded with highway trust funds be developed based on a systems engineering analysis. Systems engineering is a phrase used to describe the cyclical process of planning, designing, implementing, testing, operation, and maintenance of an ITS system or project throughout its useful life. The systems engineering process begins with the development and implementation of an ITS architecture and continues by outlining the steps and level of detail of each phase of project deployment, from high-level tasks such as establishing the Concept of Operations to very detailed component design, installation, and testing. The purpose of the systems engineering process is to ensure that a well-planned foundation is in place and then to affirm the requirements of an ITS system.

As illustrated in Figure 4, Systems Engineering Approach recommended by the FHWA, an ITS architecture provides a starting point for systems engineering analyses that are performed during ITS project development.
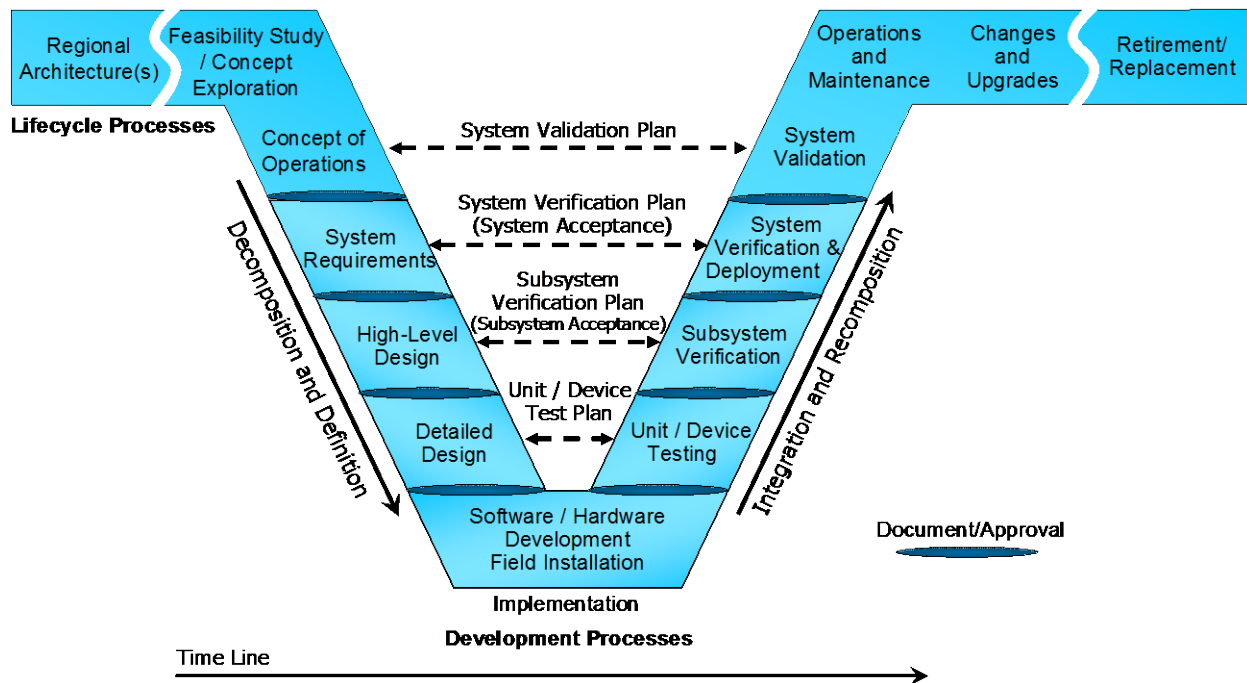
Figure 4. Systems Engineering Approach

Figure 5 maps the systems engineering "V" diagram to the high-level HPDP. The steps in the "V" diagram that are color-coded correspond to the steps in the HPDP. The figure illustrates the high-level connections that exist between the project development process and the process steps that make up the systems engineering process. This relationship should be well understood by stakeholders and management at the outset of the project development process improvement. As illustrated, many of the systems engineering process steps have parallels in the traditional project development process. The challenge is that technology implementation is often more complex from an integration standpoint than traditional capital projects.
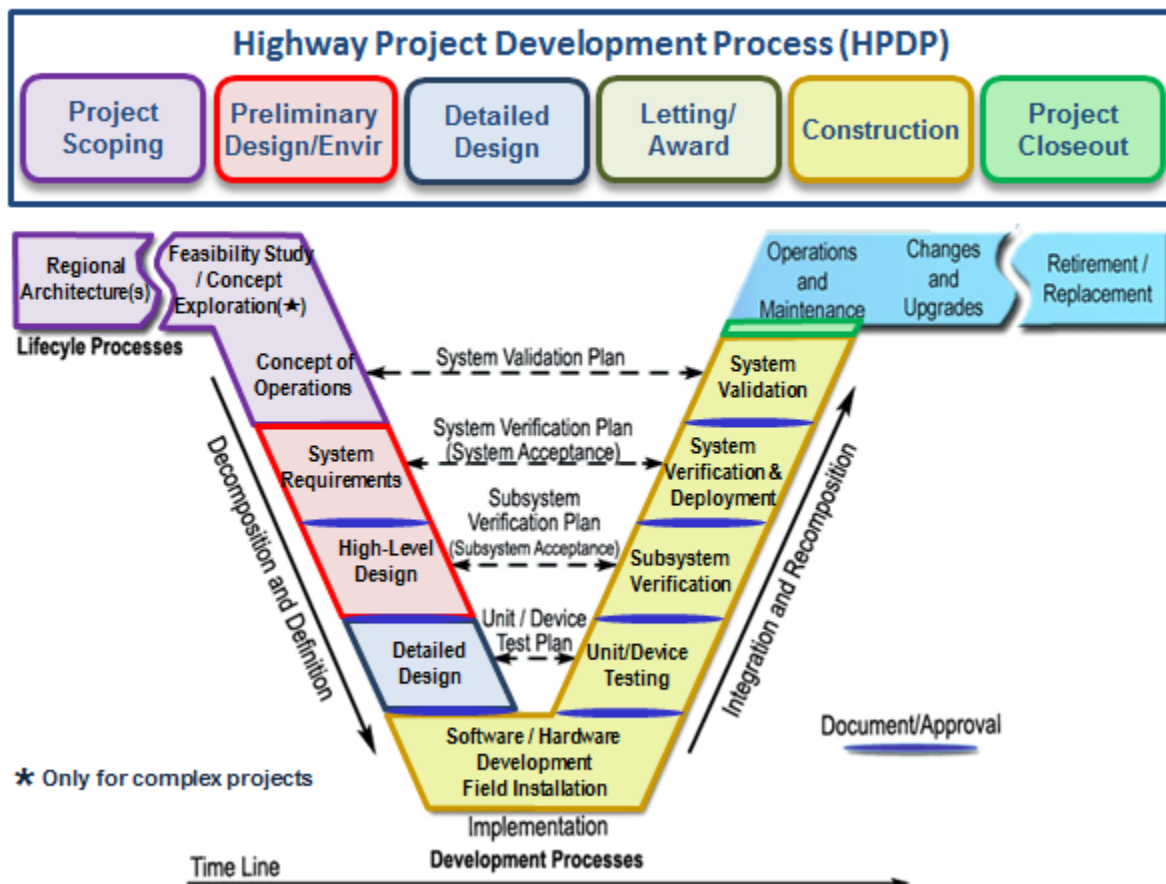
Figure 5. HPDP and Systems Engineering Process

The ITS Architecture is a dynamic document that requires periodic updates to reflect changes in an agency's ITS program due to funding levels, evolving project or system requirements, or the introduction of improved technology. Once ITS projects are programmed, the ITS architecture provides initial inputs to support the systems engineering process including the establishment of the concept of operations, requirements, and high-level design and test planning of ITS projects. The ITS architecture improves continuity across the project lifecycle, from planning through project development and operations. As required by the FHWA and FTA, the Statewide Regional ITS Architecture serves to meet the criteria of Final Rule 940.

The development and implementation of the Minnesota Statewide Regional ITS Architecture is within the framework of the National ITS Architecture, and using the systems engineering approach will help ensure the stability and longevity of ITS projects and systems deployed throughout Minnesota.

4.   ITS Initiatives and Project Concepts for Implementation

This section identifies the overall vision and approach for ITS system deployments over the next 15-20 years throughout Minnesota. Section 4.1 provides a summary of all potential ITS initiatives and project concepts and their relationships with the Minnesota ITS Goals. Section 4.2 summarizes the implementation sequencing and schedule of the identified short-term initiatives and project concepts, along with the costs for implementation. Section 4.3 provides detailed descriptions of the short-term initiatives and project concepts, while Section 4.4 describes the medium- and long-term initiatives and project concepts.

4.1   Summary of Potential Initiatives and Project Concepts

This section presents a list of all potential ITS initiatives and their relationships with the Minnesota ITS Goals and Objectives. The Minnesota ITS Goals and Objectives were presented in the Overview document. Specific objectives were categorized under the following eight Minnesota ITS Goals:

- A. Improve the Safety of the State's Transportation System
- B. Increase Operational Efficiency and Reliability of the Transportation System
- C. Enhance Mobility, Convenience, and Comfort for Transportation System Users
- D. Improve the Security of the Transportation System
- E. Support Regional Economic Productivity and Development
- F. Preserve the Transportation System
- G. Enhance the Integration and Connectivity of the Transportation System
- H. Reduce Environmental Impacts

The goals that would be achieved with potential ITS initiatives have been linked to those initiatives, and such linkages are presented in Table 2. Linkages between individual ITS initiatives and Minnesota ITS Objectives are presented in Sections 4.3 and 4.4.

Table 3 shows the linkages between individual ITS initiatives and the twelve service package areas defined in ARC-IT. The linkages allow for connecting ITS initiatives with appropriate service package area(s) and Architecture Volume(s) to obtain additional information.

4.2   Implementation Schedule and Cost Summary

Table 4 illustrates the implementation sequencing and schedule for the 63 potential short-term ITS initiatives identified in Section 4.3. Implementation schedule is subject to change over time as initiatives are deployed or priorities change. Factors such as funding, impact of previous deployments, and unforeseen circumstances may require alternations of some initiatives, especially those scheduled for deployment in later years. As such, it is recommended that this implementation sequence and schedule is evaluated on an annual basis.

To the extent possible, cost estimates for individual initiatives are provided in Section 4.3. It should be noted that the cost estimates are based on current technologies that are most likely to be deployed, along with many assumptions. Final costs may vary based on site-specific circumstances and are more accurately determined during the design/preliminary engineering phase.

Table 2. Mapping of Minnesota ITS Goals with Potential ITS Initiatives and Project Concepts

ID	ITS Initiatives and Project Concepts	A. Improve the Safety of the State's Transportation System	B. Increase Operational Efficiency and Reliability of the Transportation System	C. Enhance Mobility, Convenience, and Comfort for Transportation System Users	D. Improve the Security of the Transportation System	E. Support Regional Economic Productivity and Development	F. Preserve the Transportation System	G. Enhance the Integration and Connectivity of the Transportation System	H. Reduce Environmental Impacts
	Short Term ITS Initiatives and Project Concepts								
S01	Real-Time Integration of Arrow Board Messages into Traveler Information Systems	●	●	●				●	
S02	Electronic Alerts to Trucking Companies		●	●		●			
S03	Enhance Traveler Information Map for Mobile Devices	●	●	●					
S04	511 Telephone Interface Enhancements and Maintenance	●	●	●	●				
S05	ATIS Customization and Enhancements			●				●	●
S06	Rest Area Truck Parking Availability			●					
S07	Traffic Signal Timing and Control Improvements, Centralized Traffic Signal Control, and Automated Traffic Signal Performance Measures		●	●					
S08	Adaptive Traffic Signal Control		●	●					
S09	Develop an Automated System for Traffic Data Archiving							●	
S10	MSP CAD and CARS Integration Enhancements	●	●	●					
S11	Dynamic Speed Display Signs ("Your Speed Is")	●	●	●					
S12	Expand Provision of Travel Time and Delay Information		●	●					
S13	Advance Warning Flasher Deployment Expansion	●							
S14	Standard Traffic Signals	●	●	●					
S15	Arterial Traffic Management Systems	●	●	●	●			●	

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ID	ITS Initiatives and Project Concepts	Minnesota ITS Goals							
		A. Improve the Safety of the State's Transportation System	B. Increase Operational Efficiency and Reliability of the Transportation System	C. Enhance Mobility, Convenience, and Comfort for Transportation System Users	D. Improve the Security of the Transportation System	E. Support Regional Economic Productivity and Development	F. Preserve the Transportation System	G. Enhance the Integration and Connectivity of the Transportation System	H. Reduce Environmental Impacts
S16	Freeway Traffic Management Systems	●	●	●	●			●	
S17	Integrated Corridor Management (ICM)		●	●					
S18	Sharing Video Images Between Agencies		●	●		●			
S19	ATMS for Major Event Management		●						
S20	Expand HOT Lane Deployment in Metro Area		●						●
S21	Passenger Occupancy Monitoring/ Enforcement System for MnPASS		●						●
S22	Active Flashing Signals and Gates at Highway/Railroad Intersections	●							
S23	Overheight Detection/Warning Systems	●		●					
S24	Expand Geographic Coverage of the RTMC Systems	●	●	●	●				
S25	Use Driving Simulation for Teenage and Older Driver Education	●							
S26	Transit Customer Information Systems			●		●		●	●
S27	Transit Fleet Management Systems		●	●			●		
S28	Transit Operations and Management Systems		●	●			●	●	
S29	Transit Safety and Security Systems	●			●				
S30	Transit Communications		●	●	●			●	
S31	Commercial Vehicle Mainline Sorting System		●			●	●		
S32	Virtual Weigh Stations					●	●		
S33	Congestion Reduction in Major Freight Bottlenecks			●		●			

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ID	ITS Initiatives and Project Concepts	Minnesota ITS Goals							
		A. Improve the Safety of the State's Transportation System	B. Increase Operational Efficiency and Reliability of the Transportation System	C. Enhance Mobility, Convenience, and Comfort for Transportation System Users	D. Improve the Security of the Transportation System	E. Support Regional Economic Productivity and Development	F. Preserve the Transportation System	G. Enhance the Integration and Connectivity of the Transportation System	H. Reduce Environmental Impacts
S34	Enhance Automated Permit Routing System					●	●		
S35	CVO Database and CARS Database Enhancement			●		●			
S36	ATIS for CVO Enhancements			●		●			
S37	Multi-State OS/OW Permitting System					●	●		
S38	Emergency Responder Database		●						
S39	Enhance Routing of Emergency Vehicles		●						
S40	Expand Deployment of Mobile Data Computers for Emergency Responders		●	●					
S41	Critical Infrastructure Monitoring		●		●				
S42	Use Preemption on Vehicle Radios to Provide Real-Time Information	●							
S43	Automated Field Reporting Systems for MSP and Local Law Enforcement		●						
S44	DVR to Review Central Images during an Incident		●						
S45	AVL for MnDOT Maintenance and Other Fleet Vehicles					●			●
S46	Roadway Condition and Environmental Sensors on Maintenance Vehicles for Traveler Information	●		●					
S47	Expand Maintenance and Decision Support System (MDSS) Deployment	●							●
S48	Dynamic Speed in Work Zones to Advise Drivers	●	●	●					
S49	RWIS Station Deployment and Enhancements	●		●					
S50	Expand Automated Flagging System for Work Zones	●	●						
S51	Portable Queue Detection and Stopped Traffic Advisory		●	●					

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ID	ITS Initiatives and Project Concepts	Minnesota ITS Goals							
		A. Improve the Safety of the State's Transportation System	B. Increase Operational Efficiency and Reliability of the Transportation System	C. Enhance Mobility, Convenience, and Comfort for Transportation System Users	D. Improve the Security of the Transportation System	E. Support Regional Economic Productivity and Development	F. Preserve the Transportation System	G. Enhance the Integration and Connectivity of the Transportation System	H. Reduce Environmental Impacts
S52	Roadway and Bridge Automated Treatment System Deployment	●							●
S53	Expand Dynamic Late Merge System Deployment		●						
S54	Infrastructure GIS Mapping Enhancement					●		●	
S55	Enhanced Data Entry and Integration of Work Zone Information		●	●					
S56	Expand IWZ Deployment to Greater Minnesota		●	●					
S57	Work Zone Intrusion Alarm System	●							
S58	Bridge Inspection / Structural Monitoring System					●			
S59	Graphical-Based Construction Scheduling Tool		●					●	
S60	Portable Work Zone Dynamic Speed Display Signs	●	●	●					
S61	Rural Intersection Conflict Warning System (RICWS)	●							
S62	Connected Corridor Initiative	●	●	●	●	●	●	●	●
S63	Automated Vehicle Truck Demonstration	●	●				●		
S64	Integrate Private Sector Traffic and Incident Data with Public Agency Data	●	●	●				●	
	Medium Term ITS Initiatives and Project Concepts								
M01	Provide Information on Alternate Routes and Detours Due to Roadwork	●	●	●					
M02	CARS Integration Across State Borders	●	●	●	●	●		●	
M03	ITS Communications Interstate Connectivity	●	●	●	●				
M04	CARS ITS Data Addition	●		●					

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ID	ITS Initiatives and Project Concepts	A. Improve the Safety of the State's Transportation System	B. Increase Operational Efficiency and Reliability of the Transportation System	C. Enhance Mobility, Convenience, and Comfort for Transportation System Users	D. Improve the Security of the Transportation System	E. Support Regional Economic Productivity and Development	F. Preserve the Transportation System	G. Enhance the Integration and Connectivity of the Transportation System	H. Reduce Environmental Impacts
							Minnesota ITS Goals		
M05	Congestion and Closure Information for Transit Dispatchers and Operators			●				●	
M06	Automated Data Interface between Local Public Safety CAD Systems and CARS	●	●	●	●			●	
M07	Instrument Local Roads	●	●	●	●				
M08	Implement Enhanced Enforcement of Red Light Running at Intersections	●		●					
M09	Expand Video Monitoring at High Incident Locations		●	●	●				
M10	ITS and Communications Coordination and Information Sharing for Incident Responses		●	●	●				
M11	Alternate Route Database for CVO	●	●		●	●			
M12	Emergency Management Alternate Route Database Development	●	●	●	●				
M13	Incident Response Vehicle Strategic Deployment		●	●					
M14	Expand Greater Minnesota Population Center Ramp Meter Deployment	●	●	●					
M15	Automated/Remote Operated Gate Systems	●	●	●	●				
M16	Integrated Payment System for MnPASS, Transit and Parking			●					
M17	Additional Air Quality Sensors at Strategic Locations								●
M18	Curve Speed Warning Systems	●		●					
M19	Flood Warning Systems	●		●					
M20	Additional Installation of Highway Rail Intersection (HRI) Monitoring Equipment	●							
M21	Queue Length at Ramps, Incident and Work Zones	●	●	●					
M22	Expand Total Stations and Photogrammetry Deployment	●	●						

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ID	ITS Initiatives and Project Concepts	A. Improve the Safety of the State's Transportation System	B. Increase Operational Efficiency and Reliability of the Transportation System	C. Enhance Mobility, Convenience, and Comfort for Transportation System Users	D. Improve the Security of the Transportation System	E. Support Regional Economic Productivity and Development	F. Preserve the Transportation System	G. Enhance the Integration and Connectivity of the Transportation System	H. Reduce Environmental Impacts
					Minnesota ITS Goals				
M23	Detectors for Speed Data Collection at High Incident Locations	●		●				●	
M24	CVO Database Enhancement	●			●	●	●		
M25	Work Zone Restriction Information Automation	●		●		●	●		
M26	Commercial Vehicles as Probes	●		●					
M27	RFID Tags for Identification of HAZMAT Materials	●	●		●	●			
M28	Enhanced Crash Database	●						●	
M29	Enhance Commercial Vehicle Shipment Performance					●		●	
M30	Evacuation/Reentry Real-time Information ITS Systems				●	●			
M31	Enhanced Mayday Notification Assistance		●						
M32	AVL Systems for Local Emergency Responders		●			●			
M33	Wireless Digital Feeds Between MSP and Local EM Responders		●	●					
M34	Local Agency Public Works AVL Equipment					●			
M35	Use Agency Vehicles as Data Probes	●	●	●					
M36	Provide Real-Time Information to Equipped Vehicles That Deliver Warnings to Drivers	●							
M37	Blow Ice Signalized Warning System	●		●					
M38	Implement Improved Lane Guidance System	●							
M39	State Crash Report and MN-CRASH Software Enhancements	●	●						
	Long Term ITS Initiatives and Project Concepts								

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ID	ITS Initiatives and Project Concepts	Minnesota ITS Goals							
		A. Improve the Safety of the State's Transportation System	B. Increase Operational Efficiency and Reliability of the Transportation System	C. Enhance Mobility, Convenience, and Comfort for Transportation System Users	D. Improve the Security of the Transportation System	E. Support Regional Economic Productivity and Development	F. Preserve the Transportation System	G. Enhance the Integration and Connectivity of the Transportation System	H. Reduce Environmental Impacts
L01	Route-specific Weather Information for Travelers	●		●					
L02	511 Expansion to Local Roads	●	●	●	●				
L03	Enhanced Traveler Information for Transit and Other Modes	●	●	●					
L04	Priced Dynamic Shoulder Lanes Expansion		●						
L05	Expand Quick Clearance Policies for Incidents		●	●					
L06	Allow Law Enforcement to Retrieve Data from Onboard Vehicle Computers	●		●					
L07	Automated Speed Enforcement	●		●					
L08	Contraflow Lanes on Metro Freeways		●						
L09	In-Pavement LEDs	●	●						
L10	Enhanced Speed Monitoring Equipment for Work Zones	●	●	●					
L11	Incorporate Road Construction Data in CAD Systems		●						
L12	Develop and Provide a Uniform, Real-Time Automated Crash Notification System		●						

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Table 3. ITS Initiatives / Project Concepts and Service Package Areas

ID	ITS Initiatives and Project Concepts	Data Management (Volume 1)	Traveler Information (Volume 2)	Traffic Management (Volume 3)	Public Transportation (Volume 4)	Commercial Vehicle Operations (Volume 5)	Public Safety (Volume 6)	Maintenance and Construction (Volume 7)	Vehicle Safety (Volume 8)	Parking Management (Volume 9)	Weather (Volume 10)	Support (Volume 11)	Sustainable Travel (Volume 12)
	Short Term ITS Initiatives and Project Concepts												
S01	Real-Time Integration of Arrow Board Messages into Traveler Information Systems		♦	♦				♦					
S02	Electronic Alerts to Trucking Companies		♦			♦							
S03	Enhance Traveler Information Map for Mobile Devices		♦										
S04	511 Telephone Interface Enhancements and Maintenance		♦										
S05	ATIS Customization and Enhancements		♦										
S06	Rest Area Truck Parking Availability		♦							♦			
S07	Traffic Signal Timing and Control Improvements, Centralized Traffic Signal Control, and Automated Traffic Signal Performance Measures			♦									
S08	Adaptive Traffic Signal Control			♦									
S09	Develop an Automated System for Traffic Data Archiving	♦		♦									
S10	MSP CAD and CARS Integration Enhancements		♦	♦			♦						
S11	Dynamic Speed Display Signs ("Your Speed Is")			♦									
S12	Expand Provision of Travel Time and Delay Information			♦									
S13	Advance Warning Flasher Deployment Expansion			♦									
S14	Standard Traffic Signals			♦									
S15	Arterial Traffic Management Systems			♦									
S16	Freeway Traffic Management Systems			♦									
S17	Integrated Corridor Management (ICM)			♦									

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ID	ITS Initiatives and Project Concepts	Data Management (Volume 1)	Traveler Information (Volume 2)	Traffic Management (Volume 3)	Public Transportation (Volume 4)	Commercial Vehicle Operations (Volume 5)	Public Safety (Volume 6)	Maintenance and Construction (Volume 7)	Vehicle Safety (Volume 8)	Parking Management (Volume 9)	Weather (Volume 10)	Support (Volume 11)	Sustainable Travel (Volume 12)
							Service Package Areas (and Architecture Volumes)						
S18	Sharing Video Images Between Agencies			♦			♦					♦	
S19	ATMS for Major Event Management		♦	♦						♦			
S20	Expand HOT Lane Deployment in Metro Area			♦									♦
S21	Passenger Occupancy Monitoring/Enforcement System for MnPASS												♦
S22	Active Flashing Signals and Gates at Highway/Railroad Intersections			♦									
S23	Overheight Detection/Warning Systems			♦			♦		♦				
S24	Expand Geographic Coverage of the RTMC Systems			♦									
S25	Use Driving Simulation for Teenage and Older Driver Education						♦						
S26	Transit Customer Information Systems				♦								
S27	Transit Fleet Management Systems				♦								
S28	Transit Operations and Management Systems				♦								
S29	Transit Safety and Security Systems				♦								
S30	Transit Communications				♦								
S31	Commercial Vehicle Mainline Sorting System					♦							
S32	Virtual Weigh Stations					♦							
S33	Congestion Reduction in Major Freight Bottlenecks					♦							
S34	Enhance Automated Permit Routing System					♦							
S35	CVO Database and CARS Database Enhancement		♦			♦							
S36	ATIS for CVO Enhancements		♦			♦							
S37	Multi-State OS/OW Permitting System					♦							

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ID	ITS Initiatives and Project Concepts	Service Package Areas (and Architecture Volumes)											
		Data Management (Volume 1)	Traveler Information (Volume 2)	Traffic Management (Volume 3)	Public Transportation (Volume 4)	Commercial Vehicle Operations (Volume 5)	Public Safety (Volume 6)	Maintenance and Construction (Volume 7)	Vehicle Safety (Volume 8)	Parking Management (Volume 9)	Weather (Volume 10)	Support (Volume 11)	Sustainable Travel (Volume 12)
S38	Emergency Responder Database	♦					♦						
S39	Enhance Routing of Emergency Vehicles						♦						
S40	Expand Deployment of Mobile Data Computers for Emergency Responders						♦						
S41	Critical Infrastructure Monitoring						♦						
S42	Use Preemption on Vehicle Radios to Provide Real-Time Information						♦						
S43	Automated Field Reporting Systems for MSP and Local Law Enforcement	♦					♦						
S44	DVR to Review Central Images during an Incident	♦					♦						
S45	AVL for MnDOT Maintenance Vehicle							♦					
S46	Roadway Condition and Environmental Sensors on Maintenance Vehicles for Traveler Information		♦					♦					
S47	Expand Maintenance and Decision Support System (MDSS) Deployment							♦					
S48	Dynamic Speed in Work Zones to Advise Drivers			♦				♦					
S49	RWIS Station Deployment and Enhancements		♦	♦							♦		
S50	Expand Automated Flagging System for Work Zones							♦					
S51	Portable Queue Detection and Stopped Traffic Advisory							♦					
S52	Roadway and Bridge Automated Treatment System Deployment							♦					
S53	Expand Dynamic Late Merge System Deployment							♦					
S54	Infrastructure GIS Mapping Enhancement							♦					
S55	Enhanced Data Entry and Integration of Work Zone Information							♦					

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ID	ITS Initiatives and Project Concepts	Data Management (Volume 1)	Traveler Information (Volume 2)	Traffic Management (Volume 3)	Public Transportation (Volume 4)	Commercial Vehicle Operations (Volume 5)	Public Safety (Volume 6)	Maintenance and Construction (Volume 7)	Vehicle Safety (Volume 8)	Parking Management (Volume 9)	Weather (Volume 10)	Support (Volume 11)	Sustainable Travel (Volume 12)
								Service Package Areas (and Architecture Volumes)					
S56	Expand IWZ Deployment to Greater Minnesota							♦					
S57	Work Zone Intrusion Alarm System							♦					
S58	Bridge Inspection / Structural Monitoring System							♦					
S59	Graphical-Based Construction Scheduling Tool							♦					
S60	Portable Work Zone Dynamic Speed Display Signs							♦					
S61	Rural Intersection Conflict Warning System (RICWS)								♦				
S62	Connected Corridor Initiative							♦	♦			♦	
S63	Automated Vehicle Truck Demonstration								♦				
S64	Integrate Private Sector Traffic and Incident Data with Public Agency Data		♦	♦									
	Medium Term ITS Initiatives and Project Concepts												
M01	Provide Information on Alternate Routes and Detours Due to Roadwork		♦					♦					
M02	CARS Integration Across State Borders		♦										
M03	ITS Communications Interstate Connectivity		♦										
M04	CARS ITS Data Addition		♦										
M05	Congestion and Closure Information for Transit Dispatchers and Operators											♦	
M06	Automated Data Interface between Local Public Safety CAD Systems and CARS											♦	
M07	Instrument Local Roads		♦	♦									
M08	Implement Enhanced Enforcement of Red Light Running at Intersections			♦			♦						
M09	Expand Video Monitoring at High Incident Locations			♦									

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ID	ITS Initiatives and Project Concepts	Data Management (Volume 1)	Traveler Information (Volume 2)	Traffic Management (Volume 3)	Public Transportation (Volume 4)	Commercial Vehicle Operations (Volume 5)	Public Safety (Volume 6)	Maintenance and Construction (Volume 7)	Vehicle Safety (Volume 8)	Parking Management (Volume 9)	Weather (Volume 10)	Support (Volume 11)	Sustainable Travel (Volume 12)
M10	ITS and Communications Coordination and Information Sharing for Incident Responses			♦			♦						
M11	Alternate Route Database for CVO			♦		♦							
M12	Emergency Management Alternate Route Database Development			♦			♦						
M13	Incident Response Vehicle Strategic Deployment			♦									
M14	Expand Greater Minnesota Population Center Ramp Meter Deployment			♦									
M15	Automated/Remote Operated Gate Systems			♦									
M16	Integrated Payment System for MnPASS, Transit and Parking			♦	♦					♦			♦
M17	Additional Air Quality Sensors at Strategic Locations												♦
M18	Curve Speed Warning Systems			♦					♦				
M19	Flood Warning Systems			♦				♦					
M20	Additional Installation of Highway Rail Intersection (HRI) Monitoring Equipment			♦									
M21	Queue Length at Ramps, Incident and Work Zones			♦				♦					
M22	Expand Total Stations and Photogrammetry Deployment			♦									
M23	Detectors for Speed Data Collection at High Incident Locations			♦									
M24	CVO Database Enhancement	♦				♦							
M25	Work Zone Restriction Information Automation					♦							
M26	Commercial Vehicles as Probes			♦		♦							
M27	RFID Tags for Identification of HAZMAT Materials					♦							

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ID	ITS Initiatives and Project Concepts	Data Management (Volume 1)	Traveler Information (Volume 2)	Traffic Management (Volume 3)	Public Transportation (Volume 4)	Commercial Vehicle Operations (Volume 5)	Public Safety (Volume 6)	Maintenance and Construction (Volume 7)	Vehicle Safety (Volume 8)	Parking Management (Volume 9)	Weather (Volume 10)	Support (Volume 11)	Sustainable Travel (Volume 12)
M28	Enhanced Crash Database	♦											
M29	Enhance Commercial Vehicle Shipment Performance					♦							
M30	Evacuation/Reentry Real-time Information ITS Systems						♦						
M31	Enhanced Mayday Notification Assistance						♦						
M32	AVL Systems for Local Emergency Responders						♦						
M33	Wireless Digital Feeds Between MSP and Local EM Responders						♦						
M34	Local Agency Public Works AVL Equipment							♦					
M35	Use Agency Vehicles as Data Probes			♦									
M36	Provide Real-Time Information to Equipped Vehicles That Deliver Warnings to Drivers								♦				
M37	Blow Ice Signalized Warning System								♦				
M38	Implement Improved Lane Guidance System								♦				
M39	State Crash Report and MN-CRASH Software Enhancements	♦					♦						
	Long Term ITS Initiatives and Project Concepts												
L01	Route-specific Weather Information for Travelers		♦								♦		
L02	511 Expansion to Local Roads		♦										
L03	Enhanced Traveler Information for Transit and Other Modes		♦		♦								
L04	Priced Dynamic Shoulder Lanes Expansion			♦									
L05	Expand Quick Clearance Policies for Incidents			♦									
L06	Allow Law Enforcement to Retrieve Data from Onboard Vehicle Computers			♦									

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ID	ITS Initiatives and Project Concepts	Data Management (Volume 1)	Traveler Information (Volume 2)	Traffic Management (Volume 3)	Public Transportation (Volume 4)	Commercial Vehicle Operations (Volume 5)	Public Safety (Volume 6)	Maintenance and Construction (Volume 7)	Vehicle Safety (Volume 8)	Parking Management (Volume 9)	Weather (Volume 10)	Support (Volume 11)	Sustainable Travel (Volume 12)
	Service Package Areas (and Architecture Volumes)												
L07	Automated Speed Enforcement			♦									
L08	Contraflow Lanes on Metro Freeways			♦									
L09	In-Pavement LEDs			♦									
L10	Enhanced Speed Monitoring Equipment for Work Zones			♦				♦					
L11	Incorporate Road Construction Data in CAD Systems						♦					♦	
L12	Develop and Provide a Uniform, Real-Time Automated Crash Notification System						♦						

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Table 4. Implementation Schedule of Short-Term ITS Initiatives and Project Concepts

ID	ITS Initiatives and Project Concepts	Years									
		0	1	2	3	4	5	6	7	8	9 & Beyond
S01	Real-Time Integration of Arrow Board Messages into Traveler Information Systems	■	■								
S02	Electronic Alerts to Trucking Companies	■									
S03	Enhance Traveler Information Map for Mobile Devices	■	■	■							
S04	511 Telephone Interface Enhancements and Maintenance	■	■	■	■						
S05	ATIS Customization and Enhancements	■	■	■	■						
S06	Rest Area Truck Parking Availability	■	■	■	■						
S07	Traffic Signal Timing and Control Improvements, Centralized Traffic Signal Control, and ATSPMs	■	■	■	■						
S08	Adaptive Traffic Signal Control	■	■	■	■						
S09	Develop an Automated System for Traffic Data Archiving	■	■	■	■						
S10	MSP CAD and CARS Integration Enhancements	■	■	■	■						
S11	Dynamic Speed Display Signs ("Your Speed Is")	■	■	■	■						
S12	Expand Provision of Travel Time and Delay Information	■	■	■	■						
S13	Advance Warning Flasher Deployment Expansion	■	■	■	■						
S19	ATMS for Major Event Management	■	■	■	■						
S25	Use Driving Simulation for Teenage and Older Driver Education	■	■	■	■						
S31	Commercial Vehicle Mainline Sorting System	■	■	■	■						
S32	Virtual Weigh Stations	■	■	■	■						
S34	Enhance Automated Permit Routing System	■	■	■	■						
S35	CVO Database and CARS Database Enhancement	■	■	■	■						
S37	Multi-State OS/OW Permitting System	■	■	■	■						
S38	Emergency Responder Database	■	■	■	■						
S42	Use Preemption on Vehicle Radios to Provide Real-Time Information	■	■	■	■						
S44	DVR to Review Central Images during an Incident	■	■	■	■						
S45	AVL for MnDOT Maintenance and Other Fleet Vehicles	■	■	■	■						
S46	Roadway Condition and Environmental Sensors on Maintenance Vehicles for Traveler Information	■	■	■	■						
S47	Expand Maintenance and Decision Support System (MDSS) Deployment	■	■	■	■						

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ID	ITS Initiatives and Project Concepts	Years									
		0	1	2	3	4	5	6	7	8	9 & Beyond
S48	Dynamic Speed in Work Zones to Advise Drivers	█	█	█	█						
S49	RWIS Station Deployment and Enhancements	█	█	█	█						
S50	Expand Automated Flagging System for Work Zones	█	█	█	█						
S51	Portable Queue Detection and Stopped Traffic Advisory	█	█	█	█						
S52	Roadway and Bridge Automated Treatment System Deployment	█	█	█	█						
S53	Expand Dynamic Late Merge System Deployment	█	█	█	█						
S54	Infrastructure GIS Mapping Enhancement	█	█	█	█						
S55	Enhanced Data Entry and Integration of Work Zone Information	█	█	█	█						
S56	Expand IWZ Deployment to Greater Minnesota	█	█	█	█						
S57	Work Zone Intrusion Alarm System	█	█	█	█						
S59	Graphical-Based Construction Scheduling Tool	█	█	█	█						
S60	Portable Work Zone Dynamic Speed Display Signs	█	█	█	█						
S61	Rural Intersection Conflict Warning System (RICWS)	█	█	█	█						
S63	Automated Vehicle Truck Demonstration	█	█	█	█						
S21	Passenger Occupancy Monitoring/ Enforcement System for MnPASS	█	█	█	█	█	█	█	█	█	
S23	Overheight Detection/Warning Systems	█	█	█	█	█	█	█	█	█	
S40	Expand Deployment of Mobile Data Computers for Emergency Responders	█	█	█	█	█	█	█	█	█	
S43	Automated Field Reporting Systems for MSP and Local Law Enforcement	█	█	█	█	█	█	█	█	█	
S58	Bridge Inspection / Structural Monitoring System	█	█	█	█	█	█	█	█	█	
S62	Connected Corridor Initiative	█	█	█	█	█	█	█	█	█	
S14	Standard Traffic Signals	█	█	█	█	█	█	█	█	█	█
S15	Arterial Traffic Management Systems	█	█	█	█	█	█	█	█	█	█
S16	Freeway Traffic Management Systems	█	█	█	█	█	█	█	█	█	█
S18	Sharing Video Images Between Agencies	█	█	█	█	█	█	█	█	█	█
S22	Active Flashing Signals and Gates at Highway/Railroad Intersections	█	█	█	█	█	█	█	█	█	█
S24	Expand Geographic Coverage of the RTMC Systems	█	█	█	█	█	█	█	█	█	█
S26	Transit Customer Information Systems	█	█	█	█	█	█	█	█	█	█
S27	Transit Fleet Management Systems	█	█	█	█	█	█	█	█	█	█
S28	Transit Operations and Management Systems	█	█	█	█	█	█	█	█	█	█

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ID	ITS Initiatives and Project Concepts	Years									
		0	1	2	3	4	5	6	7	8	9 & Beyond
S29	Transit Safety and Security Systems	■	■	■	■	■	■	■	■	■	■
S30	Transit Communications	■	■	■	■	■	■	■	■	■	■
S36	ATIS for CVO Enhancements	■	■	■	■	■	■	■	■	■	■
S33	Congestion Reduction in Major Freight Bottlenecks		■	■	■						
S39	Enhance Routing of Emergency Vehicles		■	■	■	■					
S64	Integrate Private Sector Traffic and Incident Data with Public Agency Data		■	■	■	■					
S17	Integrated Corridor Management (ICM)		■	■	■	■	■	■	■		■
S20	Expand HOT Lane Deployment in Metro Area			■	■	■	■	■	■	■	
S41	Critical Infrastructure Monitoring				■	■					

4.3   Short Term ITS Initiatives and Project Concepts

This section details the short-term ITS initiatives and project concepts to be considered for implementation over the next 4 years. A total of 63 short-term ITS initiatives and project concepts are identified. Each ITS initiative and project concept is described with the following information:

- **ID:** a unique identification number for each initiative and project concept.
- **Initiative:** Title of the initiative or project concept.
- **Timeframe:** planned or recommended timeframe for implementation.
- **Multimodal Transportation Objective:** Objectives in the Minnesota Statewide Multimodal Transportation Plan addressed by the initiative or project concept.
- **SHSP Focus Area:** Focus areas defined in the 2014 Minnesota SHSP that are relevant to the initiative or project concept. This information is presented only if the initiative/project concept is included in the 2014 Minnesota SHSP.
- **ITS Service Area:** ITS service areas or functional areas the initiative/project concept covered. ITS service areas include: Data Management, Public Transportation, Traveler Information, Traffic Management, Vehicle Safety, Commercial Vehicle Operations, Public Safety, Maintenance and Construction, Parking Management, Weather, Support, and Sustainable Travel.
- **Type:** Type(s) of the initiative/project concept, including operational test, deployment, research, and policy/legislation.
- **Description:** Scope and general information of the initiative/project concept.
- **Champion and Stakeholder:** Champion agency of the initiatives/project concept and other stakeholder agencies involved.
- **Project Element:** Elements in the Statewide Regional ITS Architecture associated with the initiative/project concept.
- **Service Package:** Architecture service packages included in the initiative/project concept.
- **Interconnect:** High-level architecture interconnections between initiative elements.

- **Technology Readiness:** A brief assessment on the level of readiness of relevant technology. Technology readiness is categorized in three levels as described in the table below:

Research	Development	Implementation
❖ Basic principles and research ❖ Application formulated ❖ Proof of concept ❖ Components validated in a laboratory environment ❖ Integrated components demonstrated in a laboratory environment	❖ Prototype demonstrated in relevant environment ❖ Prototype demonstrated in operational environment ❖ Technology proven in operational environment	❖ Technology refined and adopted

Icons, as shown below, are used to denote the level of technology readiness for each initiative/project concept.

Research   Development   Implementation

- **Dependency:** Interdependency between the initiative and existing systems and other initiatives.
- **Cost Estimate:** a preliminary cost estimate for the initiative/project concept.
- **Needs and Objectives Addressed:** Stakeholder needs and Minnesota ITS Objectives addressed.
- **TSMO Goals and Objectives Supported:** Goals and objectives from the MnDOT Transportation Systems Management and Operations (TSMO) Strategic Plan supported.
- **Agreement:** Agreement(s) needed for implementation, operations, and/or maintenance.

In addition, initiatives and project concepts that are included in the Minnesota SHSP as safety strategies are denoted with an "SHSP" icon next to the their titles. The SHSP icon is as shown on the right.

Similarly, initiatives and project concepts that support MnDOT TSMO Strategic Plan are denoted with a "TSMO" icon next to the initiative titles.

An addition icon or icons are included on the upper right corner of the initiative/project concept description pages. The icon indicates to which service area the initiative/project concept belong. This helps readers navigate through the Section and information.

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ID: S01

Initiative: Real-Time Integration of Arrow Board Messages into Traveler Information Systems

TSMO

Timeframe: Short Term – Years 0-2

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making

ITS Service Area: Traveler Information, Traffic Management, Maintenance and Construction

Type: Deployment, Research

Description
This project will equip arrow boards used by Twin Cities metro area maintenance shops with the functionality to export status and location for stationary and mobile/rolling closures to MnDOT's Regional Transportation Management Center (RTMC) systems. The reported arrow board status information will then be integrated with the MnDOT Intelligent Roadway Information System (IRIS) and the MnDOT Condition Acquisition and Reporting System (CARS). This initiative will disseminate detailed lane closure information to traveler information mechanisms such as 511 web and social media. RTMC operators will be alerted of closures in real-time so they may post messages to the appropriate Dynamic Message Signs (DMS). RTMC and work zone planning professionals will have improved information for performance reporting and measurement due to improved accuracy of lane closure information. The ENTERPRISE Pooled Fund plans to evaluate this MnDOT system integration, along with similar integrations in other states, to assist in advancing a standard approach for this type of system.

Champion and Stakeholder
Champion: MnDOT (RTMC, Maintenance, Construction)
Stakeholders: MnDOT, Travelers, ENTERPRISE Pooled Fund Study

Project Element
- RTMC
- CARS
- 511 Traveler Information website
- Arrow Board Roadside Equipment
- Arrow Board Reporting System Server

Service Package
- TI01 – Broadcast Traveler Information
- TM06 – Traffic Information Dissemination
- TM08 – Traffic Incident Management System
- MC06 – Work Zone Management

Interconnect
- Arrow Board Roadside Equipment and Arrow Board Reporting System Server
- Arrow Board Reporting System Server and RTMC
- RTMC and CARS
- CARS and 511 Traveler Information website

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Technology Readiness   <mark>Implementation</mark>

This initiative utilizes a new after-market product (arrow board status/location reporting system) being developed by an intelligent work zone vendor.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate

The cost estimate for a pilot deployment to equip 20 Arrow Boards for a one-year period and to make updates to IRIS and CARS to process Arrow Board Reporting System information is estimated to be $225,000-$250,000.

Needs and Objectives Addressed

Needs: ATIS05 – Provide information on roadway construction and maintenance activities

ATMS05 – Provide incident and congestion information to travelers

MCM10 – Provide work zone information to travelers

ITS Objectives: B-3-01 – Reduce total vehicle hours of delay by time period (peak, off-peak) caused by work zones

B-3-05 – Reduce the variability of travel time in work zones during peak and off-peak periods

C-3-11 – Increase number of 511 calls per year

C-3-12 – Increase number of visitors to traveler information website per year

G-1-02 – Increase the number of planning activities using data from ITS systems

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency

TSMO Objectives: Reduce delays associated with construction activities

Reduce the period of time traffic is congested or delayed due to maintenance and reactive work zone activities

Agreement

Agreements are not required for this initiative.

ID: S02

Initiative: Electronic Alerts to Trucking Companies

Timeframe: Short Term – Years 0-2

Multimodal Transportation Objective: Open Decision-Making, System Stewardship

ITS Service Area: Traveler Information, Commercial Vehicle Operations

Type: Operational Test

Description
This initiative will provide electronic alerts to major trucking companies about seasonal and construction road weight restrictions. This will ensure that trucking companies are receiving timely, accurate information about weight restrictions so that they can adjust their route plans appropriately.

Participating trucking companies will select roadways that they want to receive seasonal weight restriction information. MnDOT will send automated updates to participating trucking companies when weight restrictions change. Initially this initiative will only cover a select number of roadways with significant truck traffic and be offered to all major trucking companies that pick-up or deliver on those roadways. If this pilot initiative is successful, the service will be expanded to cover additional roadways and to allow more trucking companies to participate.

Champion and Stakeholder
Champion: MnDOT (Office of Materials)
Stakeholders: MnDOT, Major Trucking Companies

Project Element
- CARS
- Truck Center
- Private Fleet and Freight Management Center
- Commercial Vehicles

Service Package
- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information
- CVO01 – Carrier Operations and Fleet Management

Interconnect
- CARS and Truck Center
- Truck Center and Private Fleet and Freight Management Center
- Private Fleet and Freight Management Center and Commercial Vehicles

Technology Readiness   Implementation
This initiative is an expansion of existing technologies.

Dependency
This initiative is not dependent upon any other initiatives.

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Cost Estimate
Total costs have been estimated at $10,000.

Needs and Objectives Addressed
Need: ATIS08 - Provide information about seasonal road weight restrictions
ITS Objectives: B-1-08 - Annual rate of change in regional average commute travel time will
                          not exceed regional rate of population growth
                C-3-13 - Increase number of users of notifications for traveler information
                          (e.g., e-mail, text message)
                C-3-15 - Increase the number of specifically tailored traveler information
                          messages provided
                E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on
                          selected freight-significant highways

Agreement
Agreements may be necessary between MnDOT and participating trucking firms regarding the use and distribution of information in the information in this pilot initiative.

ID: S03

Initiative: Enhance Traveler Information Map for Mobile Devices

Timeframe: Short Term – Years 0-3

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Intersections, Lane Departure

ITS Service Area: Traveler Information

Type: Deployment

Description
A traffic flow map showing real-time traffic conditions of freeways and selected expressways in the metro area is currently available on MnDOT's website and the MnDOT 511 app. This initiative will enhance this service to provide travelers with a better view of the traffic flow map using mobile devices such as smartphones and tablets as well as easily accessible road condition information during inclement weather. This will allow users with a better way to access real-time traffic flow and road condition information and make informed travel decisions.

The MnDOT Regional Transportation Management Center (RTMC) creates a data feed from its website to allow handheld devices to properly display the traffic flow map that is updated in real-time.

Champion and Stakeholder
Champion: MnDOT (RTMC)
Stakeholders: MnDOT, Private Information Service Providers

Project Element
- RTMC
- 511 Traveler Information Website
- User Personal Portable Computing Devices

Service Package
- TI01 – Broadcast Traveler Information

Interconnect
- RTMC (website) and User Personal Portable Computing Devices
- RTMC and 511 Traveler Information Website
- 511 Traveler Information Website and User Personal Portable Computing Devices

Technology Readiness   Implementation
Traffic flow map for the metro area is already available on the MnDOT website and 511 app.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
The development/enhancement cost ranges roughly between $5,000 and $40,000, depending on the features and functionalities desired for the end product.

Needs and Objectives Addressed

Need: ATIS03 - Provide traffic flow maps showing recurring freeway congestion levels

ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                   A-2-04 - Reduce number of fatalities due to unexpected congestion
                   A-2-25 - Reduce number of injuries due to unexpected congestion
                   B-1-02 - Reduce the percentage of Twin Cities freeway miles congested in weekday peak periods
                   B-1-06 - Reduce the number of hours per day that the top 20 most congested roadways experience recurring congestion
                   C-3-12 - Increase number of visitors to traveler information website per year

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                   Increase Safety

TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota
                   Increase pre-trip and en-route traveler awareness of incidents and alternate options in both the Twin Cities and Greater Minnesota
                   Reduce the crashes related to congestion in Minnesota metro areas

Agreement
Agreements are not required for this initiative.

ID: S04

Initiative: 511 Telephone Interface Enhancements and Maintenance

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Intersections, Lane Departure

ITS Service Area: Traveler Information

Type: Deployment

Description
This initiative aims to improve the Minnesota 511 Traveler Information telephone user interface by enhancing or developing new, user friendly approaches to deliver real-time information via the 511 telephone system. Travelers along Minnesota roads and highways currently dial 511 on cell phones to obtain real-time travel information on congestion and crashes that may affect their daily travel patterns. An upgrade to the current system will improve traveler information dissemination and reduce recurring and non-recurring traffic congestion. This initiative also includes the on-going maintenance of the system.

Champion and Stakeholder
Champion: MnDOT (RTMC)
Stakeholders: Travelers

Project Element
- CARS
- 511 Telephone Information Service
- Travelers

Service Package
- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information

Interconnect
- CARS and 511 Telephone Information Service
- 511 Telephone Information Service and Travelers

Technology Readiness   Implementation
This initiative aims to improve a traveler information service that is currently available.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Based on available cost data for similar telephone system enhancements, the total cost can vary between $500,000 and $2,000,000 depending on the type of upgrades planned for this initiative.

Needs and Objectives Addressed

Needs: ATMS05 - Provide incident and congestion information to travelers

                    ATIS10 - Operate a statewide web-based and telephone 511 system

ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions

                    A-1-04 - Reduce number of crashes due to unexpected congestion

                    A-1-17 - Reduce number of crashes due to roadway/geometric restrictions

                    A-1-19 - Reduce number of all secondary crashes

                    A-2-03 - Reduce number of fatalities due to road weather conditions

                    A-2-04 - Reduce number of fatalities due to unexpected congestion

                    A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions

                    A-2-24 - Reduce number of injuries due to road weather conditions

                    A-2-25 - Reduce number of injuries due to unexpected congestion

                    A-2-39 - Reduce number of injuries due to roadway/geometric restrictions

                    B-1-05 - Reduce the daily hours of recurring congestion on major freeways

                    B-1-08 - Annual rate of change in regional average commute travel time will not exceed regional rate of population growth

                    C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection/response

                    C-3-02 - Reduce single occupancy vehicle trips through travel demand management strategies (e.g., employer or residential rideshare)

                    C-3-11 - Increase number of 511 calls per year

                    D-2-03 - Increase the number of travelers routed around Hazmat incidents

                    D-2-04 - Increase the number of travelers routed around homeland security incidents

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency

                    Increase Safety

TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota

                    Increase availability of information about travel times to drivers

                    Increase pre-trip and en-route traveler awareness of incidents and alternate options in both the Twin Cities and Greater Minnesota

                    Reduce the crashes related to congestion in Minnesota metro areas

                    Reduce the frequency of crashes related to road weather conditions

Agreement

Agreements are not required for this initiative.

ID: S05

Initiative: ATIS Customization and Enhancements

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making

ITS Service Area: Traveler Information

Type: Deployment

Description
This initiative will enhance personalized Traveler Information Service to individual users. 511 Web and phone systems currently provide personalized information to users who subscribe to customized information. Motorists can enter up to 20 routes they travel to see where incidents, such as crashes or construction, are located. Users can also click on a specific incident to see a camera view. This initiative will further enhance the systems to generate additional customized reports with such information as travel times, weather, predicted pavement conditions, and other events on roadway segments that subscribers have preselected. Participating users will set up accounts and select the roadway segments and types of information that they would like to receive and the thresholds (time of day, speeds, travel times, etc.) that would need to be met to send the alert. This will allow travelers to receive targeted, real-time information via email, text message, or phone on roadways that they regularly use.

This initiative can follow the Short Term Initiative S02 - Enhance Traveler Information Map for Mobile Devices.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Travelers, Private Companies

Project Element
- CARS
- 511 Telephone Information Service and Traveler Information Website
- User Personal Portable and Computing Devices

Service Package
- TI02 – Personalized Traveler Information
- TI04 – Infrastructure-Provided Trip Planning and Route Guidance

Interconnect
- CARS and 511 Telephone Information Service
- CARS and Traveler Information Website
- 511 Telephone Information Service/Traveler Information Website and User Personal Portable and Computing Devices

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Technology Readiness   <mark>Implementation</mark>

511 systems already have the capability to provide data that users select. This would implement preselected data to be sent as alerts when certain thresholds are met. Similar systems have been implemented in other urban areas such as Chicago.

Dependency

This initiative may be dependent upon the success of the Short Term Initiative S02 – Enhance Traveler Information Map for Mobile Devices.

Cost Estimate

Costs associated with this initiative have not been determined.

Needs and Objectives Addressed

Need: ATIS16 - Improve quality, consistency, and thoroughness of traveler information

ITS Objectives: C-3-15 - Increase the number of specifically tailored traveler information messages provided

                G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning

                G-1-06 - Reduce operations cost deviation

                H-1-04 - Reduce MnDOT fleet gasoline use

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency

                Increase Safety

TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota

                Increase availability of information about travel times to drivers

                Increase pre-trip and en-route traveler awareness of incidents and alternate options in both the Twin Cities and Greater Minnesota

                Reduce the crashes related to congestion in Minnesota metro areas

                Reduce the frequency of crashes related to road weather conditions

Agreement

Agreements are not required for this initiative.

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ID: S06

Initiative: Rest Area Truck Parking Availability

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, System Stewardship

ITS Service Area: Parking Management, Traveler Information

Type: Deployment

Description
MnDOT is currently working on a truck parking availability project funded by a federal TIGER grant. The grant was awarded to the Mid America Association of State Transportation Officials (MAASTO) to develop a multi-state Truck Parking Information and Management System (TPIMS). The initiative targets the development of an automated truck stop management system that can determine the number of occupied parking spaces at MnDOT safety rest areas. The system uses a network of in-ground magnetic sensors to monitor parking availability at truck stops, automatically identifying available spaces in real time. In this initiative, the information will be used to notify drivers and carriers about parking availability via a website and variable message displays in advance of the rest area on the highway. The system will be installed at the following MnDOT rest areas on Interstate 94 (I-94) and Interstate 35 (I-35) surrounding the Twin Cities:.

- I-94 EB Lake Latoka
- I-94 EB Big Spunk Lake
- I-94 EB Enfield
- I-94 EB Elm Creek
- I-94 WB St. Croix
- I-35 NB Heath Creek
- I-35 SB Forest Lake

Upon a successful completion, the system will provide parking availability information at roadside rest areas to truck drivers through multiple forms of currently available traveler information dissemination, such as Dynamic Message Signs (DMS) and 511 traveler information web site and phone system. Parking availability will be detected with in-pavement or non-intrusive detection technologies to ascertain the level of rest area truck parking space availability. This project could potentially expand to private truck stops in the future.

Champion and Stakeholder
Champion: MnDOT OFCVO
Stakeholders: MnDOT, Minnesota Department of Public Safety (DPS), Private Trucking Companies, Kansas DOT (lead agency for TIGER grant)

Project Element
- 511 Telephone Information Service
- 511 Traveler Information Website
- Parking Management Roadside Equipment
- Parking Management System

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- Other States TPIMS
- TPIMS Central Data Repository

Service Package
- PM01 – Parking Space Management
- PM04 – Regional Parking Management
- TI01 – Broadcast Traveler Information
- DM01 – ITS Data Warehouse

Interconnect
- Parking Management Roadside Equipment and Parking Management System
- Parking Management System and 511 Telephone Information Service
- Parking Management System and 511 Traveler Information Website
- Parking Management System and TPIMS Central Data Repository
- Parking Management System and Other States TPIMS

Technology Readiness   `Implementation`

Traveler information dissemination technology (511, DMS, etc.) is currently being used. This initiative will also utilize parking management technology that is readily available from past demonstration projects, utilizing IRIS for system software. The approved ITS standard ITE TM 1.03 – Standard for Functional Level Traffic Management Data Dictionary – is applicable to this initiative.

Dependency
This initiative is not dependent upon any other initiatives. However, the results of the current truck parking availability demonstration may support this initiative.

Cost Estimate
Based on available system cost data for dynamic message signs and wireless magnetic detectors used to detect and count vehicles at the rest area facility, the total cost for one rest area facility is estimated to be between $50,000 and $75,000. Total construction cost for 7 sites and 7 signs is estimated at $915,000.

Needs and Objectives Addressed

Needs:	ATIS23 - Provide information on available public and private truck parking facilities
	ATMS21 - Provide information on parking availability
ITS Objectives:	C-3-11 - Increase number of 511 calls per year
	C-3-12 - Increase number of visitors to traveler information website per year
	C-3-13 - Increase number of users of notifications for traveler information (e.g., e-mail, text message)
	C-4-04 - Increase the number of parking facilities with automated occupancy counting and space management
	C-4-05 - Increase the number of parking facilities with advanced parking information to customers

Agreement
Agreements are required between MnDOT and Kansas DOT for administration of TIGER grant monies.

ID: S07

TSMO

Initiative: Traffic Signal Timing and Control Improvements, Centralized Traffic Signal Control, and Automated Traffic Signal Performance Measures

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will implement the following four strategies to relieve traffic congestion on arterial roads managed by coordinated signal systems: 1) Improve the current signal timing and coordination within a jurisdiction as well as across jurisdictions, 2) Deploy centralized traffic signal control systems to improve signal operations and travel time reliability, and 3) Utilize automated traffic signal performance measures (ATSPMs) to proactively monitor and improve traffic signal efficiency.

ATSPMs consist of a high-resolution data-logging capability added to existing traffic signal infrastructure and data analysis techniques. This provides agency professionals with the information needed to proactively identify and correct deficiencies. They can then manage traffic signal maintenance and operations in support of an agency's safety, livability and mobility goals. Signal retiming efforts can be based directly on actual performance without dependence on software modeling or expensive, manually collected data.

This deployment will address a highly prioritized need from the TM stakeholders – ATMS01: Provide efficient signal timing.

Champion and Stakeholder
Champion: MnDOT (District Traffic)
Stakeholders: Local Agencies

Project Element
- Traffic Signal Roadside Equipment
- RTMC
- Local TMCs
- Minneapolis TMC

Service Package
- TM03 – Traffic Signal Control

Interconnect
- RTMC and traffic signal roadside equipment
- Local TMCs/Minneapolis TMC and traffic signal roadside equipment
- RTMC and Local TMCs/Minneapolis TMC

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Technology Readiness   <mark>Implementation</mark>

Hardware and software to be utilized in providing efficient signal timings is available from numerous vendors. ATSPMs is the outcome of a collaboration among FHWA, AASHTO, state DOTs and academic research efforts. The technology is available and has implemented in over 12 states in the U.S.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate

The per-intersection cost for improving signal timing and coordination is estimated to range from $2,000 to $4,000.

The costs per signal for ATSPM implementation range from $250 to $450. The costs include the server, database license and vendor/consultant support. Costs for controllers with high-definition loggers or communications are not included in the cost estimates.

Needs and Objectives Addressed

Need: ATMS01 - Provide efficient signal timing
ITS Objectives: B-1-03 - Reduce the share of major intersections operating at LOS F
                     B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                             group of specific travel routes or trips in the region

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce the frequency of congestion or slowed traffic on the freeways and
                             arterials in metro areas throughout Minnesota

Agreement

This initiative may require jurisdictional agreements for signal timing work performed on arterial coordinated signal systems that span more than one jurisdiction.

ID: S08

TSMO

Initiative: Adaptive Traffic Signal Control

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative is designed to improve the operation of closed loop signal systems by utilizing adaptive signal control software. Adaptive signal control technology adjusts the timing of red, yellow and green lights to accommodate changing traffic patterns and ease traffic congestion. The main benefits of adaptive signal control technology over conventional signal systems are that it can continuously distribute green light time equitably for all traffic movements, improve travel time reliability by progressively moving vehicles through green lights, reduce congestion by creating smoother flow, and prolong the effectiveness of traffic signal timing.

This deployment will address a highly prioritized need from the TM stakeholders – ATMS01: Provide efficient signal timing.

Champion and Stakeholder
Champion: Local Agencies
Stakeholders: Local Agencies, MnDOT

Project Element
- Traffic Signal Roadside Equipment
- Local TMCs
- Minneapolis TMC
- RTMC

Service Package
- TM03 – Traffic Signal Control

Interconnect
- Local TMCs/Minneapolis TMC and traffic signal roadside equipment
- RTMC and traffic signal roadside equipment

Technology Readiness   Implementation
Adaptive signal control is readily available from vendors. An ITS standard under development – NTCIP 1210: Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters – provides guidance for traffic management and operations personnel to control, manage, and monitor signal system masters (SSMs) and signal system locals (SSLs) through the SSM.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
The per-intersection cost for deploying adaptive signal control software is estimated to range from $2,000 to $5,000.

Needs and Objectives Addressed
Need: ATMS01 - Provide efficient signal timing
ITS Objectives: B-1-03 - Reduce the share of major intersections operating at LOS F
                  B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                         group of specific travel routes or trips in the region

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce the frequency of congestion or slowed traffic on the freeways and
                     arterials in metro areas throughout Minnesota

Agreement
Agreements are not required for this initiative.

ID: S09

TSMO

Initiative: Develop an Automated System for Traffic Data Archiving

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making

ITS Service Area: Data Management, Traffic Management

Type: Deployment

Description
This initiative will develop an automated and more robust central system for management and retrieval of archived traffic data. This system will give state and local agencies the ability to retrieve traffic related data to better manage and plan resources and to determine effective strategies to address transportation challenges. MnDOT Transportation Data and Analysis (TDA) currently manages an archive which stores Automated Traffic Recorder (ATR) data. This initiative will expand and centralize the archived database to include other information such as GIS (geographic information system) data, crashes, lane closures, work zone activities, emergencies, etc. A standard data storage format will be implemented to allow agencies to quickly find and retrieve the focused information necessary for performing planning and analyses.

This deployment will meet a highly prioritized need from the ATMS stakeholder meeting: TM03 – Use archived data for traffic management strategy development and long range planning.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Project Element
- Traffic Data Archive
- RTMC
- Local TMCs

Service Package
- TM09 – Integrated Decision Support and Demand Management
- DM01 – ITS Data Warehouse

Interconnect
- RTMC and Traffic Data Archive
- Local TMCs and Traffic Data Archive

Technology Readiness   Implementation
This initiative utilizes current technology that is readily available. This initiative will require coordination between MnDOT and Local agencies. Applicable ITS standards include: NTCIP C2C: NTCIP Center-to-Center Standards Group; ITE TMDD 2.1: Traffic Management Data Dictionary and Message Sets for External TMC Communication (TMDD and MS/ETMCC); ASTM E2468-05: Standard Practice for Metadata to Support Archived Data Management

Systems; and ASTM WK7604: Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been determined.

Needs and Objectives Addressed
Need: ATMS03 - Use archived data for traffic management strategy development and long range planning
ITS Objectives: G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning
                 G-1-03 - Increase the number of years of data in database that is easily searchable and extractable
                 G-1-06 - Reduce operations cost deviation
                 G-1-07 - Reduce administrative support rate (as part of overall project budget)

TSMO Goals and Objectives Supported
TSMO Goal: Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objective: Acquire, secure, and retain the data needed for MnDOT to effectively perform operations, performance management and planning

Agreement
This initiative may require jurisdictional agreements between state and local agencies for usage of automated data archiving system.

ID: S10

Initiative: MSP CAD and CARS Integration Enhancements

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, Transportation Safety, Critical Connections

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Traffic Management, Traveler Information, Public Safety

Type: Deployment

Description

Minnesota State Patrol (MSP) district offices manage resources and communicate incident data and resource requests to other public and private agencies. CARS is a central source of roadway event information for both the management and dissemination of traffic-related information to the traveling public. The CARS system is maintained by the MnDOT RTMC and the State Patrol CAD system is maintained by MSP. Minnesota State Patrol users also enter information to CARS on road conditions and incidents each day.

The integration of CAD data from the Minnesota State Patrol with the CARS was done recently. Roadway condition-related data entered into CAD is integrated into CARS database. Agencies that use CARS are able to obtain the data to facilitate multi-agency coordination during emergencies. This data includes real-time information on emergency conditions, response resource deployment, lane closures, and other related information. The integration also increases the amount of information relating to closures due to incidents in the CARS database.

This initiative will provide further enhancements to the integration between CARS and MSP CAD. Lessons learned from this initiative can be used in future CAD integration between responders. This initiative meets an identified stakeholder need for providing incident information to emergency management agencies.

Champion and Stakeholder
Champion: MnDOT (RTMC)
Stakeholders: MnDOT, Minnesota State Patrol

Project Element
- 911 Dispatch Center
- Emergency Vehicle Equipment
- Condition Acquisition and Reporting System (CARS)
- Minnesota State Patrol District Office
- RTMC

Service Package
- PS01 – Emergency Call-Taking and Dispatch
- TM06 – Traffic Information Dissemination
- SU03 – Data Distribution

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Interconnect
- RTMC and Condition Acquisition and Reporting System (CARS)
- RTMC and Minnesota State Patrol District Office
- Emergency Vehicles Equipment and 911 Dispatch Center
- 911 Dispatch Center and CARS

Technology Readiness   `Implementation`
Technology for data entry automation and integration is readily available. IEEE IM: Incident Management Standards Group and NTCIP C2C: NTCIP Center-to-Center Standards Group are ITS standards that will apply to this data integration.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
The estimated capital cost for CAD to CARS software automation range from $150,000 to $300,000. O&M includes software upgrades, revisions and expansion of the system.

Needs and Objectives Addressed
Needs: ATMS13 - Provide incident information to emergency management agencies
                PSFT05 - Operate and enhance CAD Systems
ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                A-1-19 - Reduce number of all secondary crashes
                A-2-04 - Reduce number of fatalities due to unexpected congestion
                A-2-25 - Reduce number of injuries due to unexpected congestion
                B-1-15 - Reduce mean incident notification time
                B-1-16 - Reduce mean time for needed responders to arrive on-scene after
                        notification
                B-1-17 - Reduce mean incident clearance time per incident
                B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway
                        incidents
                C-1-01 - Reduce the vehicle hours of total delay associated with traffic
                        incidents during peak and off-peak periods
                C-3-10 - Increase the percent of transportation facilities whose owners share
                        their traveler information with other agencies in the region

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                Increase Safety
TSMO Objectives: Reduce incident response and clearance times in the Twin Cities and
                    Greater Minnesota
                Reduce the crashes related to congestion in Minnesota metro areas
                Reduce responder exposure

Agreement
This initiative may require agency agreements between MnDOT and MSP over the integration of CAD system and MnDOT CARS.

ID: S11

Initiative: Dynamic Speed Display Signs ("Your Speed Is")

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Speed-Related

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will focus on deploying active speed-warning systems (with speed detection and playback signs) on selected arterial roads. Systems will detect the traveling speeds of approaching vehicles and display the detected speeds dynamically via message signs that are located underneath the posted speed limit along the arterial road. This initiative will address deployment of these systems on both a temporary and permanent basis. Upgrades and replacements of current system equipment are also covered in this initiative. These systems are currently in operation at select locations throughout Minnesota. Systems will be deployed at additional locations where applicable.

The purpose of the initiative is to make drivers aware of their traveling speeds compared to the posted speed limit, thereby reducing vehicle speeds along arterial roads and improve pedestrian and roadway safety.

Champion and Stakeholder
Champion: MnDOT (District Traffic)
Stakeholders: MnDOT, Local Agencies

Project Element
- Speed Monitoring Roadside Equipment
- Dynamic Message Sign Roadside Equipment

Service Package
- TM17 – Speed Warning and Enforcement

Interconnect
- Speed Monitoring Roadside Equipment and Dynamic Message Sign Roadside Equipment

Technology Readiness   Implementation
This technology is currently deployed and operational in the metro area.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Capital costs for portable speed monitoring systems range from $5,000 to $15,000 per unit.

Needs and Objectives Addressed

Need: ATMS18 - Provide dynamic speed feedback to drivers and enforcement agencies

ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                       A-1-04 - Reduce number of crashes due to unexpected congestion
                       A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
                       A-1-19 - Reduce number of all secondary crashes
                       A-2-03 - Reduce number of fatalities due to road weather conditions
                       A-2-04 - Reduce number of fatalities due to unexpected congestion
                       A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
                       A-2-24 - Reduce number of injuries due to road weather conditions
                       A-2-25 - Reduce number of injuries due to unexpected congestion
                       A-2-39 - Reduce number of injuries due to roadway/geometric restrictions
                       B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period
                       C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

Agreement
Agreements are not required for this initiative.

ID: S12

Initiative: Expand Provision of Travel Time and Delay Information

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will expand the provision of travel time or operating speed information outside of the Twin Cities area. MnDOT currently displays estimated travel times on freeway dynamic message signs (DMS) in the Twin Cities area. The travel times are estimated based on traffic data gathered from traffic detectors. Estimated travel times from the DMS to major roadways (i.e. highways and interstates) are presented in numbers of minutes for travelers, who make travel decisions based on the presented information.

This initiative will expand the travel time/travel speed/delay provision service to greater Minnesota. Vehicle operating speed or travel delay information will be gathered through roadway traffic sensors or detection stations. The information will be processed and posted on DMS, the Internet web site (511), as well as be shared with external information service providers (e.g. radio, TV stations, private information service providers, etc.).

This initiative also includes replacements of DMS and/or traffic sensors/detection stations that support provision of travel time and delay information.

Champion and Stakeholder
MnDOT (District Traffic)

Project Element
- Traffic Detector Roadside Equipment
- Dynamic Message Sign Roadside Equipment
- RTMC
- 511 Traveler Information Website
- 511 Telephone Information Service

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM06 – Traffic Information Dissemination
- TM17 – Speed Warning and Enforcement
- TI01 – Broadcast Traveler Information
- MC06 – Work Zone Management

Interconnect
- Traffic Detector Roadside Equipment and RTMC
- RTMC and Dynamic Message Sign Roadside Equipment
- RTMC and 511 Traveler Information Website

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- RTMC and 511 Telephone Information Service

Technology Readiness   <mark>Implementation</mark>
This technology is currently deployed and operational in the metro area and is mature.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs for this initiative include traffic detectors and signs, with speed and delay information generated at the RTMC. Equipment can be deployed either temporarily or permanently. Permanent traffic detectors range from $3,000 to $9,000 and permanent DMS range from $50,000 to $100,000. Temporary traffic detectors range from $4,000 to $14,000 and portable changeable message signs (PCMS) range from $20,000 to $45,000.

Needs and Objectives Addressed
Need: ATMS15 - Provide operating speed/travel time information to travelers
ITS Objectives: B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                        experiencing recurring congestion during the peak period
                   C-3-09 - Increase the percent of the transportation system in which travel
                        conditions can be detected remotely via video monitoring cameras,
                        speed detectors, etc.

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Increase availability of information about travel times to drivers

Agreement
Agreements are not required for this initiative.

ID: S13

Initiative: Advance Warning Flasher Deployment Expansion

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Intersections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will expand the deployment of Advance Warning Flashers (AWFs) to signalized intersections on high speed approaches. Upgrades and replacements of AWFs are also covered in this initiative. AWF's are installed upstream of traffic signals along high-speed approaches to provide an advance warning to drivers that the traffic signal will be turning from the green phase to a yellow and red phase. AWFs generally consist of two flashing yellow beacons a static sign to indicate that drivers should prepare to stop at the upcoming traffic signal. AWF's are connected to the traffic signal upstream and are activated at the appropriate time during the last few seconds of a green light phase. Drivers can adjust their speeds as appropriate when flashing beacons are activated.

Champion and Stakeholder
Champion: MnDOT

Project Element
- Advance Warning Flasher Roadside Equipment
- Traffic Signal Roadside Equipment

Service Package
- TM03 – Traffic Signal Control
- TM12 – Dynamic Roadway Warning

Interconnect
- Traffic Signal Roadside Equipment and Advance Warning Flasher Roadside Equipment

Technology Readiness   Implementation
This technology is currently deployed and operational statewide.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Based on unit cost estimates, capital costs for this initiative range from $4,000 to $7,000 for each installation location.

Needs and Objectives Addressed

Need: ATMS37 - Provide safe signal phase transition

ITS Objectives: A-1-05 - Reduce number of crashes due to red-light running
                  A-1-10 - Reduce number of crashes at signalized intersections
                  A-2-05 - Reduce number of fatalities due to red-light running
                  A-2-11 - Reduce number of fatalities at signalized intersections
                  A-2-26 - Reduce number of injuries due to red-light running
                  A-2-32 - Reduce number of injuries at signalized intersections
                  A-2-44 - Reduce number of traffic law violations

TSMO Goals and Objectives Supported

TSMO Goal: Increase Safety

TSMO Objective: Reduce the frequency of crashes at signalized and unsignalized
                    intersections

Agreement

Agreements are not required for this initiative.

ID: S14

Initiative: Standard Traffic Signals

Timeframe: Short to Long Term

Multimodal Transportation Objective: Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will deploy standard traffic signals at intersections. This initiative also covers replacements and upgrades of existing standard traffic signals. Standard traffic signals are defined as basic traffic signals, which provides standard red-yellow-green operation to assign movement right-of-way. They may also include the following features:

- Vehicle presence detection
- Countdown pedestrian signals
- Accessible pedestrian signals that provide both audio and vibrating surface information
- Flashing yellow arrows
- Advanced warning flashers
- Railroad preemption
- Emergency vehicle preemption (EVP)
- Transit signal priority (TSP)
- Enforcement lights on the back or the side of signal heads, or blue lights
- Interconnects that allow traffic signal coordination

Champion and Stakeholder
Champion: MnDOT (District Traffic)
Stakeholders: MnDOT, Local Agencies, Transit Agencies

Project Element
- Traffic Signal Roadside Equipment
- RTMC
- Local TMCs
- Minneapolis TMC

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM03 – Traffic Signal Control

Interconnect
- Traffic Signal Roadside Equipment and RTMC
- Traffic Signal Roadside Equipment and Minneapolis TMC
- Traffic Signal Roadside Equipment and Local TMCs

Technology Readiness   Implementation

This initiative is an expansion of a current application and utilizes current technology already deployed and readily available.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with a standard traffic signal vary depending on the site and desired features. Total costs of this initiative are to be determined based on the number and location of devices to be deployed.

Needs and Objectives Addressed

Needs: ATMS01 - Provide efficient signal timing
  ATMS14 - Monitor operation and performance of traffic signal

ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
  A-1-19 - Reduce number of all secondary crashes
  A-2-04 - Reduce number of fatalities due to unexpected congestion
  A-2-25 - Reduce number of injuries due to unexpected congestion
  B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period
  B-1-03 - Reduce the share of major intersections operating at LOS F
  C-1-10 - Increase number of traffic signals equipped with emergency vehicle preemption

Agreement
Agreements are not required for this initiative.

ID: S15

Initiative: Arterial Traffic Management Systems

Timeframe: Short to Long Term

Multimodal Transportation Objective: Open Decision-Making, Transportation Safety, Critical
Connections

SHSP Focus Area: Intersections, Lane Departure

ITS Service Area: Traffic Management

Type: Deployment

Description
MnDOT has deploying arterial traffic management systems along major corridors and arterial
networks. Arterial traffic management systems include signal hardware, detection equipment,
control software, video monitoring equipment, dynamic message signs (DMS), transit signal
priority, emergency vehicle preemption, and fiber-optic communications. This initiative will
implement traffic signal control and monitoring systems and expand monitoring and traveler
information dissemination services to other signalized arterial roadway network. Replacements
and upgrades of existing equipment of the arterial traffic management system are also covered
in this initiative.

The ITS systems identified for this initiative will meet a highly prioritized stakeholder need from
the Traveler Information stakeholder meetings, which is to provide incident information on
freeways and major arterials. Properly placed DMS equipment will provide travelers with
incident and congestion information which can be utilized in selecting an alternate route along
the arterial roadway network. Additional video monitoring equipment will also allow for visual
confirmation incidents impacting traffic and alert TMC operators to dispatch appropriate state
patrol and emergency response personnel.

This initiative is also related to the USDOT-led Integrated Corridor Management (ICM) Program.
The system deployed along TH7 and TH 55 will be integrated with other existing systems within
the ICM initiative boundary.

Champion and Stakeholder
Champion: MnDOT (District Traffic)
Stakeholders: MnDOT, Local Agencies, Transit Agencies

Project Element
- Traffic Signal Roadside Equipment
- Video Monitoring Roadside Equipment
- Dynamic Message Sign Roadside Equipment
- RTMC
- Local TMCs
- Minneapolis TMC

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM03 – Traffic Signal Control
- TM06 – Traffic Information Dissemination

Interconnect
- Traffic Signal Roadside Equipment and RTMC
- Traffic Signal Roadside Equipment and Minneapolis TMC
- Traffic Signal Roadside Equipment and Local TMCs
- Video Monitoring Roadside Equipment and RTMC/Local TMCs/Minneapolis TMC
- Dynamic Message Sign Roadside Equipment and RTMC/Local TMCs/Minneapolis TMC

Technology Readiness   `Implementation`

Software and signal controllers for traffic signal timing operation and monitoring are currently available from numerous vendors. Applicable ITS standards include: NTCIP C2F: NTCIP Center-to-Field Standards Group; NTCIP 1201: Global Object Definitions; NTCIP 1210: Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters; and NTCIP 1211: Object Definitions for Signal Control and Prioritization (SCP).

This initiative is an expansion of a current application and utilizes current technology already deployed and readily available. Published ITS standards NTCIP 1101, 1203, 1205, and 1208 are applicable to this initiative.

Dependency
This initiative is not dependent upon any other initiatives. Equipment in phase 1 of this initiative will support and be integrated with other existing systems in Initiative S14: Integrated Corridor Management.

Cost Estimate
The estimated cost for signal control software and integration ranges from $100,000 to $180,000. The estimated cost for a signal controller and a cabinet ranges from $10,000 to $15,000. Upgrading existing signal controller cost approximately between $3,000 and $6,000 per controller. Total costs of this initiative are to be determined based on the number and location of devices to be deployed.

Needs and Objectives Addressed

Needs: ATIS01 - Provide incident information on freeways and major arterials
                ATMS14 - Monitor operation and performance of traffic signal
                ATMS24 - Operate freeway/expressway/arterial DMS
                ATMS25 - Operate video monitoring cameras
ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                A-1-19 - Reduce number of all secondary crashes
                A-2-04 - Reduce number of fatalities due to unexpected congestion
                A-2-25 - Reduce number of injuries due to unexpected congestion
                B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                        experiencing recurring congestion during the peak period
                B-1-03 - Reduce the share of major intersections operating at LOS F
                B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                        group of specific travel routes or trips in the region

C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection/response

C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.

C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

D-1-06 - Major and minor arterials are equipped with and operating with video monitoring cameras

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
       Increase Safety
       Carefully and Responsibly Manage Transportation Operations Assets

TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota
       Increase availability of information about travel times to drivers
       Reduce the crashes related to congestion in Minnesota metro areas
       Reduce the frequency of crashes at signalized and unsignalized intersections
       Acquire, secure, and retain the data needed for MnDOT to effectively perform operations, performance management and planning

Agreement
Agreements are not required for this initiative.

ID: S16

Initiative: Freeway Traffic Management Systems

Timeframe: Short to Long Term

Multimodal Transportation Objective: Open Decision-Making, Transportation Safety, Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description

MnDOT has deploying freeway traffic management systems along Interstates and expressways. Freeway traffic management systems perform four broad groups of actions, including: observation and detection; data processing and response formulation information sharing to other agencies and the public; and traffic control and management. Freeway traffic management systems include traffic management center software (including data extract tools), traffic detection equipment, video monitoring equipment, dynamic message signs (DMS), ramp meters, lane control signs, automated gate closure systems, MnPASS electronic toll collection equipment, incident detection systems, and fiber-optic and wireless communications.

Freeway traffic management systems covered in this initiative may also include the following features:

- Monitoring AVL on the Freeway Incident Response Team (FIRST) vehicles to track vehicle location and to effectively dispatch the nearest vehicle to an incident.
- Using AVL on the Minnesota State Patrol vehicles to assist in incident response.
- Providing information on road conditions, roadwork activities, crashes and other real-time incidents impacting freeways/expressways into a condition reporting system
- Using weather information to assist in traffic control planning, roadwork planning, and scheduling and dispatching maintenance crews.
- Sharing information to the public via radio broadcasts, Internet web pages, and the MnDOT 511 system.
- Sharing information with other agencies, including Minnesota State Patrol, local transportation agencies, and law enforcement agencies.

This initiative will deploy and expand freeway traffic management capabilities in Minnesota. Replacements and upgrades of existing equipment of the freeway traffic management systems are also covered in this initiative.

Champion and Stakeholder
Champion: MnDOT (District Traffic)
Stakeholders: MnDOT, Local Agencies

Project Element
- Traffic Detector Roadside Equipment
- Video Monitoring Roadside Equipment
- Dynamic Message Sign Roadside Equipment

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- Ramp Meter Roadside Equipment
- Lane Control Roadside Equipment
- Lane/Ramp Access Control Roadside Equipment
- MnPASS Roadside Equipment
- RTMC
- Local TMCs
- Minneapolis TMC
- CARS
- 511 Traveler Information Website
- 511 Telephone Information Service
- Minnesota State Patrol District Office
- Emergency Vehicle Equipment
- FIRST Emergency Vehicle
- Maintenance and Construction Vehicle Equipment
- Maintenance and Construction Management Center

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM03 – Traffic Signal Control
- TM06 – Traffic Information Dissemination
- TM08 – Traffic Incident Management System
- TM10 – Electronic Toll Collection
- TM16 – Reversible Lane Management
- TM19 – Roadway Closure Management
- TM22 – Dynamic Lane Management and Shoulder Use
- TI01 – Broadcast Traveler Information
- MC01 – Maintenance and Construction Vehicle and Equipment Tracking
- PS01 – Emergency Call-Taking and Dispatch
- PS08 – Roadway Service Patrols

Interconnect
- RTMC and Traffic Detector Roadside Equipment
- RTMC and Video Monitoring Roadside Equipment
- RTMC and Dynamic Message Sign Roadside Equipment
- RTMC and Ramp Meter Roadside Equipment
- RTMC and Lane Control Roadside Equipment
- RTMC and Lane/Ramp Access Control Roadside Equipment
- RTMC and MnPASS Roadside Equipment
- RTMC and CARS
- RTMC and FIRST Emergency Vehicle
- RTMC and Minneapolis TMC/Local TMCs
- RTMC and Minnesota State Patrol
- Minnesota State Patrol and Emergency Vehicle
- CARS and 511 Traveler Information Website
- CARS and 511 Telephone Information Service
- Maintenance and Construction Vehicle Equipment and Maintenance and Construction Management Center

Technology Readiness   <mark>Implementation</mark>

This initiative is an expansion of a current application and utilizes current technology already deployed and readily available.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate

Total costs of this initiative are to be determined based on the number and location of devices to be deployed.

Needs and Objectives Addressed

Needs: ATIS01 - Provide incident information on freeways and major arterials

ATIS14 - Expand traveler information coverage in Greater Minnesota

ATMS05 - Provide incident and congestion information to travelers

ATMS07 - Provide lane and shoulder control

ATMS11 - Operate reversible lanes

ATMS15 - Provide operating speed/travel time information to travelers

ATMS22 - Provide a system-coordinated response for incidents and emergencies

ATMS23 - Operate ramp meters

ATMS24 - Operate freeway/expressway/arterial DMS

ATMS25 - Operate video monitoring cameras

ATMS29 - Provide automated/remote control gate systems

ATMS39 - Monitor queue length at ramps, incident scenes, and work zones

ATMS45 - Provide road closure information for far away closures

ITS Objectives: A-1-01 - Reduce number of vehicle crashes

A-1-02 - Reduce number of vehicle crashes per VMT

A-1-03 - Reduce number of crashes due to road weather conditions

A-1-04 - Reduce number of crashes due to unexpected congestion

A-1-19 - Reduce number of all secondary crashes

A-2-01 - Reduce number of roadway fatalities

A-2-02 - Reduce number of roadway fatalities per VMT

A-2-03 - Reduce number of fatalities due to road weather conditions

A-2-04 - Reduce number of fatalities due to unexpected congestion

A-2-22 - Reduce number of roadway injuries

A-2-23 - Reduce number of roadway injuries per VMT

A-2-24 - Reduce number of injuries due to road weather conditions

A-2-25 - Reduce number of injuries due to unexpected congestion

B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during peak periods

B-1-02 - Reduce the percentage of Twin Cities freeway miles congested in weekday peak periods

B-1-04 - Maintain the rate of growth in facility miles experiencing recurring congestion as less than the population growth rate (or employment growth rate)

B-1-05 - Reduce the daily hours of recurring congestion on major freeways

B-1-06 - Reduce the number of hours per day that the top 20 most congested roadways experience recurring congestion

B-1-07 - Reduce the regional average travel time index

B-1-08 - Annual rate of change in regional average commute travel time will not exceed regional rate of population growth

B-1-09 - Improve average travel time during peak periods

B-1-10 - Reduce hours of delay per capita

B-1-11 - Reduce hours of delay per driver

B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for (a group of specific travel routes or trips in the region)

B-1-13 - Reduce the 90th (or 95th) percentile travel times for each route selected

B-1-14 - Reduce the variability of travel time on specified routes during peak and off-peak periods

B-1-15 - Reduce mean incident notification time

B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification

B-1-17 - Reduce mean incident clearance time per incident

B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents

B-2-23 - Increase vehicle throughput on specified routes

B-2-24 - Increase AM/PM peak hour vehicle throughput on specified routes

B-2-25 - Increase AM/PM peak hour person throughput on specified routes

B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak) caused by work zones

B-3-02 - Reduce the percentage of vehicles traveling through work zones that are queued

B-3-03 - Reduce the average and maximum length of queues, when present,

B-3-04 - Reduce the average time duration (in minutes) of queue length greater than some threshold (e.g., 0.5 mile)

B-3-05 - Reduce the variability of travel time in work zones during peak and off-peak periods

C-1-01 - Reduce the vehicle hours of total delay associated with traffic incidents during peak and off-peak periods

C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection / response

C-2-01 - Decrease the average buffer index for multiple routes or trips

C-2-02 - Reduce the average planning time index for specific routes in region

C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
Increase Safety
Carefully and Responsibly Manage Transportation Operations Assets

TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota
Increase availability of information about travel times to drivers
Reduce the impacts of snow and ice on mobility
Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Increase pre-trip and en-route traveler awareness of incidents and alternate options in both the Twin Cities and Greater Minnesota
Reduce the crashes related to congestion in Minnesota metro areas
Reduce the frequency of crashes related to road weather conditions
Acquire, secure, and retain the data needed for MnDOT to effectively perform operations, performance management and planning

Agreement
Agreements are not required for this initiative.

TSMO

ID: S17

Initiative: Integrated Corridor Management (ICM)

Timeframe: Short to Long Term

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will integrate existing systems that manage the dispersal of traffic along high volume corridors by coordinating multiple transportation and transit networks. This initiative will utilize currently deployed technologies or deploy new devices, such as traffic monitoring cameras, and dynamic message signs during peak period hours and special events impacting the roadway network. Recurring and non-recurring congestion will be reduced by monitoring and guiding traffic through parallel transportation networks to effectively use the available lane capacity in the area. There are already a number of network and corridor management strategies in place and this initiative will upgrade the existing systems as necessary, and integrate these capabilities and the operations of the different facilities and agencies in a more effective manner to decrease congestion.

Champion and Stakeholder
Champion: MnDOT (Freeway Operations and Traffic Signal Operations)
Stakeholders: MnDOT Districts, Minnesota State Patrol, Emergency Management Providers, Local Government Signal Operations, Metro Area Transit Providers, Local Transit Agencies

Project Element
- Traffic Detector Roadside Equipment
- Video Monitoring Roadside Equipment
- Dynamic Message Sign Roadside Equipment
- Highway Advisory Radio Roadside Equipment
- Traffic Signal Roadside Equipment
- Ramp Meter Roadside Equipment
- Minneapolis TMC
- Local TMCs
- RTMC
- Metro Area Transit Management Centers
- Local Transit Management Centers
- MnPASS Roadside Equipment
- MnPASS Service Center
- Parking Management System

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM03 – Traffic Signal Control
- TM05 – Traffic Metering
- TM07 – Regional Traffic Management

- TM09 – Integrated Decision Support and Demand Management
- TM10 – Electronic Toll Collection
- TM16 – Reversible Lane Management
- ST06 – HOV/HOT Lane Management

Interconnect
- Roadside equipment and RTMC
- Roadside equipment and Minneapolis TMC/Local TMCs
- MnPASS roadside equipment and MnPASS Service Center
- Metro area transit management centers / local transit management centers and transit vehicles
- RTMC and Minneapolis TMC/Local TMCs
- RTMC and metro area transit management centers / local transit management centers
- Minneapolis TMC/Local TMCs and metro area transit management centers / local transit management centers
- Minneapolis TMC/Local TMCs and 911 dispatch center
- Minneapolis TMC/Local TMCs and parking management system

Technology Readiness   <mark>Implementation</mark>
This initiative will integrate existing technology and systems already deployed in the initiative area. NTCIP C2C: NTCIP Center-to-Center Standards Group and NTCIP C2F: Center-to-Field Standards Group are ITS standards that will apply to this initiative.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Total costs have been estimated between $4-5 Million for the I-394 ICM initiative in the Twin Cities metro area.

Needs and Objectives Addressed
Need: ATMS36 - Implement Integrated Corridor Management (ICM) Strategies
ITS Objectives: B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period
        B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a group of specific travel routes or trips in the region
        B-2-01 - Increase annual transit ridership
        B-2-23 - Increase vehicle throughput on specified routes
        B-2-24 - Increase AM/PM peak hour vehicle throughput on specified routes
        B-2-25 - Increase AM/PM peak hour person throughput on specified routes
        C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection/response

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
            Increase Safety
            Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota

Increase availability of information about travel times to drivers
Increase pre-trip and en-route traveler awareness of incidents and
alternate options in both the Twin Cities and Greater Minnesota
Reduce the crashes related to congestion in Minnesota metro areas
Reduce the frequency of crashes related to road weather conditions
Acquire, secure, and retain the data needed for MnDOT to effectively
perform operations, performance management and planning

Agreement

The I-394 ICM initiative in the metro area will require a Memorandum of Understanding between MnDOT, City of Minneapolis, Hennepin County, FHWA, Metro Transit, and other stakeholders. Other ICM initiatives will require Memorandums of Understanding among MnDOT, county and city agencies along the corridors, transit agencies and other stakeholders.

ID: S18

Initiative: Sharing Video Images Between Agencies

Timeframe: Short to Long Term

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open Decision-Making, Critical Connections

SHSP Focus Area: Intersections, Lane Departure, EMS Response & Trauma Systems

ITS Service Area: Traffic Management, Support, Public Safety

Type: Deployment

Description
This initiative will ensure the sharing of video camera images with transportation agencies, transit agencies, public safety, and emergency services to assist them in incident/emergency response and management. Transportation agencies that operate video cameras will send available images to control centers or dispatchers at other agencies. Control of the cameras will not be shared, but agencies will be able to contact the camera operator and request changing camera views. Types of images shared (e.g. snapshots vs. streamed) will vary by agency needs and camera locations. The purpose of this initiative is to improve the effectiveness of emergency response to traffic incidents, emergencies, and other events.

This deployment will meet a highly prioritized need from the Public Safety stakeholder meeting – Share video with other PSAPs (Public Safety Answering Points).

Champion and Stakeholder
Champion: MnDOT (RTMC), Minnesota DPS
Stakeholders: MnDOT, Local Transportation Agencies, Minnesota DPS, Local EM Agencies, Transit Agencies

Project Element
- Video Monitoring Roadside Equipment
- RTMC
- Minneapolis TMC
- Local TMCs
- 911 Dispatch Center
- County Sheriff and City Police Offices
- Minnesota State Patrol District Office
- Metro Area Transit Management Centers

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM08 – Traffic Incident Management System
- SU03 – Data Distribution
- PS01 – Emergency Call-Taking and Dispatch

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Interconnect
- RTMC and Video Monitoring Roadside Equipment
- Minneapolis TMC and Video Monitoring Roadside Equipment
- Local TMCs and Video Monitoring Roadside Equipment
- RTMC and Minneapolis TMC/Local TMCs
- RTMC and Minnesota State Patrol
- RTMC/Minneapolis TMC/Local TMCs and 911 Dispatch Center/County Sheriff/City Police
- RTMC/Minneapolis TMC/Local TMCs and Metro Area Transit Management Centers

Technology Readiness
This initiative features technology that is readily available and currently operational.

Dependency
This initiative is not dependent upon any other initiative.

Cost Estimate
Total equipment costs have not been estimated given that scope of initiative needs to be further determined.

Needs and Objectives Addressed

Needs: ATMS09 - Share video, data, and other information with PSAPs
                ATIS21 - Make real-time transportation operations data available to other
                         transportation system operators (i.e. interagency data sharing)
ITS Objectives: B-1-16 - Reduce mean time for needed responders to arrive on-scene after
                         notification
                B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway
                         incidents
                C-1-01 - Reduce the vehicle hours of total delay associated with traffic
                         incidents during peak and off-peak periods
                C-1-02 - Increase percentage of incident management agencies in the region
                         that participate in a multi-modal information exchange network
                C-1-09 - Increase number of regional road miles covered by ITS-related
                         assets (e.g., roadside cameras, dynamic message signs, vehicle
                         speed detectors) in use for incident detection / response
                E-4-04 - Increase the rate at which equipment is utilized

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce incident response and clearance times in the Twin Cities and
                 Greater Minnesota

Agreement
Agreements are required for interagency sharing of camera image viewing and control.

ID: S19

Initiative: ATMS for Major Event Management

TSMO

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management, Parking Management, Traveler Information

Type: Deployment

Description
This initiative will deploy technologies to help manage major events by utilizing the following techniques: 1) Smart traffic signal control on approach arterials, 2) Parking demand/exit management systems, including use of debit cards and/or transponders, 3) Traveler information directing arriving/departing customers to appropriate freeway exit access points to available parking locations and other way-finding information, 4) Portable Intelligent Work Zone technology (i.e., DMS, cameras, communications) to control work zone traffic during major events.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Local Agencies, MSP, Event Organizers

Project Element
- Traffic Detector Roadside Equipment
- Video Monitoring Roadside Equipment
- Dynamic Message Sign Roadside Equipment
- Traffic Signal Roadside Equipment
- Minneapolis TMC
- Local TMCs
- RTMC
- Parking Management System
- Parking Management Roadside Equipment
- 511 Traveler Information Website
- 511 Telephone Information Service

Service Package
- TM06 – Traffic Information Dissemination
- TM08 – Traffic Incident Management System
- TI01 – Broadcast Traveler Information
- PM01 – Parking Space Management

Interconnect
- RTMC/Minneapolis TMC/Local TMCs and Traffic Detector Roadside Equipment
- RTMC/Minneapolis TMC/Local TMCs and Video Monitoring Roadside Equipment
- RTMC/Minneapolis TMC/Local TMCs and Dynamic Message Sign Roadside Equipment
- RTMC/Minneapolis TMC/Local TMCs and Traffic Signal Roadside Equipment
- Parking Management System and Parking Management Roadside Equipment

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- RTMC/Minneapolis TMC/Local TMCs and Parking Management System
- Parking Management System and 511 Traveler Information Website
- Parking Management System and 511 Telephone Information Service

Technology Readiness   <mark>Implementation</mark>
This initiative features technology that is readily available and currently operational.

Dependency
This initiative is not dependent upon any other initiative.

Cost Estimate
Total equipment costs have not been estimated given that scope of initiative needs to be further determined.

Needs and Objectives Addressed
Need: ATMS17 - Provide travel information on special events
ITS Objectives: B-1-02 - Reduce the percentage of Twin Cities freeway miles congested in
                     weekday peak periods
                  B-1-03 - Reduce the share of major intersections operating at LOS F

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce the frequency of congestion or slowed traffic on the freeways and
                     arterials in metro areas throughout Minnesota

Agreement
This initiative may require a Memorandum of Understanding between MnDOT, local transportation and law enforcement agencies, and other stakeholders.

ID: S20

TSMO

Initiative: Expand HOT Lane Deployment in Metro Area

Timeframe: Short to Medium Term – Years 2-4 and Beyond

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management, Sustainable Travel

Type: Deployment

Description
The objective of this initiative is to convert existing traffic lanes or shoulders in the metro area into HOT (High-Occupancy Toll) lanes similar to the HOT/MnPASS Lane operation on I-394, I-35W and I-35E. Various traffic management tools that could be utilized include lane control signals, dynamic pricing, and Advanced Traveler Information System (ATIS), as well as improvement in transit reliability. In addition to traffic management tools, major items in creating hard or HOT shoulders include shoulder reconstruction, drainage control, and noise walls.

Champion and Stakeholder
Champion: MnDOT
Stakeholder: Minnesota State Patrol

Project Element
- MnPASS Roadside Equipment
- MnPASS Service Center
- MnPASS Vehicle Equipment
- Account Management Providers
- Passenger Occupancy Monitoring/Enforcement Roadside Equipment
- RTMC
- Variable Speed Limit Roadside Equipment
- Minnesota State Patrol District Office

Service Package
- ST06 – HOV/HOT Lane Management
- TM10 – Electronic Toll Collection
- TM20 – Variable Speed Limits
- TM22 – Dynamic Lane Management and Shoulder Use

Interconnect
- MnPASS Service Center and MnPASS Roadside Equipment
- MnPASS Service Center and MnPASS Vehicle Equipment
- MnPASS Vehicle Equipment and MnPASS Roadside Equipment
- MnPASS Service Center and Account Management Providers
- RTMC and Passenger Occupancy Monitoring/Enforcement Roadside Equipment
- RTMC and Minnesota State Patrol District Office
- RTMC and Variable Speed Limit Roadside Equipment

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Technology Readiness **Implementation**

MnPASS HOT Lane technology has been deployed along the I-394 and I-35W corridors and can readily be deployed along future corridors. Existing variable speed limit roadside equipment currently allows for shoulder use along the I-35W corridor.

Dependency

This initiative is not dependent upon any other initiative.

Cost Estimate

The overall cost for deploying various tools that are part of a HOT Lane project, such as variable speed limit signs, lane control signals, dynamic pricing, and Advanced Traveler Information System (ATIS), will vary depending on the amount of equipment needed and the amount of road infrastructure that needs to be expanded or re-built.

Needs and Objectives Addressed

Need: ATMS26 - Operate and Enforce MnPASS Lanes

ITS Objectives: B-1-02 - Reduce the percentage of Twin Cities freeway miles congested in weekday peak periods

                  B-1-14 - Reduce the variability of travel time on specified routes during peak and off-peak periods

                  B-2-19 - Increase the number of carpools

                  B-2-20 - Increase use of vanpools

                  B-2-23 - Increase vehicle throughput on specified routes

                  B-2-24 - Increase AM/PM peak hour vehicle throughput on specified routes

                  B-2-25 - Increase AM/PM peak hour person throughput on specified routes

                  H-2-01 - Increase the average vehicle passenger occupancy rate in HOV lanes

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency

TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota

Agreement

Agreements are not required for this initiative.

ID: S21

Initiative: Passenger Occupancy Monitoring/Enforcement System for MnPASS

Timeframe: Short to Medium Term

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Sustainable Travel

Type: Operational Test, Deployment

Description
This initiative will conduct operational tests and, upon successful testing, deploy roadside equipment to monitor passenger occupancies along MnPASS lanes to assist in enforcement. When passenger occupancy violations are detected, a signal will be sent to the appropriate law enforcement agency to verify and confirm violations. MnPASS lanes are currently in operation along I-394, I-35E and I-35W in the metro area. HOV bypass lanes are also provided at ramp meter locations to allow vehicles with 2 or more people to bypass traffic queues at the ramp meter.

MnDOT is currently testing a MnPASS Enforcement Assistance System (EASy). The EASy system was designed to aid State Patrol in enforcing the MnPASS HOV 2+ lanes. The systems works by taking near infrared images and sending them directly to the Troopers onboard laptop. The Trooper can then make the decision if a stop is needed. The images are only shown temporarily, and not stored or used as evidence. The Trooper must still visually confirm that a vehicle is in violation. In addition to the camera system, two beacons are also deployed and flash if a car does or does not have a MnPASS tag.

Initial tests took place on I-394 and have more recently been moved to I-35W and Black Dog Road. The system is deployed on the north bound lanes and will continue testing with the State Patrol throughout the winter months. Currently MnDOT is working with NEC, the company who developed the system, to come up with a cost for the system. No decision on how many sites will have the system installed at this time.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, MSP

Project Element
- MnPASS Roadside Equipment
- Passenger Occupancy Monitoring/Enforcement Roadside Equipment
- RTMC
- MSP District Office

Service Package
- ST06 – HOV/HOT Lane Management

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Interconnect
- MnPASS Roadside Equipment and RTMC
- MSP and Passenger Occupancy Monitoring/Enforcement Roadside Equipment
- RTMC and Passenger Occupancy Monitoring/Enforcement Roadside Equipment

Technology Readiness   Development
Technology for this initiative is under development and has not being fully adopted in an operational environment.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been determined.

Needs and Objectives Addressed
Need: ATMS27 - Provide HOV bypass lanes at ramp meter locations
ITS Objectives: B-1-02 - Reduce the percentage of Twin Cities freeway miles congested in
                          weekday peak periods
                  B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                          group of specific travel routes or trips in the region
                  H-2-01 - Increase the average vehicle passenger occupancy rate in HOV
                          lanes

Agreement
An agreement is not required for this initiative.

ID: S22

Initiative: Active Flashing Signals and Gates at Highway/Railroad Intersections

Timeframe: Short to Long Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Train Involved

ITS Service Area: Traffic Management

Type: Deployment

Description
Active flashing signals and gates have been installed at many highway/railroad grade crossings throughout Minnesota. This initiative will deploy active flashing light signals and gates at additional highway/railroad intersections that have historically high incident rates. This initiative also covers upgrades and replacements of active flashing signals, gates and associate equipment. Standard deployments generally include warning systems that are activated on notification by interfaced wayside equipment of an approaching train. Standard railroad crossing equipment may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Advanced deployments are needed where approaching train speeds exceed 80 miles per hour and have additional safety features to mitigate the risks associated with higher rail speeds.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Local Agencies, Railroad Companies

Project Element
- Railroad Active Warning Roadside Equipment
- Railroad Wayside Equipment

Service Package
- TM13 – Standard Railroad Grade Crossing
- TM14 – Advanced Railroad Grade Crossing

Interconnect
- Railroad Active Warning Roadside Equipment and Railroad Wayside Equipment

Technology Readiness   Implementation
This technology is currently deployed and operational statewide.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative vary by type of systems installed.

Needs and Objectives Addressed

Need: ATMS28 - Provide railroad flashing light signals and gates

ITS Objectives: A-1-09 - Reduce number of crashes at railroad crossings

                      A-2-10 - Reduce number of fatalities at railroad crossings

                      A-2-31 - Reduce number of injuries at railroad crossings

Agreement

Agreements between railroad companies, MnDOT and/or local agencies are needed.

ID: S23

Initiative: Overheight Detection/Warning Systems

Timeframe: Short to Medium Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Lane Departure, Commercial Vehicle Involved

ITS Service Area: Traffic Management, Public Safety, Vehicle Safety

Type: Deployment

Description
This initiative will target and deploy overheight detection/warming systems at bridge, overpasses, and tunnels with low height clearance. A system of roadside detectors and electronic warning signs currently exists in MnDOT District 7 that warns drivers of vehicles that are too tall or too wide to pass under bridges or through tunnels. The system is operated by the MnDOT District 7.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Project Element
- Oversize/overheight Warning Roadside Equipment
- Commercial Vehicles
- Dynamic Message Sign Roadside Equipment
- RTMC

Service Package
- TM12 – Dynamic Roadway Warning
- PS09 – Transportation Infrastructure Protection
- VS11 – Oversize Vehicle Warning

Interconnect
- Oversize/overheight Warning Roadside Equipment and Commercial Vehicles
- Oversize/overheight Warning Roadside Equipment and Dynamic Message Sign Roadside Equipment
- RTMC and Oversize/overheight Warning Roadside Equipment
- RTMC and Dynamic Message Sign Roadside Equipment

Technology Readiness   Implementation   Development
Overheight detection and warning systems are readily available from vendors. Further R&D and technology testing is underway to advance connected vehicle technology for this application.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative vary by type of systems installed.

Needs and Objectives Addressed

Need: ATMS35 - Provide vehicle overheight detection/warning systems

ITS Objectives: A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
                 A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
                 A-2-39 - Reduce number of injuries due to roadway/geometric restrictions
                 C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.

Agreement
Agreements are not required for this initiative.

ID: S24

Initiative: Expand Geographic Coverage of the RTMC Systems

Timeframe: Short to Long Term – Years 0-9 and beyond

Multimodal Transportation Objective: Transportation Safety, Critical Connections, System Stewardship

SHSP Focus Area: Management Systems

ITS Service Area: Traffic Management

Type: Deployment

Description
The goal of the Regional Transportation Management Center (RTMC) is to provide motorists with a faster and safer trip on metro-area freeways by using cutting-edge technology, progressive programs, and real time information delivery systems. The MnDOT RTMC integrates MnDOT's Metro District Maintenance Dispatch and Office of Traffic, Security, and Operations with the Minnesota Department of Public Safety's State Patrol Dispatch into a unified communications center. The integration provides the communications and computer infrastructure necessary for coordinated transportation management on metro freeways during normal commuting periods, as well as during special events and major incidents.

This initiative will require actions to evaluate current expansion plans and available funding to identify gaps. There may be staffing limitations that could limit the level of monitoring/response that would be needed for expanded RTMC coverage.

Champion and Stakeholder
Champion: MnDOT State Traffic Engineer
Stakeholders: Minnesota State Patrol

Project Element
- RTMC
- Dynamic Message Sign Roadside Equipment
- Video Monitoring Roadside Equipment
- Traffic Detector Roadside Equipment
- Minnesota State Patrol District Office

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM06 – Traffic Information Dissemination
- TM07 – Regional Traffic Management
- TM08 – Traffic Incident Management System

Interconnect
- RTMC and Dynamic Message Sign Roadside Equipment
- RTMC and Video Monitoring Roadside Equipment
- RTMC and Traffic Detector Roadside Equipment

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- RTMC and Minnesota State Patrol District Office

Technology Readiness   <mark>Implementation</mark>
This initiative is an expansion of existing technologies. Newer technology will be assessed once it has become available and proven stable for deployment.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Total equipment costs have not been estimated given that scope of initiative needs to be further determined.

Needs and Objectives Addressed
Need: ATMS24 - Operate freeway/expressway/arterial DMS
                 ATMS25 - Operate video monitoring cameras
ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                 A-1-19 - Reduce number of all secondary crashes
                 A-2-04 - Reduce number of fatalities due to unexpected congestion
                 A-2-25 - Reduce number of injuries due to unexpected congestion
                 B-1-07 - Reduce the regional average travel time index
                 B-1-14 - Reduce the variability of travel time on specified routes during peak and off-peak periods
                 C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection/response
                 C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.
                 C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways
                 D-1-06 - X percent of major and minor arterials are equipped with and operating with video monitoring cameras

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                  Increase Safety
                  Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and arterials in metro areas throughout Minnesota
                  Increase availability of information about travel times to drivers
                  Increase pre-trip and en-route traveler awareness of incidents and alternate options in both the Twin Cities and Greater Minnesota
                  Reduce the crashes related to congestion in Minnesota metro areas
                  Acquire, secure, and retain the data needed for MnDOT to effectively perform operations, performance management and planning

Agreement
No additional agreements have been identified beyond current agreements that have been established for RTMC and State Patrol operations.

ID: S25

Initiative: Use Driving Simulation for Teenage and Older Driver Education

Timeframe: Short Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Safety Culture & Awareness, Older Drivers, Younger Drivers

ITS Service Area: Public Safety

Type: Policy/Legislation, Research

Description
Driving simulation technology has been developed to address the underlying attitudes that influence how teens drive. It intends to define teen driving problems, identify solutions and test those solutions for real results before they are introduced into the market. Individuals would be asked to participate in driving simulation to see the effects of driving too fast, tailgating, reaction time, etc. This technology has been available for many years. However, political support will be needed to proceed at a state level in enhance the applications.

This initiative will require actions to review driving regulations to determine if they allow for further evaluation of older and new teenaged drivers and evaluate current simulation technology to determine effectiveness, potential application and cost parameters. There are some legal issues that needed to be considered including that driving regulations may need to be evaluated to determine if they allow for further evaluation of older and/or new teenaged drivers. Some institutional issues needed to be considered include that there may be older driver resistance to this additional evaluation of their driving skills and privileges.

Champion and Stakeholder
Champion: Minnesota DPS – Driver & Vehicle Services
Stakeholders: MnDOT

Project Element
- None.

Service Package
- None.

Interconnect
- None.

Technology Readiness
None.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Total equipment costs have not been estimated given further research required.

Needs and Objectives Addressed

Need: CEA 3 – Addressing Young Drivers over Involvement and Curbing Aggressive Driving

ITS Objectives: A-1-18 - Reduce number of crashes involving younger drivers (under 21)
                  A-2-19 - Reduce number of fatalities involving younger drivers (under 21)
                  A-2-40 - Reduce number of injuries involving younger drivers (under 21)

Agreement

Agreements are not required for this initiative.

ID: S26

Initiative: Transit Customer Information Systems

Timeframe: Short to Long Term

Multimodal Transportation Objective: Critical Connections, Open Decision-Making

ITS Service Area: Public Transportation

Type: Deployment

Description
This initiative provides travel information to transit customers. Information can include: route, fare and schedule information, real-time vehicle arrival/departure information, parking, park and ride lot locations, and space availability, service alerts, service changes, and other information. The information can be provided at transit stops, on transit vehicles and online through websites, social media and mobile applications.

Examples of ITS projects for this initiative include deployments of: real-time, overhead and roadside dynamic message signs, annunciators on transit vehicles and at stops, transit arrival notifications/beacons, parking management and information systems at park-and-ride lots, web-based real-time transit information systems, mobile customer information systems/apps, fare payment kiosks, online reservation systems for demand-responsive services, and carpool/vanpool ridematching systems.

This initiative also supports upgrades, expansion and/or preservation of existing transit customer information systems.

Champion and Stakeholder
Champion: Metropolitan Council, Metro Transit, Suburban Transit Providers, Local Transit
                Agencies
Stakeholders: Greater Minnesota MPOs

Project Element
- Metro Area Transit Management Centers (Regional Transit Providers)
- Local Transit Management Centers
- Commuter Rail Operations Center
- Light Rail Operations Center
- Intercity Transit Management Centers
- Transit Kiosks
- Transit Information Websites
- Transit Information Telephone Systems
- Transit Vehicle Equipment
- Park-and-Ride Parking Information System Roadside Equipment
- Real-Time Transit Arrival Time Display Roadside Equipment
- Real-Time Transit Travel Time Display Roadside Equipment
- User Personal Portable and Computing Devices

Service Package
- PT08 – Transit Traveler Information
- PM02 – Smart Park and Ride System
- PT03 – Dynamic Transit Operations
- PT04 – Transit Fare Collection Management

Interconnect
- Transit Management Centers and Transit Kiosks
- Transit Management Centers and Transit Information Websites
- Transit Management Centers and Transit Information Telephone Systems
- Transit Management Centers and Transit Vehicle Equipment
- Transit Management Centers and Real-Time Transit Arrival Time Display Roadside Equipment
- Transit Management Centers and Real-Time Transit Travel Time Display Roadside Equipment
- Transit Management Centers and Park-and-Ride Parking Information System Roadside Equipment
- Light Rail Operations Center and Real-Time Transit Arrival Time Display Roadside Equipment
- Commuter Rail Operations Center and Real-Time Transit Arrival Time Display Roadside Equipment
- User Personal Portable and Computer Devices and Transit Information Websites

Technology Readiness   `Implementation`
This initiative features technology that is readily available and currently operational.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs will vary by size of agency, equipment used to convey information, and number of devices used. Projects can range from $175,000 for software enhancements and integration into a transit website to $4 million for dense deployment of numerous signs along a corridor. Real-Time Bus Arrival Displays can cost from $4,000 to $25,000 per sign to deploy. Changeable message signs for transit centers can cost from $5,000 to $25,000 per sign to deploy. Unit cost estimates for interactive informational kiosks for transit agencies range from $15,000 to $30,000. Software costs for trip planning / route selection technology ranges from $250,000 to over $1,000,000 for systems that include voice recognition, while hardware costs range from $20,000 to $30,000. The estimates do not include O&M costs.

Needs and Objectives Addressed
Need: APTS01 - Provide transit route, schedule, and fare information
               APTS02 - Provide real-time transit vehicle arrival/departure information
               APTS10 - Provide on-board automated enunciators
               APTS16 - Provide information on ridesharing opportunities
               APTS20 - Provide real-time transfer information to travelers enroute
               APTS21 - Provide on-line reservation system for demand-responsive transit
               ATIS19 - Provide different alternatives to travelers for the most appropriate
                        route/mode/time of travel

<u>ITS Objectives:</u>   B-2-01 - Increase annual transit ridership
B-2-02 - Increase annual express bus ridership
B-2-21 - Provide carpool/vanpool matching and ridesharing information services
C-3-03 - Increase alternative (non-single occupancy vehicle) mode share in transit station communities (or other areas)
C-3-14 - Increase the number of transit routes with information being provided by ATIS
C-3-17 - Increase annual transit ridership reported by urbanized area transit providers
C-3-18 - Increase annual transit ridership reported by rural area transit providers
C-4-02 - Increase the number of users aware of park-and-ride lots in their region

Agreement
Agreements might be necessary to place schedule systems providing route and schedule information on property not owned by listed stakeholders.

ID: S27

Initiative: Transit Fleet Management Systems

Timeframe: Short to Long Term

Multimodal Transportation Objective: System Stewardship, Critical Connections

ITS Service Area: Public Transportation

Type: Deployment

Description
This initiative will implement technologies to support transit fleet maintenance and management activities. Examples of ITS projects for this initiative include deployments of: transit asset management systems, automatic vehicle maintenance scheduling systems, vehicle telematics/ diagnostics and health monitoring systems, garage vehicle locator systems. This includes allowing transit garage/fleet management systems to wirelessly download transit vehicle diagnostic data from transit vehicles as they enter maintenance garages to improve vehicle diagnostics and preventative maintenance.

This initiative also include the implementation of employee smart card systems to support transit personnel resource management for transit agencies. Employee smart cards can be used for employee time-clock management and potentially for personnel management, fleet operations, and customer service.

This initiative also supports upgrades, expansion and/or preservation of existing transit fleet management and maintenance systems.

Champion and Stakeholder
Champion: Metropolitan Council, Metro Transit, Suburban Transit Providers, Local Transit Agencies
Stakeholders: Greater Minnesota MPOs

Project Element
- Metro Area Transit Management Centers (Regional Transit Providers)
- Local Transit Management Centers
- Commuter Rail Operations Center
- Light Rail Operations Center
- Transit Vehicle Equipment

Service Package
- PT06 – Transit Fleet Management

Interconnect
- Transit Management Centers and Transit Vehicle Equipment
- Commuter Rail Operations Center and Transit Vehicle Equipment
- Light Rail Operations Center and Transit Vehicle Equipment

Technology Readiness   **Implementation**
This initiative features technology that is readily available and currently operational.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been identified.

Needs and Objectives Addressed

<u>Need:</u>   APTS08 - Support vehicle diagnostics and maintenance
<u>ITS Objectives:</u>   E-4-05 - Increase the percentage of fleet/equipment within its lifecycle
                   E-4-06 - Increase the number of fleet vehicles with maintenance diagnostic
                       equipment

Agreement
Agreements are not required for this initiative.

ID: S28

Initiative: Transit Operations and Management Systems

Timeframe: Short to Long Term

Multimodal Transportation Objective: Critical Connections, Open Decision-Making

ITS Service Area: Public Transportation

Type: Deployment

Description
This initiative will implement technologies on-board transit vehicles, roadside, and/or in transit control centers to support operations and management of transit systems. Technologies implemented in this initiative also support and/or enable services provided in Initiative S26 – Transit Customer Information Systems. Technologies in this initiative include but are not limited to: automated vehicle location/global positioning systems (AVL/GPS), automated passenger counters (APC), electronic fare collection systems, bike rack sensors, transit signal priority, transit control room software and hardware, transit scheduling software systems, data analysis tools for transit performance, and other advanced transit vehicle technologies.

This initiative also supports upgrades, expansion, integration and/or preservation of existing transit operations and management systems, as well as integration with other transit initiatives.

Champion and Stakeholder
Champion: Metropolitan Council, Metro Transit, Suburban Transit Providers, Local Transit Agencies
Stakeholders: Greater Minnesota MPOs, MnDOT, Local Agencies

Project Element
- Metro Area Transit Management Centers (Regional Transit Providers)
- Local Transit Management Centers
- Commuter Rail Operations Center
- Light Rail Operations Center
- Intercity Transit Management Centers
- Transit Vehicle Equipment
- Transit Data Archives
- Local TMCs
- Minneapolis TMC
- RTMC
- Traffic Signal Roadside Equipment

Service Package
- PT01 – Transit Vehicle Tracking
- PT02 – Transit Fixed-Route Operations
- PT03 – Dynamic Transit Operations
- PT04 – Transit Fare Collection Management
- PT07 – Transit Passenger Counting
- PT09 – Transit Signal Priority

- PT14 – Multi-modal Coordination
- PT17 – Transit Connection Protection
- DM01 – ITS Data Warehouse

Interconnect
- Transit Management Centers and Transit Vehicle Equipment
- Light Rail Operations Center and Transit Vehicle Equipment
- Commuter Rail Operations Center and Transit Vehicle Equipment
- Transit Management Centers and Transit Data Archives
- Light Rail Operations Center and Transit Data Archives
- Commuter Rail Operations Center and Transit Data Archives
- Transit Vehicle Equipment and Traffic Signal Roadside Equipment
- Minneapolis TMC and Traffic Signal Roadside Equipment
- RTMC and Traffic Signal Roadside Equipment
- Local TMCs and Traffic Signal Roadside Equipment

Technology Readiness   `Implementation`
This initiative features technology that is readily available and currently operational.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs will vary depending on the type and amount of APTS technologies deployed by Transit Agencies. Transit center software for CAD/GPS/AVL technology can range from $500,000 to $1,200,000 for small and medium areas. Vehicle hardware can range from $1,000 to $5,000 per bus. Transit Signal Priority technology generally ranges from $3,000 to $5,000 for both vehicle and intersection equipment.

Needs and Objectives Addressed

Need: APTS02 - Provide real-time transit vehicle arrival/departure information
     APTS03 - Provide simple and flexible fare payment systems
     APTS04 - Coordinate timed transfers between route segments, providers & modes
     APTS07 - Provide electronic fare payment card
     APTS09 - Measure historical transit route performance
     APTS15 - Optimize schedule efficiency
     APTS17 - Coordinate transit vehicle movements with traffic control devices

ITS Objectives: B-1-09 - Improve average travel time during peak periods
     B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a group of specific travel routes or trips in the region
     B-1-14 - Reduce the variability of travel time on specified routes during peak and off-peak periods
     B-2-01 - Increase annual transit ridership
     B-2-02 - Increase annual express bus ridership
     B-2-05 - Maintain performance targets set by MnDOT for rides per hour of transit service
     B-2-06 - Maintain transit passengers per capita rate for service types
     B-2-07 - Maintain the cost efficiency of the statewide public transit network

B-2-08 - Maintain the service effectiveness of the statewide public transit network in terms of passengers/service hour and passengers/mile

B-2-09 - Maintain the cost effectiveness of the statewide public transit network in terms of cost per service hour, cost per passenger trip, and revenue recovery percentage

B-2-10 - Maintain the availability of the statewide public transit network in terms of hours (span) of service and frequency

B-2-15 - Improve average on-time performance for specified transit routes/facilities

B-2-16 - Increase use of automated fare collection system

B-2-17 - Increase the percent of transfers performed with automated fare cards

C-3-05 - Increase transit mode share during peak periods

C-3-06 - Increase average transit load factor

C-3-17 - Increase annual transit ridership reported by urbanized area transit providers

C-3-18 - Increase annual transit ridership reported by rural area transit providers

D-1-01 - Reduce on an annual basis the number of complaints per 1,000 boarding passengers

E-1-02 - Improve average transit travel time compared to auto in major corridors

E-4-04 - Increase the rate at which equipment is utilized

E-4-07 - Increase the number of vehicles operating under CAD

G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning

G-1-06 - Reduce operations cost deviation

Agreement
This initiative will require agreements between the transit agencies that manage TSP operations and the traffic agency responsible for operating and maintaining safe traffic signal operations.

Agreements will be needed to allow data sharing and service coordination among transit agencies.

ID: S29

Initiative: Transit Safety and Security Systems

Timeframe: Short to Long Term

Multimodal Transportation Objective: Transportation Safety

ITS Service Area: Public Transportation

Type: Deployment

Description
This initiative will implement technologies to provide for the security of transit passengers, vehicle operators and systems. Transit safety and security systems include technologies performing detection and monitoring of potentially hazardous situations. Sensing and monitoring technologies can be deployed on-board of transit vehicles, at stops, park-and-ride lots, and major transit facilities such as customer, administrative buildings, railways and maintenance facilities.

Deployments of advanced vehicle safety features, such as pedestrian and bicycle detection and warning systems, vehicle lateral safety detection and warning systems, and other advanced transit vehicle safety systems, are also included in this initiative.

This initiative also includes upgrades, expansion, integration and/or preservation of existing transit safety and security systems.

Champion and Stakeholder
Champion: Metropolitan Council, Metro Transit, Suburban Transit Providers, Local Transit Agencies
Stakeholders: Greater Minnesota MPOs, Local Law Enforcement Agencies

Project Element
- Metro Area Transit Management Centers (Regional Transit Providers)
- Local Transit Management Centers
- Commuter Rail Operations Center
- Light Rail Operations Center
- Intercity Transit Management Centers
- Transit Vehicle Equipment
- Transit Center and Station Surveillance System Roadside Equipment
- Local Law Enforcement Agencies
- User Personal Portable and Computing Devices

Service Package
- PT05 – Transit Security
- PT11 – Transit Pedestrian Indication
- PT12 – Transit Vehicle at Station/Stop Warnings
- PT13 – Vehicle Turning Right in Front of a Transit Vehicle

Interconnect
- Transit Management Centers and Transit Vehicle Equipment
- Light Rail Operations Center and Transit Vehicle Equipment
- Commuter Rail Operations Center and Transit Vehicle Equipment
- Transit Center and Station Surveillance System Roadside Equipment and Transit Management Centers
- Transit Center and Station Surveillance System Roadside Equipment and Local Law Enforcement Agencies
- Transit Vehicle Equipment and User Personal Portable and Computing Devices
- Transit Management Centers and Local Law Enforcement Agencies
- Light Rail Operations Center and Local Law Enforcement Agencies
- Commuter Rail Operations Center and Local Law Enforcement Agencies

Technology Readiness   `Implementation`   `Development`
Technologies for safety/security monitoring and detection on-board of transit vehicles, at stops, park-and-ride lots, and major transit facilities are readily available and currently operational

Advanced vehicle safety technologies such as pedestrian and bicycle detection and warning systems, vehicle lateral safety detection and warning systems, etc. are currently in developmental stage.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Unit cost estimates for a security surveillance system are expected to range from $30,000 to $50,000 per site.

Needs and Objectives Addressed

<u>Need:</u>   APTS06 - Provide surveillance and enforcement on transit vehicles and transit facilities
               APTS13 - Provide collision avoidance assistance for transit vehicles
               APTS14 - Provide security at park and ride lots

<u>ITS Objectives:</u>   A-1-08 – Reduce number of crashes due to inappropriate lane departure, crossing and merging
               A-1-16 – Reduce number of crashes at intersections due to inappropriate crossing
               A-2-09 – Reduce number of fatalities due to inappropriate lane departure, crossing and merging
               A-2-17 – Reduce number of fatalities at intersections due to inappropriate crossing
               A-2-30 – Reduce number of injuries due to inappropriate lane departure, crossing and merging
               A-2-38 – Reduce number of injuries at intersections due to inappropriate crossing
               D-1-01 - Reduce on an annual basis the number of complaints per 1,000 boarding passengers
               D-1-02 - Increase the number of video monitoring cameras installed on platforms, park-n-ride lots, vehicles, and other transit facilities
               D-1-07 - Increase the number of critical sites with security monitoring

D-1-08 - Reduce the number of security incidents on transportation infrastructure

Agreement

Agreements are required between transit service provides and enforcement agencies.

ID: S30

Initiative: Transit Communications

Timeframe: Short to Long Term

Multimodal Transportation Objective: Critical Connections, Transportation Safety

ITS Service Area: Public Transportation

Type: Deployment

Description
This initiative will deploy communications technology and components to support the operations and connectivity of transit-related technologies and services. Example projects in this initiative include: wireless communications for vehicle diagnostic data, upgrades or enhancements of current radio communications, and deployment of multimodal communications networks for transit systems. Upgrades, expansion, and/or preservation of existing transit communications systems are also covered under this initiative.

Champion and Stakeholder
Champion: Metropolitan Council, Metro Transit, Suburban Transit Providers, Local Transit Agencies
Stakeholders: Greater Minnesota MPOs, Local Law Enforcement Agencies

Project Element
- Communications Equipment
- Metro Area Transit Management Centers
- Local Transit Management Centers
- Commuter Rail Operations Center
- Light Rail Operations Center
- Intercity Transit Management Centers
- Transit Vehicle Equipment
- Transit Center and Station Surveillance System Roadside Equipment
- Real-Time Transit Arrival Time Display Roadside Equipment
- Real-Time Transit Travel Time Display Roadside Equipment

Service Package
- PT01 – Transit Vehicle Tracking
- PT02 – Transit Fixed-Route Operations
- PT03 – Dynamic Transit Operations
- PT04 – Transit Fare Collection Management
- PT05 – Transit Security
- PT06 – Transit Fleet Management
- PT08 – Transit Traveler Information

Interconnect
This initiative supports multiple center-to-center, center-to-vehicle and center-to-infrastructure communications.

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Technology Readiness   <mark>Implementation</mark>
This initiative features technology that is readily available and currently operational.

Dependency
This initiative supports other transit initiatives that include communications components.

Cost Estimate
Costs will vary based on the scopes and technology implemented for individual agencies or projects.

Needs and Objectives Addressed

Need:
- APTS02 - Provide real-time transit vehicle arrival/departure information
- APTS06 - Provide surveillance and enforcement on transit vehicles and transit facilities
- APTS08 - Support vehicle diagnostics and maintenance
- APTS14 - Provide security at park and ride lots
- APTS20 - Provide real-time transfer information to travelers enroute
- APTS23 - Provide multi-communication mode hub/ infrastructure on buses to transmit/ receive high speed data in the most efficient and cost-effective manner

ITS Objectives:
- B-2-01 - Increase annual transit ridership
- B-2-02 - Increase annual express bus ridership
- C-3-06 - Increase average transit load factor
- C-3-14 - Increase the number of transit routes with information being provided by ATIS
- C-3-17 - Increase annual transit ridership reported by urbanized area transit providers
- C-3-18 - Increase annual transit ridership reported by rural area transit providers
- D-1-01 - Reduce on an annual basis the number of complaints per 1,000 boarding passengers
- D-1-02 - Increase the number of video monitoring cameras installed on platforms, park-n-ride lots, vehicles, and other transit facilities
- D-1-07 - Increase the number of critical sites with security monitoring
- D-1-08 - Reduce the number of security incidents on transportation infrastructure
- E-4-04 - Increase the rate at which equipment is utilized
- E-4-05 - Increase the percentage of fleet/equipment within its lifecycle
- E-4-06 - Increase the number of fleet vehicles with maintenance diagnostic equipment
- E-4-07 - Increase the number of vehicles operating under CAD
- G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning
- G-1-06 - Reduce operations cost deviation

Agreement
Agreements are not required for this initiative.

ID: S31

Initiative: Commercial Vehicle Mainline Sorting System

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: System Stewardship

ITS Service Area: Commercial Vehicle Operations

Type: Deployment

Description
This initiative will deploy mainline sorting systems to allow for real-time identification of trucks violating weight restrictions. MnDOT plans to deploy the first mainline sorting system at Clarks Grove. The mainline sorting system will include a weigh-in-motion (WIM) scale and other enhancements, such as weight enforcement equipment (e.g. video monitoring cameras) to improve enforcement. The mainline sorting system utilizes WIM on the mainline to screen vehicles traveling at highway speeds for weight compliance as they approach a weigh station, signaling vehicles either to bypass or pull-in to the station for further inspection. When used as part of an electronic screening or bypass system, WIM provides real-time weight verification concurrent with safety and credentials verification for bypass eligibility. Vehicles cleared for bypass are not generally directed to pull into the weigh station.

WIM significantly increases the capacity of weigh stations. In the absence of mainline WIM, queues may form and cause closure of weigh stations; as a result, compliance checks are not performed on the bypassed vehicles. WIM also reduces congestion within the fixed weigh station facility; focuses enforcement on high-risk operators, thereby increasing enforcement personnel's effectiveness; and provides time savings for safe and legal carriers, supporting more efficient movement of freight. The reduced number of trucks that idle and stop as they enter the weigh station queue to be weighed on the static scale also improves air quality.

This initiative also includes replacements, upgrades and enhancements of existing WIM stations.

Champion and Stakeholder
Champion: MnDOT OFCVO
Stakeholders: Minnesota State Patrol

Project Element
- Weigh-in-Motion Stations
- Commercial Vehicles

Service Package
- CVO03 – Electronic Clearance
- CVO08 – Smart Roadside and Virtual WIM

Interconnect
- Weigh-in-Motion Stations and in-vehicle equipment (Commercial Vehicles)
- MnDOT OFCVO and in-vehicle equipment (Commercial Vehicles)

Technology Readiness   **Implementation**

This initiative utilizes current technology already tested and proven through an operational test.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate

Capital costs and operations and maintenance costs have yet to be determined.

Needs and Objectives Addressed

Needs: CF02 - Provide mobile weight enforcement

                        CF03 - Target enforcement at locations with history of violations

ITS Objectives: E-2-06 - Reduce the frequency of delays at intermodal facilities

                        E-4-04 - Increase the rate at which equipment is utilized

                        F-1-02 - Decrease the number of size and weight violations

Agreement

Agreements are not required for this initiative.

ID: S32

Initiative: Virtual Weigh Stations

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: System Stewardship

ITS Service Area: Commercial Vehicle Operations

Type: Deployment

Description
This initiative will deploy Virtual Weigh-in-Motion (WIM) Stations to allow for real-time identification of trucks violating weight restrictions using a weigh-in-motion (WIM) scale and other enhancements, such as weight enforcement equipment (e.g. video monitoring cameras) to improve enforcement. Replacements, upgrades and enhancements of current virtual WIM stations are also covered in this initiative.

Virtual WIM sites will flag potential violators for enforcement officers to perform further checks. Virtual WIM sites can either act as standalone WIM sites or be connected to a central operating network. Virtual WIM Stations will also investigate the use of a dynamic feedback system that will present a weight compliance message to vehicles immediately after they have passed over a WIM scale.

Champion and Stakeholder
Champion: MnDOT OFCVO
Stakeholders: Minnesota State Patrol

Project Element
- Virtual Weigh Stations
- Commercial Vehicles

Service Package
- CVO03 – Electronic Clearance
- CVO08 – Smart Roadside and Virtual WIM

Interconnect
- Virtual WIM Stations and in-vehicle equipment (Commercial Vehicles)
- MnDOT OFCVO and in-vehicle equipment (Commercial Vehicles)

Technology Readiness **Implementation**
This initiative utilizes current technology already tested and proven through an operational test.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Capital costs and operations and maintenance costs have yet to be determined.

Needs and Objectives Addressed

Needs: CF02 - Provide mobile weight enforcement
                   CF03 - Target enforcement at locations with history of violations
ITS Objectives: E-2-06 - Reduce the frequency of delays at intermodal facilities
                   E-4-04 - Increase the rate at which equipment is utilized
                   F-1-02 - Decrease the number of size and weight violations

Agreement

Agreements are not required for this initiative.

ID: S33

Initiative: Congestion Reduction in Major Freight Bottlenecks

Timeframe: Short Term – Years 1-3

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Commercial Vehicle Operations

Type: Deployment

Description
This is a program led by the Federal Highway Administration (FHWA) which aims to reduce freight traffic "bottleneck" congestion at major urban highway interchanges throughout the country. Bottlenecks are defined as localized sections of highways that experience reduced travel speeds and inherent delays due to recurring operational influences or nonrecurring impacting events. An initial assessment of freight bottlenecks concluded in 2005 that the FHWA should work closely with states, metropolitan planning organizations, and the trucking industry to monitor truck delay at urban Interstate interchange bottlenecks with heavy amounts of freight traffic.

The FHWA defined eight highway interchange bottlenecks in the Minneapolis-St. Paul metro area located at the following interchanges: I-35W & SR 62, I-35W & I-494, I-394 & I-494, I-94 & I-35E, US 169 & I-394, I-35E & TH 36, I-394 & TH 100, and SR 100 & I-394.

MnDOT will work the FHWA to monitor these bottlenecks and focus future Federal highway improvement and operations programs in these areas. ITS-related efforts that could assist in the reduction of freight congestion at these locations include the dissemination of congestion information at these locations via Dynamic Message Signs (DMS) and 511 traveler information systems. Other alternatives include improving communications between the MnDOT RTMC and Private Fleet and Freight Management Centers that provide route plans to Commercial Vehicles approaching the bottleneck areas.

Champion and Stakeholder
Champion: FHWA
Stakeholders: MnDOT, Metropolitan Council, Private Trucking Companies

Project Element
- Traffic Detector Roadside Equipment
- Video Monitoring Roadside Equipment
- Dynamic Message Sign Roadside Equipment
- Highway Advisory Radio Roadside Equipment
- Ramp Meter Roadside Equipment
- Minneapolis TMC
- RTMC
- Metro Area Transit Management Centers
- MnPASS Roadside Equipment
- MnPASS Service Center

Service Package
- CVO01 – Carrier Operations and Fleet Management
- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information
- TM06 – Traffic Information Dissemination

Interconnect
- Roadside equipment and RTMC
- Roadside equipment and Minneapolis TMC
- MnPASS roadside equipment and MnPASS Service Center
- RTMC and Minneapolis TMC
- RTMC and metro area transit management centers
- Minneapolis TMC and metro area transit management centers

Technology Readiness   `Implementation`
This initiative utilizes current technology already deployed.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Capital costs and operations and maintenance costs will vary depending on the bottleneck improvements that are made.

Needs and Objectives Addressed

<u>Need:</u>   CF14 - Direct commercial vehicle operators to the quickest route/time of travel

<u>ITS Objectives:</u>   C-3-12 - Increase number of visitors to traveler information website per year

E-1-03 - Decrease the annual average travel time index for selected freight-significant highways

E-1-04 - Decrease point-to-point travel times on selected freight-significant highways

E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on selected freight-significant highways

Agreement
This initiative requires a Memorandum of Understanding between MnDOT, City of Minneapolis, Hennepin County, FHWA, and Metro Transit.

ID: S34

Initiative: Enhance Automated Permit Routing System

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, System Stewardship

ITS Service Area: Commercial Vehicle Operations

Type: Deployment

Description
MnDOT uses two online systems implemented in the 1990s to issue and manage permits for oversize/overweight (OS/OW) freight and motor carrier credentials:

- RouteBuilder, an OS/OW permitting system with a routing component.
- Motor Carrier Information System (MCIS), which processes and tracks motor carrier credentials, operating authority and associated transactions. MCIS also tracks enforcement cases and hazardous materials incidents.

This initiative will implement new online systems that will replace these outdated systems. MnDOT OFCVO is currently developing a scope of work to design and implement new online systems.

Champion and Stakeholder
Champion: MnDOT OFCVO
Stakeholders: Minnesota State Patrol

Project Element
- Automated Permit Routing System
- Condition Acquisition and Reporting System (CARS)
- Private Fleet and Freight Management Center

Service Package
- CVO01 – Carrier Operations and Fleet Management

Interconnect
- Automated Permit Routing System and CARS
- Automated Permit Routing System and Private Fleet and Freight Management Center

Technology Readiness   Implementation
This initiative utilizes technology that is currently being used. This enhancement would require the integration of real time route information data from CARS to the Automated Permit Routing System and an enhancement of CARS data to provide useful data to the commercial vehicle subset of users.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Capital costs and operations and maintenance costs have yet to be determined.

Needs and Objectives Addressed

Need: CF12 – Permit and route commercial vehicle operators of oversize and overweight loads to routes that accommodate size and weight requirements

ITS Objectives: C-3-12 - Increase number of visitors to traveler information website per year

E-1-03 - Decrease the annual average travel time index for selected freight-significant highways

E-1-04 - Decrease point-to-point travel times on selected freight-significant highways

E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on selected freight-significant highways

E-2-02 - Increase the percent (or number) of freight shipment tracked

F-1-02 - Decrease the number of size and weight violations

Agreement
Agreements are not required for this initiative.

ID: S35

Initiative: CVO Database and CARS Database Enhancement

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, System Stewardship

ITS Service Area: Traveler Information, Commercial Vehicle Operations

Type: Deployment

Description
This initiative will automate the data entry into CVO oversize/overweight (OS/OW) Online Permitting System to allow for the provision of real time data. MnDOT will provide commercial vehicle operators, fleet managers, and service providers with information on commercial vehicle permit restrictions through the 511 Traveler Information website and the CVO OS/OW Online Permitting System. This will allow commercial vehicle operators and fleet managers to route shipments along appropriate routes.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Commercial Vehicles, Private Fleet and Freight Management Centers, Private Information Service Providers

Project Element
- Automated Permit Routing System
- 511 Traveler Information Website
- CARS
- Commercial Vehicles
- Private Fleet and Freight Management Center
- Private Information Service Providers

Service Package
- TI01 – Broadcast Traveler Information
- CVO01 – Carrier Operations and Fleet Management

Interconnect
- Automated Permit Routing System and CARS/511 Traveler Information Website
- Automated Permit Routing System and Private Fleet and Freight Management Center
- Private Fleet and Freight Management Center and 511 Traveler Information Website
- Private Information Service Providers and 511 Traveler Information Website
- Private Fleet and Freight Management Center and Commercial Vehicles

Technology Readiness **Implementation**
511 Traveler Information Website and Minnesota CVO OS/OW Online Permitting System are already available via the MnDOT website. Technology for automating data entry for providing real-time data is readily available.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been identified.

Needs and Objectives Addressed
Need: ATIS09 - Provide information on CVO permit restrictions
ITS Objectives: C-3-12 - Increase number of visitors to traveler information website per year
                       C-3-13 - Increase number of users of notifications for traveler information
                                    (e.g., e-mail, text message)
                       E-1-03 - Decrease the annual average travel time index for selected freight-
                                    significant highways
                       E-1-04 - Decrease point-to-point travel times on selected freight-significant
                                    highways
                       E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on
                                    selected freight-significant highways

Agreement
Agreements are not required for this initiative.

ID: S36

Initiative: ATIS for CVO Enhancements

Timeframe: Short to Long Term

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Commercial Vehicle Operations, Traveler Information

Type: Deployment

Description
This initiative will extend real-time traveler information to commercial vehicles. MnDOT 511 has a Truckers' page that provide tailored information specific to commercial vehicle drivers. This information includes weight/height restrictions, construction zone and detour information, weather information, and real-time traffic congestion information. This initiative will continue expanding features of the Truckers' page to include parking availability in rest areas and additional enhancements to the page.

Champion and Stakeholder
Champion: MnDOT

Project Element
- 511 Traveler Information Website
- CARS
- Parking Management System
- Private Fleet and Freight Management Center
- Commercial Vehicles

Service Package
- CVO01 – Carrier Operations and Fleet Management
- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information

Interconnect
- 511 Traveler Information Website and CARS
- Parking Management System and CARS
- Private Fleet and Freight Management Center and Commercial Vehicles

Technology Readiness   `Implementation`
This initiative is an enhancement and expansion of existing technologies.

Dependency
This initiative can build upon Initiative S05: Rest Area Truck Parking Availability.

Cost Estimate
The development/enhancement cost ranges roughly between $15,000 and $50,000, depending on the features and functionalities desired for the end product.

Needs and Objectives Addressed

Need: CF14 - Direct commercial vehicle operators to the quickest route/time of travel

ITS Objectives: C-3-12 - Increase number of visitors to traveler information website per year

                       E-1-03 - Decrease the annual average travel time index for selected freight-significant highways

                       E-1-04 - Decrease point-to-point travel times on selected freight-significant highways

                       E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on selected freight-significant highways

Agreement

Agreements are not required for this initiative.

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ID: S37

Initiative: Multi-State OS/OW Permitting System

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, System Stewardship

ITS Service Area: Commercial Vehicle Operation

Type: Deployment

Description
This initiative will integrate the Minnesota Oversize/Overweight (OS/OW) permitting system with those of neighboring states so that commercial vehicle operators can obtain OS/OW permits from multiple states with one application. A permit application portal with Wisconsin DOT, WINNDOT Portal) was developed that allows one carrier application to be sent to each state's permit system. The new online permit routing system (Initiative S34) will likely expand the multi-state permitting to include other neighboring states.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Neighboring States

Project Element
- Commercial Vehicle Administration Center
- Private Fleet and Freight Management Center
- Neighboring State Traffic Management Centers

Service Package
- CVO04 – CV Administrative Processes

Interconnect
- Commercial Vehicle Administration Center and Neighboring State Traffic Management Centers
- Commercial Vehicle Administration Center and Private Fleet and Freight Management Center

Technology Readiness   `Implementation`
Integration of OS/OW permitting system with other states will require coordination with neighboring states so that commercial vehicle operators obtain an OS/OW permit in a consistent manner across states. Technology currently used for issuing OS/OW permits is anticipated to be utilized for this initiative and is readily available.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been identified.

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Needs and Objectives Addressed

Need: CF18 - Provide multi-state oversize/overweight permitting

ITS Objectives: E-2-02 - Increase the percent (or number) of freight shipment tracked
                      E-2-05 - Increase the number of automated permits/credentials issued
                      F-1-02 - Decrease the number of size and weight violations

Agreement

Agreements between states regarding the integration of systems that provide OS/OW permits may be required for this initiative.

ID: S38

Initiative: Emergency Responder Database

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Public Safety, Data Management

Type: Deployment

Description
This initiative aims to coordinate emergency responder databases (i.e. Minnesota State Patrol, Local Law Enforcement, Local EMS Agencies, etc.) to create an online database to route on-the-scene incident data, road condition, or other data through a single dispatch center or system for processing. The initiative area would include the seven-county metro area and 10 out-state counties.

The coordination of emergency responder databases could be a further evolution of the Minnesota State Ambulance Report System (MNSTAR) – a web-based, statewide data system that went online April 1, 2003 that gives Minnesota's 256 agencies the flexibility to collect their own data and Mn Track, a victim tracking system used by emergency responders. Additional research is needed to identify if similar activities are being implemented in other parts of the country.

Such coordination would allow the seamless sharing of consistent information on crash and victim details to facilitate better emergency response and care. A single dispatch center would act on the information request by dispatching the proper emergency personnel to a traffic incident. Road and weather conditions data may also be uploaded to a central source and disseminated via various means from the center. Improved incident clearance will allow for better traffic flow/mobility.

Champion and Stakeholder
Champion: Minnesota EMSRB (Emergency Medical Services Regulatory Board)
Stakeholders: Minnesota DPS, MSP, local emergency management, local emergency responders, Minnesota State Fire Chiefs Association, Minnesota Ambulance Association, Minnesota Chiefs of Police Association, Chief of Police, MnDOT

Project Element
- 911Dispatch Center
- County Emergency Operations Centers
- Minnesota State Emergency Operations Center (SEOC)
- Minnesota State Patrol Databases
- Minnesota Emergency Responder Database

Service Package
- PS01 – Emergency Call-Taking and Dispatch
- DM01 – ITS Data Warehouse

Interconnect
- 911 Dispatch Center and County Emergency Operations Centers
- 911 Dispatch Center and Minnesota SEOC
- 911 Dispatch Center and Minnesota State Patrol Databases
- County Emergency Operations Centers and Minnesota State Patrol Databases
- Minnesota SEOC and Minnesota State Patrol Databases

Technology Readiness   `Implementation`
This initiative will require software and hardware applications that are readily available from vendors to coordinate information entered into separate databases. The published set of ITS standards IEEE 1512 -2006 - Standard for Common Incident Management Message Sets for use by Emergency Management Centers – allow for the efficient sharing of information between agencies that participate in incident response.

Dependency
This initiative is dependent upon additional research into similar database coordination efforts in other parts of the country and upon continued discussions with the Minnesota EMSRB and Minnesota Department of Health.

Cost Estimate
Total costs have been estimated at $12,000,000.

Needs and Objectives Addressed
Need: PSFT01 - Provide CAD to CAD integration for multi-agency coordination at major incidents
ITS Objectives: B-1-15 - Reduce mean incident notification time
                 B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification
                 B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents

Agreement
This coordination of emergency responder databases will require working Memorandums of Understanding between all agencies involved in the initiative, such as Minnesota State Patrol, Local Law Enforcement, and local emergency management agencies that are independently collecting incident information. These agreements must have language to comply with privacy laws.

ID: S39

Initiative: Enhance Routing of Emergency Vehicles

Timeframe: Short Term – Years 1-4

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Public Safety

Type: Deployment

Description
This initiative will provide roadway monitoring to incident/emergency dispatch centers and responders. This real-time video data will allow dispatcher to view potential routes to the site of an emergency or incident and direct response vehicles along a route with minimal obstacles to arrive at the site quickly, thereby reducing response time.

The first step of this initiative will focus on the metro area by providing all metro area roadway monitoring videos to MnDOT FIRST (Freeway Incident Response Safety Team), MSP, and other dispatch centers and emergency responders. FIRST and some dispatchers already use camera feeds from MnDOT RTMC to assist with routing to incidents on metro freeways. As cameras are added along freeway system to provide full coverage, this video data will be provided to FIRST and other dispatch centers. Video monitoring from other metro area cities will be provided to responders to provide dynamic routing information along arterials.

The next phase of this initiative will expand this shared video monitoring to areas of greater Minnesota. This initiative will also provide RTMC roadway monitoring videos to local and regional dispatch centers and emergency responders in greater Minnesota.

Champion and Stakeholder
Champion: MSP
Stakeholders: MSP, Metro area 911 dispatch centers, local and regional emergency response dispatch centers, local emergency response agencies, MnDOT RTMC

Project Element
- Video Monitoring Roadside Equipment
- 911 Dispatch Centers
- Emergency Vehicle Equipment
- FIRST Emergency Vehicles
- RTMC

Service Package
- PS02 – Routing Support for Emergency Responders
- TM08 – Traffic Incident Management System

Interconnect
- Video Monitoring Roadside Equipment and RTMC
- RTMC and 911 Dispatch Centers
- 911 Dispatch Centers and Emergency Vehicle Equipment
- RTMC and FIRST Emergency Vehicles

Technology Readiness   <mark>Implementation</mark>
This initiative utilizes technology already deployed or soon to be deployed in the initiative area. This initiative will require coordination between MnDOT RTMC, MSP, and local and regional emergency responders. ITS Standards that are applicable for this data sharing include: NTCIP C2C: NTCIP Center-to-Center Standards Group and ITE TMDD 2.1: Traffic Management Data Dictionary and Message Sets for External TMC Communication (TMDD and MS/ETMCC).

Dependency
This initiative depends on deployment of video monitoring cameras along roadways.

Cost Estimate
The estimated unit cost per workstation for adding hardware, range between $8,000 and $10,000. The annual O&M estimated cost is estimated at 2% of the estimated cost.

Video and monitoring software estimated cost range between $10,000 and $20,000. The annual O&M estimated cost is $3,300.

Unit cost estimates for video monitoring cameras with pan/tilt capabilities range between $10,000 and $20,000. The annual O&M cost is estimated at $1,800 per camera.

Needs and Objectives Addressed
Need: PSFT02 - Provide dynamic routing of emergency vehicles
ITS Objectives: B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification
                        B-1-17 - Reduce mean incident clearance time per incident
                        B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Agreement
This initiative will require agreements between MnDOT and participating local emergency response agencies over transmission and use of video data.

ID: S40

Initiative: Expand Deployment of Mobile Data Computers for
Emergency Responders

Timeframe: Short to Medium Term

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open
Decision-Making

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Public Safety

Type: Deployment

Description
Emergency response agencies that do not have mobile data computers will install equipment in their vehicles and integrate it with databases. These data computers allow responders to access information in a central database and to transmit and receive data to a dispatch center. This enhances the flow of information between responders and dispatch centers, improving response effectiveness.

Champion and Stakeholder
Champion: Minnesota State Patrol
Stakeholders: Minnesota State Patrol, Local Emergency Response Agencies, MnDOT

Project Element
- Emergency Vehicle Equipment
- 911 Dispatch Center
- Minnesota State Patrol District Office

Service Package
- PS01 – Emergency Call-Taking and Dispatch
- PS02 – Routing Support for Emergency Responders

Interconnect
- 911 Dispatch Center and Emergency Vehicle Equipment
- Minnesota State Patrol District Office and Emergency Vehicle Equipment

Technology Readiness　　`Implementation`
This initiative utilizes technology that is proven and readily available.

Dependency
This initiative is not dependent upon any other initiatives. It could be deployed in conjunction with M32 – AVL Systems for Local Emergency Responders. It could also support S39 – Enhance Routing of Emergency Vehicles.

Cost Estimate
The estimated cost for a mobile data computer ranges from $1,000 to $3,000 per unit.

Needs and Objectives Addressed

Need: PSFT08 - Provide mobile data computers in emergency vehicles to provide real-time information

ITS Objectives: B-1-15 - Reduce mean incident notification time

                     B-1-17 - Reduce mean incident clearance time per incident

                     C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection / response

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency

TSMO Objective: Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Agreement

Agreements are not required for this initiative.

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ID: S41

Initiative: Critical Infrastructure Monitoring

Timeframe: Short Term – Years 3-4

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Public Safety

Type: Deployment

Description
This initiative will implement threat detection, video monitoring, and emergency alert systems at critical infrastructure areas (bridges, ports, tunnels, etc.) throughout the state. Critical infrastructure has previously been identified but the specific locations for this initiative have yet to be determined. Monitoring cameras and threat sensors will monitor critical facilities and when suspicious activity or objects in restricted areas detected an alert will automatically be sent to RTMC and emergency management personnel.

Champion and Stakeholder
Champion: Minnesota Homeland Security and Emergency Management
Stakeholders: MnDOT, MSP, local emergency management agencies, local emergency response agencies

Project Element
- Security Monitoring Roadside Equipment
- RTMC
- 911 Dispatch Centers

Service Package
- PS09 – Transportation Infrastructure Protection
- PS11 – Early Warning System

Interconnect
- Video Monitoring Roadside Equipment and RTMC
- RTMC and 911 Dispatch Centers

Technology Readiness   `Implementation`
This monitoring and automated alert technology is readily available from various vendors. An application of this type of security is currently operated by MnDOT District 1 and Minnesota State Patrol.

Dependency
This initiative is not dependent upon any other initiatives.

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Cost Estimate
The deployment cost depends largely on the number, location, and types of features chosen for the Critical Infrastructure Monitoring system. Infrastructure monitoring systems can range from $150,000 to $250,000 per infrastructure facility for hardware, software, installation, and integration.

Needs and Objectives Addressed
Need: PSFT04 - Provide technology to monitor transportation infrastructure
ITS Objectives: B-1-17 - Reduce mean incident clearance time per incident
                  B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents
                  D-1-02 - Increase the number of video monitoring cameras installed on platforms, park-n-ride lots, vehicles, and other transit facilities
                  D-1-03 - Increase customer service and personal safety ratings
                  D-1-04 - Reduce the number of reported personal safety incidents
                  D-1-05 - Decrease the number of security incidents on roadways
                  D-1-07 - Increase the number of critical sites with security monitoring
                  D-1-08 - Reduce the number of security incidents on transportation infrastructure
                  D-1-09 - Increase the number of critical sites with hardened security enhancements

Agreement
Agreements are not required for this initiative.

ID: S42

Initiative: Use Preemption on Vehicle Radios to Provide Real-Time Information

Timeframe: Short Term

Multimodal Transportation Objective:

SHSP Focus Area: Intersections, Inattentive Drivers, Train Involved, Work Zones

ITS Service Area: Public Safety

Type: Operational Test, Policy/Legislation

Description
Real-time information related to road emergencies could be delivered to drivers by preempting radio broadcasts or through Radio Data Systems (RDS) messages. The RDS can enhance driving safety because it lets the driver pay attention to the road instead of to the radio controls. A listener who is traveling or commuting in a vehicle can arrange to have special traffic bulletins break into programs automatically, even if the traffic information is broadcast by a station other than the one the listener is tuned to at the moment.

The RDS receiver can also be set to display brief text messages from broadcasters, and to periodically re-set the car clock to show the exact time. This initiative will require actions to explore the parameters of existing PSA requirements for radio broadcasters, gather information regarding preemption delivery methods used in other countries, identify what type of information may be provided (i.e., road conditions, work zone information, etc.), assess the quality (i.e., consistency, accuracy, reliability, etc.) of information that may be provided, determine if and when information will be provided for all, most or some public roads, and propose the delivery of information to radio broadcasters to gauge their interest.

There may be implications to public service announcement (PSA) requirements for radio broadcasters. If existing emergency broadcast preemption is used as the delivery method for this preemption, there may be some implications to current rules governing emergency broadcasts. Some institutional issues need to be considered include that delivery of information will be dependent upon radio broadcasters, radio broadcasters may interpret this as a loss in air time that could impact their advertising, programming and revenue, accurate information will be necessary to ensure reliability, maintaining information accuracy or quality will have staffing implications, and providing information on all, most or some public roads will have to be decided as this will impact city, county and state staff.

Champion and Stakeholder
Champion: MnDOT State Traffic Engineer
Stakeholders: Minnesota Homeland Security and Emergency Management, Private Information Service Providers (Radio Broadcasters), Federal Communications Commission, Local Agencies

Project Element
- CARS
- Minnesota Emergency Alert System
- Minnesota State Emergency Operations Center
- County Emergency Operations Centers

- Vehicle
- Private Information Service Providers
- Media Outlets

Service Package
- PS10 – Wide-Area Alert
- TI01 – Broadcast Traveler Information

Interconnect
- CARS and Private Information Service Providers
- CARS and Media Outlets
- Minnesota Emergency Alert System and Private Information Service Providers
- Minnesota Emergency Alert System and Media Outlets
- Minnesota State Emergency Operations Center and Private Information Service Providers
- Minnesota State Emergency Operations Center and Media Outlets
- County Emergency Operations Centers and Private Information Service Providers
- County Emergency Operations Centers and Media Outlets
- Private Information Service Providers and Vehicle
- Media Outlets and Vehicle

Technology Readiness   Implementation

This initiative is an expansion of existing technologies.

Dependency

No cost estimate provided for equipment costs.

Cost Estimate

Total costs have not been estimated given the nature of the initiative.

Needs and Objectives Addressed

Need: CEA 5 – Increasing Driver Safety Awareness and Improving Information Systems

ITS Objectives: A-1-14 - Reduce number of crashes related to driver inattention and distraction

A-2-15 - Reduce number of fatalities related to driver inattention and distraction

A-2-36 - Reduce number of injuries related to driver inattention and distraction

Agreement

Agreements required for this initiative have not been identified.

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ID: S43

Initiative: Automated Field Reporting System Deployments and
Enhancements for MSP and Local Law Enforcement

Timeframe: Short to Medium Term

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: EMS Response & Trauma Systems, Management Systems

ITS Service Area: Public Safety, Data Management

Type: Deployment

Description
This initiative will deploy automated field reporting system that ties in license swipe technology, automated filling of report fields, and DUI/DWI automated reporting. These systems would automatically fill in some of the fields that law enforcement personnel have to fill in on multiple reports that are necessary at incidents. This automation will save them time on filling out multiple reports and reduce their exposure to traffic at incidents.

Champion and Stakeholder
Champion: MSP
Stakeholders: MSP, Local Law Enforcement Agencies

Project Element
- Minnesota State Patrol District Office
- 911 Dispatch Center
- County Sheriff and City Police Offices
- Minnesota State Patrol Database
- Minnesota Emergency Responder Database

Service Package
- DM01 – ITS Data Warehouse

Interconnect
- Minnesota State Patrol District Office and Minnesota State Patrol Database
- 911 Dispatch Center and Minnesota Emergency Responder Database
- County Sheriff and City Police Offices and Minnesota Emergency Responder Database

Technology Readiness   <mark>Implementation</mark>
This initiative utilizes technology that is readily available.

Dependency
This initiative is dependent upon the Rapid Incident Clearance Initiative that is currently underway.

Cost Estimate
Costs associated with this initiative have not been identified.

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Needs and Objectives Addressed
Need: PSFT12 - Implement automated field reporting system
ITS Objectives: B-1-17 - Reduce mean incident clearance time per incident
                  B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway
                           incidents

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                   Increase Safety
TSMO Objectives: Reduce incident response and clearance times in the Twin Cities and
                       Greater Minnesota
                   Reduce responder exposure

Agreement
Agreements are not required for this initiative.

ID: S44

Initiative: DVR to Review Central Images during an Incident

Timeframe: Short Term

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Data Management

ITS Service Area: Public Safety, Data Management

Type: Deployment

Description
This initiative will integrate digital video recorder (DVR) technology into MSP dispatch center, RTMC, and vehicles to allow personnel to review camera images captured at and near incident scenes. Emergency responders and dispatchers will use DVR to review camera images during an incident to verify events at incident sites and make decisions to better respond to an incident.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MSP

Project Element
- RTMC
- Minnesota State Patrol District Office
- 911 Dispatch Center
- Video Monitoring Roadside Equipment
- Minnesota State Patrol Database
- Minnesota Emergency Responder Database

Service Package
- PS01 – Emergency Call-Taking and Dispatch
- PS12 – Disaster Response and Recovery
- DM01 – ITS Data Warehouse

Interconnect
- Video Monitoring Roadside Equipment and RTMC
- RTMC and Minnesota State Patrol District Office
- RTMC and 911 Dispatch Center
- Minnesota State Patrol District Office and 911 Dispatch Center
- Minnesota State Patrol District Office and Minnesota State Patrol Database
- 911 Dispatch Center and Minnesota Emergency Response Database

Technology Readiness   `Implementation`
This initiative is an expansion of a current deployment and utilizes technology that has already been deployed and is readily available.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been identified.

Needs and Objectives Addressed
Need: PSFT13 - Provide Real-time Digital Video Recordings (DVR)
ITS Objective: B-1-15 - Reduce mean incident notification time

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce incident response and clearance times in the Twin Cities and
                        Greater Minnesota

Agreement
Agreements are not required for this initiative.

ID: S45

Initiative: AVL for MnDOT Maintenance and Other Fleet Vehicles

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: System Stewardship, Transportation Safety

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will install or upgrade AVL technology in maintenance vehicles in order to fully maximize available resources during snowfall and icy conditions. This initiative can be expanded to include all other MnDOT vehicle fleet to allow for tracking agency-wide sustainability goals. Fleet management systems at a regional control center will allow maintenance managers to better deploy and manage their fleet and resources. AVL technology will also improve traffic flow by reducing the number of crashes that would otherwise occur. This initiative can be coordinated with MnDOT's involvement in the Maintenance Decision Support System (MDSS) – an initiative to develop a prototype predictive tool using a variety of weather and maintenance inputs to recommend most effective treatment and timing.

MnDOT has equipped AVL technology on maintenance vehicles in different districts throughout the state. This initiative will focus on deploying AVL on additional maintenance and other MnDOT fleet vehicles statewide as well as replacing or upgrading AVL equipment. This initiative will meet a highly prioritized need identified in the Maintenance and Construction stakeholder meeting – Track locations of maintenance fleet and personnel and usage of materials.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Travelers

Project Element
- Maintenance and Construction Vehicle Equipment
- Maintenance and Construction Management Center
- Condition Acquisition and Reporting System (CARS)
- RTMC

Service Package
- MC01 – Maintenance and Construction Vehicle and Equipment Tracking
- MC04 – Winter Maintenance

Interconnect
- Maintenance and construction vehicle equipment and maintenance and construction management centers.
- Maintenance and construction management centers and CARS
- Maintenance and construction management centers and RTMC

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Technology Readiness <mark>Implementation</mark>

This initiative is an expansion of a current deployment and utilizes technology that has already been deployed and is readily available.

Dependency

This initiative could be implemented in conjunction with Initiative S47 – Expand Maintenance and Decision Support System (MDSS) Deployment. This initiative will support the implementation of Initiative S46 – Roadway Condition and Environmental Sensors on Maintenance Vehicles for Traveler Information.

Cost Estimate

AVL vehicle hardware can range from $500 to $4,000 per vehicle, depending on the amount of auxiliary equipment and sensors are included in the system. This cost does not include operations and maintenance.

Needs and Objectives Addressed

Need: MCM01 - Track locations of maintenance fleet and personnel and usage of
                       materials
ITS Objectives: E-4-01 - Increase the number of ITS-related assets tracked
                  E-4-07 - Increase the number of vehicles operating under CAD
                  H-1-04 - Reduce MnDOT fleet gasoline use
                  H-1-05 - Reduce MnDOT fleet diesel use

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                  Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the impacts of snow and ice on mobility
                  Acquire, secure, and retain the data needed for MnDOT to effectively
                      perform operations, performance management and planning

Agreement

Agreements are not required for this initiative.

ID: S46

Initiative: Roadway Condition and Environmental Sensors on Maintenance Vehicles for Traveler Information

Timeframe: Short Term

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Intersections, Lane Departure

ITS Service Area: Maintenance and Construction, Traveler Information

Type: Deployment

Description
MnDOT currently has over 600 maintenance vehicles equipped with sensors to collect pavement and environmental conditions. This initiative will equip the remaining maintenance vehicles with sensors to monitor pavement surface and other environmental conditions. Dash cams have also been installed on selected snow plows. The installation of dash cams to additional snow plows are on-going. Data collected from the sensors is fed to the Maintenance Decision Support System (MDSS) to assist in decisions on scheduling of maintenance vehicle activity during inclement weather conditions. Data is also integrated with RWIS data, entered into CARS, and made available to the public via the 511 Traveler Information Website and the 511 app. Images captured by the snow plow dash cams are also made available to the public via the 511 Traveler Information Website and the 511 app.

Champion and Stakeholder
MnDOT

Project Element
- Maintenance and Construction Vehicle Equipment
- Maintenance and Construction Management Center
- Condition Acquisition and Reporting System (CARS)
- 511 Traveler Information Website
- RTMC

Service Package
- WX01 – Weather Data Collection
- WX02 – Weather Information Processing and Distribution
- TI01 – Broadcast Traveler Information

Interconnect
- Maintenance and construction vehicle equipment and maintenance and construction management centers.
- Maintenance and construction management centers and CARS
- Maintenance and construction management centers and RTMC
- CARS and 511 Traveler Information Website

Technology Readiness   `Implementation`

This initiative utilizes technology that has already been deployed and is readily available.

Dependency

This initiative could be implemented in conjunction with Initiative S45 – AVL for MnDOT Maintenance Vehicles. This initiative could also be implemented in conjunction with Initiative S47 – Expand Maintenance and Decision Support System (MDSS) Deployment.

Cost Estimate

Unit cost estimates for pavement and air temperature sensors range from $800 to $1,200. Unit cost estimates for dash cams range from $200 to $800. Costs associated with installation, integration, operations and maintenance are not included in the estimates.

Needs and Objectives Addressed

Need: WTR01 - Provide automated monitoring of road weather conditions
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                      A-2-03 - Reduce number of fatalities due to road weather conditions
                      A-2-24 - Reduce number of injuries due to road weather conditions
                      C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.
                      C-3-12 - Increase number of visitors to traveler information website per year

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                      Increase Safety
                      Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the impacts of snow and ice on mobility
                      Reduce the frequency of crashes related to road weather conditions
                      Acquire, secure, and retain the data needed for MnDOT to effectively perform operations, performance management and planning

Agreement

Agreements are not required for this initiative.

ID: S47

Initiative: Expand Maintenance and Decision Support System (MDSS) Deployment

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Lane Departure

ITS Service Area: Maintenance and Construction

Type: Deployment

Description

The Maintenance Decision Support System (MDSS) serves MnDOT maintenance staff as a decision support tool that provides maintenance staff with an optimal maintenance plan based on real-time weather and roadway conditions. Combined with information on maintenance vehicle resources (i.e. salt, sand, etc.), MDSS recommends appropriate roadway maintenance treatments.

MDSS assimilates data on road surface conditions from RWIS stations and on-board vehicle sensors to report pavement temperatures. It also allows for field staff observations on road visibility to be factored into the MDSS recommendation for appropriate maintenance treatments. With all sources of information taken into account, MDSS offers users various treatment options, such as "optimal" treatments – where travel safety is prioritized higher than treatment costs – and "what-if" treatments – where the effects of several maintenance actions on overall resources can be understood by the system user before recommending certain actions.

This initiative will continue expanding the use of MDSS throughout MnDOT districts. The deployment of MDSS could be in coordination with Initiative S45 – AVL for MnDOT Maintenance Vehicles which will deploy AVL equipment on additional MnDOT maintenance vehicles statewide as well as Initiative S46 – Roadway Condition and Environmental Sensors on Maintenance Vehicles for Traveler Information.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Travelers

Project Element
- Maintenance Decision Support System (MDSS)
- Maintenance Vehicle Equipment
- Maintenance and Construction Management Center
- RTMC

Service Package
- MC04 – Winter Maintenance

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Interconnect

- Automated treatment systems include interconnects between roadside detection equipment and roadside treatment equipment
- They also include interconnects between roadside equipment and RTMC/local MCM centers.

Technology Readiness   <mark>Implementation</mark>

The software applications and communications technology have been implemented and operational.

Dependency

This initiative could be coordinated with Initiatives S45 – AVL for MnDOT Maintenance Vehicles and S46 – Roadway Condition and Environmental Sensors on Maintenance Vehicles for Traveler Information.

Cost Estimate

The cost for MDSS deployment is to be determined. MnDOT has contributed $250,000 toward the development of MDSS through a pooled fund study effort. Estimated average cost per vehicle is $2500 for MDSS and AVL.

Needs and Objectives Addressed

Need: MCM07 - Provide maintenance decision support
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                  A-2-03 - Reduce number of fatalities due to road weather conditions
                  A-2-24 - Reduce number of injuries due to road weather conditions
                  H-1-04 - Reduce MnDOT fleet gasoline use
                  H-1-05 - Reduce MnDOT fleet diesel use

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                  Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the impacts of snow and ice on mobility
                  Reduce the frequency of crashes related to road weather conditions
                  Acquire, secure, and retain the data needed for MnDOT to effectively
                      perform operations, performance management and planning

Agreement

Interagency agreements between district offices may be required to ensure consistent operation and maintenance of equipment.

ID: S48

Initiative: Dynamic Speed in Work Zones to Advise Drivers

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Speed-Related, Work Zones

ITS Service Area: Maintenance and Construction, Traffic Management

Type: Deployment

Description

This initiative will deploy dynamic advisory speed systems in advance of work zones to provide smooth traffic flow through the work zones. MnDOT Construction and Maintenance and local agencies advise drivers on the actual speed ahead to safely travel through a work zone.

The purpose of the initiative is to make drivers aware of the traveling speeds ahead compared to the posted speed limit. Locations for further system deployment have yet to be determined.

Champion and Stakeholder

Champion: MnDOT (Construction), Local Agencies

Project Element

- Dynamic Message Sign Roadside Equipment
- Speed Monitoring Roadside Equipment

Service Package

- TM17 – Speed Warning and Enforcement
- MC06 – Work Zone Management

Interconnect

- Speed Monitoring Roadside Equipment and Dynamic Message Sign Roadside Equipment

Technology Readiness   Implementation

This technology is readily available, fully developed and ready for implementation. MnDOT has utilized this technology for maintenance and construction projects.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate

Based on unit cost estimates, capital costs for this initiative range from $5,000 to $15,000 for each installation location. The duration of the application will also have impact of the overall cost.

Needs and Objectives Addressed

Needs: ATMS18 - Provide dynamic speed feedback to drivers and enforcement agencies

MCM17 - Enforce timely sign changes in construction zones

MCM16 - Alert distracted motorists near work zones

ITS Objectives: A-1-17 - Reduce number of crashes due to roadway/geometric restrictions

A-1-19 - Reduce number of all secondary crashes

A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions

A-2-39 - Reduce number of injuries due to roadway/geometric restrictions

A-3-01 - Reduce number of crashes in work zones

A-3-02 - Reduce number of fatalities in work zones

A-3-03 - Reduce number of motorist injuries in work zones

A-3-04 - Reduce number of workers injured by vehicles in work zones

C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

TSMO Goals and Objectives Supported

TSMO Goal: Increase Safety

TSMO Objective: Reduce the frequency of secondary crashes and crashes related to work zones

Agreement

Agreements are not required for this initiative.

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ID: S49

Initiative: RWIS Station Deployment and Enhancements

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Intersections, Lane Departure

ITS Service Area: Weather, Traffic Management, Traveler Information

Type: Deployment

Description
This initiative will expand RWIS station deployments throughout the state. This includes deployment at new sites as well as upgrades and replacements of current RWIS station equipment, including sensors, controllers, video monitoring cameras, and communications. MnDOT, NWS and local agencies use RWIS and AWOS (automated weather observation system) to measure environmental and pavement surface conditions to assist in decisions on snow plowing schedules and chemical applications. Pan/tilt video monitoring cameras are added at RWIS sites where are prone to freezing, snow, curves, fog, high wind, and/or flooding to monitor traffic flows and road conditions and to verify incident and severity. Camera images can provide maintenance crews with additional information on pavement conditions. They are also available to travelers through the 511 Traveler Information website.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, University of Minnesota Duluth

Project Element
- Video Monitoring Roadside Equipment
- RWIS Stations
- RWIS Central Control System
- CARS
- 511 Traveler Information Website
- RTMC

Service Package
- WX01 – Weather Data Collection
- WX02 – Weather Information Processing and Distribution
- TI01 – Broadcast Traveler Information
- TM01 – Infrastructure-Based Traffic Surveillance

Interconnect
- Video Monitoring Roadside Equipment and RTMC
- RTMC and 511 Traveler Information Website
- RWIS stations and RWIS Central Control System
- RWIS Central Control System and CARS

Technology Readiness `Implementation`

This initiative utilizes current technology already deployed and readily available. NTCIP C2F: NTCIP Center-to-Field Standards Group are ITS standards that will apply to this initiative.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate

Unit cost estimates for video monitoring cameras with pan/tilt capabilities range between $10,000 and $20,000. The annual O&M cost is estimated at $1,800 per camera.

Needs and Objectives Addressed

Needs: WTR01 - Provide automated monitoring of road weather conditions
      ATIS15 - Make camera images available to travelers
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
      A-2-03 - Reduce number of fatalities due to road weather conditions
      A-2-24 - Reduce number of injuries due to road weather conditions
      C-3-09 - Increase the percent of the transportation system in which travel
         conditions can be detected remotely via video monitoring cameras,
         speed detectors, etc.

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
      Increase Safety
      Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the impacts of snow and ice on mobility
      Reduce the frequency of crashes related to road weather conditions
      Acquire, secure, and retain the data needed for MnDOT to effectively
        perform operations, performance management and planning

Agreement

If RWIS images are shared with other agencies, an agreement between those agencies and MnDOT on the use of the image data will need to be signed.

ID: S50

Initiative: Expand Automated Flagging System for Work Zones

SHSP

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Maintenance and Construction

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will procure additional automated flagging system units for use at more work zones to enhance safety of work zone crews and motorists. An automated flagging system controls traffic in a work zone by automatically providing stop and proceed indications to motorists. It is designed to remove the flag person from the dangers of traffic control on roadways. These systems can operate autonomously, similar to a traffic signal system, or can be manually controlled. Automated flagging systems are one of the Intelligent Work Zone (IWZ) applications. MnDOT currently uses an AutoFlagger system at some work zones. Construction and maintenance crews utilize the system to alert motorists of trucks entering and exiting work zones.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Counties, Cities, Private Contractors

Project Element
- Maintenance and Construction Vehicle Equipment
- Intelligent Work Zone System Roadside Equipment

Service Package
- MC06 – Work Zone Management
- MC07 – Work Zone Safety Monitoring

Interconnect
- Intelligent Work Zone System Roadside Equipment and Maintenance and Construction Vehicle Equipment

Technology Readiness   Implementation
This initiative is an expansion of a current application and utilizes technology already deployed and readily available.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
The cost of an automated flagging system is approximately $24,000.

Needs and Objectives Addressed

Needs: MCM04 - Warn travelers about trucks entering/exiting work zones

                   MCM13 - Provide automated flagging for stationary work zones

                   MCM16 - Alert distracted motorists near work zones

ITS Objectives: A-3-04 - Reduce number of workers injured by vehicles in work zones

                   B-3-05 - Reduce the variability of travel time in work zones during peak and

                          off-peak periods

Agreement

Agreements are not required for this initiative.

ID: S51

Initiative: Portable Queue Detection and Stopped Traffic Advisory

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Speed-Related, Work Zones

ITS Service Area: Maintenance and Construction

Type: Deployment

Description

A portable queue detection and stopped traffic advisory system uses portable vehicle queue detection systems or information from existing commercial telematics units and portable changeable message signs to alert drivers of stopped vehicle queue within a work zone, reducing number of crashes. The system consists of multiple portable, non-intrusive detection devices as well as multiple portable changeable message signs spaced incrementally along the roadway approaching the work zone. The system will alert drivers of an upcoming traffic slow-down or stopped traffic. Drivers can use the information to determine whether to take an alternate route or to slow down and be prepared to stop safely. Information from this initiative can also be integrated with Connected Vehicle systems in the future, when roadside infrastructure/equipment is deployed.

Portable queue detection and stopped traffic advisory systems have been used by MnDOT construction crews on freeway construction projects. This initiative will procure additional systems that can be used for more construction projects.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Local Agencies

Project Element
• Intelligent Work Zone System Roadside Equipment

Service Package
• MC06 – Work Zone Safety Monitoring
• TM01 – Infrastructure-Based Traffic Surveillance

Interconnect
• Intelligent Work Zone System Roadside Equipment (detector) and Intelligent Work Zone System Roadside Equipment (DMS)

Technology Readiness   Implementation
This initiative is an expansion of a current application and utilizes technology already deployed and readily available. This technology supports other maintenance systems such as Dynamic Late Merge systems and travel delay systems.

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Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
The system cost ranges between $100,000 and $150,000 for purchasing the system. Systems can also be rented by vendors, in which case the vendor is responsible for setup and maintenance and cost is dependent upon project duration and is included in the construction project.

Needs and Objectives Addressed
Need: MCM05 - Provide queue detection and advisory to warn traffic of a stopped queue at work zone
ITS Objectives: B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak) caused by work zones
                  B-3-02 - Reduce the percentage of vehicles traveling through work zones that are queued
                  B-3-03 - Reduce the average and maximum length of queues, when present,
                  C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                  Increase Safety
TSMO Objectives: Reduce delays associated with construction activities
                  Reduce the period of time traffic is congested or delayed due to maintenance and reactive work zone activities
                  Reduce the frequency of secondary crashes and crashes related to work zones

Agreement
Agreements are not required for this initiative.

ID: S52

Initiative: Roadway and Bridge Automated Treatment System
      Deployment

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Lane Departure

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
Automated roadway treatment systems have been deployed in the metro area and in MnDOT Districts 1, 4, 6, and 7 to apply anti-icing chemicals to bridges and roadway segments with recurring icing issues. Portable anti-icing systems are being tested in the metro area. This initiative will deploy additional fixed anti-icing systems on bridges and roadways with recurring icing issues, as well as purchase portable anti-icing systems for effective road weather management. Several agencies, including MnDOT, Hennepin County, City of Moorhead, and City of East Grand Forks, have planned to deploy such systems.

Champion and Stakeholder
MnDOT (District Maintenance), Local Agencies

Project Element
- Roadway Automated Treatment System
- Maintenance and Construction Management Center
- RTMC

Service Package
- MC03 – Roadway Automated Treatment

Interconnect
- Roadway Automated Treatment System and Maintenance and Construction Management Center
- Roadway Automated Treatment System and RTMC

Technology Readiness   `Implementation`
This initiative is an expansion of a current application and utilizes current technology already deployed.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Unit cost for automatic anti-icing systems for areas spanning 120 to 180 feet is approximately $25,000. Costs increase for automated systems that require larger roadway coverage.

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Needs and Objectives Addressed

Need: MCM06 - Provide roadway automated treatment with stationary units
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                  A-2-03 - Reduce number of fatalities due to road weather conditions
                  A-2-24 - Reduce number of injuries due to road weather conditions
                  H-2-02 - Increase the amount of environmentally friendly de-icing material
                           used

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                   Increase Safety
TSMO Objectives: Reduce the impacts of snow and ice on mobility
                   Reduce the frequency of crashes related to road weather conditions

Agreement

Agreements are not required for this initiative.

ID: S53

Initiative: Expand Dynamic Late Merge System Deployment

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will focus on deploying dynamic late merge systems at construction projects in larger urban and rural centers throughout Minnesota. This system is placed in advance of lane closures due to roadway maintenance and construction and consists of three Portable Changeable Message Signs (PCMS) and a Remote Traffic Microwave Sensor (RTMS) detector. As traffic congestion begins to form, the PCMS are activated to provide lane use instructions to drivers. The system is self-contained with the possibility of remote operator override from the RTMC. The system is recommended to use on longer term construction projects, with a duration greater than one month at high traffic volume locations.

Champion and Stakeholder
Champion: MnDOT (Construction, District Traffic)
Stakeholders: Local Agencies

Project Element
- Dynamic Late Merge Central Control System
- Dynamic Late Merge Roadside Equipment
- RTMC
- Maintenance and Construction Management Center

Service Package
- MC06 – Work Zone Management

Interconnect
- Dynamic Late Merge Central Control System and Dynamic Late Merge Roadside Equipment
- Dynamic Late Merge Roadside Equipment and Dynamic Late Merge Roadside Equipment
- Dynamic Late Merge Central Control System and RTMC/Maintenance and Construction Management Center

Technology Readiness   Implementation
This initiative utilizes technology that is used in work zone management and can be included with other intelligent work zone systems to utilize their detection equipment.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate

Unit cost estimates for PCMS can range from $20,000 to $45,000. Unit cost estimates for remote traffic microwave sensors for a corridor can range from $10,000 to $14,000 per detector.

Needs and Objectives Addressed
Need: MCM08 - Provide dynamic late merge systems for construction/ maintenance activities
ITS Objectives: B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak) caused by work zones
                  B-3-02 - Reduce the percentage of vehicles traveling through work zones that are queued
                  B-3-03 - Reduce the average and maximum length of queues, when present

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                  Increase Safety
TSMO Objectives: Reduce delays associated with construction activities
                  Reduce the period of time traffic is congested or delayed due to maintenance and reactive work zone activities
                  Reduce the frequency of secondary crashes and crashes related to work zones

Agreement
Interagency agreements between district offices may be required to ensure consistent operation and maintenance of equipment.

ID: S54

TSMO

Initiative: Infrastructure GIS Mapping Enhancement

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: System Stewardship, Transportation Safety

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will enhance agencies' GIS mapping systems by incorporating infrastructure data. The enhanced systems will keep up-to-date records and allow agencies and contractors to use the data to target and record replacement and repair of infrastructure.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Local Agencies

Project Element
- Infrastructure GIS Database Systems
- Maintenance and Construction Management Center
- RTMC

Service Package
- MC05 – Roadway Maintenance and Construction

Interconnect
- Infrastructure GIS Database Systems and Maintenance and Construction Management Center
- Infrastructure GIS Database Systems and RTMC

Technology Readiness   Implementation
This initiative utilizes technology that is currently available from technology vendors.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been determined.

Needs and Objectives Addressed
Need: MCM09 - Use GPS/GIS data to target and record replacement and repair of Infrastructure
ITS Objectives: E-4-04 - Increase the rate at which equipment is utilized
                  E-4-05 - Increase the percentage of fleet/equipment within its lifecycle
                  G-1-06 - Reduce operations cost deviation

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G-1-07 - Reduce administrative support rate (as part of overall project budget)

TSMO Goals and Objectives Supported

<u>TSMO Goal:</u>   Carefully and Responsibly Manage Transportation Operations Assets

<u>TSMO Objective:</u>   Acquire, secure, and retain the data needed for MnDOT to effectively perform operations, performance management and planning

Agreement

Agreements are not required for this initiative.

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ID: S55

Initiative: Enhanced Data Entry and Integration of Work Zone Information

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, Transportation Safety

SHSP Focus Area: Management Systems, Work Zones

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will expand the capability of entering work zone data via web-enabled cell phones. This capability currently exists in MnDOT District 7 and will be expanded to other MnDOT districts. This initiative will also improve the level of detail of the reporting system and simplify the data entry system. The result of this initiative will improve the accuracy of data entry on work zones and the dissemination of real-time work zone information to travelers through various traveler information systems (511, DMS, HAR, media, etc.).

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, MSP, Local Agencies

Project Element
- Condition Acquisition and Reporting System (CARS)
- Maintenance and Construction Management Center
- RTMC

Service Package
- MC06 – Work Zone Management

Interconnect
- CARS and Maintenance and Construction Management Center
- CARS and RTMC

Technology Readiness   `Implementation`
This initiative utilizes technology that is currently deployed.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
The cost for this initiative is estimated around $50,000. The annual O&M cost is estimated at $5,000.

Needs and Objectives Addressed
Need: MCM10 - Provide work zone information to travelers
ITS Objectives: B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak)
                          caused by work zones
                 B-3-05 - Reduce the variability of travel time in work zones during peak and
                          off-peak periods
                 C-3-11 - Increase number of 511 calls per year
                 C-3-12 - Increase number of visitors to traveler information website per year

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objectives: Reduce delays associated with construction activities
                  Reduce the period of time traffic is congested or delayed due to
                    maintenance and reactive work zone activities

Agreement
Interagency agreements between district offices may be required to ensure consistent data
entry of work zone information.

ID: S56

Initiative: Expand IWZ Deployment to Greater Minnesota

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Inattentive Drivers, Speed-Related, Work Zones

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
It is planned to expand the deployment of Intelligent Work Zone (IWZ) technologies to work zone areas outside of the RTMC coverage area. IWZ systems represent an automated system of devices that provide motorists and/or workers real-time information for improved safety and mobility through a work zone. Information can be categorized into 3 levels: (1) Conflict Warning - high priority information to warn motorists of eminent traffic and roadway hazards; (2) Traffic Control - provides important driving information such as advisory speeds, merging instructions, and lane control directions; and (3) Travel Information - provides information which the motorist may use to make route decisions, such as travel times, alternate route info, incident warnings and work zone staging information.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies, Travelers

Project Element
- Intelligent Work Zone System Roadside Equipment
- Maintenance and Construction Management Center
- RTMC

Service Package
- MC06 – Work Zone Management

Interconnect
- IWZ System Roadside Equipment and IWZ System Roadside Equipment
- IWZ System Roadside Equipment and Maintenance and Construction Management Center
- IWZ System Roadside Equipment and RTMC

Technology Readiness   `Implementation`
This initiative utilizes technology that is currently deployed.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Unit cost estimates for PCMS can range from $20,000 to $45,000. Unit cost estimates for remote traffic microwave sensors for a corridor can range from $10,000 to $12,000.

Needs and Objectives Addressed
Need: MCM11 - Notify travelers of delays or travel times through work zones
ITS Objectives: B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak) caused by work zones
                   B-3-05 - Reduce the variability of travel time in work zones during peak and off-peak periods
                   C-3-15 - Increase the number of specifically tailored traveler information messages provided

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                   Increase Safety
TSMO Objectives: Reduce delays associated with construction activities
                   Reduce the period of time traffic is congested or delayed due to maintenance and reactive work zone activities
                   Reduce the frequency of secondary crashes and crashes related to work zones

Agreement
Agreements are not required for this initiative.

ID: S57

Initiative: Work Zone Intrusion Alarm System

SHSP

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Work Zones

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
A work zone intrusion alarm system will detect errant vehicles entering a work zone and provide warning to crew workers and drivers of errant vehicles of imminent encroachment or other potential safety hazards. A pilot project is currently being conducted in MnDOT District 3. Upon successful demonstration of the pilot, additional Work Zone Intrusion Alarm System units will be procured and used in work zones.

Champion and Stakeholder
MnDOT (Maintenance)

Project Element
- Intelligent Work Zone System Roadside Equipment
- Maintenance and Construction Field Personnel

Market Package
- MC07 – Work Zone Safety Monitoring

Interconnect
- Roadside detection equipment and roadside alarm equipment.

Technology Readiness   Implementation
This initiative is an expansion of a current system that is being tested. Commercial, off-the-shelf systems are also available from private vendors.

Dependency
This initiative depends upon the result of the pilot project that is currently being conducted in MnDOT District 3. Additional research into system design and functionality may be needed to improve system effectiveness.

Cost Estimate
The capital cost of a work zone intrusion system ranges between $6,000 and $12,000. The annual O&M cost is estimated at $600.

Needs and Objectives Addressed
Need: MCM03 – Warn work crews of errant vehicles
ITS Objective: A-3-04 - Reduce number of workers injured by vehicles in work zones

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TSMO Goals and Objectives Supported

TSMO Goal: Increase Safety

TSMO Objective: Reduce the frequency of secondary crashes and crashes related to work zones

Agreement

Agreements are not required for this initiative.

ID: S58

Initiative: Bridge Inspection / Structural Monitoring System

Multimodal Transportation Objective: System Stewardship, Transportation Safety

Timeframe: Short to Medium Term – Years 0-8

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will utilize cameras and/or sensors to assist in the inspection of transportation infrastructure (bridges, tunnels, etc.) by recording key structural measures that indicate when maintenance is needed. Roadside cameras and sensors are planned to be utilized for maintenance inspections of key bridges in Minnesota. Roadside equipment is planned to be controlled by MnDOT RTMC and Maintenance and Construction Management Centers for maintenance inspections. Initial testing on the I-35W Bridge in Minneapolis will test sensors such as linear potentiometers to measure bridge movements, accelerometers to monitor bridge deflections under loads, and acoustical sensors to detect unusual sounds of a specific frequency. Cameras and sensors can also be mounted on drones to perform aerial inspection and monitoring. Data on inspection activity can be archived to indicate dates of inspection and exactly what was inspected.

Champion and Stakeholder
MnDOT

Project Element
- Bridge Inspection / Structural Monitoring Roadside Equipment
- RTMC
- Maintenance and Construction Management Center

Service Package
- MC09 – Infrastructure Monitoring

Interconnect
- Bridge Inspection/Structural Monitoring Roadside Equipment and RTMC
- Bridge Inspection/Structural Monitoring Roadside Equipment and Maintenance and Construction Management Center

Technology Readiness   Implementation   Development
Cameras/sensors for bridge inspection and structural monitoring are available from vendors. However, further R&D is needed to advance to capabilities, accuracy and usability of the technology.

Dependency
This initiative may be dependent upon results of initial testing on the Minneapolis I-35W Bridge.

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Cost Estimate
Costs associated with this initiative have not been determined.

Needs and Objectives Addressed

<u>Need:</u>   MCM12 - Provide cameras/ sensors on bridges to assist for inspection and continual monitoring

<u>ITS Objective:</u>   E-4-01 - Increase the number of ITS-related assets tracked

Agreement
Agreements are not required for this initiative.

ID: S59

Initiative: Graphical-Based Construction Scheduling Tool

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, System Stewardship

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will develop a dynamic graphical-based tool for communication of construction and maintenance activity within and between multiple maintenance agencies. MnDOT will need to investigate staffing requirements for data entry into the dynamic scheduling tool. MnDOT maintenance and local agencies currently release project schedules of construction and maintenance activity via website and media outlets and communicate with local stakeholders as appropriate. A centrally managed graphical-based tool will improve communication of maintenance and construction activities within and between multiple maintenance agencies.

Champion and Stakeholder
Champion: MnDOT

Project Element
- Maintenance and Construction Management Center
- Local Maintenance and Construction Management Centers
- 511 Traveler Information Website

Service Package
- MC08 – Maintenance and Construction Activity Coordination

Interconnect
- Maintenance and Construction Management Center and Local Maintenance and Construction Management Centers
- Maintenance and Construction Management Center and 511 Traveler Information Website

Technology Readiness   Implementation
MnDOT currently disseminates traveler information through the 511 Traveler Information Website on maintenance and construction activity. Additional information from local agencies can readily be added to the 511 Website.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been identified.

Needs and Objectives Addressed

Need: MCM02 - Coordinate construction and maintenance project schedules within and between agencies

ITS Objectives: B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak) caused by work zones

                               B-3-05 - Reduce the variability of travel time in work zones during peak and off-peak periods

                               G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning

Agreement

Agreements regarding the frequency of maintenance and construction information to be shared among agencies may be required for this initiative.

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ID: S60

Initiative: Portable Work Zone Dynamic Speed Display Signs

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Open Decision-Making, Transportation Safety, System Stewardship

SHSP Focus Area: Speed-Related, Work Zones

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will deploy portable dynamic speed displays at more work zones to increase worker safety and expand the use of permanent dynamic speed displays to additional locations. Systems will detect the traveling speeds of approaching vehicles and display the detected speeds dynamically via message signs that are located underneath the posted speed limit along the arterial road. These systems are currently in operation at select locations throughout the metro area. The purpose of the initiative is to make drivers aware of their traveling speeds compared to the posted speed limit, thereby reducing vehicle speeds along arterial roads and improve pedestrian and roadway safety.

Champion and Stakeholder
Champion: MnDOT

Project Element
- Speed Monitoring Roadside Equipment
- Driver

Service Package
- MC06 – Work Zone Management

Interconnect
- Speed Monitoring Roadside Equipment and Driver

Technology Readiness   Implementation
This technology has been deployed previously at work zones and is readily available.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
General cost estimate for a system installation can range from $5,000 to $10,000. System could include a trailer mounted two-digit dynamic message sign, radar gun, and computer for storing information presented to drivers. Equipment could be powered by local generator or solar power if available.

Needs and Objectives Addressed

Needs: MCM14 – Provide dynamic speed display

                      MCM16 – Alert distracted motorists near work zones

ITS Objectives: A-3-01 - Reduce number of crashes in work zones

                      A-3-02 - Reduce number of fatalities in work zones

                      A-3-03 - Reduce number of motorist injuries in work zones

                      A-3-04 - Reduce number of workers injured by vehicles in work zones

                      B-3-05 - Reduce the variability of travel time in work zones during peak and off-peak periods

                      C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

TSMO Goals and Objectives Supported

TSMO Goal: Increase Safety

TSMO Objective: Reduce the frequency of secondary crashes and crashes related to work zones

Agreement

Agreements are not required for this initiative.

Vehicle Safety

ID: S61

Initiative: Rural Intersection Conflict Warning System (RICWS)

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Intersections

ITS Service Area: Vehicle Safety

Type: Deployment

Description
Rural Intersection Conflict Warning System (RICWS) has been deployed at multiple rural locations along Minnesota roads and highways. This initiative will continue the installation of RICWS at additional rural locations throughout Minnesota. RICWS consists of field equipment at key intersections that detects a vehicle's presence that cannot be seen by oncoming vehicles due to poor geometric field conditions, resulting in potential traffic incidents. The field equipment will send a notification to additional field equipment that will alert drivers on rural highways with information indicating when entry into an intersection is unsafe.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Project Element
- Intersection Collision Warning Roadside Equipment
- Traffic
- Driver

Service Package
- VS13 – Intersection Safety Warning and Collision Avoidance

Interconnect
- Traffic and Intersection Collision Warning Roadside Equipment
- Driver and Intersection Collision Warning Roadside Equipment

Technology Readiness   `Implementation`
Intersection Collision Warning Roadside Equipment has been deployed at various locations and is readily available.

Dependency
This initiative is dependent upon the success of the Intersection Warning System Operational Test at rural highway and rural highway/rail intersections in Mankato.

Cost Estimate
The costs of the system range from $60,000 to $100,000 per intersection.

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Needs and Objectives Addressed

Need: ATMS33 - Provide intersection collision avoidance systems

ITS Objectives: A-1-11 - Reduce number of crashes at un-signalized intersections
                      A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
                      A-2-12 - Reduce number of fatalities at un-signalized intersections
                      A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
                      A-2-33 - Reduce number of injuries at un-signalized intersections
                      A-2-39 - Reduce number of injuries due to roadway/geometric restrictions

TSMO Goals and Objectives Supported

TSMO Goal: Increase Safety

TSMO Objective: Reduce the frequency of crashes at signalized and unsignalized
                      intersections

Agreement

Agreements may be required if systems are deployed on facilities operated by multiple agencies.

ID: S62

Initiative: Connected Corridor Initiative

Timeframe: Short to Medium Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Vehicle Safety Enhancements

ITS Service Area: Vehicle Safety, Maintenance and Construction, Support

Type: Deployment, Research, Operational Test

Description

The aim of the Connected Corridor Initiative is to deploy connected vehicle (CV) technology and enable a communications infrastructure that supports vehicle-to-infrastructure, as well as vehicle-to-vehicle communications. This initiative encompasses the national vision for Connected Vehicles, which will build on the availability of advanced vehicle safety systems and on the results of related research and operational tests. It is also supported by radio spectrum at 5.9 GHz specifically allocated for dedicated short range communications (DSRC).

The Connected Corridor will consist of the deployment of CV technology on the roadside and in select vehicles, as well as the use of and interface to existing infrastructure and devices to improve information dissemination. The Connected Corridor system boundary encompasses all devices that are deployed as part of the project, as well as the communications between them, and interfaces between the deployed devices and existing systems and users.

Together, equipment deployed on the roadside and in vehicles, the transmission of messages, and the deployment of applications supports the needs of users. Roadside equipment is expected to consist of communications equipment, data processing/handling equipment, and other ITS hardware such as pedestrian detection equipment. Communications equipment enables the secure communication of signal phase and timing (SPaT) data, along with other associated message types to vehicles.

Equipment deployed in select vehicles will receive messages from roadside equipment to support Vehicle-Pedestrian Intersection Conflict Warning, Snow Plow Signal Priority, and the Mobile Work Zone Warning System. In-Vehicle Equipment also broadcasts data (such as Basic Safety Message and Signal Request Messages) that can be captured by other in-vehicle equipment and roadside equipment.

The Connected Corridor System will provide a means to manage and monitor the configuration, operation, and data associated with the connected vehicle system, and will also provide support for maintenance staff to help with diagnosing and repairing problems. The system will provide wired and wireless communication security, and will interface with Global Navigation Satellite System (GNSS) to provide positioning and allow time synchronization between devices.

The Connected Corridor System will be deployed along the TH-55 and I-394 corridors from downtown Minneapolis (I-94) to I-494 and in select vehicles. The deployment of in-vehicle devices will be targeted toward general equipped vehicles, snow plows and work zone vehicles. For the purpose of initial deployment, it is anticipated that transit vehicles will be used to

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represent general equipped vehicle users due to the partnership with Metro Transit and the controlled nature of the vehicle fleet. The Connected Corridor will also provide sources of high quality data for traffic management purposes.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Automotive industry, Information service providers (i.e., Google, Traffic.com, etc.), Minnesota Information Technology, Metro Transit, City transportation agencies, County transportation agencies

Project Element
- CV Roadside Equipment
- Vehicles
- Transit Vehicle Equipment
- Maintenance and Construction Vehicle Equipment
- Dynamic Message Sign Roadside Equipment
- Traffic Signal Roadside Equipment
- Ramp Meter Roadside Equipment
- Minneapolis TMC
- Local TMCs
- RTMC
- Metro Area Transit Management Centers

Service Package
- VS02 – V2V Basic Safety
- VS03 – Situational Awareness
- VS04 – V2V Special Vehicle Alert
- VS07 – Road Weather Motorist Alert and Warning
- VS08 – Queue Warning
- VS09 – Reduced Speed Zone Warning / Lane Closure
- VS10 – Restricted Lane Warnings
- VS12 – Pedestrian and Cyclist Safety
- VS13 – Intersection Safety Warning and Collision Avoidance
- MC06 – Work Zone Management
- SU01 – Connected Vehicle System Monitoring and Management
- SU02 – Core Authorization
- SU03 – Data Distribution
- SU04 – Map Management
- SU05 – Location and Time
- SU08 – Security and Credentials Management

Interconnect
- CV roadside equipment and RTMC
- CV roadside equipment and vehicle equipment
- CV roadside equipment and dynamic message sign roadside equipment
- CV roadside equipment and traffic signal roadside equipment
- CV roadside equipment and ramp meter roadside equipment
- Vehicle equipment and vehicle equipment
- RTMC and dynamic message sign roadside equipment

- RTMC and traffic signal roadside equipment
- RTMC and ramp meter roadside equipment
- RTMC and Minneapolis TMC/Local TMCs
- RTMC and metro area transit management centers

Technology Readiness   <mark>Implementation</mark>   <mark>Development</mark>
This initiative utilizes connected vehicle technologies that are at various levels of technology readiness.

Dependency
This initiative is not dependent upon any other initiatives.

Cost Estimate
Costs associated with this initiative have not been identified.

Needs and Objectives Addressed

Needs: ATMS02 - Implement red-light running technology
                ATMS33 - Provide intersection collision avoidance systems
                APTS13 - Provide collision avoidance assistance for transit vehicles
                APTS18 - Install pedestrian and bike detection/warning system to reduce
                         incidents (transit applications)
                AVCV01 - Better moving roadwork information to vehicles – VMS sign
                         information to vehicles
                AVCV02 - Better moving roadwork information to vehicles – WZARD signs
                AVCV03 - SPaT information to vehicles
                AVCV04 - Reduce rear end crashes with DOT maintenance vehicles
                SUP02 - Managing and sharing transportation data

ITS Objectives: A-1-01 - Reduce number of vehicle crashes
                A-1-02 - Reduce number of vehicle crashes per VMT
                A-1-03 - Reduce number of crashes due to road weather conditions
                A-1-04 - Reduce number of crashes due to unexpected congestion
                A-1-05 - Reduce number of crashes due to red-light running
                A-1-06 - Reduce number of crashes involving large trucks and buses
                A-1-08 - Reduce number of crashes due to inappropriate lane departure,
                         crossing and merging
                A-1-10 - Reduce number of crashes at signalized intersections
                A-1-11 - Reduce number of crashes at un-signalized intersections
                A-1-15 - Reduce number of crashes involving pedestrians and non-motorized
                         vehicles
                A-1-16 - Reduce number of crashes at intersections due to inappropriate
                         crossing
                A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
                A-1-19 - Reduce number of all secondary crashes
                A-2-01 - Reduce number of roadway fatalities
                A-2-02 - Reduce number of roadway fatalities per VMT
                A-2-03 - Reduce number of fatalities due to road weather conditions
                A-2-04 - Reduce number of fatalities due to unexpected congestion
                A-2-05 - Reduce number of fatalities due to red-light running
                A-2-06 - Reduce number of fatalities involving large trucks and buses
                A-2-08 - Reduce number of transit fatalities

A-2-09 - Reduce number of fatalities due to inappropriate lane departure, crossing and merging
A-2-11 - Reduce number of fatalities at signalized intersections
A-2-12 - Reduce number of fatalities at un-signalized intersections
A-2-16 - Reduce number of fatalities involving pedestrians and non-motorized vehicles
A-2-17 - Reduce number of fatalities at intersections due to inappropriate crossing
A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
A-2-22 - Reduce number of roadway injuries
A-2-23 - Reduce number of roadway injuries per VMT
A-2-24 - Reduce number of injuries due to road weather conditions
A-2-25 - Reduce number of injuries due to unexpected congestion
A-2-26 - Reduce number of injuries due to red-light running
A-2-27 - Reduce number of injuries involving large trucks and buses
A-2-29 - Reduce number of transit injuries
A-2-30 - Reduce number of injuries due to inappropriate lane departure, crossing and merging
A-2-32 - Reduce number of injuries at signalized intersections
A-2-33 - Reduce number of injuries at un-signalized intersections
A-2-37 - Reduce number of injuries involving pedestrians and non-motorized vehicles
A-2-38 - Reduce number of injuries at intersections due to inappropriate crossing
A-2-39 - Reduce number of injuries due to roadway/geometric restrictions
A-3-01 - Reduce number of crashes in work zones
A-3-02 - Reduce number of fatalities in work zones
A-3-03 - Reduce number of motorist injuries in work zones
A-3-04 - Reduce number of workers injured by vehicles in work zones

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                Increase Safety
                Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the impacts of snow and ice on mobility
                Reduce the frequency of crashes at signalized and unsignalized intersections
                Reduce the frequency of crashes related to road weather conditions
                Acquire, secure, and retain the data needed for MnDOT to effectively perform operations, performance management and planning

Agreement

Agreements may be necessary between MnDOT and MnIT to manage the storage and maintenance of data collected by logging the SPaT messages. Agreements may also be needed for this initiative to address data sharing, security and privacy concerns.

ID: S63

Initiative: Automated Vehicle Truck Demonstration

Timeframe: Short Term – Years 0-4

Multimodal Transportation Objective: Transportation Safety

ITS Service Area: Vehicle Safety, Maintenance and Construction

Type: Research, Operational Test

Description
MnDOT will pursue an Automated Vehicle (AV) Truck project to be executed at the MnROAD facility, Camp Ripley Test Track or other appropriate site. This initiative will define requirements of the project, perform AV truck technology partner outreach, establish technology deployment partnerships and perform live operations. This initiative will research the ability to utilize an AV truck for MnDOT's pavement research program and will assess performance of AV technology in Minnesota climate conditions.

The MnROAD facility provides an excellent environment to test automated vehicle technology on trucks. The site provides a restricted roadway to test, excellent communication equipment with fiber optic and GPS capability throughout the site, the ability to test in winter weather conditions, the ability to manufacturer snow/ice/slush for controlled weather testing, and excellent facilities for storing and maintaining equipment.

In addition to testing on the low volume road, MnDOT will also consider testing the vehicle on the high speed segment of I-94 at MnROAD (closed to other vehicular traffic), testing on the closed track facility at Camp Ripley, and explore opportunities to test on a public roadway.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Automotive industry

Project Element
- Maintenance and Construction Vehicle Equipment

Service Package
- VS01 – Autonomous Vehicle Safety Systems

Interconnect
- None

Technology Readiness   Development
This initiative utilizes automated vehicle technologies that are currently under development.

Dependency
This initiative is not dependent upon any other initiatives and will build upon recently completed Autonomous Shuttle Bus Pilot Project led by MnDOT.

Cost Estimate
Costs associated with this initiative have not been identified.

Needs and Objectives Addressed

<u>Need:</u>   ATMS33 - Provide intersection collision avoidance systems
<u>ITS Objectives:</u> A-1-01 - Reduce number of vehicle crashes
                    A-1-02 - Reduce number of vehicle crashes per VMT

Agreement
Agreements are not required for this initiative.

ID: S64

Initiative: Integrate Private Sector Traffic and Incident Data with Public Agency Data

TSMO

Timeframe: Short Term – Years 1-4

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management, Traveler Information

Type: Deployment

Description
Much of the wide variety of traffic and incident data that agencies use for traffic management and traveler information has become available via crowdsourcing in recent years. Crowdsourced traffic and incident data is anticipated to become more widely available in the near future. With the growth in mobile computing and communications technology, the private sector is now obtaining traffic conditions and incident data from in-vehicle sources and mobile devices such as navigation systems and smartphones. Over the past years, the private sector has greatly expanded its geographic coverage of both urban and rural areas, and has the ability to collect traffic flow and speed/travel time data and traffic incident data on roadways beyond what is currently collected by sensor-based systems deployed by public agencies.

This initiative will form public-private partnership to allow MnDOT RTMC to obtain and integrate data from private sector providers and use the data to supplement MnDOT's data. Currently, the private sector, such as Google/WAZE, HERE, TOMTOM and INRIX, owns most of the market share for large-scale travel time data and other traffic-related data. MnDOT may purchase and integrate this information for RTMC operations or share/exchange data with private sector providers.

Champion and Stakeholder
Champion: MnDOT (RTMC)
Stakeholders: Private Information Service Providers

Project Element
- Traffic Detector Roadside Equipment
- RTMC
- CARS
- 511 Traveler Information Website
- 511 Telephone Information Services
- Private Information Service Providers

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM02 – Vehicle-Based Traffic Surveillance
- TI01 – Broadcast Traveler Information

Interconnect
- Roadside equipment and RTMC

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- RTMC and CARS
- CARS and 511 Traveler Information Website/Telephone Information Services
- Private Information Service Providers and CARS

Technology Readiness   Implementation

This initiative will integrate existing technology and systems already deployed in the initiative area.

Dependency

This initiative is not dependent upon any other initiatives.

Cost Estimate

Costs associated with this initiative depend on the agreements with the private sectors on data acquisition.

Needs and Objectives Addressed

Need: ATIS01 - Provide incident information on freeways and major arterials
                ATIS04 - Provide current and forecast road and weather condition information
                ATMS05 - Provide incident and congestion information to travelers
                ATMS15 - Provide operating speed/travel time information to travelers
                ATMS54 - Import of WAZE and other crowdsourced data to mine for incidents
ITS Objectives: B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                        experiencing recurring congestion during the peak period
                B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                        group of specific travel routes or trips in the region
                C-1-09 - Increase number of regional road miles covered by ITS-related
                        assets (e.g., roadside cameras, dynamic message signs, vehicle
                        speed detectors) in use for incident detection/response
                C-3-09 - Increase the percent of the transportation system in which travel
                        conditions can be detected remotely via video monitoring cameras,
                        speed detectors, etc.
                G-1-01 - Increase the amount of data gathered from ITS enhancements used
                        in infrastructure and operations planning
                G-1-03 - Increase the number of years of data in database that is easily
                        searchable and extractable

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                Increase Safety
                Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and
                        arterials in metro areas throughout Minnesota
                Increase availability of information about travel times to drivers
                Increase pre-trip and en-route traveler awareness of incidents and
                        alternate options in both the Twin Cities and Greater Minnesota
                Reduce the crashes related to congestion in Minnesota metro areas
                Reduce the frequency of crashes related to road weather conditions
                Acquire, secure, and retain the data needed for MnDOT to effectively
                        perform operations, performance management and planning

Agreement

This initiative will require agreements between MnDOT and private information service providers.

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4.4   Medium and Long Term ITS Initiatives and Project Concepts

This section provides information on the medium- and long-term ITS initiatives and project concepts. 38 medium-term and 12 long-term ITS initiatives and project concepts are identified. Each ITS initiative and project concept is described with the following information:

- **ID:** a unique identification number for each initiative and project concept.
- **Initiative:** Title of the initiative or project concept.
- **Timeframe:** planned or recommended timeframe for implementation.
- **Multimodal Transportation Objective:** Objectives in the Minnesota Statewide Multimodal Transportation Plan addressed by the initiative or project concept.
- **SHSP Focus Area:** Focus areas defined in the 2014 Minnesota SHSP that are relevant to the initiative or project concept. This information is presented only if the initiative/project concept is included in the 2014 Minnesota SHSP.
- **ITS Service Area:** ITS service areas or functional areas the initiative/project concept covered. ITS service areas include: Data Management, Public Transportation, Traveler Information, Traffic Management, Vehicle Safety, Commercial Vehicle Operations, Public Safety, Maintenance and Construction, Parking Management, Weather, Support, and Sustainable Travel.
- **Type:** Type(s) of the initiative/project concept, including operational test, deployment, research, and policy/legislation.
- **Description:** Scope and general information of the initiative/project concept.
- **Champion and Stakeholder:** Champion agency of the initiatives/project concept and other stakeholder agencies involved.
- **Dependency:** Interdependency between the initiative and existing systems and other initiatives.
- **Needs and Objectives Addressed:** Stakeholder needs and Minnesota ITS Objectives addressed.
- **TSMO Goals and Objectives Supported:** Goals and objectives from the MnDOT TSMO Strategic Plan supported.
- **Service Package:** Architecture service packages included in the initiative/project concept.

Similar to Section 4.3, initiatives and project concepts that are included in the Minnesota SHSP as safety strategies are denoted with an "SHSP" icon next to the their titles. A sidebar is also included to indicate to which service area(s) the initiative/project concept belong.

ID: M01

Initiative: Provide Information on Alternate Routes and
Detours Due to Roadwork

SHSP

TSMO

Timeframe: Medium Term – Years 5-6

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical
Connections

SHSP Focus Area: Work Zones

ITS Service Area: Traveler Information, Maintenance and Construction

Type: Deployment

Description
This initiative will provide recommended alternate routes around roadways closures or heavy
congestion caused by construction or maintenance activities. This alternate route information
will be provided through existing traveler information systems. This information will provide
travelers with timely information about their route of travel and enhance their confidence in
traveler systems by being provided with constructive information about roadway closures and
construction activities.

MnDOT provides information on roadway construction, closures and alternate routes on MnDOT
511. Several counties and cities also post such information on their websites. This initiative will
allow other agencies to provide timely information about construction and maintenance activities
and recommended alternate routes or detours for their construction projects to the public.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Counties, Cities

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATIS05 - Provide information on roadway construction and maintenance
activities
ITS Objectives: A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
A-2-39 - Reduce number of injuries due to roadway/geometric restrictions
B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak)
caused by work zones
B-3-05 - Reduce the variability of travel time in work zones during peak and
off-peak periods
C-3-11 - Increase number of 511 calls per year
C-3-12 - Increase number of visitors to traveler information website per year

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency

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Increase Safety

TSMO Objectives: Reduce delays associated with construction activities
Reduce the period of time traffic is congested or delayed due to maintenance and reactive work zone activities
Reduce the frequency of secondary crashes and crashes related to work zones

Service Package

- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information
- MC06 – Work Zone Management

ID: M02

Initiative: CARS Integration Across State Borders

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Critical Connections

SHSP Focus Area: Management Systems

ITS Service Area: Traveler Information

Type: Deployment

Description

The focus of this initiative will be to integrate the Minnesota Condition and Acquisition Reporting System (CARS) with neighboring state reporting systems similar to CARS. The benefits to this initiative include improved traffic incident management, improved emergency traffic operations, and enhanced transportation security at interstate border areas. Interstate partnerships with Iowa, North and South Dakota, and Wisconsin will also improve the detection of hazardous highway conditions and security threats along the roadway.

Champion and Stakeholder

Champion: MnDOT
Stakeholders: Neighboring States (North Dakota, South Dakota, Iowa, and Wisconsin)

Dependency

This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed

Needs:	ATIS02 - Provide traveler information across state borders
	ATIS21 - Make real-time transportation operations data available to other transportation system operators
	ATMS45 - Provide road closure information for far away closures
ITS Objectives:	A-1-01 - Reduce number of vehicle crashes
	A-1-02 - Reduce number of vehicle crashes per VMT
	A-2-01 - Reduce number of roadway fatalities
	A-2-02 - Reduce number of roadway fatalities per VMT
	A-2-22 - Reduce number of roadway injuries
	A-2-23 - Reduce number of roadway injuries per VMT
	B-1-07 - Reduce the regional average travel time index
	B-1-09 - Improve average travel time during peak periods
	C-3-10 - Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region
	D-2-03 - Increase the number of travelers routed around Hazmat incidents
	D-2-04 - Increase the number of travelers routed around homeland security incidents
	E-4-04 - Increase the rate at which equipment is utilized
	G-1-02 - Increase the number of planning activities using data from ITS systems

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G-1-06 - Reduce operations cost deviation

Service Package

- SU03 – Data Distribution

ID: M03

Initiative: ITS Communications Interstate Connectivity

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Critical Connections

SHSP Focus Area: Management Systems

ITS Service Area: Traveler Information

Type: Deployment

Description
This focus of this initiative will be to implement communications connectivity to adjacent states that support ITS deployments. This initiative has potential to improve traffic and incident management in border areas governed by metropolitan planning organizations, such as Duluth-Superior, Fargo-Moorhead, and Grand Forks-East Grand Forks. Regional ITS Architectures have been developed for these areas that indicate planned traffic control and information coordination between MnDOT and neighboring state agencies.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Neighboring States (North Dakota and Wisconsin)

Dependency
This initiative depends on planned deployment of a National ATIS Network or standards.

Needs and Objectives Addressed
Need: ATIS02 - Provide traveler information across state borders
ITS Objectives: A-1-01 - Reduce number of vehicle crashes
                A-1-02 - Reduce number of vehicle crashes per VMT
                A-2-01 - Reduce number of roadway fatalities
                A-2-02 - Reduce number of roadway fatalities per VMT
                A-2-22 - Reduce number of roadway injuries
                A-2-23 - Reduce number of roadway injuries per VMT
                B-1-07 - Reduce the regional average travel time index
                B-1-09 - Improve average travel time during peak periods
                C-3-10 - Increase the percent of transportation facilities whose owners share
                    their traveler information with other agencies in the region
                D-2-03 - Increase the number of travelers routed around Hazmat incidents
                D-2-04 - Increase the number of travelers routed around homeland security
                    incidents

Service Package
- SU03 – Data Distribution

ID: M04

Initiative: CARS ITS Data Addition

SHSP

TSMO

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, Critical Connections

SHSP Focus Area: Management Systems

ITS Service Area: Traveler Information

Type: Deployment

Description
This initiative will focus on adding data from ITS and emerging technology to the Minnesota Condition Acquisition and Reporting System (CARS). CARS supports the Minnesota 511 traveler information network. CARS integrates multiple data sources, including RWIS stations, traffic detectors and construction information, to provide real-time traveler information to the 511 telephone service and website.

Champion and Stakeholder
Champion: MnDOT

Dependency
This initiative is not dependent upon other initiatives.

Needs and Objectives Addressed
Need: ATIS04 - Provide current and forecast road and weather condition information
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                   A-2-03 - Reduce number of fatalities due to road weather conditions
                   A-2-24 - Reduce number of injuries due to road weather conditions
                   C-3-11 - Increase number of 511 calls per year
                   C-3-12 - Increase number of visitors to traveler information website per year

TSMO Goals and Objectives Supported
TSMO Goal: Carefully and Responsibly Manage Transportation Operations Assets
TSMO Objective: Acquire, secure, and retain the data needed for MnDOT to effectively
                   perform operations, performance management and planning

Service Package
- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information
- WX02 – Weather Information Processing and Distribution

ID: M05

Initiative: Congestion and Closure Information for Transit Dispatchers and Operators

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Support

Type: Deployment

Description
This initiative will provide real-time traffic congestion/ roadway closure information to Metro Transit dispatchers and bus operators. Traveler information currently collected and disseminated by the MnDOT RTMC will be sent to Metro Transit Control Center for use in suggesting more efficient transit routes to buses that will be affected by traffic congestion/ roadway closures. This initiative could also be expanded to serve suburban transit providers with traffic congestion/ roadway closure information. This initiative could be a component of the ICM initiative (S17).

Champion and Stakeholder
Champion: Metro Transit
Stakeholders: Metro Area Transit Providers, MnDOT

Dependency
This initiative is not dependent on any other initiatives.

Needs and Objectives Addressed
Need: TI21 - Make real-time transportation operations data available to other transportation system operators (i.e. interagency data sharing)
ITS Objectives: C-3-10 - Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region
                        G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning
                        G-1-06 - Reduce operations cost deviation

Service Package
• SU03 – Data Distribution

ID: M06

Initiative: Automated Data Interface between Local Public Safety CAD Systems and CARS

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Support

Type: Deployment

Description
This initiative will provide an automated data interface between CARS and local public safety CAD systems. Automated data interface between CARS and Minnesota State Patrol has been implemented statewide. This initiative will expand the automate data entry features from local public safety CAD systems to the CARS database to provide more complete and accurate information about incidents outside of the metro area. This initiative will also implement a data quality and consistency verification system as part of this effort. MnDOT CARS will automatically incorporate data from local public safety agencies' CAD systems, increasing the timeliness and accuracy of information in CARS.

Champion and Stakeholder
MnDOT, Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Needs: ATMS13 - Provide incident information to emergency management agencies
                ATIS12 - Share/integrate public safety CAD data with CARS
                ATIS16 - Improve quality, consistency and thoroughness of traveler information
ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                A-1-19 - Reduce number of all secondary crashes
                A-2-04 - Reduce number of fatalities due to unexpected congestion
                A-2-25 - Reduce number of injuries due to unexpected congestion
                B-4-01 - Reduce vehicle hours of delay per capita during evacuation from homeland security and Hazmat incidents
                C-1-01 - Reduce the vehicle hours of total delay associated with traffic incidents during peak and off-peak periods
                C-3-12 - Increase number of visitors to traveler information website per year
                D-2-03 - Increase the number of travelers routed around Hazmat incidents
                G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency

TSMO Objectives: Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Increase pre-trip and en-route traveler awareness of incidents and alternate options in both the Twin Cities and Greater Minnesota

Service Package

- SU03 – Data Distribution

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ID: M07

Initiative: Instrument Local Roads

SHSP

TSMO

Timeframe: Medium to Long Term – Year 5 and Beyond

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Intersections, Lane Departure, Speed-Related

ITS Service Area: Traveler Information, Traffic Management

Type: Deployment

Description
This initiative would expand the instrumentation of traffic detectors and roadway sensors to local arterial roads to gather traveler information on local roadways. Detectors collect data on traffic patterns, volumes, and vehicle speeds. This data would be utilized by local agencies to monitor roadway operations and aid to planning, design and maintenance of roadways. Local agencies could disseminate the information to the public via websites, social media, etc. Data could also be entered into the MnDOT Condition Acquisition and Reporting System (CARS) for dissemination to the public through the Minnesota 511 Telephone Information Service and Traveler Information Website.

Champion and Stakeholder
Champion: Local Agencies
Stakeholders: Local Agencies, MnDOT

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATIS22 - Include information on local roads in 511
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                  A-1-04 - Reduce number of crashes due to unexpected congestion
                  A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
                  A-1-19 - Reduce number of all secondary crashes
                  A-2-03 - Reduce number of fatalities due to road weather conditions
                  A-2-04 - Reduce number of fatalities due to unexpected congestion
                  A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
                  A-2-24 - Reduce number of injuries due to road weather conditions
                  A-2-25 - Reduce number of injuries due to unexpected congestion
                  A-2-39 - Reduce number of injuries due to roadway/geometric restrictions
                  B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                            experiencing recurring congestion during the peak period
                  C-3-11 - Increase number of 511 calls per year
                  C-3-12 - Increase number of visitors to traveler information website per year
                  D-2-03 - Increase the number of travelers routed around Hazmat incidents
                  D-2-04 - Increase the number of travelers routed around homeland security
                             incidents

TSMO Goals and Objectives Supported

<u>TSMO Goal:</u>   Improve Reliability, Mobility and Efficiency
<u>TSMO Objectives:</u>   Reduce the frequency of congestion or slowed traffic on the freeways and
                       arterials in metro areas throughout Minnesota
                       Increase availability of information about travel times to drivers

Service Package

- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information
- TM01 – Infrastructure-Based Traffic Surveillance

ID: M08

Initiative: Implement Enhanced Enforcement of Red Light Running at Intersections

Timeframe: Medium to Long Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Intersections, Safety Culture & Awareness

ITS Service Area: Traffic Management, Vehicle Safety

Type: Policy/Legislation, Deployment

Description

The purpose of this initiative is to prevent red light running and improve intersection safety by monitoring red light running, speed and aggressive driving and incorporating engineering, education, and enforcement countermeasures. The initiative is to identify signalized intersections where there have been higher than average crash rates, or have been identified as high risk through a data driven safety analysis or safety plan, and deploy portable or permanent photo/video monitoring systems that automatically mail citations to drivers running red lights.

The effort will require actions to explore if the City of Minneapolis plans to re-start their red light running (Stop on Red) program, and determine how Minneapolis red light running experience may affect future efforts to pursue automated enforcement and/or be implemented in other jurisdictions. There are legal restrictions on the issuance of citations when an officer is not physically present to witness the violation. In addition, institutional issues would be that some members of the public have been resistant to this approach to enforcing traffic violations under the auspices of privacy and accuracy of the technology.

To address the legal restrictions on the issuance of citations when an officer is not physically present to witness the violation, MnDOT is currently conducting a project to design and test an Enhanced Red Light Enforcement (ERLE) system. This system uses current off-the-shelf technology to support police officers in performing safe and effective onsite law enforcement by providing them with real-time red light violation monitoring and visual evidence. It is anticipated that the system can provide a non-disruptive and legally accepted approach to monitor red light violations and become highly focused in optimizing the time and monetary resources necessary for an enforcement program. The system is also anticipated to be operational in 2018 for use by law enforcement.

Champion and Stakeholder
Champion: Minnesota State Patrol
Stakeholders: Local Law Enforcement Agencies, Judicial System, Minnesota Department of Public Safety-Traffic Safety, MnDOT, Local Transportation Agencies

Dependency
This initiative is dependent upon authorized legislation to re-enforce automated red-light running violations. The City of Minneapolis deployed a system as an operational test from 2005 to 2006 which was de-activated when a 2006 legislative ruling declared tickets issued to vehicle owners, as opposed to the actual drivers that caused the violation, was illegal.

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Needs and Objectives Addressed

Need: ATMS02 - Implement red-light running technology

ITS Objectives: A-1-05 - Reduce number of crashes due to red-light running

                     A-1-10 - Reduce number of crashes at signalized intersections

                     A-2-05 - Reduce number of fatalities due to red-light running

                     A-2-11 - Reduce number of fatalities at signalized intersections

                     A-2-26 - Reduce number of injuries due to red-light running

                     A-2-32 - Reduce number of injuries at signalized intersections

                     A-2-44 - Reduce number of traffic law violations

TSMO Goals and Objectives Supported

TSMO Goal: Increase Safety

TSMO Objectives: Reduce the frequency of crashes at signalized and unsignalized intersections

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM03 – Traffic Signal Control
- VS13 – Intersection Safety Warning and Collision Avoidance

ID: M09

Initiative: Expand Video Monitoring at High Incident Locations

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open Decision-Making, Critical Connections

SHSP Focus Area: Intersections, Lane Departure, EMS Response & Trauma Systems

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will improve video monitoring at high incident locations throughout Minnesota. This includes providing video monitoring of rural high incident roadways and areas of high importance to RTMC, such as sections of I-35 to Rochester. This initiative may also include providing video images from local agencies to the RTMC and providing live motion video to the public over the Internet.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, MSP, Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed

Need: ATMS04 - Provide cameras at locations with high incidents and areas of high importance for incident identification and verification to improve operations

ITS Objectives: B-1-15 - Reduce mean incident notification time
B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification
B-1-17 - Reduce mean incident clearance time per incident
C-1-01 - Reduce the vehicle hours of total delay associated with traffic incidents during peak and off-peak periods
C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection / response
D-1-06 - Increase number of major and minor arterials that are equipped with and operating with video monitoring cameras

Service Package
- TM01 – Infrastructure-Based Traffic Surveillance
- TM08 – Traffic Incident Management System

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ID: M10

Initiative: ITS and Communications Coordination and Information Sharing for Incident Responses

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Intersections, Lane Departure, EMS Response & Trauma Systems

ITS Service Area: Traffic Management, Public Safety

Type: Deployment

Description
This initiative focuses on providing avenues of interagency coordination and sharing of ITS technologies (e.g. video monitoring, RWIS, DMS, EVP etc.) and communications (e.g. CAD to CAD from MSP to local law enforcement agencies) for incident response and clearance.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MSP, Local Law Enforcement Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed

Needs:
ATMS12 - Reduce clearance time for primary crashes
ATMS22 - Provide a system-coordinated response for incidents and emergencies

ITS Objectives:
B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification
B-1-17 - Reduce mean incident clearance time per incident
B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents
C-1-02 - Increase percentage of incident management agencies in the region that participate in a multi-modal information exchange network
C-1-03 - Increase percentage of incident management agencies in the region that use interoperable voice communications
C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection / response
D-2-05 - Reduce the Hazmat incident response time
D-2-06 - Reduce the homeland security incident response time

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

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Service Package

- TM08 – Traffic Incident Management System
- PS01 – Emergency Call-Taking and Dispatch
- PS03 – Emergency Vehicle Preemption

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ID: M11

Initiative: Alternate Route Database for CVO

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Commercial Vehicle Involved

ITS Service Area: Traffic Management, Commercial Vehicle Operations

Type: Deployment

Description
Develop CVO database incorporating roadway capacity, restrictions, construction information, and additional information to be used in recommending alternate routes for commercial vehicles.

Champion and Stakeholder
Champion: MnDOT Maintenance
Stakeholders: MnDOT OFCVO, Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS16 - Identify alternate routes
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                 A-1-04 - Reduce number of crashes due to unexpected congestion
                 A-2-03 - Reduce number of fatalities due to road weather conditions
                 A-2-04 - Reduce number of fatalities due to unexpected congestion
                 A-2-24 - Reduce number of injuries due to road weather conditions
                 A-2-25 - Reduce number of injuries due to unexpected congestion
                 B-1-17 - Reduce mean incident clearance time per incident
                 B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents
                 D-2-03 - Increase the number of travelers routed around Hazmat incidents
                 D-2-04 - Increase the number of travelers routed around homeland security incidents
                 E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on selected freight-significant highways

Service Package
- TM08 – Traffic Incident Management System
- CVO04 – AV Administrative Processes

ID: M12

Initiative: Emergency Management Alternate Route Database
Development

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open
Decision-Making, Critical Connections

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Traffic Management, Public Safety

Type: Deployment

Description
Develop emergency management database identifying roadways that are closed or congested
due to incidents, emergencies, evacuations or planned events.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MSP, Local EM Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS16 - Identify alternate routes
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                 A-1-04 - Reduce number of crashes due to unexpected congestion
                 A-2-03 - Reduce number of fatalities due to road weather conditions
                 A-2-04 - Reduce number of fatalities due to unexpected congestion
                 A-2-24 - Reduce number of injuries due to road weather conditions
                 A-2-25 - Reduce number of injuries due to unexpected congestion
                 B-1-17 - Reduce mean incident clearance time per incident
                 C-1-01 - Reduce the vehicle hours of total delay associated with traffic
                          incidents during peak and off-peak periods
                 D-2-03 - Increase the number of travelers routed around Hazmat incidents
                 D-2-04 - Increase the number of travelers routed around homeland security
                          incidents

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
TSMO Objective: Increase pre-trip and en-route traveler awareness of incidents and
                   alternate options in both the Twin Cities and Greater Minnesota

Service Package
- TM08 – Traffic Incident Management System
- PS13 – Evacuation and Reentry Management
- PS14 – Disaster Traveler Information

ID: M13

Initiative: Incident Response Vehicle Strategic Deployment

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will utilize and convert available crash location information in developing an operational guide used by MnDOT and emergency/incident response agencies to strategically deploy emergency vehicles at high-risk crash locations along the roadway.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, MSP, Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed

Need: ATMS22 - Provide system-coordinated response for incidents and emergencies

ITS Objectives: B-1-15 - Reduce mean incident notification time

               B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification

               B-1-17 - Reduce mean incident clearance time per incident

               B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents

               B-2-14 - Create a transportation access guide, which provides concise directions to reach destinations by alternative modes (transit, walking, bike, etc.)

               C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection / response

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency

TSMO Objective: Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Service Package
- TM08 – Traffic Incident Management System

ID: M14

Initiative: Expand Greater Minnesota Population Center Ramp Meter
Deployment

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative entails placing ramp meters on freeway on-ramps in population centers in greater Minnesota to mitigate congestion due to traffic, incidents or construction. Ramp meters work to increase freeway volumes, trip reliability, and freeway speeds, while decreasing travel time and crashes. Ramp meters have the potential to operate during the morning and evening peak traffic periods. Timing and operation of ramp meters in the metropolitan area is controlled by Intelligent Roadway Information System (IRIS) at the MnDOT RTMC.

Champion and Stakeholder
Champion: MnDOT

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS23 - Operate Ramp Meters
ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                 A-1-19 - Reduce number of all secondary crashes
                 A-2-04 - Reduce number of fatalities due to unexpected congestion
                 A-2-25 - Reduce number of injuries due to unexpected congestion
                 B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                         experiencing recurring congestion during the peak period
                 B-1-09 - Improve average travel time during peak periods
                 B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                         group of specific travel routes or trips in the region
                 B-2-24 - Increase AM/PM peak hour vehicle throughput on specified routes
                 C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane
                         highways

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                 Increase Safety
TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and
                 arterials in metro areas throughout Minnesota
                 Reduce the crashes related to congestion in Minnesota metro areas

Service Package
- TM05 – Traffic Metering

ID: M15

Initiative: Automated/Remote Operated Gate Systems

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Lane Departure, EMS Response & Trauma Systems

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will deploy automated/remote control gate systems at rural locations experiencing unsafe driving conditions. This system may include video monitoring cameras to assure safe operation.

Champion and Stakeholder
Champion: MnDOT

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS29 - Provide automated/remote control gate systems
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
          A-1-04 - Reduce number of crashes due to unexpected congestion
          A-2-03 - Reduce number of fatalities due to road weather conditions
          A-2-04 - Reduce number of fatalities due to unexpected congestion
          A-2-24 - Reduce number of injuries due to road weather conditions
          A-2-25 - Reduce number of injuries due to unexpected congestion
          B-1-15 - Reduce mean incident notification time
          B-4-01 - Reduce vehicle hours of delay per capita during evacuation from
               homeland security and Hazmat incidents
          C-1-01 - Reduce the vehicle hours of total delay associated with traffic
               incidents during peak and off-peak periods
          D-2-05 - Reduce the Hazmat incident response time
          D-2-06 - Reduce the homeland security incident response time

TSMO Goals and Objectives Supported
TSMO Goal: Increase Safety
TSMO Objective: Reduce the frequency of crashes related to road weather conditions

Service Package
• TM19 – Roadway Closure Management

ID: M16

Initiative: Integrated Payment System for MnPASS, Transit and Parking

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management, Parking Management, Public Transportation, Sustainable Travel

Type: Deployment

Description
This initiative will integrate various payment systems for transit, parking, and MnPASS into a single electronic payment system. Currently, MnPASS transponders that are mounted on the dashboards of vehicles traveling on MnPASS Lanes are used to electronically deduct variable toll amounts from separate accounts that are maintained by drivers. The same transponder used to pay the tolls could be used to pay parking fees at various parking ramps in the metro area and to pay for transit fares on board transit vehicles. Electronic readers currently exist on transit vehicles that allow passengers to swipe their transit card past the reader to pay the fare.

Drivers and transit passengers will benefit from a simple and integrated electronic payment system. Violation notifications of parking payments can be designed in the same way that violations are detected along MnPASS Lanes.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: City of Minneapolis, Metro Transit, Private Parking Operators

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS30 - Provide simple and integrated electronic payment systems
ITS Objectives: C-4-03 - Increase the number parking facilities with electronic fee collection
                  C-4-06 - Increase the number of parking facilities with coordinated electronic
                       payment systems

Service Package
- TM10 – Electronic Toll Collection
- PM03 – Parking Electronic Payment
- PT04 – Transit Fare Collection Management
- PT18 – Integrated Multi-Modal Electronic Payment
- ST06 – HOV/HOT Lane Management

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ID: M17

Initiative: Additional Air Quality Sensors at Strategic Locations

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Healthy Communities

ITS Service Area: Sustainable Travel

Type: Deployment

Description
This initiative will allow federal and state agencies to collect air quality data in selected locations to measure air pollution and emissions levels. Travelers will use air quality information to make travel and modal choices.

Champion and Stakeholder
Champion: Federal Agencies, Minnesota Pollution Control Agency (MPCA)
Stakeholders: MnDOT, Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS31 - Monitor and collect air quality data
ITS Objectives: H-1-06 - Reduce the amount of all emissions in the atmosphere
H-1-07 - Reduce the amount of carbon dioxide emissions measured

Service Package
- ST01 – Emissions Monitoring

ID: M18

Initiative: Curve Speed Warning Systems

TSMO

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Lane Departure, Speed-Related

ITS Service Area: Traffic Management, Vehicle Safety

Type: Deployment

Description
This initiative will focus on deploying speed warning systems at curves with recurring adverse roadway conditions, high crash rates, and/or identified through a safety planning process. Roadside equipment placed before the curve in the roadway can notify drivers of adverse roadway conditions through a combination of static information on the sign and flashing lights to indicate adverse conditions. Additional roadside equipment placed at the curve can detect adverse conditions and send a signal to the roadside equipment placed before the curve.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS32 - Provide curve speed warnings
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                    A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
                    A-2-03 - Reduce number of fatalities due to road weather conditions
                    A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
                    A-2-24 - Reduce number of injuries due to road weather conditions
                    A-2-39 - Reduce number of injuries due to roadway/geometric restrictions
                    C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.

TSMO Goals and Objectives Supported
TSMO Goal: Increase Safety
TSMO Objective: Reduce the frequency of single vehicle roadway departures

Service Package
- TM17 – Speed Warning and Enforcement
- VS05 – Curve Speed Warning

ID: M19

Initiative: Flood Warning Systems

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Management Systems

ITS Service Area: Traffic Management, Maintenance and Construction

Type: Deployment

Description
This initiative will place flood warning systems at locations with a history of flooding. The flood warning systems will detect potential and actual flood of roadways and alert state and local agencies to divert travelers to alternate roadways. This initiative will also allow automated data entry regarding flood information and alternate routes into the statewide 511 system.   A system currently exists on TH 59 and TH 60 near Worthington that automatically detects a rise in water level and issues an alert based on commands from the Mankato Signal Center in District 7. A system is also planned in Mower County that would alert the Mower County dispatch center and trigger advanced warning signs (static signs with flashing beacons) to alert approaching vehicles. This planned system would also include communication and utilities at both the flood-warning sensor and the static warning signs with flashing beacons.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS34 - Provide roadway flood warnings
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                  A-2-03 - Reduce number of fatalities due to road weather conditions
                  A-2-24 - Reduce number of injuries due to road weather conditions
                  C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.

Service Package
- TM06 – Traffic Information Dissemination
- TM12 – Dynamic Roadway Warning
- MC09 – Infrastructure Monitoring

ID: M20

Initiative: Additional Installation of Highway Rail Intersection (HRI) Monitoring
Equipment

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Intersections, Bicycle Involved, Train Involved

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will allow MnDOT to detect faults in the HRI equipment and send maintenance
crews to make appropriate repairs. Local agencies and railroad companies will perform health
monitoring of rail crossings.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies, Railroad Companies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
<u>Need</u>:   ATMS38 - Provide health monitoring of rail crossings
<u>ITS Objectives</u>:   A-1-09 - Reduce number of crashes at railroad crossings
                A-2-10 - Reduce number of fatalities at railroad crossings
                A-2-31 - Reduce number of injuries at railroad crossings

Service Package
- TM13 – Standard Railroad Grade Crossing
- TM14 – Advanced Railroad Grade Crossing

ID: M21

Initiative: Queue Length at Ramps, Incident and Work Zones

SHSP

TSMO

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, Critical Connections

SHSP Focus Area: Inattentive Drivers, Speed-Related, Work Zones

ITS Service Area: Traffic Management, Maintenance and Construction

Type: Deployment

Description
This initiative will deploy enhanced queue detection technology to monitor queues at ramps, incidents (i.e. crashes, congestion etc.) maintenance and construction projects. Lengthy vehicle queues can result in increased traffic congestion and potential risks to traffic safety. Automated monitoring of queues can provide traffic management personnel and maintenance and construction personnel of potential changes that will need to be made to reduce traffic queues at certain areas.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS39 - Monitor queue length at ramps, incident scenes, and work zones
ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                  A-2-04 - Reduce number of fatalities due to unexpected congestion
                  A-2-25 - Reduce number of injuries due to unexpected congestion
                  A-3-01 - Reduce number of crashes in work zones
                  A-3-02 - Reduce number of fatalities in work zones
                  A-3-03 - Reduce number of motorist injuries in work zones
                  A-3-04 - Reduce number of workers injured by vehicles in work zones
                  B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak)
                       caused by work zones
                  C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane
                       highways

TSMO Goals and Objectives Supported
TSMO Goal: Increase Safety
TSMO Objectives: Reduce the crashes related to congestion in Minnesota metro areas
                    Reduce the frequency of secondary crashes and crashes related to work
                       zones

Service Package

- TM01 – Infrastructure-Based Traffic Surveillance
- TM12 – Dynamic Roadway Warning
- MC06 – Work Zone Management

ID: M22

Initiative: Expand Total Stations and Photogrammetry Deployment

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Data Management

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will make Total Stations and/or photogrammetry (including using unmanned aerial systems – UASs or drones) available to public safety agencies for incident investigation, crash scene reconstruction and documentation. Currently, these systems are not distributed to all agencies that could use them.

Champion and Stakeholder
Champion: MSP
Stakeholders: Local Law Enforcement Agencies

Dependency
This initiative is not dependent upon any other initiatives

Needs and Objectives Addressed
Need: ATMS41 - Improve incident investigation capabilities
ITS Objectives: A-2-44 - Reduce number of traffic law violations
                          B-1-17 - Reduce mean incident clearance time per incident

TSMO Goals and Objectives Supported
TSMO Goal: Increase Safety
TSMO Objective: Reduce responder exposure

Service Package
- TM08 – Traffic Incident Management System

ID: M23

Initiative: Detectors for Speed Data Collection at High Incident Locations

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, Critical Connections

SHSP Focus Area: Speed-Related, Management Systems

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will install speed detection systems at locations with history of high incidents and incidents with high speeds. The purpose of the initiative is to collect and analyze speed data at those locations to investigate and evaluate counter measures to reduce incidents, in particular with those of high speeds.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Dependency
This initiative is not dependent upon any other initiatives

Needs and Objectives Addressed
Need: ATMS42 - Use roadside data collectors to determine locations with high
                                  incident of speeding
ITS Objectives: A-2-44 - Reduce number of traffic law violations
                            C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane
                                  highways
                            G-1-01 - Increase the amount of data gathered from ITS enhancements used
                                  in infrastructure and operations planning

Service Packages
- TM01 – Infrastructure-Based Traffic Surveillance
- TM17 – Speed Warning and Enforcement

ID: M24

Initiative: CVO Database Enhancement

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Open Decision-Making, System Stewardship

SHSP Focus Area: Commercial Vehicle Involved

ITS Service Area: Commercial Vehicle Operations, Data Management

Type: Deployment

Description
This initiative will implement ways to improve efficiency of using multiple databases, such as the Motor Carrier Management Information System (MCMIS), to identify vehicles or operators with safety issues. This enhanced database system will also perform analysis and identification of carriers, vehicles, and drivers that have a high level of violations, and thus provide assistance to enforcement agencies to perform target enforcement. MnDOT and MSP currently use databases such as PRISM (Performance and Registration information Systems Management) and SAFER (Safety and Fitness Electronic Records) to query vehicle or operator safety issues.

Champion and Stakeholder
Champion: MnDOT OFCVO
Stakeholders: Minnesota State Patrol

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Needs: CF04 - Target enforcement on carriers, vehicles and drivers with history of
       violations and poor safety records
      CF07 - Provide safety information from CVO databases to roadside and
       enforcement vehicles/personnel
ITS Objectives: A-1-06 - Reduce number of crashes involving large trucks and buses
      A-2-06 - Reduce number of fatalities involving large trucks and buses
      A-2-27 - Reduce number of injuries involving large trucks and buses
      D-1-04 - Reduce the number of reported personal safety incidents
      D-1-05 - Decrease the number of security incidents on roadways
      D-2-01 - Reduce the number of Hazmat incidents
      D-2-02 - Reduce the number of homeland security incidents
      D-2-07 - Increase the number of Hazmat shipments tracked in real-time
      E-2-02 - Increase the percent (or number) of freight shipment tracked
      E-2-06 - Reduce the frequency of delays per month at intermodal facilities
      E-2-07 - Reduce the average duration of delays per month at intermodal
       facilities
      E-4-02 - Reduce the number of pavement miles damaged by commercial
       vehicles
      F-1-01 - Decrease the number of pavement miles damaged by commercial
       vehicles

Service Package

- CVO04 – CV Administrative Processes
- CVO07 – Roadside CVO Safety
- DM01 – ITS Data Warehouse

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ID: M25

Initiative: Work Zone Restriction Information Automation

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: Commercial Vehicle Involved, Work Zones

ITS Service Area: Commercial Vehicle Operations

Type: Deployment

Description
This initiative will automate the entry of commercial vehicle restriction data due to work zones into CARS and the Automated Permit Routing System. Permitted commercial vehicle operators and oversize/ overweight vehicles currently use the Automated Permit Routing System to generate route information based on size and weight requirements. Work zone information will help generate more accurate routes for commercial vehicles.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Dependency
This initiative could be built upon Initiative S34: Enhance Automated Permit Routing System.

Needs and Objectives Addressed
Need: CF13 - Provide size and weight restrictions due to work zones for permitted
                         loads
ITS Objectives: A-1-06 - Reduce number of crashes involving large trucks and buses
                  A-2-06 - Reduce number of fatalities involving large trucks and buses
                  A-2-27 - Reduce number of injuries involving large trucks and buses
                  C-3-12 - Increase number of visitors to traveler information website per year
                  E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on
                            selected freight-significant highways
                  F-1-02 - Decrease the number of size and weight violations

Service Package
- CVO01 – Carrier Operations and Fleet Management

ID: M26

Initiative: Commercial Vehicles as Probes

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Commercial Vehicle Involved

ITS Service Area: Commercial Vehicle Operations, Traffic Management

Type: Deployment

Description

This initiative will utilize private fleet management vehicle GPS systems to provide MnDOT with anonymous probe traffic data. This data would provide MnDOT with more accurate information on travel conditions on metro area freeways. MnDOT will need to develop a partnership with private trucking companies.

Champion and Stakeholder

Champion: MnDOT OFCVO
Stakeholders: Private Trucking Companies

Dependency

This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed

Need: CF16 - Track commercial fleet
ITS Objectives: A-1-06 - Reduce number of crashes involving large trucks and buses
                      A-2-06 - Reduce number of fatalities involving large trucks and buses
                      A-2-27 - Reduce number of injuries involving large trucks and buses
                      D-1-08 - Reduce the number of security incidents on transportation
                                   infrastructure
                      D-2-03 - Increase the number of travelers routed around Hazmat incidents
                      D-2-04 - Increase the number of travelers routed around homeland security
                                   incidents

Service Package

- CVO01 – Carrier Operations and Fleet Management
- TM02 – Vehicle-Based Traffic Surveillance

ID: M27

Initiative: RFID Tags for Identification of HAZMAT Materials

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Commercial Vehicle Involved

ITS Service Area: Commercial Vehicle Operations

Type: Deployment

Description
This initiative will focus on developing Radio Frequency Identification (RFID) tags that will help identify HAZMAT materials that may be involved commercial vehicle rollovers and incidents. RFID tags are objects that can be applied to or incorporated into a product for the purpose of identification and tracking using radio waves. In the event of a HAZMAT incident, local maintenance, law enforcement and emergency response agencies will be notified of the incident and have the ability to quickly identify type(s) of hazardous materials carried by a commercial vehicle involved in an incident or at an inspection request.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Law Enforcement and Emergency Management Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: CF17 - Manage HAZMAT Incidents
ITS Objectives: A-1-06 - Reduce number of crashes involving large trucks and buses
                    A-2-06 - Reduce number of fatalities involving large trucks and buses
                    A-2-27 - Reduce number of injuries involving large trucks and buses
                    B-1-15 - Reduce mean incident notification time
                    D-2-01 - Reduce the number of Hazmat incidents
                    D-2-03 - Increase the number of travelers routed around Hazmat incidents
                    D-2-05 - Reduce the Hazmat incident response time
                    E-2-02 - Increase the percent (or number) of freight shipment tracked

Service Package
- CVO01 – Carrier Operations and Fleet Management
- CVO12 – HAZMAT Management

ID: M28

Initiative: Enhanced Crash Database

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open Decision-Making

SHSP Focus Area: Data Management

ITS Service Area: Data Management

Type: Deployment

Description
This initiative will investigate the use of advanced equipment to more efficiently collect crash data while minimizing the amount of field investigation time needed. Minnesota State Patrol (MSP) and other law enforcement agencies currently collect relevant information during investigations of crashes. This initiative will provide MSP and local law enforcement the ability to collect and enter more detailed data regarding crashes involving commercial vehicles into crash databases.

Champion and Stakeholder
Champion: MSP/DPS
Stakeholders: MnDOT

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed

Need:	CF19 - Improve quality and accessibility of commercial vehicle-related crash data
ITS Objectives:	A-1-06 - Reduce number of crashes involving large trucks and buses
	A-2-06 - Reduce number of fatalities involving large trucks and buses
	A-2-27 - Reduce number of injuries involving large trucks and buses
	G-1-03 - Increase the number of years of data in database that is easily searchable and extractable
	G-1-06 - Reduce operations cost deviation

Service Package
- DM01 – ITS Data Warehouse

ID: M29

Initiative: Enhance Commercial Vehicle Shipment Performance

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: System Stewardship, Transportation Safety, Critical Connections

ITS Service Area: Commercial Vehicle Operations

Type: Deployment

Description
This initiative will improve the timeliness and accuracy of shipment information to provide better data for commercial vehicle shipment performance analysis. This initiative will also provide new types of freight shipment data for new analysis and planning. MnDOT Office of Commercial Vehicle Operations (OFCVO) currently obtains information on freight movement and analyzes it to develop strategies and performance measures for MnDOT's role in improving or augmenting freight movement.

Champion and Stakeholder
Champion: MnDOT OFCVO

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: CF20 - Measure historic commercial vehicle shipment performance
ITS Objectives: E-2-02 - Increase the percent (or number) of freight shipment tracked
                       G-1-01 - Increase the amount of data gathered from ITS enhancements used in infrastructure and operations planning
                       G-1-02 - Increase the number of planning activities using data from ITS systems
                       G-1-06 - Reduce operations cost deviation
                       G-1-07 - Reduce administrative support rate (as part of overall project budget)

Service Package
- CVO01 – Carrier Operations and Fleet Management
- CVO04 – CV Administrative Processes

ID: M30

Initiative: Evacuation/Reentry Real-time Information ITS Systems

Timeframe: Medium Term – Years 5-7

Multimodal Transportation Objective: System Stewardship, Transportation Safety, Open Decision-Making, Critical Connections

ITS Service Area: Public Safety

Type: Deployment

Description
This initiative will develop systems to recommend alternate routes based on real-time traffic information and historic travel information. This initiative will also enhance evacuation/ reentry simulations to provide better information. Travelers use this service to determine time to travel and routes to take during evacuation and reentry.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, MSP, Minnesota DPS, Local Emergency Management Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: PSFT09 - Provide emergency/evacuation and reentry information
ITS Objectives: D-2-03 - Increase the number of travelers routed around Hazmat incidents
                 D-2-04 - Increase the number of travelers routed around homeland security incidents
                 E-1-03 - Decrease the annual average travel time index for selected freight-significant highways
                 E-1-04 - Decrease point-to-point travel times on selected freight-significant highways
                 E-1-05 - Decrease hours of delay per 1,000 vehicle miles traveled on selected freight-significant highways

Service Package
- PS14 – Disaster Traveler Information

ID: M31

Initiative: Enhanced Mayday Notification Assistance

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Public Safety

Type: Deployment

Description
This initiative will deploy an Enhanced Mayday system (i.e. Next-Generation 911) to process data and voice messages from commercial systems to provide automatic crash location and severity notification. This information would reduce incident response time for local emergency responders and provide them with more information to provide appropriate response. A uniform, real-time automated crash notification system can be an extension of the current Mayday System.

Champion and Stakeholder
Champion: Minnesota State Patrol
Stakeholders: PSAPs, First Responders, MnDOT, Local Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: PSFT03 - Provide enhanced Mayday services
ITS Objectives: B-1-15 - Reduce mean incident notification time
                  B-1-16 - Reduce mean time for needed responders to arrive on-scene after
                     notification

Service Package
• PS04 – Mayday Notification

ID: M32

Initiative: AVL Systems for Local Emergency Responders

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open Decision-Making

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Public Safety

Type: Deployment

Description
This initiative will deploy AVL systems to local emergency responding agencies. AVL will assist local emergency response agencies in tracking resources. AVL in coordination with Computer Aided Dispatch (CAD) will also assist in reducing incident response time and effectively providing resources to emergency response. Minnesota State Patrol vehicles already have CAD.

Champion and Stakeholder
Champion: Local Emergency Management Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: PSFT06 - Provide AVL to emergency vehicles
ITS Objectives: B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification
                  B-1-17 - Reduce mean incident clearance time per incident
                  E-4-07 - Increase the number of vehicles operating under CAD

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Service Package
- PS01 – Emergency Call-Taking and Dispatch
- PS02 – Routing Support for Emergency Responders

ID: M33

Initiative: Wireless Digital Feeds Between MSP and Local EM
Responders

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Public Safety

Type: Deployment

Description
This initiative will enhance the coordination and data sharing capability between emergency management responders. It will complete the conversion of data transmissions to digital format and deploy additional stations/repeaters and transmitters in area where topography limits transmissions. This will ensure coverage in non-urban areas and allow transmission of more data between agencies.

Champion and Stakeholder
Champion: MSP
Stakeholders: MSP, Local Emergency Management Agencies, MnDOT

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: PSFT11 - Provide wireless digital feed between patrol and emergency responder vehicles and dispatch centers
ITS Objectives: B-1-15 - Reduce mean incident notification time
                  B-1-17 - Reduce mean incident clearance time per incident
                  C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection / response

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objectives: Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Service Package
- PS01 – Emergency Call-Taking and Dispatch
- PS12 – Disaster Response and Recovery
- TM08 – Traffic Incident Management System

ID: M34

Initiative: Local Agency Public Works AVL Equipment

Timeframe: Medium Term – Years 5-8

Multimodal Transportation Objective: System Stewardship, Transportation Safety, Open Decision-Making

ITS Service Area: Maintenance and Construction

Type: Deployment

Description
This initiative will install Automated Vehicle Locator (AVL) devices in local agency-level maintenance vehicles in order to fully maximize available resources during snowfall and icy conditions. Local agencies can take advantage of lessons learned from MnDOT which is in the process of expanding the deployment of AVL systems on their maintenance vehicles throughout the state.

Champion and Stakeholder
Champion: Local Agencies

Dependency
This initiative could leverage on the statewide deployment of AVL technology on MnDOT maintenance vehicles (S45).

Needs and Objectives Addressed
Need: MCM01 - Track locations of maintenance fleet and personnel and usage of
                                  materials
ITS Objectives: E-4-04 - Increase the rate at which equipment is utilized
                          E-4-07 - Increase the number of vehicles operating under CAD

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                            Increase Safety
TSMO Objectives: Reduce the impacts of snow and ice on mobility
                              Reduce the frequency of crashes related to road weather conditions

Service Package
- MC01 – Maintenance and Construction Vehicle and Equipment Tracking

ID: M35

Initiative: Use Agency Vehicles as Data Probes

Timeframe: Medium to Long Term

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Lane Departure, Data Management, Management Systems

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will equip maintenance and other agency vehicles with sensors/connected vehicle technology to gather traffic data for traveler information as they drive. Types of data could include pavement conditions during inclement weather and travel speeds of maintenance and other agency vehicles. This data would then be entered into the MnDOT Condition Acquisition and Reporting System (CARS) for dissemination to the public through the Minnesota 511 Telephone Information Service and Traveler Information Website. This initiative would increase detection coverage in Greater Minnesota. MnDOT plans to implement connected vehicle technology on snowplows as part of the Connected Corridor Initiative (S62).

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local EM Agencies

Dependency
This initiative can be part of or support the implementation of S62 – Connected Corridor Initiative.

Needs and Objectives Addressed
Need: ATIS14 - Expand traveler information coverage in Greater Minnesota
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                A-1-04 - Reduce number of crashes due to unexpected congestion
                A-1-19 - Reduce number of all secondary crashes
                A-2-03 - Reduce number of fatalities due to road weather conditions
                A-2-04 - Reduce number of fatalities due to unexpected congestion
                A-2-24 - Reduce number of injuries due to road weather conditions
                A-2-25 - Reduce number of injuries due to unexpected congestion
                B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.) experiencing recurring congestion during the peak period
                C-3-09 - Increase the percent of the transportation system in which travel conditions can be detected remotely via video monitoring cameras, speed detectors, etc.

Service Package
- TM02 – Vehicle-Based Traffic Surveillance

ID: M36

Initiative: Provide Real-Time Information to Equipped Vehicles
That Deliver Warnings to Drivers

Timeframe: Medium Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Lane Departure, Inattentive Drivers, Speed-Related, Pedestrian Involved,
Commercial Vehicle Involved, Work Zones

ITS Service Area: Vehicle Safety

Type: Research, Operational Test

Description

This system includes technologies to notify drivers of the posted speed limit based on their locations. Other notifications could include indications of an unsafe area ahead, such as hazardous roadway locations, alignment changes, upcoming work zones, crash spots, or bridge surface conditions. Technologies have been developed and implemented for vehicles and infrastructures to help drivers recognize infrastructure features, traffic-control devices, and other key environmental elements surrounding the vehicle by providing drivers with real-time visual or audio warning information.

MnDOT performed a Mileage Based User Fee Demonstration in 2011, in which drivers elected to have smartphones installed within their vehicles that provided audible messages to drivers notifying them of the speed limit, as well as the presence of school zones, construction zones, and upcoming right or left curves in the roadway. The primary purpose of the demonstration was to measure the mileage driven by participants and assess a mileage-based fee using the GPS capability of the smartphones installed in the vehicles.

This initiative will require actions to identify what other types of information may be provided (i.e., speed limits, road conditions, etc.), assess the quality (i.e., consistency, accuracy, reliability, etc.) of information that may be provided, determine if information will be provided for all, most or some public roads, and propose the delivery of information to the automotive industry and information service providers to gauge their interest.

Some institutional issues need to be considered include human factors implications, careful design that will be necessary to avoid driver distraction or confusion from the additional feedback, accurate roadway characteristics and daily conditions that will be necessary to make information reliable and maintaining information to specific levels of accuracy or quality that will have staffing implications. Additional institutional issues include providing information on all, most or some public roads to be decided as this that will impact city, county and state staff, and delivering information that will be dependent upon the automotive industry and information service providers.

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Champion and Stakeholder
Champion: MnDOT State Traffic Engineer
Stakeholders: Automotive industry, Information service providers (i.e., Google, Traffic.com, etc.), Minnesota Department of Public Safety-State Patrol, City transportation agencies, County transportation agencies

Dependency
This initiative is related to and can be built upon the MnDOT Connected Corridor Initiative (S62).

Needs and Objectives Addressed
Need: CEA 5 – Increasing Driver Safety Awareness and Improving Information Systems
ITS Objectives: A-1-14 – Reduce number of crashes related to driver inattention and distraction
                  A-1-17 – Reduce number of crashes due to roadway/geometric restrictions
                  A-2-15 – Reduce number of fatalities related to driver inattention and distraction
                  A-2-18 – Reduce number of fatalities due to roadway/geometric restrictions
                  A-2-36 – Reduce number of injuries related to driver inattention and distraction
                  A-2-39 – Reduce number of injuries due to roadway/geometric restrictions
                  A-3-01 – Reduce number of crashes in work zones
                  A-3-02 – Reduce number of fatalities in work zones
                  A-3-03 – Reduce number of motorist injuries in work zones

TSMO Goals and Objectives Supported
TSMO Goal: Increase Safety
TSMO Objectives: Reduce the frequency of secondary crashes and crashes related to work zones
                  Reduce the frequency of single vehicle roadway departures
                  Reduce the frequency of crashes related to road weather conditions

Service Package
- VS02 – V2V Basic Safety
- VS03 – Situational Awareness
- VS04 – V2V Special Vehicle Alert
- VS05 – Curve Speed Warning
- VS06 – Stop Sign Gap Assist
- VS07 – Road Weather Motorist Alert and Warning
- VS08 – Queue Warning
- VS09 – Reduced Speed Zone Warning / Lane Closure
- VS10 – Restricted Lane Warnings
- VS13 – Intersection Safety Warning and Collision Avoidance
- MC06 – Work Zone Management
- WX03 – Spot Weather Impact Warning

ID: M37

Initiative: Blow Ice Signalized Warning System

Timeframe: Medium Term

Multimodal Transportation Objective: Transportation Safety

ITS Service Area: Vehicle Safety

Type: Deployment

Description
Roadway segments with unique land use can experience snow and sleet blowing across the road and creating slippery conditions in a relatively short section when the rest of the highway is clear and dry. For example, this phenomenon can be problematic when there is an open farm field on one side of the roadway with prevailing winds blowing toward the roadway. This condition is commonly referred to as blow ice. Not only does this condition violate driver's expectations increasing risks of crashes and injuries, it also prevents MnDOT from obtaining their goal of clear roadways during the winter months. This project will install pavement condition sensors that monitor the pavement status and active warning signs that alert drivers to the icy conditions. System activations will be sent to the corresponding maintenance shop to assist in decisions on scheduling of maintenance vehicle activity.

Project Champion and Stakeholder
Champion: MnDOT
Stakeholders: MSP, Dassel-Cokato High School Community, and Travelers

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: WTR01 – Provide automated monitoring of road weather conditions

ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                 A-2-03 - Reduce number of fatalities due to road weather conditions
                 A-2-24 - Reduce number of injuries due to road weather conditions
                 C-3-09 - Increase the percent of the transportation system in which travel
                          conditions can be detected remotely via video monitoring cameras,
                          speed detectors, etc.
                 C-3-15 - Increase the number of specifically tailored traveler information
                          messages provided

TSMO Goals and Objectives Supported
TSMO Goal: Increase Safety
TSMO Objective: Reduce the frequency of crashes related to road weather conditions

Service Package
- WX01 – Weather Data Collection
- WX02 – Weather Information Processing and Distribution
- TM12 – Dynamic Roadway Warning

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ID: M38

Initiative: Implement Improved Lane Guidance System

Timeframe: Medium Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Lane Departure, Vehicle Safety Enhancements

ITS Service Area: Vehicle Safety

Type: Research, Deployment

Description
The lane guidance technology is anticipated to provide greater mobility benefits as Connected Vehicle technology improves. Current discussions regarding the deployment of Connected Vehicle technology include a path from current autonomous adaptive cruise control (ACC) systems to full automation with mobility benefits at each stage of the deployment. The lane guidance concepts currently under development include assisted lateral control, adaptive cruise control, full assistance with driver vigilance, gap creation, individualized traffic flow encouragement, intelligent speed and advisory control, intersection reservation, and enhanced work zone operation.

This initiative is to provide drivers/vehicles with route guidance through the use of connected and automated vehicle technology. The effort will require actions to explore current directions being taken for the national Connected Vehicle initiative, determine if and how Minnesota will attempt to secure federal funding related to the national Connected Vehicle initiative.

This initiative should be closely coordinated with national Connected Vehicle efforts. There may be considerable infrastructure cost associated with implementing this initiative and coordination with the automotive industry will be necessary for this initiative to determine how road infrastructure will integrate with vehicles.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Automotive Industry, University Research Facilities

Dependency
This initiative is dependent upon further research and development of the Connected Vehicle Initiative led by the FHWA.

Needs and Objectives Addressed
Needs: APTS13 – Provide collision avoidance assistance for transit vehicles
                CF08 – Provide collision avoidance assistance for commercial vehicles
ITS Objectives: A-1-08 – Reduce number of crashes due to inappropriate lane departure, crossing and merging
                A-1-16 – Reduce number of crashes at intersections due to inappropriate crossing
                A-2-09 – Reduce number of fatalities due to inappropriate lane departure, crossing and merging

A-2-17 – Reduce number of fatalities at intersections due to inappropriate crossing

A-2-30 – Reduce number of injuries due to inappropriate lane departure, crossing and merging

A-2-38 – Reduce number of injuries at intersections due to inappropriate crossing

TSMO Goals and Objectives Supported

<u>TSMO Goal:</u>   Increase Safety

<u>TSMO Objective:</u>   Reduce the frequency of single vehicle roadway departures

Service Package

- VS01 – Autonomous Vehicle Safety Systems
- VS14 – Cooperative Adaptive Cruise Control
- VS15 – Infrastructure Enhanced Cooperative Adaptive Cruise Control
- VS16 – Automated Vehicle Operations

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ID: M39

Initiative: State Crash Report and MN-CRASH Software Enhancements

Timeframe: Medium Term

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open Decision-Making

ITS Service Area: Public Safety, Data Management

Type: Research, Deployment

Description
This initiative will modify and enhance the State Crash Reports and MN-CRASH Software to include the following additional data points:

- Time lanes were clear and available to traffic
- Time incident was fully cleared and no longer visible to traffic
- Information on if the crash was a "secondary incident"
- Information on if the crash was a "secondary incident" involving an emergency response vehicle

Law enforcement will be able to use the enhanced MN-CRASH software and plug-ins to electronically submit crash reports and use tools to analyze the data and generate reports. This initiative supports SHPR2 and the FHWA Everyday Counts (EDC) initiative.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MSP

Dependency
This initiative is dependent upon further research and development of the Connected Vehicle Initiative led by the FHWA.

Needs and Objectives Addressed

Need: PSFT01 - Provide CAD to CAD integration for multi-agency coordination at major incidents

ITS Objectives: B-1-15 - Reduce mean incident notification time
                      B-1-16 - Reduce mean time for needed responders to arrive on-scene after notification
                      B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway incidents

Service Package
- TM08 – Traffic Incident Management System
- DM01 – ITS Data Warehouse

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ID: L01

Initiative: Route-specific Weather Information for Travelers

Timeframe: Long Term – Year 9 and Beyond

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Management Systems

ITS Service Area: Traveler Information, Weather

Type: Deployment

Description
This initiative will enhance 511 and evolve from county-wide condition reports to route-specific weather reports. Route-specific reports will include information on current conditions and forecasted roadway conditions. This more focused weather information will provide travelers better information for them to plan their trips.

Champion and Stakeholder
Champion: MnDOT

Dependency
This initiative is dependent upon deployments of road weather data collection systems on specific routes.

Needs and Objectives Addressed
Need: ATIS04 - Provide current and forecast road and weather conditions information
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                  A-2-03 - Reduce number of fatalities due to road weather conditions
                  A-2-24 - Reduce number of injuries due to road weather conditions
                  C-3-15 - Increase the number of specifically tailored traveler information messages provided

TSMO Goals and Objectives Supported
TSMO Goals: Increase Safety
TSMO Objective: Reduce the frequency of crashes related to road weather conditions

Service Package
- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information
- WX02 – Weather Information Processing and Distribution

ID: L02

Initiative: 511 Expansion to Local Roads

Timeframe: Long Term

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical
Connections

SHSP Focus Area: Intersections, Management Systems

ITS Service Area: Traveler Information

Type: Deployment

Description
This initiative will focus on enhancing the current 511 telephone and website information system
by adding traveler information for minor arterial roads and/or County roads within the metro area
and in Greater Minnesota through expansion of the Condition Acquisition and Reporting System
(CARS) or adding data acquired from private sector partners. As information on these local
roads is reported, MnDOT will expand coverage of the traffic flow map to include those
additional roadways within the Metro area and in Greater Minnesota as well. This initiative will
require the establishment of real-time or near real-time data sharing between MnDOT and local
agencies on road conditions.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: Local Agencies

Dependency
Availability of real-time information depends on instrumentation of local roads (Initiative M07).

Needs and Objectives Addressed
Need: ATIS22 - Include information on local roads in 511
ITS Objectives: A-1-03 - Reduce number of crashes due to road weather conditions
                      A-1-04 - Reduce number of crashes due to unexpected congestion
                      A-1-17 - Reduce number of crashes due to roadway/geometric restrictions
                      A-1-19 - Reduce number of all secondary crashes
                      A-2-03 - Reduce number of fatalities due to road weather conditions
                      A-2-04 - Reduce number of fatalities due to unexpected congestion
                      A-2-18 - Reduce number of fatalities due to roadway/geometric restrictions
                      A-2-24 - Reduce number of injuries due to road weather conditions
                      A-2-25 - Reduce number of injuries due to unexpected congestion
                      A-2-39 - Reduce number of injuries due to roadway/geometric restrictions
                      B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                               experiencing recurring congestion during the peak period
                      C-3-11 - Increase number of 511 calls per year
                      C-3-12 - Increase number of visitors to traveler information website per year
                      D-2-03 - Increase the number of travelers routed around Hazmat incidents
                      D-2-04 - Increase the number of travelers routed around homeland security
                               incidents

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Increase availability of information about travel times to drivers

Service Package

- TI01 – Broadcast Traveler Information
- TI02 – Personalized Traveler Information

ID: L03

Initiative: Enhanced Traveler Information for Transit and Other Modes

Timeframe: Long Term

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traveler Information, Public Transportation

Type: Deployment

Description
This initiative will enhance the provision of traveler information through the MnDOT 511 Telephone Information Service and Traveler Information Website by providing travel information on public transit and other modes of transportation, as well as personalized travel information for customers. Types of public transit information could include real-time bus departure information currently provided by Metro Transit to passengers through their website (NexTrip), customer telephone information system, and mobile application. Information on other modes of transportation could include the locations of existing and planned bicycle-only lanes in the metro area. Personalized travel information can be provided through individual accounts for customers that frequently request travel information specific to their daily travel patterns. This enhanced traveler information will also be disseminated to other Information Service Providers (ISPs) that currently receive real-time data from the MnDOT 511 system.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Metro Area Transit Providers, Local Transit Providers

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATIS19 - Provide different alternatives to travelers for the most appropriate
                               route/mode/time of travel
ITS Objectives: B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                               experiencing recurring congestion during the peak period
                        B-1-02 - Reduce the percentage of Twin Cities freeway miles congested in
                               weekday peak periods
                        C-3-10 - Increase the percent of transportation facilities whose owners share
                               their traveler information with other agencies in the region
                        C-3-14 - Increase the number of transit routes with information being
                               provided by ATIS

Service Package
- TI01 – Broadcast Traveler Information
- TI04 – Infrastructure-Provided Trip Planning and Route Guidance
- PT08 – Transit Traveler Information

ID: L04

Initiative: Priced Dynamic Shoulder Lanes Expansion

Timeframe: Long Term

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description

MnDOT has deployed Priced Dynamic Shoulder Lanes (PDSLs) along I-35W between downtown Minneapolis and the 46th St. S. interchange through the Urban Partnership Agreement (UPA) between the USDOT, MnDOT, and the Metropolitan Council of the Twin Cities. This initiative will focus on expanding the deployment of PDSLs to other corridors.

MnDOT RTMC will operate the PDSLs to allow single occupancy vehicles (SOVs) to use the shoulders in order to reduce overall congestion and divert traffic from other lanes during traffic incidents. Transit vehicles, high occupancy vehicles (HOVs), and motorcycles will be able to use the lanes free of charge. SOV drivers will be able to enter the lanes for a fee based on the level of traffic congestion along the PDSL corridor.

Champion and Stakeholder

Champion: MnDOT

Dependency

This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed

Needs: ATMS07 - Provide lane and shoulder control
                 ATMS20 - Operate dynamic shoulders
ITS Objectives: B-1-02 - Reduce the percentage of Twin Cities freeway miles congested in
                          weekday peak periods
                 B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                          group of specific travel routes or trips in the region
                 B-2-19 - Increase the number of carpools
                 B-2-20 - Increase use of vanpools
                 B-2-23 - Increase vehicle throughput on specified routes
                 B-2-24 - Increase AM/PM peak hour vehicle throughput on specified routes
                 B-2-25 - Increase AM/PM peak hour person throughput on specified routes

TSMO Goals and Objectives Supported

TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce the frequency of congestion or slowed traffic on the freeways and
                   arterials in metro areas throughout Minnesota

Service Package

- TM22 – Dynamic Lane Management and Shoulder Use
- ST06 – HOV/HOT Lane Management

ID: L05

Initiative: Expand Quick Clearance Policies for Incidents

Timeframe: Long Term

Multimodal Transportation Objective:

SHSP Focus Area: EMS Response & Trauma Systems

ITS Service Area: Traffic Management

Type: Policy/Legislation

Description
The quick clearance legislation authorizes the removal of driver-occupied disabled or wrecked vehicles from travel lanes in addition to the authority to tow those vehicles without regard to drivers being present at the incident site. There are four categories of quick clearance legislation including driver stop law, driver removal law, authority removal law, and authority tow law. Quick clearance policies have strong effects on traffic safety and minimize incident related congestion. Studies indicate that good traffic incident management led by quick clearance actions can reduce delay nationally by 170 million hours annually.

This initiative is to expand the quick clearance policies for incidents to inform and educate motorists about existing quick clearance laws and encourage drivers to change their behavior when involved in traffic incidents. The effort will require actions to review existing Traffic Incident Management Operational Guidelines to understand the current policy related to quick clearance and explore recent discussions among the Incident Management Coordination Team to determine the strengths/weaknesses of the current policy. However, there may be jurisdictional or "turf" issues among fire, law enforcement, EMS and transportation staff related to quick clearance for incidents. Coordination with private tow truck or heavy equipment operators will be required.

Champion and Stakeholder
Champion: MnDOT State Traffic Engineer
Stakeholders: Local Law Enforcement Agencies, Local EM Agencies, Minnesota State Patrol

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS12 - Reduce clearance time for primary crashes
ITS Objectives: B-1-15 - Reduce mean incident notification time
                  B-1-16 - Reduce mean time for needed responders to arrive on-scene after
                       notification
                  B-1-17 - Reduce mean incident clearance time per incident
                  B-1-18 - Reduce mean incident clearance time for Twin Cities urban freeway
                       incidents
                  C-1-01 - Reduce the vehicle hours of total delay associated with traffic
                       incidents during peak and off-peak periods

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C-1-09 - Increase number of regional road miles covered by ITS-related assets (e.g., roadside cameras, dynamic message signs, vehicle speed detectors) in use for incident detection/response

TSMO Goals and Objectives Supported

TSMO Goals: Improve Reliability, Mobility and Efficiency
                 Increase Safety
TSMO Objectives: Reduce incident response and clearance times in the Twin Cities and
                 Greater Minnesota
                 Reduce responder exposure

Service Package
- None.

ID: L06

Initiative: Allow Law Enforcement to Retrieve Data from Onboard Vehicle Computers

Timeframe: Long Term

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Unbelted Occupants, Speed-Related, EMS Response & Trauma Systems, Data Management, Management Systems

ITS Service Area: Traffic Management

Type: Deployment

Description
An onboard vehicle unit, Event Data Recorder (EDR), has been implemented in vehicles to record vehicle data. Insurers have been using these data to help address numerous questions or issues relative to an investigation and/or evaluation of a claim. These data can provide evidence to help determine whether a driver was speeding, wearing a seat belt, had sufficient stopping distance and braking distance, and how severe the impact would be for an incident. Even when the data is not favorable to an insurer, significant investigation and legal costs can be avoided. Ideally, law enforcement would access this data to determine vehicle speed, deceleration, time of incident, etc. However, Minnesota law enforcement is only able to access the data with a warrant even though this type of information is currently available on newer model vehicles.

This initiative is to monitor future legislation that could potentially restrict or expand this initiative. There may be data privacy implications regarding the use of this information for prosecution. In addition, the public and the automotive industry may raise data privacy concerns regarding access to this type of information

Champion and Stakeholder
Champion: Minnesota State Patrol
Stakeholders: Local Law Enforcement Agencies

Dependency
This initiative is not dependent upon any other initiatives.

Needs and Objectives Addressed
Need: ATMS08 - Provide enhanced manual or automated speed enforcement to improve safety
ITS Objectives: A-2-43 - Reduce number of speed violations
                 C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

Service Package
- TM17 – Speed Warning and Enforcement

ID: L07

Initiative: Automated Speed Enforcement

Timeframe: Long Term – Year 9 and Beyond

Multimodal Transportation Objective: Transportation Safety

SHSP Focus Area: Speed-Related

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative focuses on exploring the existing legal restrictions and determining how to address them in a way that will allow for a limited deployment of automated photo enforcement of speed violations. Photo enforcement for speeding could be deployed at rural or work zone locations where there is a history of crashes with excessive speed as a contributing factor.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MSP, Local Law Enforcement Agencies

Dependency
This initiative is dependent upon authorized speed enforcement legislation.

Needs and Objectives Addressed
Needs: ATMS06 - Provide speed enforcement at high risk locations to improve safety
ATMS08 - Provide enhanced manual or automated speed enforcement to improve safety
ITS Objectives: A-2-43 - Reduce number of speed violations
C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

Service Package
- TM17 – Speed Warning and Enforcement

ID: L08

TSMO

Initiative: Contraflow Lanes on Metro Freeways

Timeframe: Long Term – Years 9 and Beyond

Multimodal Transportation Objective: Open Decision-Making, Critical Connections

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will look at using a moveable barrier system on the metro freeway system in order to better utilize existing capacity and infrastructure on the system. Moveable barrier allows for the use of contra flow lanes in order to provide additional lanes in the peak direction of flow. For example, a 6-lane corridor with an existing 3-3 lane configuration can be used as a 4-2 lane facility during peak hours. MnDOT will focus on developing and deploying a moveable barrier system, which will also require signage and other traffic control devices.

Champion and Stakeholder
Champion: MnDOT

Dependency
This initiative is dependent upon corridor studies to determine deployment location(s) and upon the development and deployment of a moveable barrier system.

Needs and Objectives Addressed
Need: ATMS11 - Operate reversible lanes
ITS Objectives: B-1-09 - Improve average travel time during peak periods
                  B-1-12 - Reduce the average of the 90th (or 95th) percentile travel times for a
                           group of specific travel routes or trips in the region
                  B-2-23 - Increase vehicle throughput on specified routes
                  B-2-24 - Increase AM/PM peak hour vehicle throughput on specified routes

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objective: Reduce the frequency of congestion or slowed traffic on the freeways and
                  arterials in metro areas throughout Minnesota

Service Package
* TM16 – Reversible Lane Management

ID: L09

Initiative: In-Pavement LEDs

Timeframe: Long Term – Year 9 and Beyond

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making, Critical Connections

SHSP Focus Area: Intersections, Lane Departure, Inattentive Drivers

ITS Service Area: Traffic Management

Type: Deployment

Description
This initiative will deploy LED (Light-Emitting Diode) Roadway Lighting to remotely direct traffic into other lanes or onto shoulders during incidents and emergencies impacting travel along Minnesota highways. Drivers will use this service to tell them what lane they should use and to be aware of upcoming intersections or crosswalks. Lighting is planned to be controlled by MnDOT staff from a central and/or remote location along the roadway. LED Roadway Lighting also has strong potential to reduce night-time driving crashes in urban and rural areas. In-pavement LEDs have been tested at the MnROAD Testing Facility.

Champion and Stakeholder
Champion: MnDOT

Dependency
This initiative is dependent upon additional testing of in-pavement LED roadway lighting techniques.

Needs and Objectives Addressed
Need: ATMS19 - Operate in-pavement dynamic lane markings
ITS Objectives: A-1-08 - Reduce number of crashes due to inappropriate lane departure,
                                  crossing and merging
                         A-2-09 - Reduce number of fatalities due to inappropriate lane departure,
                                  crossing and merging
                         A-2-30 - Reduce number of injuries due to inappropriate lane departure,
                                  crossing and merging
                         B-1-01 - Reduce the percentage of facility miles (highway, arterial, rail, etc.)
                                  experiencing recurring congestion during the peak period

TSMO Goals and Objectives Supported
TSMO Goals: Improve Reliability, Mobility and Efficiency
                          Increase Safety
TSMO Objectives: Reduce the frequency of congestion or slowed traffic on the freeways and
                            arterials in metro areas throughout Minnesota
                          Reduce the frequency of single vehicle roadway departures

Service Package
- TM22 – Dynamic Lane Management and Shoulder Use

ID: L10

Initiative: Enhanced Speed Monitoring Equipment for Work Zones

Timeframe: Long Term – Years 9 and Beyond

Multimodal Transportation Objective: Transportation Safety, System Stewardship, Open Decision-Making, Critical Connections

SHSP Focus Area: Speed-Related, Work Zones

ITS Service Area: Traffic Management, Maintenance and Construction

Type: Deployment

Description
This initiative will increase manual enforcement in work zones and gradually move toward automated enforcement through operational tests and enabling legislation. Automated speed enforcement is not permissible under current statute. Legislation must be passed to authorize it.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MSP, Local Law Enforcement Agencies

Dependency
This initiative may be dependent upon Initiative S52 – Portable Queue Detection and Stopped Traffic Advisory.

Needs and Objectives Addressed
Need: ATMS39 - Monitor queue length at ramps, incident scenes, and work zones
ITS Objectives: A-1-04 - Reduce number of crashes due to unexpected congestion
                         A-2-04 - Reduce number of fatalities due to unexpected congestion
                         A-2-25 - Reduce number of injuries due to unexpected congestion
                         A-3-04 - Reduce number of workers injured by vehicles in work zones
                         B-1-15 - Reduce mean incident notification time
                         B-3-01 - Reduce total vehicle hours of delay by time period (peak, off-peak) caused by work zones
                         C-4-01 - Reduce the speed differential between lanes of traffic on multi-lane highways

TSMO Goals and Objectives Supported
TSMO Goal: Increase Safety
TSMO Objective: Reduce the frequency of secondary crashes and crashes related to work zones

Service Package
- TM17 – Speed Warning and Enforcement
- MC06 – Work Zone Management

ID: L11

Initiative: Incorporate Road Construction Data in CAD Systems

Timeframe: Long Term

Multimodal Transportation Objective: Transportation Safety, System Stewardship

SHSP Focus Area: EMS Response & Trauma Systems, Work Zones

ITS Service Area: Public Safety, Traveler Information

Type: Deployment

Description
Enhance CAD systems to incorporate current construction and evacuation traffic management routing information into GIS maps. This initiative would ensure dispatchers have real-time information on construction and alternate routing to assist in routing emergency response resources to an incident site to make emergency response more effective.

Champion and Stakeholder
Champion: MnDOT
Stakeholders: MnDOT, Minnesota State Patrol, Local Emergency Management Agencies

Dependency
The real-time evacuation traffic management data component is dependent on Initiative M65: Evacuation/ Reentry Real-time Information ITS Systems.

Needs and Objectives Addressed
Need: PSFT07 - Enhance GIS capabilities
ITS Objective: B-1-15 - Reduce mean incident notification time

TSMO Goals and Objectives Supported
TSMO Goal: Improve Reliability, Mobility and Efficiency
TSMO Objectives: Reduce incident response and clearance times in the Twin Cities and
                      Greater Minnesota

Service Package
- PS02 – Routing Support for Emergency Responders
- SU03 – Data Distribution

ID: L12

Initiative: Develop and Provide a Uniform, Real-Time Automated
Crash Notification System

Timeframe: Long Term

Multimodal Transportation Objective: Transportation Safety, Open Decision-Making

SHSP Focus Area: EMS Response & Trauma Systems, Management Systems, Vehicle Safety
Enhancements

ITS Service Area: Public Safety

Type: Deployment

Description
This initiative would provide immediate notification of a crash to emergency responders and
provide access to driver, passenger and vehicle information. This would reduce emergency
response time and, ultimately, improve crash fatality and injury rates through faster and more
targeted medical care. This could be viewed as a continuation of the previous Mayday projects
conducted in Minnesota. The initiative is to develop and provide common location information
and communication standards to assist emergency responders in quickly and efficiently locating
crash or other road safety related incidents. The system will need to be developed based on
Location Referencing Message Specification (LRMS) standard and data concepts supported by
the LRMS standard.

The initiative will require actions to monitor future legislation that could potentially restrict or
expand this initiative and monitor implementation of a statewide trauma system. There is an
institutional issue for this effort that the public may raise data privacy concerns regarding access
to this type of information.

Champion and Stakeholder
Champion: MnDOT State Traffic Engineer
Stakeholders: Law enforcement community, Minnesota Department of Health, Private Sector,
EMS

Dependency
This initiative is related to and could support or be built upon M31 – Enhanced Mayday
Notification Assistance.

Needs and Objectives Addressed
Needs: PSFT03 - Provide enhanced Mayday services
                   ATMS44 - Provide incident detection systems
ITS Objectives: B-1-15 - Reduce mean incident notification time
                   B-1-16 - Reduce mean time for needed responders to arrive on-scene after
                       notification

TSMO Goals and Objectives Supported

<u>TSMO Goal:</u>   Improve Reliability, Mobility and Efficiency

<u>TSMO Objective:</u>   Reduce incident response and clearance times in the Twin Cities and Greater Minnesota

Service Package

- PS04 – Mayday Notification