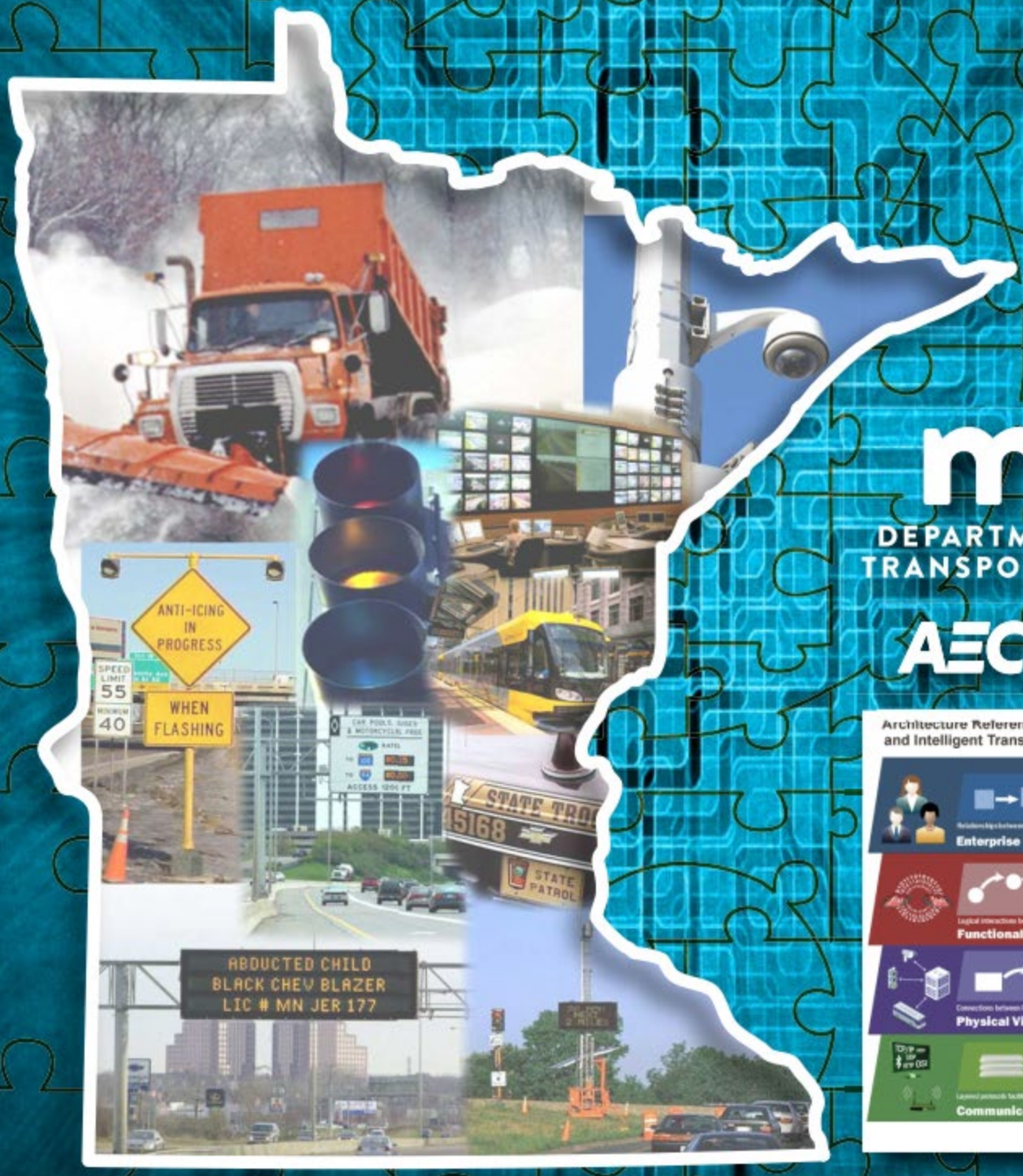
Minnesota Statewide Regional ITS Architecture

Version 2018

Volume 9:
Parking Management Service Package Area



DEPARTMENT OF TRANSPORTATION

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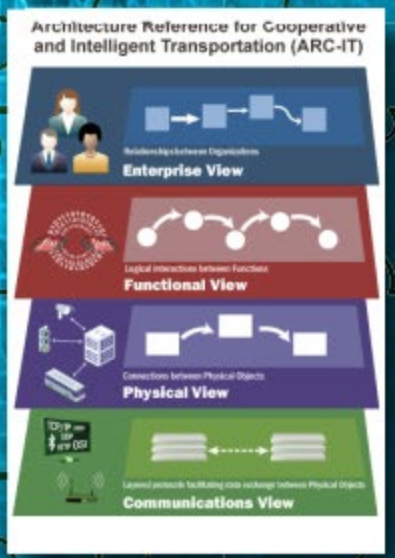

Minnesota Statewide Regional ITS Architecture
Version 2018

Volume 9: Parking Management Service Package Area

Prepared by

AECOM

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ACRONYMS

ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
CAD	Computer Aided Dispatch
CVO	Commercial Vehicle Operations
DM	Data Management
DMS	Dynamic Message Sign
DOT	Department of Transportation
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HOV	High-Occupancy Vehicle
ICS	Incident Command Structure
ISP	Information Service Provider
ITS	Intelligent Transportation Systems
LOS	Level of Service
MAASTO	Mid America Association of State Transportation Officials
MAP-21	Moving Ahead for Progress in the 21st Century Act
MC	Maintenance and Construction
MnDOT	Minnesota Department of Transportation
NIMS	National Incident Management System
OBE	On-Board Equipment
PM	Parking Management
PS	Public Safety
PT	Public Transportation
RAD-IT	Regional Architecture Development for Intelligent Transportation
ST	Sustainable Traveler
SU	Support
TI	Traveler Information
TM	Traffic Management
TPIMS	Truck Parking Information and Management System
VMT	Vehicle-Miles Traveled
VS	Vehicle Safety
WX	Weather

1. Introduction

1.1 Statewide Regional ITS Architecture Update

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 Minnesota Statewide Regional ITS Architecture represents a shared vision of how each agency's systems work together by sharing information and resources to enhance transportation safety, efficiency, capacity, mobility and security. The information exchange among the many transportation stakeholders helps illustrate various integration options, gain consensus on cost-effective ITS technologies and systems to be considered prior to investing in design, development and deployment of ITS.

The Minnesota Statewide Regional ITS Architecture is a living document and will evolve as needs, technology, stakeholders and funding change. ARC-IT is a resource to the Minnesota Statewide Regional Architecture providing framework for planning, defining and integrating ITS.

The Minnesota Statewide Regional ITS Architecture promotes deployment and integration of ITS systems and services that are compatible and interoperable with other ITS systems and services across jurisdictional boundaries. It facilitates coordination, cooperation, and information and resource sharing among State and local agencies. It guides systematic deployment and integration of regional ITS to improve the safety, efficiency, dependability, and cost effectiveness of the transportation system in Minnesota.

The Minnesota Statewide Regional ITS Architecture is organized as follows:

- **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.

- **Implementation Volume – ITS Initiatives and Project Concepts for Implementation:** This volume serves as long-range guidance to 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 specific ITS needs that are further prioritized into ITS initiatives and project concepts. It also provides the corresponding details for each initiative or project concept which include project concept descriptions, agency involved, champion, implementation timeframe, technology readiness, dependencies, benefits, service packages, estimated costs, and agreements needed.

- **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.

The purpose for developing Volumes 1 through 12 was 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.

Data collection activities were conducted early in the study process and focused on two primary tasks:

- The assemblage of an inventory of existing and planned transportation infrastructure and, facilities and services.
- The assessment of statewide needs and opportunities for further deployment of ITS.

Previously published transportation plans were the main source of data about characteristics of the existing transportation system, planned improvements, transportation system needs and goals. Strategic and long-range planning studies, ITS deployment and safety plans, transit studies and transportation planning and policy documents were reviewed.

1.2 Volume 9 – Parking Management Service Package Area

Advanced Parking Management (PM) Systems use detection technology, variable message signs and other information delivery methods such as mobile apps to provide drivers with up-to-date information on parking availability at parking lots or ramps. PM Service Package Area includes providing parking facilities and space availability information to drivers to assist in making better decisions. It also support electronic collection of parking fees. PM Service Package Area also include applications of technology to support communication and coordination between equipped parking facilities and support regional coordination between parking management systems and traffic and transit management systems.

Development of Volume 9 – PM Service Package Area entailed the Project Consultant working closely with MnDOT and stakeholders to identify and prioritize stakeholder needs; gather information on existing and future ITS infrastructure, components and technology; and define the stakeholders' roles and responsibilities in planning, deploying, operating and maintaining existing and future ITS systems.

Volume 9 summarizes the findings of data collection and analysis activities conducted to support development of the PM Service Package Area. Volume 9 is organized with the following sections:

- ***Section 1: Introduction*** provides a brief project overview and the purpose of this volume.

- ***Section 2: Identification of Existing Parking Management Systems*** provides a brief overview of statewide PM system deployments with a detailed listing of existing and planned systems in *Appendix A*.
- ***Section 3: Development Objectives*** provides an overview of the Minnesota ITS Development Objectives specific to PM. These objectives are used to identify needs and gaps, which will then be used to identify services to address those needs.
- ***Section 4: Identification of Needs and Services.*** Based on the ITS Development Objectives, needs were identified and prioritized by the stakeholders. Services were identified to address those prioritized needs.
- ***Section 5: Detail of PM Needs and Services*** describes, for each identified Need/Service, the following information:
    - **Operational Concept** - who is currently using the service and how they are using it. Users include both managers of a system and other users, like the traveling public, who use an end service.
    - **Existing Capabilities** - what systems are currently in place that are used to provide this service and who operates these services.
    - **Gaps and Planned Enhancements** - enhancements that can be made to better provide the service and address needs, who will use these enhancements, and what they will be used for. These enhancements can include expanding systems to geographic areas that currently do not have access to the service, enhancing an existing service to provide greater functionality or use by more groups, or implementing a new system to address a gap.
    - **Roles and Responsibilities** - what roles stakeholders need to fulfill to make the service operate successfully throughout a system's lifecycle (planning, design, implementation, operations, and maintenance).
    - **Interconnects** - the communications linkages between subsystems or stakeholders to provide the service.
    - **Data Archive Needs** - what data is generated for the service that should be archived, who is responsible for archiving, and any special needs or requirements for such archiving.
    - **Associated Service Packages** - other Service Packages that the service falls under. This includes both Service Packages within the Service Package Bundle and those in other Service Package Bundles.
- ***Section 6: PM Research and Development Needs*** describes general research that can be performed to help implement the identified services.

2. Identification of Existing Parking Management Systems

PM systems are deployed in several metropolitan areas in Minnesota and have aided transportation agencies to gather, process and provide parking information that impacts mobility, travel time and transit choice. Using that information has improved the overall performance of Minnesota's transportation systems, particularly in multimodal travel, parking facilities management, travel time and travel time reliability.

PM system can be used to provide the real-time status of a parking facility to travelers based on data related to availability of parking spots, parking rates and reservations. PM system involves infrastructure and technology to, collect data related to parking facility such as fares, space availability and reservations, monitor and control parking meters, operate parking spot reservation system, collect payments electronically, detect and classify vehicles at parking

facility and provide directions for travelers to empty parking spots, entry and exit paths within a parking facility. PM system also supports Dynamic Message Signs (DMS) that are used at parking facilities for travelers to provide parking information and directions.

PM system helps in improving the overall efficiency of the trips by travelers by linking components of parking facilities information and traveler information systems. The data from PM system is used by transit and traffic management systems to efficiently schedule and operate mass transit systems and parking facilities, thus improving overall efficiency, reliability and travel time of multimodal travel. The parking information helps travelers to plan the trip by providing information related to parking facility located near trip destination, using which, travelers can make better judgements about trip route and travel time. The PM system also provides information related to different transport modes available for travelers while planning the trip. This information influences travelers in choosing transport alternatives and also accomplish multimodal travel. PM system also supports fleet and freight management systems to manage loading/unloading zones for commercial vehicles.

An inventory of existing and planned PM systems in Minnesota is described in *Appendix A*. This inventory summarizes a list of existing and programmed ITS systems in the state, their general description, associated stakeholder that are involved with their operations and management, and their current deployment. The systems described in *Appendix A* are Minnesota-specific implementations of subsystems from ARC-IT.

3. Development Objectives

Transportation needs identify the transportation problems that can be solved by ITS services. They also represent a link to transportation planning efforts that define the strategies and solutions to address various challenges. These strategies involve capital improvements as well as operational improvements. PM solutions involve services that improve the overall performance of transportation systems, including safety, travel time, and travel time reliability.

Parking Management (PM) Service Package Area includes providing parking facilities information to travelers to assist in making better decisions about their trip and transit mode, and collection of parking related information to support monitoring, operating, maintaining, improving and managing parking facilities. The goal of PM systems is to improve overall performance and operations of transportation systems as well as travelers' convenience and comfort through the use of advanced data collection techniques, information management, communication systems, and system integration between multiple parking facilities and management systems. The Minnesota ITS Development Objectives in Table 1, specific to PM, are steps to determine and/or measure whether or not PM goals are being achieved. A complete list of Minnesota ITS Development Objectives is included in *Appendix B*.

Table 1. PM Specific Minnesota ITS Development Objectives

C-4 Reduce stress caused by transportation
- 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
- C-4-02 Increase the number of users aware of park-and-ride lots in their region
- C-4-03 Increase the number parking facilities with electronic fee collection
- 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
- C-4-06 Increase the number of parking facilities with coordinated electronic payment systems
- C-4-07 Increase the number of parking facilities with coordinated availability information

G. Enhance the Integration and Connectivity of the Transportation System

G-1 Aid in transportation infrastructure and operations planning
- 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

4. Needs and Services

Stakeholder outreach has been a key component for updating the Minnesota Statewide Regional ITS Architecture. A stakeholder survey was conducted in 2017 to capture the following changes since the last update of the Architecture in 2014:

- Additional ITS needs and services have been identified and added
- New technologies have come on-line
- New technologies have replaced out-of-date technology.

The survey asked each survey participant to review and provide priority ranking to each of the ITS functional/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. Stakeholders reviewed the ITS functional/informational needs as well as discussed the research and technology development needs. Subsequently, the highest priority needs that would benefit the traveling public were identified.

Table 2 displays the Specific Functional/Informational Needs/Services as potential solutions and enhancements. Priority is indicated in the Priority Points column, with each point representing

one vote from responders through the stakeholder survey. The ITS Development Objectives and ITS Architecture Service Packages corresponding with the potential solutions are also listed in Table 2. The potential solutions and enhancements identified in Table 2 will provide the required service(s) to fill the gaps summarized in *Appendix C*. This appendix will take the PM Needs and associated solutions and define what and how the system will be used, who will use it and who is responsible for planning, design, implementation, operation and maintenance of the system.

Table 2. PM Needs and Potential Solutions

Notes:

[a] *Priority point scoring system: 0 point for "no need"; 1 point for "low"; 2 points for "low to moderate"; 3 points for "moderate"; 4 points for "moderate to high"; and 5 points for "high".*

[b] *Discussions on needs/solutions fall under other service package bundles can be found in corresponding Service Package Bundle documents.*

ID	Need/Potential Solution	Priority Point[a]	ITS Development Objective	ARC-IT Reference[b]
ATIS23	Provide information on available public and private truck parking facilities	3.67	C-4-04, C-4-05, C-4-07	TI01, TI02, PM01, PM04, CVO09
ATMS21	Provide information on parking availability	1.75	C-4-04, C-4-05, C-4-07	PM01, PM02, PM04
ATMS30	Provide simple and integrated electronic payment systems	1.25	B-2-16, C-4-03, C-4-06	TM10, PM03, PT04, PT18

5. Detail of PM Needs and Services

A detailed description of each PM Needs and Services for Minnesota is found in *Appendix C. Appendix C* contains a table listing the services sorted by Service Package and details for the service. The details described in the table include:

- **Operational Concept:** Describes who is currently using the service and how they are using it. Users of the service include both managers and operators of a system and other users who may be impacted and/or benefit from such a service, such as other agencies and the traveling public.
- **Existing Capabilities:** Describes what systems are currently in place that are used to provide this service and who operates these systems and provides such services.
- **Gaps and Planned Enhancements:** Summarizes enhancements that can be made to better provide the service and address needs, who will use these enhancements, and what they will be used for. These enhancements include expanding current systems to geographic areas that presently do not have access to the service, enhancing an existing service to fill identified gaps or use by more groups, or implementing a new system to address a need.
- **Roles and Responsibilities:** Describes the roles and responsibility of involving stakeholders to make the service operate successfully throughout a system's lifecycle (planning, design, implementation, operations, and maintenance).
- **Interconnects:** Presents the communications linkages between subsystems or stakeholders to provide the service.

- **Data Archive Needs:** Summarizes what data is generated for the service that should be archived, who is responsible for archiving, and any special needs or requirements for such archiving.
- **Associated Service Packages:** Describes other Service Package(s) required to deliver the desired service. This includes both Service Packages within the DM Service Package Bundle and those in other Service Package Bundles.

6. PM Research and Development Needs

In order to fill gaps and meet the needs for technology advancement in PM services, some research must be performed to test solutions and gain a greater understanding of what can effectively address identified needs. Research and Technology development needs and opportunities for PM are as follows:

- Test parking/MnPASS payment integration

Appendix A: Existing/Planned PM Elements

System	Service Package	Description	Stakeholder	Status
Parking Management System	PM01, PM02, PM03	This element represents parking management systems that manage parking facilities, monitor parking operations, detect vehicle traffic in parking facilities, electronically collect parking fees, and control electronic display signs to inform motorists of parking space availability. City of St. Paul has an advanced parking management system in downtown St. Paul. University of Minnesota and Metropolitan Airports Commission operate parking management systems to monitor parking and distribute parking information to the public. City of Minneapolis has an advanced parking management system for its ABC ramps. Metro Transit has parking information systems at park-and-ride lots. MnDOT is deploying a rest area truck parking availability system. Duluth Transit Authority (DTA) operates a parking ramp (Duluth Transportation Center) in downtown Duluth. The parking ramp is equipped with a camera security system, secure door access, Code Blue Stations, parking pay stations/gates and electric charge stations for electric vehicles.	Local Agencies, Private Parking Operators, Metro Transit, Local Transit Providers	Existing
Park and Ride Parking Information System Roadside Equipment	PM01, PM02	Real-time information on availability of parking spaces at Metro Transit Park-and-Rides will be displayed to drivers via electronic message signs at various Metro Transit park-and-ride stations.	Metro Transit	Existing
Parking Management Roadside Equipment	PM01, PM03	This represents roadside equipment that detects vehicle traffic in parking facilities, informs motorists of parking space availability, and collects fare payments electronically. Roadside equipment is controlled by Parking Management Systems.	Local Agencies, Private Parking Operators, Local Transit Providers	Existing

Appendix B: Minnesota ITS Development Objectives

General Purpose: Create a system that enhances transportation through the safe and efficient movement of people, goods, and information, with greater mobility and fuel efficiency, less pollution, and increased operating efficiency in Minnesota.

DM:	Data Management	VS:	Vehicle Safety
PT:	Public Transportation	CVO:	Commercial Vehicle Operations
TI:	Traveler Information	PS:	Public Safety
TM:	Traffic Management	MC:	Maintenance and Construction
PM:	Parking Management	WX:	Weather
SU:	Support	ST:	Sustainable Travel

A. Improve the Safety of the State's Transportation System

A-1 Reduce crash frequency *(TI, TM, PT, CVO, PS, MC, VS & WX)*

- 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-1-07 Reduce number of crashes due to commercial vehicle safety violations
- A-1-08 Reduce number of crashes due to inappropriate lane departure, crossing and merging
- A-1-09 Reduce number of crashes at railroad crossings
- A-1-10 Reduce number of crashes at signalized intersections
- A-1-11 Reduce number of crashes at un-signalized intersections
- A-1-12 Reduce number of crashes due to excessive speeding
- A-1-13 Reduce number of crashes related to driving while intoxicated
- A-1-14 Reduce number of crashes related to driver inattention and distraction
- 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-1-18 Reduce number of crashes involving younger drivers (under 21)
- A-1-19 Reduce number of all secondary crashes

A-2 Reduce fatalities and life changing injuries *(TI, TM, PT, CVO, PS, MC, VS & WX)*

- 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-2-07 Reduce number of fatalities due to commercial vehicle safety violations
- A-2-08 Reduce number of transit fatalities
- A-2-09 Reduce number of fatalities due to inappropriate lane departure, crossing and merging
- A-2-10 Reduce number of fatalities at railroad crossings
- A-2-11 Reduce number of fatalities at signalized intersections
- A-2-12 Reduce number of fatalities at un-signalized intersections
- A-2-13 Reduce number of fatalities due to excessive speeding
- A-2-14 Reduce number of fatalities related to driving while intoxicated

A-2-15 Reduce number of fatalities related to driver inattention and distraction
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-2-19 Reduce number of fatalities involving younger drivers (under 21)
A-2-20 Reduce number of fatalities involving unbelted vehicle occupants
A-2-21 Reduce number of hazardous materials transportation incidents involving fatalities
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-2-28 Reduce number of injuries due to commercial vehicle safety violations
A-2-29 Reduce number of transit injuries
A-2-30 Reduce number of injuries due to inappropriate lane departure, crossing and merging
A-2-31 Reduce number of injuries at railroad crossings
A-2-32 Reduce number of injuries at signalized intersections
A-2-33 Reduce number of injuries at un-signalized intersections
A-2-34 Reduce number of injuries due to excessive speeding
A-2-35 Reduce number of injuries related to driving while intoxicated
A-2-36 Reduce number of injuries related to driver inattention and distraction
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-2-40 Reduce number of injuries involving younger drivers (under 21)
A-2-41 Reduce number of injuries involving unbelted vehicle occupants
A-2-42 Reduce number of hazardous materials transportation incidents involving injuries
A-2-43 Reduce number of speed violations
A-2-44 Reduce number of traffic law violations

A-3 Reduce crashes in work zones *(TI, TM, PS, MC & VS)*
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. Increase Operational Efficiency and Reliability of the Transportation System

B-1 Reduce overall delay associated with congestion *(TI, TM, MC & VS)*
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-1-03 Reduce the share of major intersections operating at LOS F
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 Increase average vehicle passenger occupancy and facility throughput *(TM, PT & ST)*
B-2-01 Increase annual transit ridership
B-2-02 Increase annual express bus ridership
B-2-03 Increase annual light rail ridership
B-2-04 Increase annual commuter rail ridership
B-2-05 Maintain agency pre-defined performance targets 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-2-11 Reduce per capita single occupancy vehicle commute trip rate
B-2-12 Increase the percentage of major employers actively participating in transportation demand management programs
B-2-13 Reduce commuter vehicle miles traveled (VMT) per regional job
B-2-14 Create a transportation access guide, which provides concise directions to reach destinations by alternative modes (transit, walking, bike, etc.)
B-2-15 Improve average on-time performance for specified transit routes/facilities
B-2-16 Increase use of automated fare collection system per year
B-2-17 Increase the percent of transfers performed with automated fare cards
B-2-18 Increase the miles of bus-only shoulder lanes in the metro area
B-2-19 Increase the number of carpools
B-2-20 Increase use of vanpools
B-2-21 Provide carpool/vanpool matching and ridesharing information services
B-2-22 Reduce trips per year in region through carpools/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

B-3 Reduce delays due to work zones *(TI, TM, PS, MC & VS)*
- 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

B-4 Reduce traffic delays during evacuation from homeland security and Hazmat incidents *(TI, TM, PT, CVO, PS & VS)*
- B-4-01 Reduce vehicle hours of delay per capita during evacuation from homeland security and Hazmat incidents

C. Enhance Mobility, Convenience, and Comfort for Transportation System Users

C-1 Reduce congestion and incident-related delay for travelers *(TI, TM, PT, PS & VS)*
- 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-1-03 Reduce the share of major intersections operating at LOS F
- 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
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- 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
- 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-1-03 Increase percentage of incident management agencies in the region that use interoperable voice communications

C-1-04 Increase percentage of incident management agencies in the region that participate in a regional coordinated incident response team
C-1-05 Increase the number of corridors in the region covered by regional coordinated incident response teams
C-1-06 Maintain a percentage of transportation operating agencies have a plan in place for a representative to be at the local or State Emergency Operations Center (EOC) to coordinate strategic activities and response planning for transportation during emergencies
C-1-07 Conduct joint training exercises among operators and emergency responders in the region
C-1-08 Maintain a percentage of staff in region with incident management responsibilities who have completed the National Incident Management System (NIMS) Training and a percentage of transportation responders in the region are familiar with the incident command structure (ICS)
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-1-10 Increase number of traffic signals equipped with emergency vehicle preemption

C-2 Improve travel time reliability *(TI, TM, PT & VS)*
B-1-07 Reduce the regional average travel time index
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-2-15 Improve average on-time performance for specified transit routes/facilities
B-2-16 Increase use of automated fare collection system per year
B-2-17 Increase the percent of transfers performed with automated fare cards
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-2-03 Increase the miles of bus-only shoulder lanes in the metro area

C-3 Increase choice of travel modes *(TI, TM, PT & ST)*
B-2-01 Increase annual transit ridership
B-2-11 Reduce per capita single occupancy vehicle commute trip rate
B-2-12 Increase the percentage of major employers actively participating in transportation demand management programs
B-2-13 Reduce commuter vehicle miles traveled (VMT) per regional job
B-2-14 Create a transportation access guide, which provides concise directions to reach destinations by alternative modes (transit, walking, bike, etc.)
C-3-01 Increase active (bicycle/pedestrian) mode share
C-3-02 Reduce single occupancy vehicle trips through travel demand management strategies (e.g., employer or residential rideshare)
C-3-03 Increase the percent of alternative (non-single occupancy vehicle) mode share in transit station communities (or other areas)
C-3-04 Increase transit mode share
C-3-05 Increase transit mode share during peak periods
C-3-06 Increase average transit load factor
C-3-07 Increase passenger miles traveled per capita on transit

C-3-08 Reduce the travel time differential between transit and auto during peak periods per year
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-3-10 Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region
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-3-14 Increase the number of transit routes with information being provided by ATIS
C-3-15 Increase the number of specifically tailored traveler information messages provided
C-3-16 Increase annual transit ridership reported by urbanized area transit providers
C-3-17 Increase annual transit ridership reported by rural area transit providers

C-4 Reduce stress caused by transportation *(TI, TM, PT, PM, PS, MC & VS)*
A-2-43 Reduce number of speed violations
A-2-44 Reduce number of traffic law violations
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-1-03 Reduce the share of major intersections operating at LOS F
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
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-3-14 Increase the number of transit routes with information being provided by ATIS
C-3-15 Increase the number of specifically tailored traveler information messages provided
C-4-01 Reduce the speed differential between lanes of traffic on multi-lane highways
C-4-02 Increase the number of users aware of park-and-ride lots in their region

C-4-03 Increase the number parking facilities with electronic fee collection
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
C-4-06 Increase the number of parking facilities with coordinated electronic payment systems
C-4-07 Increase the number of parking facilities with coordinated availability information

D. Improve the Security of the Transportation System

D-1 Enhance traveler security *(PT & PS)*

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.
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-1-03 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-1-06 Increase the percent of major and minor arterials are equipped with and operating with video monitoring cameras
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

D-2 Safeguard the motoring public from homeland security and/or Hazmat incidents *(TI, TM, PT, CVO, PS, MC & VS)*

B-1-16 Reduce mean time for needed responders to arrive on-scene after notification
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.
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-1-03 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-1-06 Increase the percent of major and minor arterials are equipped with and operating with video monitoring cameras
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
D-2-01 Reduce the number of Hazmat incidents
D-2-02 Reduce the number of homeland security 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
D-2-05 Reduce the Hazmat incident response time
D-2-06 Reduce the homeland security incident response time
D-2-07 Increase the number of Hazmat shipments tracked in real-time

E. Support Regional Economic Productivity and Development

E-1 Reduce travel time for freight, transit and businesses *(TI, TM, PT, CVO & VS)*

- B-1-14 Reduce the variability of travel time on specified routes during peak and off-peak periods
- B-2-15 Improve average on-time performance for specified transit routes/facilities
- B-2-16 Increase use of automated fare collection system per year
- B-2-17 Increase the percent of transfers performed with automated fare cards
- C-2-09 Increase the miles of bus-only shoulder lanes in the metro area
- C-3-08 Reduce the travel time differential between transit and auto during peak periods per year
- E-1-01 Maintain a travel time differential between transit and auto during peak periods
- E-1-02 Improve average transit travel time compared to auto in major corridors
- 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 Improve the efficiency of freight movement, permitting and credentials process *(TI & CVO)*

- E-2-01 Increase the percent (or number) of commercial vehicles tracked by trucking companies
- E-2-02 Increase the percent (or number) of freight shipment tracked
- E-2-03 Increase the percent of agencies involved in CVO inspection, administration, enforcement, and emergency management in the region with interoperable communications
- E-2-04 Increase the use of electronic credentialing at weigh stations and border crossings
- E-2-05 Increase the number of automated permits/credentials issued
- 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-3 Improve travel time reliability for freight, transit and businesses *(TM, PT, CVO & VS)*

- B-1-14 Reduce the variability of travel time on specified routes during peak and off-peak periods
- B-2-15 Improve average on-time performance for specified transit routes/facilities
- B-2-16 Increase use of automated fare collection system per year
- B-2-17 Increase the percent of transfers performed with automated fare cards
- C-1-06 Increase percentage of incident management agencies in the region that participate in a multi-modal information exchange network
- C-2-09 Increase the miles of bus-only shoulder lanes in the metro area
- 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-3-10 Increase the percent of transportation facilities whose owners share their traveler information with other agencies in the region
- C-3-13 Increase number of users of notifications for traveler information (e.g., e-mail, text message)
- E-1-08 Decrease the annual average travel time index for selected freight-significant highways

E-2-04 Increase the use of electronic credentialing at weigh stations and border crossings
E-3-01 Reduce average crossing times at international borders

E-4 Increase agency efficiency *(DM, TM, PT, CVO, PS, MC & SU)*
B-2-15 Improve average on-time performance for specified transit routes/facilities
B-2-16 Increase use of automated fare collection system per year
B-2-17 Increase the percent of transfers performed with automated fare cards
C-2-09 Increase the miles of bus-only shoulder lanes in the metro area
E-2-01 Increase the percent (or number) of commercial vehicles tracked by trucking companies
E-2-03 Increase the percent of agencies involved in CVO inspection, administration, enforcement, and emergency management in the region with interoperable communications
E-4-01 Increase the number of ITS-related assets tracked
E-4-02 Reduce the number of pavement miles damaged by commercial vehicles
E-4-03 Increase the rate of on-time completion of construction projects
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

E-5 Reduce vehicle operating costs *(TM, PT, CVO & VS)*
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-1-03 Reduce the share of major intersections operating at LOS F
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

E-6 Enhance efficiency at borders *(TI & CVO)*
E-2-04 Increase the use of electronic credentialing at weigh stations and border crossings
E-3-11 Reduce average crossing times at international borders

F. Preserve the Transportation System

F-1 Safeguard existing infrastructure *(TM, CVO, PS & MC)*

- 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.
- D-1-06 Increase the percent of major and minor arterials are equipped with and operating with video monitoring cameras
- 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
- E-2-03 Increase the percent of agencies involved in CVO inspection, administration, enforcement, and emergency management in the region with interoperable communications
- E-4-03 Increase the rate of on-time completion of construction projects
- F-1-01 Decrease the number of pavement miles damaged by commercial vehicles
- F-1-02 Decrease the number of size and weight violations

G. Enhance the Integration and Connectivity of the Transportation System

G-1 Aid in transportation infrastructure and operations planning *(ALL)*

- 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-1-03 Increase the number of years of data in database that is easily searchable and extractable
- G-1-04 Reduce project schedule deviation
- G-1-05 Reduce project cost deviation
- G-1-06 Reduce operations cost deviation
- G-1-07 Reduce administrative support rate (as part of overall project budget)

G-2 Reduce need for new facilities *(TM, CVO, MC & VS)*

- 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-1-03 Reduce the share of major intersections operating at LOS F
- 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
- E-2-04 Increase the use of electronic credentialing at weigh stations and border crossings

E-2-05 Increase the number of automated permits/credentials issued
E-3-11 Reduce average crossing times at international borders

H. Reduce Environmental Impacts

H-1 Reduce emissions/energy impacts and use associated with congestion *(ST, TI, TM, CVO & VS)*

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-1-03 Reduce the share of major intersections operating at LOS F
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
H-1-01 Reduce excess fuel consumed due to congestion
H-1-02 Reduce total fuel consumed per capita for transportation
H-1-03 Reduce vehicle miles traveled per capita
H-1-04 Reduce MnDOT fleet gasoline use
H-1-05 Reduce MnDOT fleet diesel use
H-1-06 Reduce the amount of all emissions in the atmosphere
H-1-07 Reduce the amount of carbon dioxide emissions measured

H-2 Reduce negative impacts of the transportation system on communities *(TM, PT, PS, ST & MC)*

A-2-44 Reduce number of traffic law violations
B-2-01 Increase annual transit ridership
B-2-12 Increase the percentage of major employers actively participating in transportation demand management programs
B-2-13 Reduce commuter vehicle miles traveled (VMT) per regional job
B-2-14 Create a transportation access guide, which provides concise directions to reach destinations by alternative modes (transit, walking, bike, etc.)
B-2-19 Increase the number of carpools
B-2-20 Increase use of vanpools
B-2-21 Provide carpool/vanpool matching and ridesharing information services
B-2-22 Reduce trips per year in region through carpools/vanpools
H-2-01 Increase the average vehicle passenger occupancy rate in HOV lanes
H-2-02 Increase the amount of environmentally friendly de-icing material used

Appendix C: Needs and Services Detail

Service Packages PM01 – Parking Space Management

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
ATIS 23	Provide information on available public and private truck parking facilities	• MnDOT provides rest area closure information to the 511 website and links to some other truck traveler information websites. • MnDOT provides truck parking availability information to fleet management, commercial vehicle operators, and private ISPs. • Commercial vehicle operators (truck drivers) obtain information from fleet management, or private ISPs.	• MnDOT provides a website with an interactive map of safety rest areas and their amenities. • MnDOT is currently implementing a system to provide real-time truck parking availability information to commercial vehicle operators.	• Instrument truck parking areas at rest facility with cameras or sensors to gather parking availability information. • Provide information on available truck parking at rest facilities on the 511 website and other truck traveler information websites. • Provide truck parking availability information to fleet management, commercial vehicle operators, and private ISPs.	• MnDOT is responsible to plan, design, operate and maintain the 511 system. • The North/West Passage states are responsible to plan, design, operate and maintain the North/West Passage website • Parking facility operators are responsible to plan, design, operate and maintain parking availability observation/ detection systems.	• Interconnects are required between roadside equipment (cameras/ sensors) and traveler information systems (websites). • Interconnects are also required between traveler information systems and fleet management/ commercial vehicle operators/private ISPs.	• Utilization of truck parking facilities should be collected and archived.	• PM04 • TI01 • TI02 • CVO09

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
ATM S21	Provide information on parking availability	• Parking operators use parking management systems to obtain parking availability and provide the information to the public via DMS at or near ramp entrances as well as via websites. • Parking operators share parking availability with transportation management agencies. • Drivers use availability information to make parking decisions. • Parking operators share availability information with other parking operators in the area for coordination and facilitation of regional parking management strategies.	• City of St. Paul has an advanced parking management system in downtown St. Paul. • University of Minnesota and Metropolitan Airports Commission operate parking management systems to monitor parking and distribute parking information to the public. • Minneapolis has an advanced parking management system for its ABC ramps. • Metro Transit has parking information systems at park-and-ride lots. • Truck parking availability systems are installed in the state.	• Upgrade the St. Paul parking management system, in particular the communications components. • Provide regional parking management systems to support coordination between parking facilities.	• Parking facility operators are responsible for coordination in planning, designing, constructing, and maintaining their parking management system. • Local agencies are responsible for coordinating with private parking ramp operators and encouraging regional information sharing and coordination.	• The parking management systems include interconnects between roadside equipment near the parking ramps and the parking operator. • Systems also include interconnects between parking operators and TMCs; and between parking operations in the same area.	• None	• PM02 • PM04

Service Package PM02 – Smart Park and Ride System

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
ATM S21	Provide information on parking availability	See information under PM01.						

Service Package PM03 – Parking Electronic Payment

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
ATM S30	Provide simple and integrated electronic payment systems	• Parking garage operators, toll operators, and transit operators integrate their payment systems into a single electronic payment system. • Travelers use a single payment card/device to pay parking, toll, and transit fare electronically.	• MnPASS is currently used on I-394 for pay tolls. • City of Minneapolis parking ramps use a separate automated payment system. • Duluth Transit Authority (DTA) operates a parking ramp (Duluth Transportation Center) in downtown Duluth. The parking ramp is equipped with parking pay stations/gates and electric charge stations for electric vehicles, along with a camera security system, secure door access and Code Blue Stations.	• Integrate MnPASS with City of Minneapolis parking payment systems. • Integrate various payment systems for transit, parking, and MnPASS to a single system. • Integration of MnPASS with other toll systems (part of MAP-21 legislation).	• MnDOT, City of Minneapolis, parking operators and transit operators are responsible to coordinate and integrate MnPASS into the parking fee payment systems.	• Electronic payment systems include interconnects between in-vehicle transponders and roadside readers. • Systems also include interconnects between roadside equipment and parking management systems. • Interconnects between parking management systems and the MnPASS customer center are also needed.	• Account transactions and parking utilization data should also be archived for back-office account management.	• TM10 • PT04 • PT18

Service Package PM04 – Regional Parking Management

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
ATIS 23	Provide information on available public and private truck parking facilities	See information under PM01.						
ATM S21	Provide information on parking availability	See information under PM01						

Service Package PM05 – Loading Zone Management

No needs or services under this service package were identified by stakeholders.

Appendix D: Parking Management Service Packages and Descriptions

The descriptions of Parking Management (PM) service packages are taken directly from the ARC-IT version 8.2.

PM01 Parking Space Management
This service package monitors and manages parking spaces in lots, garages, and other parking areas and facilities. It assists in the management of parking operations by monitoring parking lot ingress and egress, parking space occupancy and availability. Infrastructure-based detectors and/or connected vehicles may be used to monitor parking occupancy. The service package shares collected parking information with local drivers and information providers for broader distribution.

PM02 Smart Park and Ride System
This service package provides real-time information on Park and Ride capacity and supports traveler's decision-making on where best to park and make use of transit alternatives. Transit operators are provided arrival information to support efficient pickup and drop offs and drivers switching to transit are offered current transit information.

PM03 Parking Electronic Payment
This service package supports electronic collection of parking fees. It collects parking fees from in-vehicle equipment, contact or proximity cards, or any smart payment device. User accounts may be established to enhance services offered to frequent customers.

PM04 Regional Parking Management
This service package supports communication and coordination between equipped parking facilities and also supports regional coordination between parking facilities and traffic and transit management systems. This service package also shares information with transit management systems and information service providers to support multimodal travel planning, including parking reservation capabilities. Information including current parking availability, system status, and operating strategies are shared to enable local parking facility management that supports regional transportation strategies.

PM05 Loading Zone Management
This service package manages the occupancy of spaces in a loading/ unloading zone. It monitors the current status of each loading/unloading zone space under its control and makes this information available to arriving vehicles. The service package also operates a reservation system for loading zones, providing the capability for loading zone users, including commercial vehicle drivers or fleet operators, to reserve and pay for future use of a loading/unloading space. Interfaces to the general Vehicle OBE are included since loading zones may be used by any vehicle, though commercial vehicles are the most frequent users.