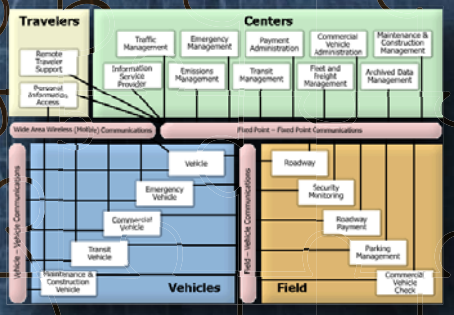
Minnesota Statewide Regional ITS Architecture

Version 2014

Volume 1:
Archived Data Management Systems Service Package Bundle

MINNESOTA DEPARTMENT OF TRANSPORTATION

URS



Minnesota Statewide Regional ITS Architecture
Version 2014

Volume 1: Archived Data Management Systems Service Package Bundle

Prepared by

URS Corporation

September 2014

TABLE OF CONTENTS

ACRONYMS

AD	Archived Data or Archived Data Management
ADMS	Archived Data Management System
AFR	Automated Field Reporting
APTS	Advanced Public Transportation System
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
ATR	Automatic Data Recorder
AVL	Automatic Vehicle Location
AVSS	Advanced Vehicle Safety System
CAD	Computer Aided Dispatch
CARS	Condition Acquisition and Reporting System
CCTV	Closed Circuit Television
CTS	Center for Transportation Studies (University of Minnesota)
DDS	Data Distribution Server
DMS	Dynamic Message Sign
DOT	Department of Transportation
DVR	Digital Video Recorder or Digital Video Recording
EM	Emergency Management
EMS	Emergency Medical Services
EMSRB	Emergency Medical Services Regulatory Board
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FTA	Federal Transit Administration
GIS	Geographic Information System
HOV	High-Occupancy Vehicle
ICS	Incident Command Structure
IEEE	Institute of Electrical and Electronics Engineers
ITS	Intelligent Transportation Systems
LOS	Level of Service
LPR	License Plate Reader
MCM	Maintenance and Construction Management
MCMIS	Motor Carrier Management Information System
MDC	Mobile Data Computer
MnDOT	Minnesota Department of Transportation
MSP	Minnesota State Patrol
MTO	Minnesota Traffic Observatory
NIMS	National Incident Management System
ODS	Office of Decision Support (MnDOT)
OIM	Office of Investment Management (MnDOT)
PD	Police Department
PRISM	Performance and Registration information Systems Management
RMS	Records Management System
RTMC	Regional Transportation Management Center (MnDOT)
RWIS	Road Weather Information System
SAFER	Safety and Fitness Electronic Records
TDA	Office of Transportation Data & Analysis (MnDOT)
TDRL	Transportation Data Research Laboratory (University of Minnesota)
TMC	Transportation/Traffic Management Center

TOCC	Transportation Operation and Communications Center
U of M	University of Minnesota
UMD	University of Minnesota-Duluth
UTSDF	Unified Transportation Sensor Data Format
VMT	Vehicle-Miles Traveled

Page Left Blank Intentionally

1. Introduction

1.1 Statewide Regional ITS Architecture Update

The Minnesota Statewide Regional Intelligent Transportation Systems (ITS) Architecture Version 2014 is an update of the previous version that was developed in 2009. It conforms with the National ITS Architecture 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. The National ITS Architecture 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.

- **Volumes 1 thru 8 – Development and Documentation of Service Package Bundles:** Each volume is specific to the corresponding Service Package Bundle and includes: a description of the Service Package Bundle, 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 9 – 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.

- **Volume 10 – Turbo Architecture Outputs of the Regional ITS Architecture:** Volume 10 consists of a Turbo Architecture generated report for the Minnesota Statewide Regional ITS Architecture.

The purpose for developing Volumes 1 through 8 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 1 – Archived Data Management Systems

Archived Data Management Systems (ADMS) provide the crucial linkage between the sources of real-time ITS data and archived data users, other archives, and the manager or operator of the system. At its most basic level, an ADMS is an information management system that collects, processes, and documents or stores real-time ITS data for use by a broad cross section of users. An ADMS provides an ITS historical data archive for all relevant ITS data and incorporates the planning, safety, operations, and research communities into ITS. It provides the data collection, manipulation, and dissemination functions of these groups, as they relate to data generated by ITS. When operations data are integrated into an ADMS, they offer a valuable tool that supports a variety of purposes, such as developing operational strategies, performance monitoring, planning for operations, long-term planning, and policy and investment decision-making.

Development of Volume 1 – ADMS entailed the project Consultant to work 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 1 summarizes the findings of data collection and analysis activities conducted to support development of the ADMS Service Package Bundle. Volume 1 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 Archived Data Management Systems*** provides a brief overview of statewide ADMS 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 ADMS. 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 ADMS 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: ADMS Research and Development Needs*** describes general research that can be performed to help implement the identified services.

2. Identification of Existing Archived Data Management Systems

ADMS offers a valuable tool and enables the use of system-enhanced archived transportation operations-related data for transportation applications such as developing operational strategies, system performance monitoring, planning for operations, long-term planning, as well as policy and investment decision-making. ITS technologies offer efficient and cost-effective solutions for transportation data collection through automation and advanced data management. Vehicle sensing and detection technology for collecting traffic volume and speed data reduces the needs for labor-intensive manual data collection methods. Other data collected from ITS, such as travel time and road weather conditions, enable a new level of decision support capability.

ITS collects a significant amount of data that support real-time control strategies such as ramp metering, incident management, traffic signal control, and traveler information services. These types of data can also be extremely valuable for many other purposes if they are saved and made accessible. Furthermore, the detailed nature of ITS-generated data allows for more accurate analyses and makes many applications possible in a cost-effective way. Data integration and fusion across modes and applications enable an information synergy, which increases the value of the separate data sources.

ADMS deployments are located throughout Minnesota and have aided roadway and transit operations to gather and provide traveler movements that affect mobility. Using that available information has improved the overall performance of the Minnesota's transportation systems, particularly in safety, travel time, and travel time reliability. An inventory of existing and planned ADMS 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 the National ITS Architecture.

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. ADMS solutions involve services that improve the overall information and data management functions. They have direct influences on improving performance of transportation systems, including safety, travel time, and travel time reliability.

An ADMS provides the crucial linkage between the sources of real-time ITS data and archived data users, other archives, and the manager or operator of the system. It provides an ITS historical data archive for all relevant ITS data and incorporates the planning, safety, operations, and research communities into ITS. An ADMS offers a valuable tool that supports a variety of purposes, such as developing operational strategies, performance monitoring and reporting, planning for operations, long-term planning, as well as policy and investment decision-making. The goal of ADMS is to improve transportation systems data management and integration through the use of advanced data collection techniques, information management, communication systems, and system integration between multiple jurisdictions. The Minnesota ITS Development Objectives in Table 3-1, specific to ADMS, are steps to determine and/or measure whether or not ADMS goals are being achieved. A complete list of Minnesota ITS Development Objectives is included in *Appendix B*.

Table 3-1. ADMS Specific Minnesota ITS Development Objectives

E. Support Regional Economic Productivity and Development

E-4 Increase agency efficiency *(ADMS, ATMS, APTS, CVO, EM & MCM)*

- B-2-15 Improve average on-time performance for specified transit routes/facilities
- 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-4-05 Increase the percentage of fleet/equipment within its lifecycle

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

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 early 2013 to capture the following changes since the last update of the Architecture in 2009:

- 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 2009 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 March and May 2013, 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 4-1 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 4-1. The potential solutions and enhancements identified in Table 4-1

will provide the required service(s) to fill the gaps summarized in *Appendix C*. This appendix will take the ADMS 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 4-1. ADMS 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.*

[c] *Priority point is calculated based on limited votes (3 or less).*

ID	Need/Potential Solution	Priority Point[a]	ITS Development Objective	National ITS Architecture Reference[b]
TM03	Use archived data for traffic management strategy development and long range planning	3.20	G-1-01, G-1-02, G-1-03	ATMS09, AD1, AD2
TM42	Use roadside data collectors to determine locations with high incident of speeding	2.44	A-1-01, A-1-02, A-1-12, A-2-43, A-2-44, G-1-01, G-1-02, G-1-03	ATMS01, ATMS19, AD1
TR09	Measure historical transit route performance	3.86	B-2-05, B-2-06, B-2-07, B-2-08, B-2-09, B-2-10, G-1-01, G-1-02, G-1-03	APTS01, AD1
TR24	Metro Transit Police records integration with other PD's	3.00[c]	B-1-16, G-1-01, G-1-02, G-1-03	AD1, AD2
TR26	Additional GIS systems integration	3.00[c]	G-1-01, G-1-02, G-1-03	AD1, APTS02, APTS03
CF03	Target enforcement at locations with history of violations	3.00	F-1-01, F-1-02	CVO06, CVO07, AD1
CF04	Target enforcement on carriers, vehicles and drivers with history of violations and poor safety records	4.00	E-2-02, E-2-04, F-1-01, F-1-02	CVO04, CVO07, AD1
CF19	Improve quality and accessibility of commercial vehicle-related crash data	3.00	A-1-01, A-1-02, A-1-06, A-1-07, G-1-01, G-1-02, G-1-03	AD1, AD2
E12	Implement automated field reporting system	4.00	B-1-15, B-1-16, B-1-17, B-1-18, D-1-04	AD1
E13	Provide real-time digital video recordings (DVR)	3.00	B-1-15, B-1-16, B-1-17, B-1-18	EM01, EM02, AD1

5. Detail of ADMS Needs and Services

A detailed description of each ADMS 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 ADMS Service Package Bundle and those in other Service Package Bundles.

6. ADMS Research and Development Needs

In order to fill gaps and meet the needs for technology advancement in ADMS 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 ADMS are as follows:

<u>Advanced Traffic Management Systems (ATMS)</u>

- Develop improved ways to access and search archived data
- Test new data gathering and archiving techniques

<u>Advanced Traveler Information Systems (ATIS)</u>

- Investigate methods and processes to improve data latency, quality and consistency
- Improve percentage and accuracy of incidents captured in CARS on statewide basis

<u>Maintenance and Construction Management (MCM)</u>

- Develop a generalized life-cycle costing model that can be used for estimating the optimum life of various MnDOT assets

- Test GIS database for infrastructure inventory, status, and maintenance history and schedule

Commercial Vehicle Operations (CVO)

- Measure historical commercial vehicle shipment performance and automated clearances at weigh stations to determine how competitive Minnesota is with other states

Emergency Management (EM)

- Develop surveillance video search tools and archiving standards

Appendix A: Existing/Planned ADMS Elements

System	Service Package	Description	Stakeholder	Status
Data Distribution Server	AD1	The Data Distribution Server (DDS) is a custom designed, real-time data distribution system used at the MnDOT RTMC from which data is shared with other agencies.	MnDOT	Existing
Media Information Release System	ATIS01, AD1	This system has been created to keep the media and the public more up to date in case of serious and fatal accidents that happen within the state of Minnesota. This system contains only those accidents in which the Minnesota State Patrol is the primary reporting law enforcement agency. Records displayed here are as current as the last time State Patrol Personnel edited data. However due to extenuating circumstances such as heavy-accident periods like ice and snow storms, data entry may get back-logged and may not be up to the minute.	Minnesota State Patrol	Existing
Minnesota Conditions Acquisition and Reporting System (CARS)	AD1, AD2, ATMS06, ATIS01, ATIS02, ATIS06, CVO01, EM06, EM10, MC04, MC06, MC08	This system represents a central source of roadway event information for both the management and dissemination of traffic-related information to the traveling public. The system is maintained by the MnDOT Office of Maintenance and data is input throughout MnDOT at District Offices and District TOCCs. Minnesota State Patrol users also enter information to CARS on road conditions, construction, incidents, special events, and over dimension vehicle restrictions each day. CARS also manages automated data entry for congestion in the Twin Cities metro area based on information from Automated Traffic Recorder Roadside Equipment and it provides traveler information for use in the display of road conditions on cable access television. In MnDOT District 7, data entry occurs via web-enabled cellular telephones with approximately 75 users, primarily snow plow operators. Similar deployment is planned for MnDOT District 6. Integration of CARS with 911 Computer Aided Dispatch System is planned.	MnDOT Office of Maintenance	Existing

System	Service Package	Description	Stakeholder	Status
Minnesota Emergency Responder Database	AD2	This element represents 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 project area would include the seven-county metro area and 10 out-state counties.	Minnesota EMSRB	Planned
Minnesota State Patrol Databases	AD1, AD2	Minnesota State Patrol databases contain information on crash and dispatching. An Automated Field Reporting (AFR) System is planned to interface with the Records Management System (RMS). With the implementation of the AFR System, four documents that are currently manually filled out and submitted by the Troopers will be electronically transferred from Troopers' laptop computers (called Mobile Data Computers or MDC's) to a central repository.	Minnesota State Patrol	Existing
Research Lab Network Surveillance Archive	AD1	This represents the data archive maintained by the Minnesota Traffic Observatory (MTO). The archive stores data on freeway traffic flows through a fully independent network of video detectors covering the I-35W/I-94 Commons freeway area in Minneapolis. Portable monitoring stations deployed on the roofs of several high-rise buildings overlooking the freeway transmit data back to the MTO.	U of M CTS ITS Institute	Existing
Research Lab New Surveillance Control System	ATMS01, AD1	This represents the Minnesota Traffic Observatory (MTO) – a transportation laboratory that gathers data on freeway traffic flows through a fully independent network of video detectors providing space- and time-continuous coverage of the I-35W/I-94 Commons freeway area in Minneapolis. Portable monitoring stations deployed on the roofs of several high-rise buildings overlooking the freeway transmit data back to the MTO via a high-speed IEEE 802.16 wireless network. MnDOT supplies eight switchable compressed/streamed Internet video feeds to the MTO. Researchers have the ability to switch between any of the MnDOT CCTV cameras monitoring the metropolitan freeway network.	U of M CTS ITS Institute	Existing

System	Service Package	Description	Stakeholder	Status
Traffic Data and Video Archive	AD1, AD2	This element represents the database in which Automated Traffic Recorder (ATR) data is stored. The ATR data is compiled from several sources into a single accessible database managed by the MnDOT Office of Transportation Data Analysis to answer data requests and provide reports to others. This element also represents the database in which CCTV video is stored.	MnDOT	Existing
Transit Data Archives	AD1, AD2	Transit data archives will store automated data generated by metro area transit providers, as well as local transit providers. It is planned to upgrade existing or install new scheduling software systems as determined by transit agencies. The automated archiving system will provide the capability to automate real time, interactive and/or batch scheduling functions and increase the efficiency of service. The basic program features will include vehicle management, driver management, trip reservations, automated scheduling and routing, coordination, dispatching, reporting, geo-coding, and mapping.	Metro Area Transit Providers	Planned
Transportation Information System (TIS)	AD2, AD3	MnDOT Office of Transportation Data Analysis (TDA) is responsible for the collection, creation, storage, maintenance, and dissemination of transportation-related data to the general public through various means. Interconnects with MnDOT RTMC and TOCCs, RWIS Central Server, and CARS. Archive coordination exists with the RTMC, TOCCs, and RWIS.	MnDOT TDA	Existing
UMD Transportation Data Research Laboratory (TDRL)	AD1	Transportation Data Research Laboratory (TDRL) server located at the University of Minnesota-Duluth (UMD) campus downloads data from the MnDOT RWIS Central Server. The TDRL server daily archives this RWIS data using the Unified Transportation Sensor Data Format (UTSDF) and makes them available to the public through Internet. This archived historic data is presently only available through TDRL.	University of Minnesota Duluth	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.

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

A-1 Reduce crash frequency *(ATIS, ATMS, APTS, CVO, EM, MCM & AVSS)*

- 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 *(ATIS, ATMS, APTS, CVO, EM, MCM & AVSS)*

- 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 *(ATIS, ATMS, EM, MCM & AVSS)*
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 *(ATIS, ATMS, MCM & AVSS)*
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
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 occupancy and facility throughput *(ATMS & APTS)*

- 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 *(ATIS, ATMS, EM, MCM & AVSS)*

- 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 *(ATIS, ATMS, APTS, CVO, EM, MCM & AVSS)*
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 *(ATIS, ATMS, APTS, EM & AVSS)*
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
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
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 *(ATIS, ATMS, APTS & AVSS)*
- 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 *(ATIS, ATMS & APTS)*
- 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 CCTV, 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
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 Reduce stress caused by transportation *(ATIS, ATMS, APTS, EM, MCM & AVSS)*
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 the peak period
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-3-12 Increase number of 511 calls per year
C-3-13 Increase number of visitors to traveler information website per year
C-3-14 Increase number of users of notifications for traveler information (e.g., e-mail, text message)
C-3-15 Increase the number of transit routes with information being provided by ATIS
C-3-16 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 *(APTS & EM)*

C-3-09 Increase the percent of the transportation system in which travel conditions can be detected remotely via CCTV, 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 closed circuit television (CCTV) 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 closed circuit television (CCTV) cameras
D-1-07 Increase the number of critical sites with security surveillance
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 *(ATIS, ATMS, APTS, CVO, EM, MCM & AVSS)*

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 CCTV, 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 closed circuit television (CCTV) 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 closed circuit television (CCTV) cameras
D-1-07 Increase the number of critical sites with security surveillance
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 *(ATIS, ATMS, APTS, CVO & AVSS)*

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 *(ATIS & 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 *(ATMS, APTS, CVO & AVSS)*
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 CCTV, 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-3-14 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 *(ADMS, ATMS, APTS, CVO, EM & MCM)*

- 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 *(ATMS, APTS, CVO & AVSS)*

- 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
- 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 *(ATIS & 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 *(ATMS, CVO, EM & MCM)*

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

D-1-06 Increase the percent of major and minor arterials are equipped with and operating with closed circuit television (CCTV) cameras
D-1-07 Increase the number of critical sites with security surveillance
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 *(ATMS, CVO, MCM & AVSS)*

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
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 *(ATIS, ATMS, CVO & AVSS)*

- 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
- 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 *(ATMS, APTS, EM & MCM)*

- A-2-44 Reduce number of traffic law violations
- 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
- C-3-17 Increase annual transit ridership
- H-2-01 Increase the average vehicle occupancy rate in HOV lanes
- H-2-02 Increase the amount of environmentally friendly de-icing material used

Appendix C: Needs and Services Detail

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
Service Packages AD1-ITS Data Mart								
TM03	Use archived data for traffic management strategy development and long range planning	• MnDOT OIM, ODS, and local agencies (i.e. Metropolitan Council) utilize collected traffic data to better manage and plan resources and determine effective strategies and actions (i.e. project development) to address transportation challenges.	• MnDOT and local agencies currently collect traffic volume, crash, and other traffic event data for planning use.	• Develop an automated system for data archiving. • Develop a user-friendly system to quickly find and process archived data. • Develop planning and operations models that incorporate non-ideal conditions, such as lane closures or emergencies. • Incorporate data into Metro GIS mapping efforts. • PeMS (Performance Monitoring System) can be used in analyzing mobility measures with respect to operations and MAP-21.	• MnDOT TDA and RTMC are responsible to plan, design, construct, operate, integrate, and maintain data archive systems. • Local agencies are responsible to plan, design, construct, operate, and maintain their own data archives.	• This service includes interconnects between TMCs and Data Archives; and between Data Archives and archive data users. • This service also includes interconnects between MnDOT (state) level data and city/county (local) level data.	• This service is dependent on archived data from other services. Statewide data formatting and archiving standards are necessary for this service to be used for all planning and traffic management purposes.	• AD2 • ATMS09

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
TM42	Use roadside data collectors to determine locations with high incident of speeding	• MnDOT and local agencies deploy speed detectors at locations to collect historic data. • MSP and local agencies use historic speed data to determine locations to target speeding enforcement.	• MnDOT uses roadside speed detectors to collect speed information, but does not archive the data.	• MnDOT and local agencies will record and analyze speed data to determine locations with a high incident of speeding and provide this information to MSP and local enforcement. • MnDOT and local agencies will use portable detection capability to track speeds in rural areas with high crash history.	• MnDOT and local agencies are responsible to plan, design, and construct, speed data gathering systems and to analyze the data. • MSP and enforcement agencies are responsible to deploy speed enforcement measures at identified locations.	• This service includes interconnects between roadside speed data collection equipment and central processing systems.	• This service requires archiving of speed data for analysis of locations with high incidents of speeding.	• ATMS01 • ATMS19
TR09	Measure historical transit route performance	• Transit agencies measure and analyze route performance to identify areas to enhance service and improve operations.	• Many metro area and local transit agencies already track route performance and use in analysis of transit operations.	• Refine data analysis tools to evaluate route performance based on archived data. • Refine tools to manage archived transit performance data.	• Transit agencies are responsible to gather, manage, archive, and analyze route performance for their system.	• This service includes interconnects between in-vehicle equipment and transit management centers. • Interconnects between transit management centers and transit data archives.	• Key measures of route performance have already been archived for future analysis and comparison.	• APTS01

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
TR24	Metro Transit Police records integration with other PD's	• Local public safety agencies and Metro Transit Police integrate their records for better data sharing and coordination in incident/ emergency responses.	• Metro Transit Police currently have a separate, non-integrated police record system. • Coordination between Metro Transit Police and local PD's is conducted by calling each other during an incident.	• Define standards for data record integration. • Integrate Metro Transit Police system with that of other PD's in the metro area.	• Metro Transit Police and local public safety agencies are responsible to develop common standards and integrate and maintain their systems.	• Data integration includes interconnects between Metro Transit Police and other PD's.	• None for data/ record integration. Separate systems already have archiving guidelines and storage protocols for police records.	• AD2
TR26	Additional GIS systems integration	• Transit police and transit agencies use GIS systems for collecting incident data and performing incident investigation.	• Transit agencies use GIS for operations and management. • Transit police uses GIS to an extent for incident data collection.	• Integrate transit agencies GIS systems with city/ county law enforcement systems for enhanced data collection and investigation capabilities.	• Transit agencies are responsible to coordinate with law enforcement agencies and to plan, procure, integrate, operate and maintain their systems.	• None.	• Transit service data and incident data are already archived.	• APTS02 • APTS03

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
CF03	Target enforcement at locations with history of violations	• Law enforcement agencies use analysis of data from WIM sites and from Virtual Weigh Stations (VWS) to determine locations with high levels of violations and use mobile enforcement to target these "hot spots"	• MnDOT currently uses both permanent and portable scales to address problem areas.	• Deploy additional VWS to provide for better identification of locations with high levels of violations.	• MnDOT is responsible to plan, design, operate and maintain portable and permanent scales. • State Patrol is responsible for enforcement.	• Interconnects between in-vehicle equipment, roadside equipment and MnDOT CVO are required.	• None	• CVO06 • CVO07

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
CF04	Target enforcement on carriers, vehicles and drivers with history of violations and poor safety records	• Data from PRISM, SAFER, and complaints made to MnDOT CVO and/or DPS are analyzed to determine carriers, drivers and vehicles that have a high level of violations or crashes. These problem drivers, carriers or vehicles are then targeted for future enforcement. • MnDOT uses federal FMCSA database to monitor safety data for compliance reviews.	• The FMCSA has a record of complaints against carriers. • FMCSA PRISM identifies problem vehicles to revoke licenses. • SAFER system has company safety data, though it is possible for companies to hide their histories within the SAFER database by changing their company. • Motor Carrier Management Information System (MCMIS) has data on commercial vehicle operation credentials. • License Pate Readers (LPR) equipment is being installed in Winona for State Patrol to distinguish between violators	• Improve company tracking in SAFER to reduce hiding of past safety issues.	• MnDOT is responsible to plan, design, operate and maintain CVO administrative databases. • State Patrol is responsible for enforcement.	• Interconnects are required between MnDOT CVO and various regional, state and federal CVO database.	• Legislation on LPR data may restrict MnDOT from archiving and reporting LPR data. LPR data may be available for up to two weeks of time to allow for state patrol to issue citations on past violations.	• CVO04 • CVO07

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
CF19	Improve quality and accessibility of commercial vehicle-related crash data	• MSP and other law enforcement agencies collect and enter improved and more detailed data regarding crashes involving commercial vehicles into crash databases. • Law enforcement, DPS, planning agencies use improved data to plan safety and enforcement enhancements.	• Minnesota State Patrol and other law enforcement agencies currently collect relevant information during investigations of crashes.	• Investigate the use of advanced equipment to more efficiently collect crash data while minimizing the amount of field investigation time needed.	• MnDOT and Minnesota State Patrol are responsible to operate and maintain the field equipment and central databases.	• Interconnects are required between field equipment, law enforcement, and MnDOT CVO.	• Crash data is archived for future safety studies and planning efforts.	• AD2

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
E12	Implement automated field reporting system	• MSP troopers, local law enforcement, and local fire/EMS agencies use this system to reduce the time for incident reporting and citation issuance, and increase data accuracy. • This system can also include license swipe technology that allow the use of a portable license reading device to pull up driver information in real-time without manually entering information.	• An automated field reporting system including a license swipe system is currently under development through the Rapid Incident Clearance Project. • Electronic citation system has been implemented to reduce paperwork process of issuing citations. • State Patrol uses an Intergraph system for crash reporting	• Complete testing of license swipe technology and deploy systems. • Complete testing and implement the automated field reporting system. • Develop a DUI/ DWI module to automate DUI/DWI reporting. • One system used by both state patrol and local agencies for crash reporting.	• MSP and local public safety agencies are responsible coordinate with each other to plan, design, construct, operate and maintain the automated field reporting system.	• Automated reporting systems include interconnects between in-vehicle equipment and central reporting system. • Systems also include interconnects between handheld devices and a central reporting systems/ databases.	• This system will automate the data entry and archiving process and will not generate new data which is not already being archived.	

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
E13	Provide real-time digital video recordings (DVR)	• Emergency responder and dispatchers will use DVR to review camera images in real-time to verify events at incident sites and make decisions to better respond to an incident.	• Dispatchers have access to some camera images, but do not have the ability to play images back immediately to review conditions or events at an incident scene. • All MSP squads can record analog video at the scene.	• Integrate DVR systems into MSP dispatch centers and MnDOT RTMC and TOCCs. • Integrate DVR systems into MSP vehicles with cameras to allow officers to review images.	• MnDOT RTMC and TOCCs are responsible to plan, design, construct, integrate, operate and maintain DVR systems for their cameras. • MSP is responsible to plan, design, construct, integrate, operate and maintain DVR systems for its fleet.	• DVR systems include interconnects between roadside camera systems and dispatch centers, emergency operations centers, and/or vehicles.	• Live video should be "buffered" for a period of time to allow saving video of interest after the fact. • Long-term archiving is covered under surveillance and CCTV camera operations services. • Law enforcement should be able to record an entire incident/ response.	• EM01 • EM02
Service Package AD2-ITS Data Warehouse								
TM03	Use archived data for traffic management strategy development and long range planning	See information under AD1						
TR24	Metro Transit Police records integration with other PD's	See information under AD1						

ID	Need/Service	Operational Concept	Existing Capability	Gap/Planned Enhancement	Role/ Responsibility	Interconnect	Data Archive Need	Associated Service Package
CF19	Improve quality and accessibility of commercial vehicle-related crash data	See information under AD1						
Service Package AD3-ITS Virtual Data Warehouse								
No needs or services under this service package were identified by stakeholders.								

Appendix D: ADMS Service Packages and Descriptions

The descriptions of ADMS service packages are taken directly from the National ITS Architecture version 7.0.

AD1 ITS Data Mart
This service package provides a focused archive that houses data collected and owned by a single agency, district, private sector provider, research institution, or other organization. This focused archive typically includes data covering a single transportation mode and one jurisdiction that is collected from an operational data store and archived for future use. It provides the basic data quality, data privacy, and meta data management common to all ITS archives and provides general query and report access to archive data users.

AD2 ITS Data Warehouse
This service package includes all the data collection and management capabilities provided by the ITS Data Mart, and adds the functionality and interface definitions that allow collection of data from multiple agencies and data sources spanning across modal and jurisdictional boundaries. It performs the additional transformations and provides the additional meta data management features that are necessary so that all this data can be managed in a single repository with consistent formats. The potential for large volumes of varied data suggests additional on-line analysis and data mining features that are also included in this service package in addition to the basic query and reporting user access features offered by the ITS Data Mart.

AD3 ITS Virtual Data Warehouse
This service package provides the same broad access to multimodal, multidimensional data from varied data sources as in the ITS Data Warehouse service package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse service package are parsed by the local archive and dynamically translated to requests to remote archives which relay the data necessary to satisfy the request.