REGIONAL ITS STRATEGIC PLAN

FOR THE MADISON METROPOLITAN AREA

An Intelligent Transportation System (ITS) represents the collection of technologies or systems (e.g., advanced sensors, computers, communications systems) that enable multiple agencies to work together to deliver various transportation services (e.g., regional traffic control) in an efficient and cost-effective manner.

January 2016

Regional ITS Strategic Plan

for the Madison Metropolitan Area

January 2016

Prepared for:
Madison Area Transportation Planning Board – An MPO

Prepared by:
HNTB Corporation

in association with:
Toole Design Group
ABRAZO Marketing

Resolution TPB No. 114

Adopting the Regional Intelligent Transportation Systems (ITS) Strategic Plan for the Madison Metropolitan Area

WHEREAS, the *2035 Regional Transportation Plan Update for the Madison Metropolitan Area & Dane County* (2012) recommends applying intelligent transportation systems (ITS) technologies and using transportation systems management (TSM) and travel demand management (TDM) strategies to manage congestion, make efficient use of existing roadway capacity, and make the transportation system more reliable, convenient, and safe; and

WHEREAS, ITS technologies or systems such as advanced sensors and communications systems enable multiple agencies to work together to collectively manage the transportation system, decreasing congestion, providing real-time traveler information, and improving the efficiency of transit, maintenance, and emergency response agencies; and

WHEREAS, effective management of the transportation system, especially the local arterial roadway and transit systems, is particularly important for the Madison metropolitan area due to its unique geography, lack of freeway access to downtown, limited opportunities for roadway capacity expansion, and large number of special events; and

WHEREAS, the *2035 Regional Transportation Plan Update* also recommends implementing the Madison Area Transportation Planning Board's (MATPB) adopted *Congestion Management Process for the Madison Metropolitan Planning Area* (2011), which outlines a process for monitoring and evaluating the performance of the multi-modal transportation system; and

WHEREAS, implementation of ITS strategies will assist the MATPB and its partner agencies in implementing the region's Congestion Management Process by providing data to assess the performance of the transportation system and systems to manage and archive the data for use in planning and project programming; and

WHEREAS, the *Regional ITS Strategic Plan for the Madison Metropolitan Area* has been prepared to provide the framework for a multi-year, multi-agency investment in an integrated set of ITS strategies and projects to help achieve transportation system goals; and

WHEREAS, the Regional ITS Strategic Plan will position the region for future federal funding opportunities, help the region prepare for the future full-scale implementation of technologies such as connected and autonomous vehicles, and position the MPO to effectively implement new federal performance based planning requirements; and

WHEREAS, the Regional ITS Strategic Plan includes a vision, goals, objectives, performance measures, and a recommended set of strategies and projects to guide implementing agencies in the effective and integrated deployment of ITS technologies and systems; and

WHEREAS, preparation of the Regional ITS Strategic Plan was guided by an oversight committee consisting of staff from the MPO, City of Madison Traffic Engineering, Metro Transit, and the UW Traffic Operations and Safety Laboratory and was also overseen by an ITS Advisory Committee with representation also by WisDOT, Dane County, and local transportation, public safety, and information technology agencies and departments; and

WHEREAS, the process for developing the plan also included two workshops with members of the advisory committee and a broader group of stakeholder agencies to assist in identifying ITS user needs and developing the ITS operational concept outlining the types of functions ITS needs to support and the agencies responsible for those functions; and

WHEREAS, information on the draft ITS plan was posted on the MATPB's site throughout the planning process and a notice was sent out in early December regarding the availability of the draft ITS Plan, which was posted on the website; and

WHEREAS, the ITS Advisory Committee has agreed to continue to meet and work together to support implementation of the ITS plan:

NOW, THEREFORE BE IT RESOLVED that the Draft *Regional ITS Plan for the Madison Metropolitan Area* (November 2015) be adopted as a supplement to the *2035 Regional Transportation Plan Update*, the MPO's current long-range multi-modal regional transportation plan, to be used as a guide for planning and programming of ITS strategies and projects in an integrated and cost effective manner; and

BE IT FURTHER RESOLVED that the ITS Advisory Committee (with attached membership list) is hereby created as a subcommittee of the MATPB's Technical Coordinating Committee and charged with overseeing efforts to implement the ITS Plan and preparation of future updates to the plan; and

BE IT FURTHER RESOLVED that the MATPB is committed to working with the committee members and other local implementing agencies to implement the ITS Plan and track, discuss, and manage regional ITS activities.

BE IT FURTHER RESOLVED, in accordance with 23 CFR 450.334(a) the MATPB hereby certifies that the metropolitan transportation planning process is addressing major issues facing the metropolitan planning area and is being conducted in accordance with all applicable requirements of:

1. 23 U.S.C. 134 and 49 U.S.C. 5303, and this subpart;
2. Title VI of the Civil Rights Act of 1964, as amended (42 USC 2000d-1) and 49 CFR part 21;
3. 49 USC 5332, prohibiting discrimination on the basis of race, color, creed, national origin, ex, or age in employment or business opportunity;
4. Sections 1101(b) of the Moving Ahead for Progress in the 21st Century Act (MAP-21) (Pub. L. 112-141) and 49 CFR Part 26 regarding the involvement of disadvantaged business enterprises in the US DOT funded projects;
5. 23 CFR part 230, regarding the implementation of an equal employment opportunity program on Federal and Federal-aid highway construction contracts;
6. The provisions of the Americans with Disabilities Act of 1990 (42 U.S.C. 12101 *et seq.*) and 49 CFR Parts 27, 37, and 38;
7. The Older Americans Act, as amended (42 U.S.C 6101), prohibiting discrimination on the basis of age in programs or activities receiving Federal financial assistance;
8. Section 324 of title 23, U.S.C regarding the prohibition of discrimination based on gender; and
9. Section 504 of the Rehabilitation Act of 1973 (29 U.S.C. 794) and 49 CFR 27 regarding discrimination against individuals with disabilities.

01/06/2016
Date Adopted

Al Matano, Chair

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TRANSPORTATION PLANNING BOARD

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The preparation of this report has been financed in part through grants from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the Metropolitan Planning Program, Section 104(f) of Title23, U.S. Code.

The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation. Information in this report is subject to change based on the final disposition of the federal transportation reauthorization bill Moving Ahead for Progress in the 21st Century (MAP-21).

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LIST OF ACRONYMS

AADT	Average Annual Daily Traffic
ADA	Americans with Disabilities Act
APC	Automatic Passenger Counter
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AVL	Automatic Vehicle Location
BRT	Bus Rapid Transit
CAD	Computer Aided Dispatch
CARPC	Capital Area Regional Planning Commission
CCTV	Closed Circuit Television
CFR	Code of Federal Regulations
CMAQ	Congestion Mitigation and Air Quality
CMP	Congestion Management Process
CMS	Changeable Message Sign
CV	Commercial Vehicle
CV	Connected Vehicle
CVRIA	Connected Vehicle Reference Implementation Architecture
DMS	Dynamic Message Sign
DSRC	Dedicated Short Range Communication
EAS	Emergency Alert System
EB	Eastbound
EMS	Emergency Medical Service
EOC	Emergency Operations Center
ESS	Environmental Sensor Station
ETA	Estimated Time to Arrival
EV	Emergency Vehicle
EVP	Emergency Vehicle Preemption
FCW	Forward Collision Warning
FST	Freeway Service Team
FTA	Federal Transit Authority
FTE	Full Time Equivalent
FTMS	Freeway Traffic Management System
GPS	Global Positioning System
HAR	Highway Advisory Radio
HOV	High Occupancy Vehicle
IP	Internet Protocol
IR	Infrared
ISIG	Intelligent Traffic Signal System
ISP	Information Service Provider
ITS	Intelligent Transportation System
IVLU	Integrated Vehicle Logic Unit
LED	Light Emitting Diode
LOS	Level of Service
M&O	Maintenance and Operation
MAC	Media Access Control
MADIS	Meteorological Assimilation Data Ingest System
MAP-21	Moving Ahead for Progress in the 21st Century
MATPB	Madison Area Transportation Planning Board
MCM	Maintenance and Construction Management
MCV	Maintenance and Construction Vehicle

MDSS	Maintenance Decision Support System
MDT	Mobile Data Terminal
MOU	Memoranda of Understanding
MPO	Metropolitan Planning Organization
MUFN	Metropolitan Unified Fiber Network
NB	Northbound
NHPP	National Highway Performance Program
NHS	National Highway System
NOAA	National Oceanic and Atmospheric Administration
NPRM	Notice of Proposed Rule Making
PPP	Public-Private Partnership
PSE	Plans Specifications and Estimates
PTZ	Pan/Tilt/Zoom
Q-WARN	Queue Warning
RD&T	Research, Development and Technology
RDC	Regional Data Clearinghouse
RFID	Radio-Frequency Identification
RITA	Research and Innovative Technology Administration
RTMC	Regional Traffic Management Center
RTP	Regional Transportation Plan
RWIS	Road Weather Information System
SB	Southbound
SDS	System Detector Station
SEA	Systems Engineering Analysis
SHAP	Strategic Highway Safety Plan
SMS	Short Range Messaging
SOV	Single Occupant Vehicle
SPaT	Signal Phase and Timing
SSTI	State Smart Transportation Initiative
STIP	State Transportation Improvement Plan
STOC	Statewide Traffic Operations Center
SW	Southwest
TBD	To Be Determined
TDM	Transportation Demand Management
TE	Traffic Engineering
TIFIA	Transportation Infrastructure Finance and Innovation Act
TIP	Transportation Improvement Plan
TMC	Traffic Management Center
TOIP	Traffic Operations Infrastructure Plan
TOPS	Traffic Operations and Safety
TSMO	Transportation Systems Maintenance and Operations
TSP	Transit Signal Priority
USDOT	United States Department of Transportation
USH	United States Highway
UW	University of Wisconsin
UWPD	University of Wisconsin Police Department
V2I	Vehicle-to-Infrastructure
V2V	Vehicle-to-Vehicle
VDTO	Vehicle Data for Traffic Operations
VMS	Variable Message Sign
VMT	Vehicle Miles Traveled
WB	Westbound
WisDOT	Wisconsin Department of Transportation
WLAN	Wireless Local Area Network

1 EXECUTIVE SUMMARY

1.1 Overview

In August 2015, the Metropolitan Area Transportation Planning Board (MATPB), in cooperation with the City of Madison Traffic Engineering (TE) Division/Parking Utility contracted the consulting services of a consultant team lead by HNTB Corporation to develop a Regional intelligent Transportation System (ITS) Strategic Plan for the Madison Metropolitan Area. The effort to develop the Strategic Plan included the following key work tasks:

- ITS Existing Conditions/Inventory Analysis
- Preparation of an ITS Vision and Corresponding Goals, Objectives and Performance Measures
- ITS Needs Assessment
- ITS Operational Concept
- Regional ITS Architecture
- ITS Implementation Plan

The project scope covers the approved MATPB Metropolitan Planning Area Boundary (see **Figure 1**). This area covers all of the City of Madison and the Madison Urban Area, including all or portions of 27 cities, villages and towns. The Plan is focused on the surface transportation system and its applicable interfaces with other modes.

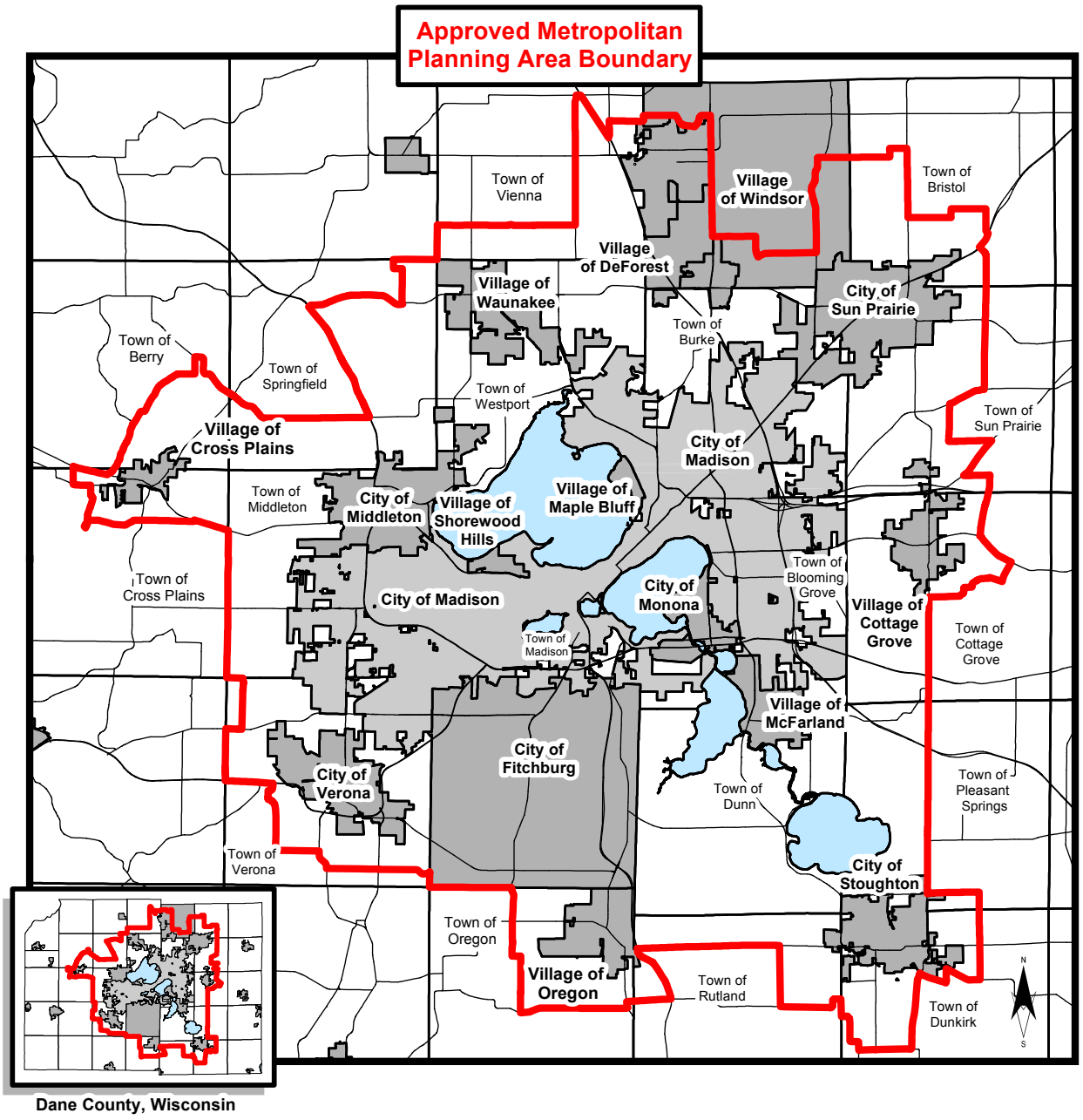
1.2 Why a Regional ITS Plan?

The Madison Metropolitan Area is the fastest growing region in the State of Wisconsin. The City of Madison is the second-fastest growing of Midwest cities with a population of 200,000 or more. This growth combined with the fact that the downtown City of Madison/UW-Madison campus area is located off the freeway network and sits on an isthmus has resulted in the need to better manage transportation congestion in the region. Due to the region's unique geographic constraints there are limited options for traffic circulation and because funding is a limited as ever, capacity expansion (i.e., new pavement) is becoming more and more difficult to implement. As a result, transportation systems management and operations (TSMO) strategies, including ITS and transportation demand management (TDM) strategies, by necessity must play a major role in managing congestion in the Madison Metropolitan Area.

Non-recurring congestion from crashes, disabled vehicles, work zones, adverse weather conditions and planned special events account for a significant amount of congestion, affecting travel reliability on the entire transportation system. Furthermore, the City of Madison hosts numerous special events throughout the year, and ITS strategies are particularly effective in managing congestion from special events and other sources of non-recurring congestion.

Aside from congestion management, ITS strategies also have the ability to provide many other benefits, including improved traveler safety, emergency management, improved transit speed and reliability, parking management, inter-agency communication, staff efficiency and data management. One of the MATPB's primary motivations for preparing this ITS Strategic Plan is to develop a phased approach for implementing ITS strategies so that the required data are collected and shared to fully implement the region's Congestion Management Process (CMP) and to facilitate performance based multi-modal transportation planning.

Figure 1: Regional ITS Strategic Plan Project Area



1.3 What is an ITS?

An Intelligent Transportation System (ITS) is a collection of technologies or systems (e.g., advanced sensors, computers, communications systems, etc.) that enable multiple agencies to work together to collectively manage a transportation network. ITS can be applied to the region's transportation infrastructure of highways, streets, bridges and to a growing number of vehicles, including cars, buses and trucks. ITS elements can also assist in the safe movement of bicycles and pedestrians and can improve transportation providers' (e.g., governments, transit agencies, emergency responders) ability to offer services to the public.

In brief, ITS technologies can perform the following functions:

- Collect and transmit information on traffic conditions. This information can be used in real-time to notify users so they can adjust their plans and by operators to better manage the transportation network. Historical information can be used to monitor how conditions change over time and to implement fixes and tweaks so that strategies can be set in place prior to when impacts are expected.
- Decrease congestion by reducing the number of traffic incidents, clearing them more quickly when they occur, and rerouting traffic flow around them to decrease emergency response times and to improve quality of life of those users that would otherwise be impacted by incidents.
- Improve the efficiency of transit, maintenance, and emergency response agencies.

1.4 Project Process

The foundation of the Project Team's approach to developing the Regional ITS Strategic Plan was based on the following principles:

- Comprehensive stakeholder engagement, including multi-agency workshops and needs identification
- Disciplined application of the systems engineering process
- Building from successful practices and existing infrastructure
- Development of an ITS vision and supporting goals, objectives and performance measures
- Recommendation of projects that address needs and are viable for the region within a 10 year planning horizon.

Because the essence of ITS is information exchange, it is imperative that planning, development, implementation and operations be done in a cooperative and coordinated environment. Development of the Regional ITS Strategic Plan was guided by an ITS Oversight Committee that met regularly throughout the plan's development. Agency members of the Oversight Committee included:

- Madison Area Transportation Planning Board (MATPB)
- City of Madison, Traffic Engineering Division/Parking Utility
- City of Madison, Metro Transit
- University of Wisconsin Traffic Operations and Safety (TOPS) Laboratory

In addition, a Project Advisory Committee was created. Advisory committee members participated in two locally held workshops and met twice towards the end of the process to provide input on project recommendations and implementation steps. Representatives from the following additional agencies were represented on the advisory committee:

- WisDOT, State Traffic Operations Center
- WisDOT, Southwest Region
- Dane County Highway Department
- Dane County Public Communications (911) Center
- Dane County Emergency Management
- Dane County Sheriff's Department
- UW Transportation Services
- City of Madison Police Department
- City of Madison Information Technology Department

In addition to the agency members of the Oversight and Project Advisory Committees, the following additional agencies contributed to the development of the plan through targeted outreach efforts and/or through the participation in the locally held workshops.

- Wisconsin State Patrol
- City of Madison Engineering Department
- City of Madison Fire Department
- City of Fitchburg Public Works Department
- UW-Madison Police
- Dane County Alliant Energy Center
- Union Cab

Outreach to regional transportation agencies, including the above listed agencies began with the first key phases of the project – collection of existing sources of information and development of the regional ITS element inventory.

1.5 ITS Element Inventory – *The Foundation*

The approach for developing the ITS Strategic Plan and for recommending specific ITS projects began by developing an understanding of existing ITS systems. Existing systems essentially represent the foundation from which future ITS efforts will be based. Therefore, it was critical to first understand what existing assets could be leveraged to enhance transportation system management and operations within the region. Current legacy systems were analyzed early in the project and throughout it to evaluate the opportunity for integrating current systems with those that are desired or planned. To be consistent with National terminology and to begin the process of mapping ITS elements to National ITS Architecture service packages the identified ITS elements that currently exist within the Madison Area were categorized into four classes:

- Field-based ITS elements
- Vehicle-based ITS elements
- Centers and center-based ITS elements
- Remote traveler support ITS elements

A summary of ITS elements discussed in existing literature and/or reported by stakeholders is provided in **Table 1**.

1.6 ITS User Needs – *The Problems/Issues*

Concurrent to the identification of existing ITS elements, the project team identified and documented transportation user needs. User needs specify the issues plaguing travelers and transportation operating agencies that may be satisfied through successful application of ITS elements. Understanding user needs is important because it provides the foundation from which remaining project activities were based and ultimately used to recommend specific projects to be implemented in the region.

User needs were categorized into high-level functional areas and sub areas to begin the process of mapping them to the National ITS Architecture – a nationally accepted and proven approach for defining system integration possibilities for regions like the Madison Metropolitan Area. The high-level functional areas are as follows:

- Archived Data Management & Communication
- Public Transportation
- Traveler Information
- Traffic Management
- Vehicle Safety
- Emergency Management
- Maintenance and Construction Management (MCM)
- Other (non-classified)

Table 1

Listing of Existing ITS Elements in the Madison Metropolitan Area Organized by ITS Element Class

ITS Element Class	Existing ITS Elements
Field-Based ITS Elements	• Closed Circuit Television Cameras • Arterial Roadway and Transit Dynamic Message Signs • Ramp Meters • Traffic Signal Systems • Emergency Signal Pre-emption • Adaptive Signal Control Technology • Pedestrian and Bicyclist Hybrid Beacons and Detection • Speed Display Signs • Road Weather Information Systems • Parking Management Systems • System Detector Stations • Bike Counters • Electric Vehicle Charging Stations
Vehicle-Based ITS Elements	• Automatic Transit Passenger Counters • Automatic Transit Vehicle Location Systems • Mobile Data Terminals/Mobile Data Computers • Transit On-Board Fareboxes • Transit On-Board Video Camera System • Transit External Announcement System • Freeway Service Team Vehicles/Equipment
Centers and Center-based ITS Elements	• Statewide Transportation Operations Center (STOC) • City of Madison Traffic Operations Center • Dane County Public Safety Communications Center • University of Wisconsin-Madison Communications Center • Metro Transit Computer Aided Dispatch System • Dane County Emergency Management Systems
Remote Traveler Support ITS Elements	• Wisconsin 511 (Phone and Website) • Metro Transit Online Bus Tracking and Real-time Schedule Information • University of Wisconsin Emergency Notification System (WiscAlerts) • Social Media (various) • Subscription based services (various)
Communications Systems	• Metropolitan Unifed Fiber Network (MUFN) • ITSNet

The user needs were compared to the existing regional ITS asset inventory to determine the approach for ITS implementation and how new ITS elements can be meshed with existing ITS elements to meet regional transportation needs. In some cases, ITS may already be addressing some of the identified issues and needs, but perhaps not at a sufficient level and in other cases ITS may not be used at all.

To identify user needs the Project Team completed an intensive data collection effort. First, the team conducted a literature review of existing reports and studies for any previous statements of transportation system needs. Concurrent with literature collection and review, the Project Team conducted a User Needs Workshop to elicit needs from stakeholders. The User Needs Workshop, held on October 29th, 2014 in the City of Madison, provided stakeholders with an overview of the project, including background and its purpose, as well as a brief understanding of ITS and its role in transportation system management and operations. The consultant team walked stakeholders through a series of operational scenarios involving situations pertinent to the region. Stakeholders were asked a series of questions that were aimed at identifying needs affecting travel and operations within the region. A sampling of the needs identified through this process is provided below.

Integrate and share data collected by multiple regional agencies to improve regional and individual agency operations.

Increase the processing speed and frequency of bus automatic vehicle location data so that transit vehicle arrival information is more accurate and timely.

Collect and share bicycle origin-destination information to better plan and locate bicycle infrastructure.

Improve multi-agency communication and data sharing during active incidents.

Provide/expand multi-agency access and control of regional traffic cameras.

Accommodate the needs of bicyclists, pedestrians and persons with disabilities at signalized intersections so these groups can safely traverse the intersection (i.e., extend signal timing when these groups are detected within the intersection).

Improve traffic signal operations so that they are more responsive to traffic during unexpected incidents and conditions.

Implement parking demand management incentives/disincentives (e.g., variable pricing) for parking during events/periods of high demand.

Take steps to plan for driverless cars.

Improve emergency management coordination, especially around jurisdictional boundaries.

Expand weather collection information for Arterial Corridors

Foster/build relationships among emergency response and municipal agencies to improve regional emergency/traffic response.

1.7 ITS Vision, Goals and Objectives – *The Path*

The Madison Regional ITS Vision sets forth a clear, concise and forward looking statement that defines what ITS should become, or in other words, what it should look like from the perspective of the user (e.g., drivers and operators). Due to the rapid evolution of technology the planning horizon for the Vision has been set at 10 years. Planning for technology beyond a ten year horizon is difficult if not impossible to do. Given that, the Vision for the Madison Metropolitan Area, as mutually agreed to by participating stakeholders is articulated below.

"ITS in the Madison Metropolitan Area will further maximize the safety, efficiency, reliability and overall performance of the multi-modal transportation system through inter-agency coordination and implementation of interconnected and sustainable technologies."

To help move the region closer to this Vision, the project team in cooperation with regional stakeholders outlined a number of goals that will help guide ITS investment. Regional needs and the existing ITS element inventory were reviewed and based on this review the following goals were identified.

- Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel
- Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing
- Goal C: Enhance Transportation System Efficiency and Reliability and Reduce its Impact on the Environment
- Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes
- Goal E: Preserve the Transportation System

Since this is the first ITS Strategic Plan for the Madison Metropolitan Area, this list of ITS goals represents a "start small" approach. This approach focuses on successfully demonstrating ITS performance in the short-term so as to help the region gain traction in developing a larger performance monitoring program and to build from successful projects. To that end, for each goal listed above a number of corresponding objectives and performance measures were developed and can be used by stakeholders in the interim to monitor and report on the performance of ITS investment. It is expected that as the region's performance monitoring program matures and as additional ITS investment is made to collect required data that additional measures will be developed and existing measures tweaked to improve on these efforts. These actions will help demonstrate the value that ITS plays in transportation management and operations and will build momentum and support for additional ITS investment and particularly for ITS programs and projects where improvements have been measured.

1.8 ITS Operational Concept – *The Pieces*

The Operational Concept is a non-technical, easy to understand document that provides a high-level overview of the types of functions ITS needs to support and satisfy the Regional Vision and to address user needs. The Operational Concept begins to answer the "who, what, where, why and how" questions that surround the proposed concept.

The Operational Concept is not intended to be a design document, but rather it addresses the high-level questions that are associated with regional ITS deployment that need to be addressed prior to project identification, programming and implementation. This reduces the risk of overlooking critical stakeholder feedback and having to revisit this stage when the system is being designed and implemented. It also creates an environment where stakeholders can easily exchange ideas and input, fostering inter-agency consensus and buy-in and reducing potential adverse stakeholder reactions that may occur when they are not provided an opportunity to provide comments.

Due to the relatively large number of stakeholders in the Madison Metropolitan Area, the Operational Concept focuses on key agencies, where stakeholder participation and input has been sufficient to clearly articulate agency ITS roles and responsibilities for delivering key transportation functions. Key agencies can be defined as those that have a major role in transportation operations, which are both information providers and receivers.

Input used to develop the Operational Concept was collected primarily through stakeholder participation at the User Needs and Operational Concept Workshops (October 2014 and January 2015, respectively).

To mitigate complexities inherent to developing an ITS Operational Concept for a region as large as the Madison Metropolitan Area and to ease understanding and facilitate an environment where inter-agency consensus can be more easily achieved, the Madison Metropolitan Area ITS Operational Concept was prepared and presented as a series of functional concepts that represent "bite-sized" pieces of the overall or complete ITS concept for the Madison Metropolitan Area. These functional concepts or pieces have been developed from previously identified user needs and map directly to National ITS Architecture Service Packages. Service Packages simply represent the physical infrastructure that corresponds with and is needed to implement a particular transportation service. By using National ITS Architecture Service Packages, it is not only easier for stakeholders to understand where they fit in terms of regional ITS activity, but

it also links Madison's Strategic ITS Plan to the National ITS Architecture – a common, consistent and required (if Federal funds are used) approach for planning and implementing ITS. This alignment ensures consistency with a nationally accepted and proven approach, helping to ensure that public investment is used in the most effective manner. Core functions that comprise the ITS Operational Concept in the Madison Metropolitan Area are illustrated in **Figure 2**. The operational concepts generally represent functional areas that can be supported through existing technologies in the marketplace though these technologies may not yet be present or implemented within the Madison region. In many cases, operational concepts lay the foundation for more sophisticated concepts that may be implemented to address regional needs in the long-term, such as connected vehicle applications and technologies. National ITS Architecture service packages that are applicable to the Madison Metropolitan Area are identified in **Table 2**.

Figure 2: Madison Metropolitan Area ITS Core Functions

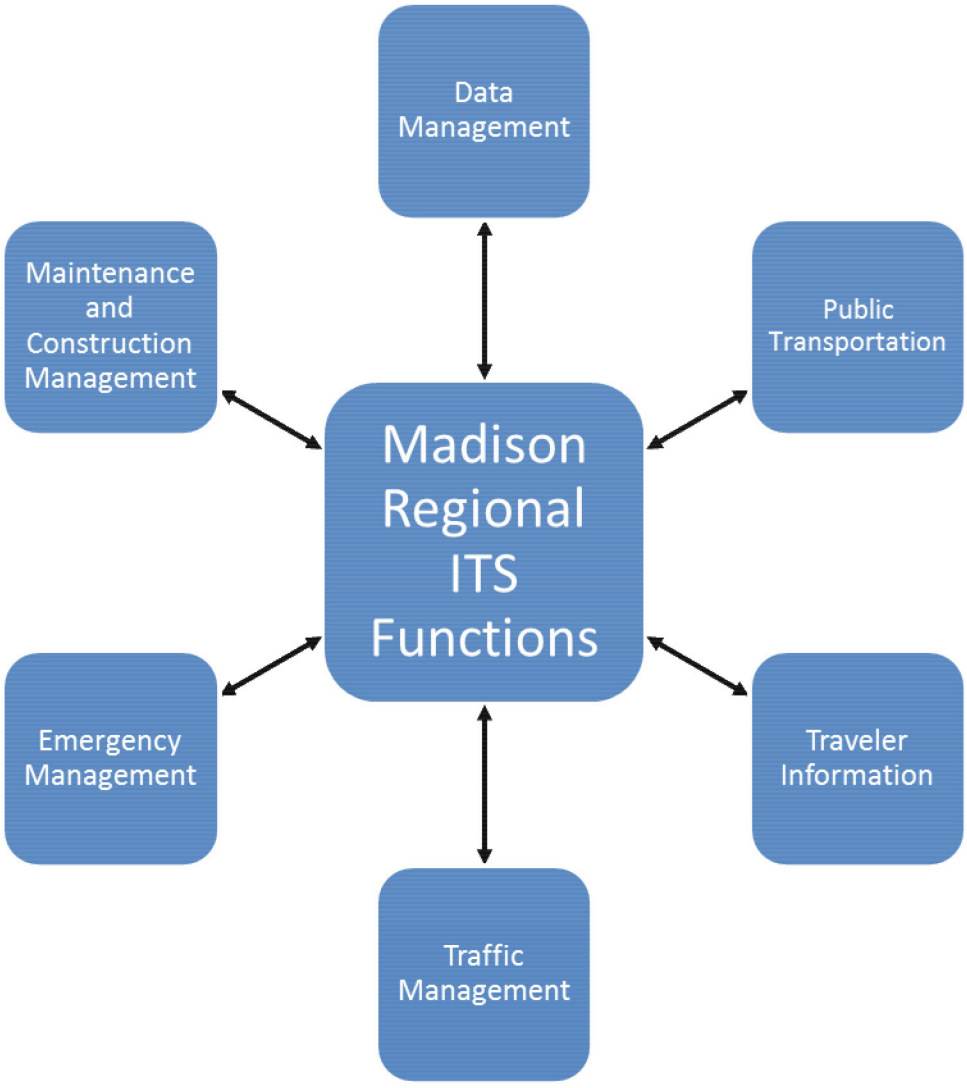


Table 2

National ITS Architecture Services Areas and Service Packages Applicable to the Madison Metropolitan Area

Archived Data Management Service Area	Traffic Management
ITS Data Mart	Network Surveillance
ITS Data Warehouse	Traffic Signal Control
Public Transportation Service Area	Traffic Metering
Transit Vehicle Tracking	Traffic Information Dissemination
Transit Fixed-Route Operations	Regional Traffic Management
Demand Response Transit Operations	Traffic Incident Management System
Transit Fare Collection Management	Transportation Decision Support and Demand Mngt.
Transit Security	Parking Facility Management
Multi-modal Coordination	Regional Parking Management
Transit Traveler Information	Mixed Use Warning Systems
Transit Signal Priority	**Maintenance & Construction Management**
Transit Passenger Counting	Maint. & Constr. Vehicle and Equipment Tracking
Multimodal Connection Protection	Road Weather Data Collection
Emergency Management	Weather Information Processing and Distribution
Emergency Call-Taking and Dispatch	Roadway Automated Treatment
Emergency Routing	Winter Maintenance
Roadway Service Patrols	Roadway Maintenance and Construction
Wide-Area Alert	Maintenance and Construction Activity Coordination
Traveler Information	**Vehicle Safety**
Broadcast Traveler Information	Automated Vehicle Operations
Interactive Traveler Information	
Dynamic Route Guidance	
ISP Based Trip Planning and Route Guidance	
Transportation Operations Data Sharing	
Dynamic Ridesharing	

1.9 ITS Architecture – *The Framework*

The Madison Regional ITS Architecture is a high-level representation or framework that illustrates and describes how existing and planned ITS elements within the region interconnect to exchange information and data. To this extent the Regional ITS Architecture can be portrayed as a "blue print" that illustrates the existing and future state of ITS integration. It identifies the individual pieces (i.e., ITS elements) that have been identified for the Madison Metropolitan Area, the functions these pieces perform, and the information and data that are exchanged. The Architecture does not define how ITS elements will be implemented, but rather defines the interactions these pieces have among each other. This helps agencies easily visualize where in the "big picture" their ITS elements fit and with what other elements they communicate.

ITS Architecture development was guided by the National ITS Architecture. The National ITS Architecture, developed and maintained by FHWA, is a common, mature framework for planning, defining, and integrating ITS elements. The National ITS Architecture reflects the contributions of a broad cross-section of the ITS community and specifically defines:

- The functions that are required of ITS to perform transportation services,
- The physical entities or subsystems where these functions reside, and
- The information and data flows that connect these functions and physical subsystems together into an integrated system.

The listing of functions, subsystems and flows contained in the National Architecture is comprehensive and is intended to serve as the underlying standardized framework from which ITS projects and their corresponding architectures are to be developed. For this reason, any locally developed architecture, including the Madison Regional ITS Architecture, reflects only a sub-set of all the possible functions, subsystems, and information flows brought forward by the National ITS Architecture.

The Madison Regional ITS Architecture was developed to be consistent not only with the National ITS Architecture but also the Wisconsin Statewide ITS Architecture. To that end, the Madison ITS Architecture was developed as a sub-architecture to the larger Statewide ITS Architecture. This was accomplished in part by using FHWA's Turbo Architecture Software Tool and the most recent version of the Statewide Architecture Turbo Architecture Database file. This approach will allow the Statewide ITS Architecture maintainer (currently the TOPS Laboratory) the ability to easily integrate the Madison Regional ITS Architecture, ensuring consistency between architectures.

Do to the complexity of the Madison ITS system and the number of interconnects that exist between existing and planned ITS elements, the Regional Architecture is illustrated as a series of wire diagrams oriented in two distinct views to ease understanding. The first view is a stakeholder oriented view that allows an individual stakeholder the ability to understand how each of it ITS elements are connected and what other agencies and elements their elements communicate with. An example of this view is illustrated in **Figure 3**. The second view is a transportation service view that allows all agencies the ability to see how regional ITS elements come to together to deliver an individual transportation service. An example of the view is illustrated in **Figure 4**.

Figure 3: ITS Element Oriented View (Floating Bike Lane Signs ITS Element)

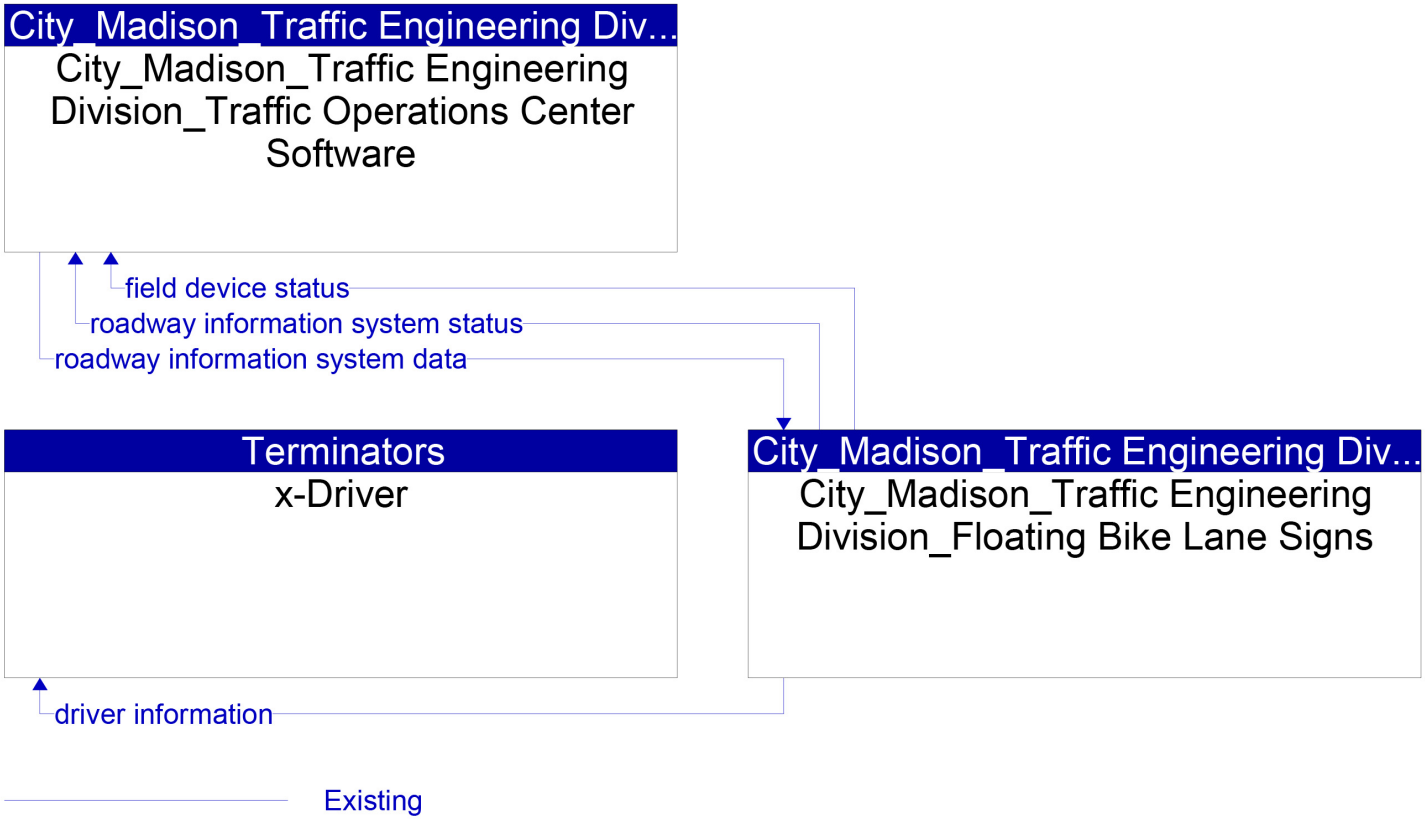
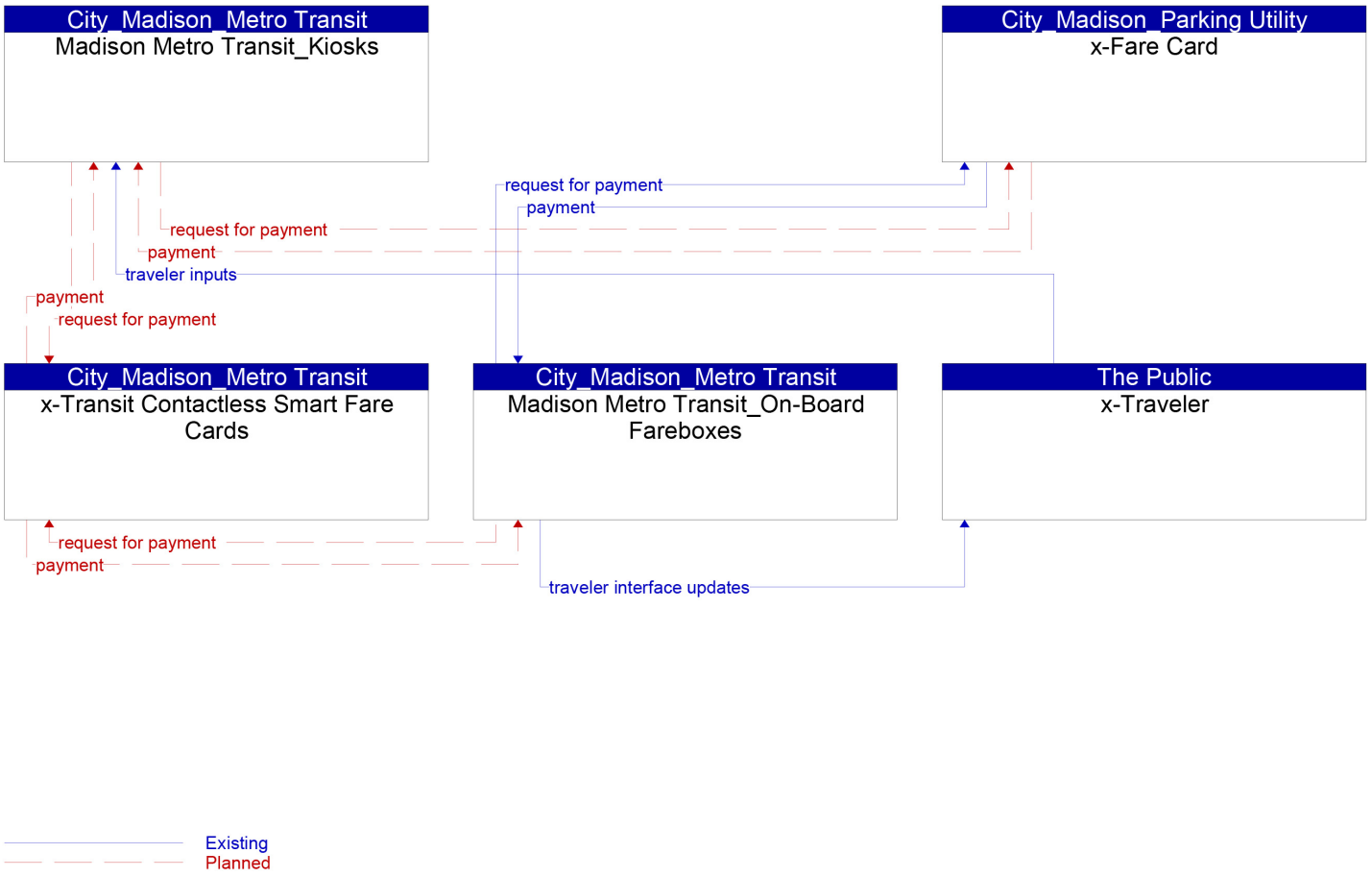


Figure 4: Service Package Oriented View (Transit Fare Collection Service Package)



1.10 Recommended Strategies and Projects – *The Building Blocks*

The ITS Implementation Plan is the last in the series of chapters that comprise the Regional ITS Strategic Plan. The purpose of the ITS Implementation Plan is to guide local transportation officials and system implementers in the effective deployment and integration of ITS technologies and operational improvements within the Madison Metropolitan Area over the next ten years. The Implementation Plan, and specifically the projects it identifies, addresses the transportation-related needs and desires expressed by regional stakeholders. However, it also takes into account the resources available for implementing ITS improvements, previous, on-going and planned ITS activity and the supporting infrastructure needed to successfully deploy them. Because technologies evolve and needs change, the Implementation Plan defines projects at a high-level so that their scope can evolve based on changes to technology and user needs. However, and with that said, projects are defined with enough detail to be further developed into detailed projects as they are programmed in the future.

The conceptual integration of ITS project in the Madison Metropolitan Area calls for implementation of 57 projects phased over the short- (0-2 years), mid- (2-5 years), and long-term (5-10 years). By phasing projects, ITS implementation can occur in a controlled, cost effective, and efficient manner, allowing benefits to be realized in the short-term while providing the needed infrastructure to support the completion of larger projects in the long-term. The high-level phasing of projects, in no particular order, is identified in **Table 3**.

ITS projects should be included within the regional transportation planning process so that they can be programmed to receive funding. ITS projects must compete with and must be mainstreamed with other "traditional" transportation improvement projects. Therefore, the list of projects is only conceptual until such time they are weighed against these other traditional projects. The timing of project implementation is not as important as their sequence. In other words, if projects must slip into a later phase it is not as critical as ensuring that all projects of a given term are implemented before proceeding to projects in a later term. This is due to the fact that projects build upon each other.

Available funding and the need for other non-ITS related transportation improvement projects will likely make it difficult to implement every project in the short –term. Given this, agencies must identify and research available funding mechanisms to find additional resources to fund ITS projects. Furthermore, the region must successfully demonstrate benefits of whatever ITS investment is made. This will build momentum and support for ITS projects, which will allow larger percentages of the funding pie to be allocated toward ITS improvements. The region's smart small approach attempts to do this while being cognizant that there are pressing needs now that still need to be addressed.

Table 3

High-level Phasing of Proposed Projects

On-going and Short-term Projects (0-2 Years)	Traffic Signal Communications Upgrades CCTV Camera Expansion Traffic Signal Optimization for Daily Ops, TIM and PSEs Traffic Signal System and Controller Upgrades for CV Floating Bike Lane Sign Expansion Traffic Incident Management Responder Training Regional Traffic Incident Management Coordination Arterial Travel Times Pilot/Technology Evaluations (incl. before/after data) Performance Measurement for Operations ITS Advisory Committee Funding/Grant Research for ITS Sponsorship Research Interagency Operations Agreements/MOUs ITS Architecture/Strategic Plan Maintenance Regional Transportation Management Center (RTMC) ConOps Transit Radio Communication System Upgrade Transit Vehicle On-Board Equipment Upgrade Metro Transit Garage Facility Communications Improvements Transit Passenger Fare Card System Upgrade Metro Transit AVL Update Traffic Count Data Storage and Analysis Software Connected Vehicle/Technology Pilot Traffic Responsive Signal Systems (Phase 1) Vehicle/Pedestrian Detection Upgrades Nakoosa Trail Bus Satellite Facility ITS Technologies Bicycle/Pedestrian (Arterial) Crossing Warning Systems

Mid-term Projects (2-5 Years)	Incident Communication System Arterial DMS at Decision Points for Travel Times Downtown Madison Parking Wayfinding System UW Visitor Parking Wayfinding System RTMC Design/Implementation Preplanned Emergency Alternate Routes & Signal Timing Transit Dynamic Message Sign (DMS) Upgrade and Expansion Transit Information Dissemination Study Transit Signal Priority (TSP) Pilot Project Smart Card for Transit and Parking Expansion of Weather/Pavement Sensors (Streets) Regional Data Clearinghouse (RDC) ConOps RDC Design/Implementation RDC Data Sharing Standard Operating Procedures Automated Motor-Vehicle and Bicycle Count System Center-to-Center Communications (existing centers) Center-to-Center Communications (planned centers) Traffic Responsive Signal Systems (Phase 2) Adaptive Traffic Signal Systems CV Roadside Infrastructure Bus Rapid Transit (BRT) Signal Priority Bus Rapid Transit (BRT) ITS Deployment Transit Vehicle Technology Evaluation Study Freeway Service Team Expansion Arterial Traffic Incident Response Teams

Long-term Projects (5-10 Years)	RTMC Operations (ongoing) incl mode choice Real-time Transit Vehicle CCTV Camera Image Communications Pilot Automatic Bridge Deicing Pilot Big Data Analysis Software & Support

1.11 Next Steps

Transportation agencies within the Madison Metropolitan Area can use the Regional ITS Strategic Plan to deploy and integrate ITS elements in an efficient, cost-effective manner. However, maintenance of the Regional Plan will be critical to the success of ITS deployment and to preserve the initial investment used to develop it. While the plan is useful to guide decision making, if the plan is not updated it becomes less useful as time passes. This stems from the fact that user needs, technologies that address them, and the funding environment to support them all evolve. To be effective the plan must also evolve. Therefore, one of the first critical next steps will be to establish a regional ITS working group to track, discuss and manage regional ITS activity. The regional ITS working group should be charged with the responsibility of updating the plan but also for delving deeper into issues such as:

- Defining agency roles and responsibilities for promoting and building support for regional ITS activity and making related resources more widely available to individuals at all levels within agencies. This may include identifying areas where technical support may be needed and identifying training programs and resources that may be tapped to fill this need.
- Identifying available funding streams that can be leveraged to support recommended ITS projects.
- Identifying potential projects where public private partnerships can be leveraged to enhance services without incurring significant costs.
- Identifying mechanisms to collect report and assemble information needed to determine the performance of the system overtime. This includes collecting "before" data prior to the implementation of projects to accurately access performance.
- Identifying agencies/individuals to shepherd projects where significant multiagency collaboration is needed.
- Identifying projects where multi-agency agreements need to be defined or where formal policy need to be developed to dictate agency roles and responsibilities prior to project implementation.

2 INTRODUCTION

In August 2014, the Madison Area Transportation Planning Board (MATPB) – an MPO in conjunction with the City of Madison Traffic Engineering Division/Parking Utility and other regional stakeholders initiated the effort to develop a regional Intelligent Transportation Systems (ITS) Strategic Plan for the Madison Metropolitan Area. The plan was born from the need to develop a roadmap for implementation of an integrated system of ITS strategies that enhance the efficiency and safety of the regional transportation system and achieve related regional transportation system goals. The plan consists of a series of chapters that outline and describe in detail the phases of work undertaken to identify, recommend and prioritize ITS projects that can be implemented within the region.

2.1 Project Background

The Madison Metropolitan Area is the fastest growing region in the State of Wisconsin. The City of Madison is the second-fastest growing of Midwest cities with a population of 200,000 or more. The City of Madison and greater metropolitan area face unique geographic constraints due to the fact that downtown Madison sits on an isthmus and lakes and natural resources create additional barriers to area traffic circulation. As a result, for example, the South/West Beltline (USH 12/14/18/151) is the only continuous east-west roadway through the Madison area to the south connecting to the interstate. Unlike many large metropolitan areas, the interstate system does not serve downtown Madison.

There are very limited opportunities for roadway capacity expansion inside the Beltline and interstate system. As a result, transportation systems management and operations (TSMO) strategies, including ITS and transportation demand management (TDM) strategies, by necessity must play a major role in managing congestion in the Madison Metropolitan Area. Non-recurring congestion from crashes, disabled vehicles, work zones, adverse weather conditions and planned special events account for a significant amount of congestion, affecting travel reliability on the entire transportation system. Madison has numerous special events throughout the year, including University of Wisconsin-Madison (UW-Madison) and Wisconsin Interscholastic Athletic Association events, World Dairy Expo, Madison Marathon and Triathlon, Shake the Lake fireworks show, Ride the Drive event and Monona Terrace convention center events. ITS strategies are particularly effective in managing congestion from special events and other sources of non-recurring congestion.

Aside from congestion management, ITS strategies also have the ability to provide many other benefits, including improved traveler safety, emergency management, transit speed/reliability, parking management, inter-agency communication, staff efficiency and data management. One of the MATPB's primary motivations for preparing the ITS Plan is to develop a prioritized plan for implementing ITS strategies so that the required data is collected and shared to fully implement the region's Congestion Management Process (CMP) and facilitate more performance based multi-modal transportation planning.

2.2 Purpose of the Regional ITS Strategic Plan

The Regional ITS Plan is intended to supplement the Wisconsin Department of Transportation's (WisDOT) ITS initiatives for the state freeway system and other state arterials. These include the mostly implemented Traffic Operations Infrastructure Plan (TOIP) for the freeway system, the new Arterial Infrastructure Management (AIM) Plan, and the new Transportation Systems Management & Operations (TSMO) – Traffic Infrastructure Process being developed. The Regional ITS Plan will also further develop and refine the Wisconsin Statewide ITS Architecture for the Madison area.

The Regional ITS Plan was developed within the framework of the MATPB's 2035 Regional Transportation Plan (RTP) Update and CMP and designed to implement the recommendations of the RTP to meet its policy objectives and to assist in implementing the CMP. The ITS Plan will be adopted as a supplement to the RTP. Recommendations from the ITS Plan will be incorporated into the City of Madison's Sustainable Transportation Master Plan currently being developed.

2.3 Geographic Scope

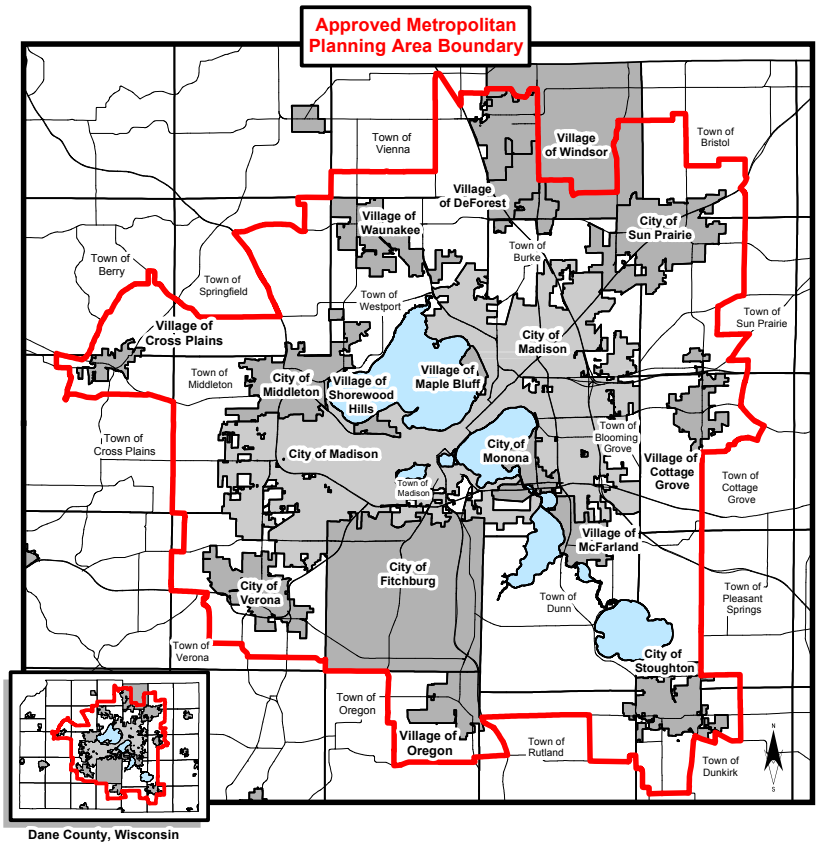
The Regional ITS Strategic Plan for the Madison Metropolitan Area covers the approved MATPB Metropolitan Planning Area Boundary (Figure 5). This area covers all of the City of Madison and the Madison Urban Area, including all or portions of 27 cities, villages and towns. The Plan is focused on the surface transportation system and its applicable interfaces with other modes. Since the surface transportation system does not stop at the boundaries of the planning area, the Plan attempts to consider and include aspects of the bordering region so that ITS development and integration can occur efficiently and as seamlessly as possible. To this extent, the pertinent ITS related activities undertaken on a statewide level that impact the region were taken into account when developing this Plan.

2.4 Conformity with National Guidance

On May 25, 2000, the United States Department of Transportation (USDOT) published a Notice of Proposed Rule Making (NPRM) that specifically addressed the conformity requirements of the National ITS Architecture and standards in the planning, development and implementation of ITS projects. Subsequently, in early 2001, the USDOT released the Federal Highway Administration's Final Rule and the Federal Transit Administration's Policy (referred hereafter as the Final Rule) for applying the National ITS Architecture at the regional level.

The focus of the Final Rule is to ensure that current and future opportunities to integrate ITS across modes and multiple jurisdictions for the purpose of improving transportation operations are not overlooked in project development. Specifically, the Final Rule requires states and regions that are funding ITS projects through the National Highway Trust Fund to develop a State/Regional ITS architecture that conforms with the National ITS Architecture. It is important to note that conformity with the National ITS Architecture does not require operating agencies, like the City of Madison, to link their operational functions internally or with external agencies. Rather, the Final Rule encourages operating agencies to consider the possibilities and make decisions that provide the best opportunity to ensure safe and efficient transportation services to travelers.

Figure 5: Regional ITS Strategic Plan Project Area



2.5 Timeframe

This plan is effective for the 10 year period beginning the date of the plan (2015-2025). Due to the rapid evolution of technology, planning beyond a 10 year horizon yields little benefit as technologies considered attractive today may hold little value 10 years into the future. In fact, it is likely that select technologies will evolve well in advance of the 10 year horizon, requiring that this plan be updated periodically so it remains an up-to-date, valid document. Encompassing such an approach not only ensures that the plan remains up-to-date, it also preserves the initial investment used to develop it and minimizes both level of effort to develop a new plan and loss of knowledge that occurs when a proactive approach is not taken. Therefore, it is recommended that stakeholders update this plan whenever there is a change in needs or when new, unplanned technologies are proposed for the region. For more information on updating and maintaining this plan, a separate maintenance plan has been developed and included in Appendix A. The maintenance plan provides a more comprehensive approach for plan maintenance and offer insights into the timing for when related activities should occur.

2.6 Approach and Organization

The Regional ITS Strategic Plan for the Madison Metropolitan Area was developed using a disciplined systems engineering approach. This approach began with the identification of existing and planned regional ITS elements and continued in an iterative fashion through a series of tasks culminating with the development of an ITS Implementation Plan. The following six chapters correlate to one of the six main tasks undertaken to develop the Regional ITS Strategic Plan.

- Chapter 3: ITS Element Inventory
- Chapter 4: ITS User Needs
- Chapter 5: ITS Vision, Goals, Objectives and Performance Measures
- Chapter 6: ITS Operational Concept
- Chapter 7: ITS Architecture
- Chapter 8: ITS Implementation Plan

3 ITS ELEMENT INVENTORY

There are very limited opportunities for roadway capacity expansion inside the Beltline and Interstate system. As a result, transportation system management and operation strategies, including Intelligent Transportation (ITS) and TDM strategies and will continue to play a major role in managing congestion in the Madison area. Non-recurring congestion from crashes, disabled vehicles, work zones, adverse weather conditions and planned special events account for a significant amount of congestion, affecting travel reliability on the entire transportation system. Madison also has numerous special events throughout the year, including University of Wisconsin (UW)-Madison and Wisconsin Interscholastic Athletic Association events, World Dairy Expo, Madison Marathon and Triathlon, Shake the Lake Fireworks show, Ride the Drive event and Monona Terrance convention center events. All of the above factors have contributed to the need to use ITS in the Madison Metropolitan Area and will likely contribute to this need in the future.

Before developing the Regional ITS Strategic Plan, it is important to understand and document existing ITS infrastructure used in the Madison Metropolitan Area. This understanding will form the foundation for further developing and enhancing ITS within the region. An analysis of current legacy systems is also critical for evaluating whether these systems have the potential to provide the desired transportation functions needed to support the regional ITS Vision. Additionally, this analysis helps evaluate the opportunity for integrating current systems with those that are desired or planned.

3.1 Participating Stakeholders

Multiple agencies collect, analyze and share information and data to improve transportation operations, make travel more convenient and improve multi-modal safety throughout the Madison Metropolitan Area. Furthermore, many other agencies have a stake in ITS operations but do not necessarily own or operate ITS elements. Agencies (listed in alphabetical order) that have a stake in ITS deployment in the Madison Metropolitan Area include the following:

- Cities of Fitchburg, Middleton, Sun Prairie, and Verona
- City of Madison, Fire Department
- City of Madison, Metro Transit
- City of Madison, Police Department
- City of Madison, Traffic Engineering/Parking Utility
- Dane County Public Works, Highway, and Transportation Department
- Dane County Public Safety Communications (9-1-1)
- Dane County Emergency Management
- Dane County Sheriff's Office
- Madison Area Transportation Planning Board
- UW-Madison, Police Department
- UW-Madison, Traffic Operations & Safety (TOPS) Laboratory
- UW-Madison, Transportation Services
- Wisconsin Department of Transportation (WisDOT), Bureau of Traffic Operations, State Traffic Operations Center (STOC)
- WisDOT, State Patrol
- WisDOT, SW Region

While all of the aforementioned agencies were invited to contribute to the development of this plan, individual agency participation varied leading to varied levels of input received. Project tasks and overall project direction were primarily guided by the project oversight committee, which was comprised of the following agencies:

- Madison Area Transportation Planning Board
- City of Madison, Traffic Engineering/Parking Utility
- City of Madison, Metro Transit
- UW TOPS Laboratory

The remainder of this section provides a brief discussion of the various ITS elements that currently exist within the region as they were identified through existing documentation or by the various stakeholders who participated in the development of this plan. To be consistent with National terminology and to begin the process of mapping ITS elements to National ITS Architecture service packages (see Chapter 7, ITS Architecture), the identified ITS elements that currently exist within the Madison Area are categorized into four classes:

- Field-based ITS elements
- Vehicle-based ITS elements
- Centers and center-based ITS elements
- Remote traveler support ITS elements

3.2 Field-Based ITS Elements

Field elements represent the intelligent infrastructure distributed along the transportation network that perform surveillance, information provision and plan execution control functions and whose operation is governed by center-based ITS elements. Field elements are typically controlled by operators located in a remote facility and are used to either disseminate information to travelers or collect information from the field in order to make better operational decisions. Field elements may also directly interface with vehicle or field elements.
ITS field elements deployed in the Madison Metropolitan Area include:

- Closed circuit television (CCTV) cameras
- Fixed and portable dynamic message signs (DMS)
- Ramp meters
- Traffic signal systems and related equipment
- Environmental sensor stations
- Roadway detection
- Parking management systems

Each of these elements is described in greater detail in the following sections.

3.2.1 Closed Circuit Television Cameras

CCTV cameras like that shown in Figure 6 are used to monitor and control traffic and are used by various agencies including but not limited to maintenance and law enforcement to remotely assess and verify roadway conditions, incidents or other conditions that have the potential to or are impacting travel. CCTV cameras are most prevalent along regional freeways, arterial intersections and at transit transfer points.

The City of Madison operates a network of 48 arterial CCTV cameras, located primarily at signalized intersections. Both standard and high-definition cameras have been installed and are currently being operated. The standard definition camera used by the City is the P5522-E Pan/Tilt/Zoom (PTZ) Dome Network Camera manufactured by AXIS Communications. This camera has an 18x optical zoom with autofocus. The High Definition camera is the Q6045_E Mk II PTZ Dome Network Camera also manufactured by AXIS. This camera is capable of producing HDTV 1080p video and has a 32x optical zoom.

Figure 6: WisDOT Freeway CCTV Camera

The public is able to view real-time video from any of the City of Madison CCTV cameras through the City's web client software located at following website: https://cameras.cityofmadison.com/advanced.web?s=0;#eyJsIjowLCJpdGVtcyI6W10sInNiIjoxLCJtIjoxfQ

The City of Madison's video management system vendor is ExacqVision.

WisDOT operates a network of 45 freeway CCTV cameras in Dane County. CCTV camera images and video provide WisDOT and other first responders a valuable tool, not only for monitoring traffic conditions, but also for monitoring activities at major incident scenes. The State Traffic Operations Center (STOC) has primary control of the cameras. Agencies other than the STOC (i.e., Wisconsin State Patrol) have the ability to control WisDOT cameras.

Camera images are shared real-time via a direct communication link with key local agencies. These agencies can view cameras as part of a routine scan, select a specific camera to view, or control the pan, tilt, zoom, or focus of a camera. The STOC, however, retains ultimate control of their camera network and can override a local agencies attempt to control a camera. For agencies without direct communication links, the STOC allows secured internet-based access to video. Local agencies can log on with a secure ID and password to view full-motion video; however, the application does not allow control of the camera. During winter storms the City's Streets Department and Metro Transit are heavy users of the cameras. With these cameras, agencies like these can easily determine which street needs more attention or whether buses will be able to operate.

WisDOT shares video feeds with local media, including WISC-TV (Madison Channel 3) and these feeds are provided to the public via media broadcasts. Members of the public are able to view images from any of WisDOT CCTV camera through the State's 511 traveler information website located at: http://www.511wi.gov/web/traffic/cameras.aspx

WisDOT's video management system vendor is Teleste.

Besides CCTV cameras that are used for traffic monitoring purposes, various City entities own and operate security cameras located throughout the City. For example, the City of Madison Parking Utility operates a number of security cameras within parking garages and ramps. Additionally, Metro Transit, City of Madison Police, Parks Division, Streets Department and the Water Utility also own and operate security cameras. For example, Metro Transithas a Building and Transfer Point camera system. These are fixed position CCTV cameras installed at the bus transfer points for security purposes. City of Madison agencies, including the City of Madison Traffic Engineering (TE) Department are able to access video if granted permission. Pan/Zoom/Tilt is a capability that is desired in the future. This capability will give Metro Transit dispatchers and maintenance personnel the ability to view and verify messages on transfer point DMS.

In February 2014, various departments within the UW including, division of information technology, facilities planning and management, and the University of Wisconsin Police Department (UWPD) secured a $8 million to replace approximately 1,400 analog cameras on campus with internet protocol (IP) cameras. The project also implemented a centralized video management system that placed all UW cameras on one system so cameras could be more efficiently managed. As of the end of 2014, 260 cameras had been installed as part of this project.

Traffic monitoring cameras deployed in the Madison Metropolitan Area are shown in Figure 7. The location of the City of Madison and WisDOT cameras are provided in Table 4 and Table 5 respectively.

Figure 7: Location of Madison Metropolitan Area CCTV Cameras

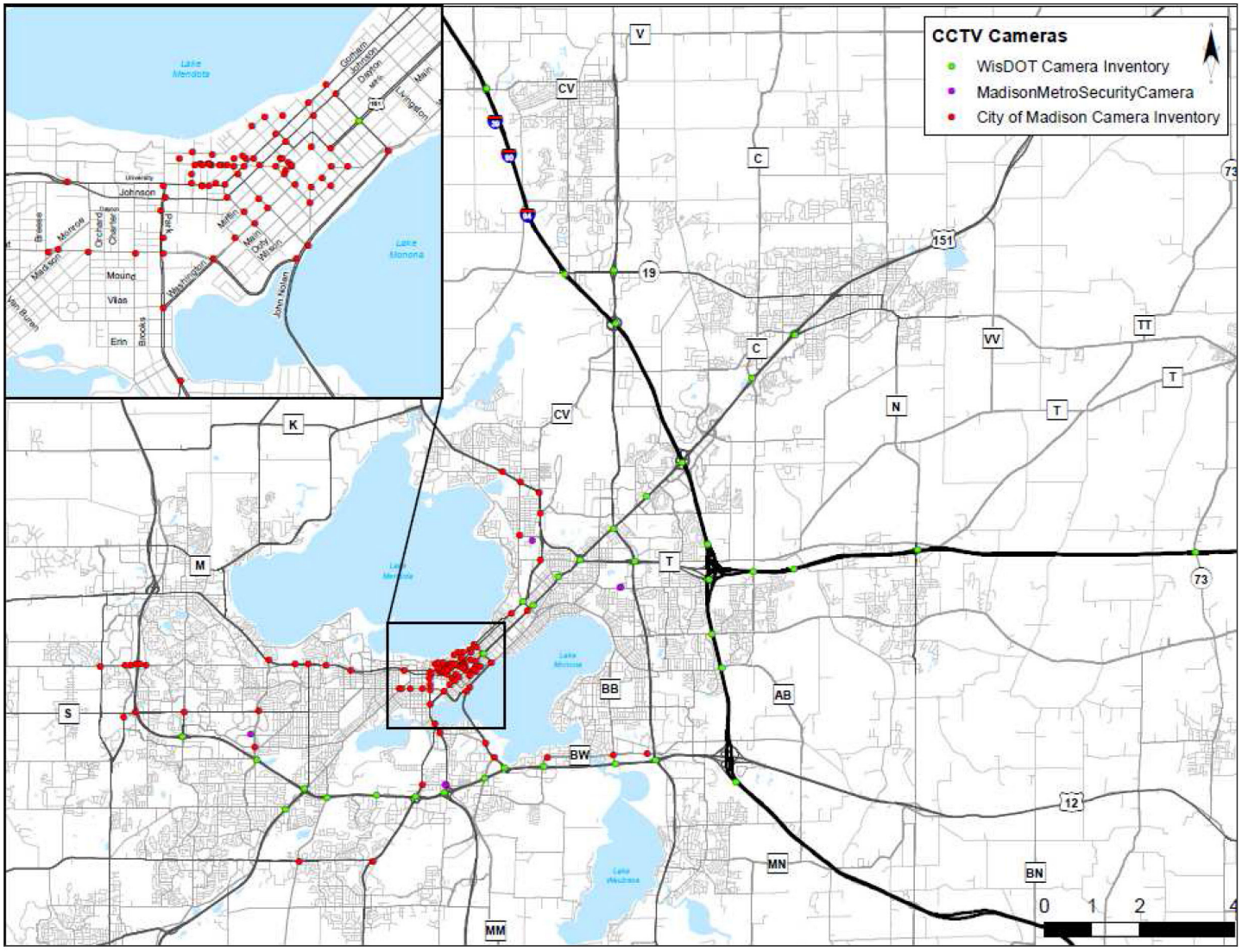


Table 4

City of Madison CCTV Camera Locations

No.	WisDOT Device ID	Route	Location
1	CCTV-13-0001	US 12/14	@ Whitney Way
2	CCTV-13-0035	US 12/14	@ Gammon Road
3	CCTV-13-0065	US 12/14	@ Mineral Point Road
4	CCTV-13-0066	US 12/14	@ Old Sauk Road
5	CCTV-13-0067	US 12/14	@ Greenway Boulevard
6	CCTV-13-0002	US 12/18	@ Verona Road
7	CCTV-13-0003	US 12/18	@ Seminole Highway
8	CCTV-13-0004	US 12/18	@ Park Street
9	CCTV-13-0005	US 12/18	@ Fish Hatchery Road
10	CCTV-13-0006	US 12/18	@ Monona Drive
11	CCTV-13-0007	US 12/18	@ Stoughton Road
12	CCTV-13-0025	US 12/18	@ Todd Drive
13	CCTV-13-0061	US 12/18	@ John Nolan Drive
14	CCTV-13-0062	US 12/18	@ South Towne Drive
15	CCTV-13-0049	US 12/18	@ Rimrock Road
16	CCTV-13-0008	I-39/90	@ County AB
17	CCTV-13-0009	I-39/90	@ County BB
18	CCTV-13-0014	I-39/90	@ US 12/18
19	CCTV-13-0042	I-39/90	@ WIS 30
20	CCTV-13-0100	I-39/90	@ County N
21	CCTV-13-0101	I-39/90	@ South of County B
22	CCTV-13-0102	I-39/90	@ US 51
23	CCTV-13-0010	I-39/90/94	@ US 51
24	CCTV-13-0011	I-39/90/94	@ WIS 19
25	CCTV-13-0040	I-39/90/94	@ County V
26	CCTV-13-0043	I-39/90/94	@ County T
27	CCTV-13-0015	I-39/90/94	@ US 151
28	CCTV-13-0024	I-39/90/94	@ Wisconsin River
29	CCTV-13-0012	I-94	@ Gaston Road
30	CCTV-13-0013	I-94	@ County N
31	CCTV-13-0030	I-94	@ WIS 73
32	CCTV-13-0041	I-94	@ Sprecher Road
33	CCTV-13-0016	East Washington Avenue	@ Continental Lane
34	CCTV-13-0017	East Washington Avenue	@ Stoughton Road
35	CCTV-13-0018	East Washington Avenue	@ WIS 30
36	CCTV-13-0019	East Washington Avenue	@ Dayton Street
37	CCTV-13-0020	East Washington Avenue	@ Second Street
38	CCTV-13-0021	East Washington Avenue	@ Blair Street
39	CCTV-13-0022	East Johnson	@ First Street
40	CCTV-13-0023	WIS 30	@ Stoughton Road
41	CCTV-13-0063	US 18/151 (Verona Road)	@ County PD
42	CCTV-13-0059	US 51	@ WIS 19
43	CCTV-13-0103	US 51	@ I-39/90
44	CCTV-13-0033	US 151	@ Main Street
45	CCTV-13-0064	US 151	@ County C

Table 5

WisDOT Camera Locations (Dane County)

No.	WisDOT Device ID	Route	Location
1	CCTV-13-0001	US 12/14	@ Whitney Way
2	CCTV-13-0035	US 12/14	@ Gammon Road
3	CCTV-13-0065	US 12/14	@ Mineral Point Road
4	CCTV-13-0066	US 12/14	@ Old Sauk Road
5	CCTV-13-0067	US 12/14	@ Greenway Boulevard
6	CCTV-13-0002	US 12/18	@ Verona Road
7	CCTV-13-0003	US 12/18	@ Seminole Highway
8	CCTV-13-0004	US 12/18	@ Park Street
9	CCTV-13-0005	US 12/18	@ Fish Hatchery Road
10	CCTV-13-0006	US 12/18	@ Monona Drive
11	CCTV-13-0007	US 12/18	@ Stoughton Road
12	CCTV-13-0025	US 12/18	@ Todd Drive
13	CCTV-13-0061	US 12/18	@ John Nolan Drive
14	CCTV-13-0062	US 12/18	@ South Towne Drive
15	CCTV-13-0049	US 12/18	@ Rimrock Road
16	CCTV-13-0008	I-39/90	@ County AB
17	CCTV-13-0009	I-39/90	@ County BB
18	CCTV-13-0014	I-39/90	@ US 12/18
19	CCTV-13-0042	I-39/90	@ WIS 30
20	CCTV-13-0100	I-39/90	@ County N
21	CCTV-13-0101	I-39/90	@ South of County B
22	CCTV-13-0102	I-39/90	@ US 51
23	CCTV-13-0010	I-39/90/94	@ US 51
24	CCTV-13-0011	I-39/90/94	@ WIS 19
25	CCTV-13-0040	I-39/90/94	@ County V
26	CCTV-13-0043	I-39/90/94	@ County T
27	CCTV-13-0015	I-39/90/94	@ US 151
28	CCTV-13-0024	I-39/90/94	@ Wisconsin River
29	CCTV-13-0012	I-94	@ Gaston Road
30	CCTV-13-0013	I-94	@ County N
31	CCTV-13-0030	I-94	@ WIS 73
32	CCTV-13-0041	I-94	@ Sprecher Road
33	CCTV-13-0016	East Washington Avenue	@ Continental Lane
34	CCTV-13-0017	East Washington Avenue	@ Stoughton Road
35	CCTV-13-0018	East Washington Avenue	@ WIS 30
36	CCTV-13-0019	East Washington Avenue	@ Dayton Street
37	CCTV-13-0020	East Washington Avenue	@ Second Street
38	CCTV-13-0021	East Washington Avenue	@ Blair Street
39	CCTV-13-0022	East Johnson	@ First Street
40	CCTV-13-0023	WIS 30	@ Stoughton Road
41	CCTV-13-0063	US 18/151 (Verona Road)	@ County PD
42	CCTV-13-0059	US 51	@ WIS 19
43	CCTV-13-0103	US 51	@ I-39/90
44	CCTV-13-0033	US 151	@ Main Street
45	CCTV-13-0064	US 151	@ County C

3.2.2 Permanent Dynamic Message Signs

DMSs are highly visible traffic control devices installed along or over the roadway that display near real-time traveler information and alerts such as the one shown in Figure 8. Signs are located in advance of key decision points to allow motorists to change driving behavior or alter route choice based on downstream conditions. Traffic management operators use DMS to perform a myriad of functions, including:

Figure 8: WisDOT Freeway Dynamic Message Sign

- Provide advance notice of conditions that may require a change in driving behavior (traffic, weather and environmental),
- Provide specific information on the nature and location of congestion and incidents so the motorist can make an effective decision regarding speed and/or lane or route selection,
- Advise motorists of roadwork, detours and alternate routes,
- Provide route guidance and current travel times to unfamiliar drivers, and
- Provide special event information.

In performing these functions, DMS messages provide motorists with the information they need to alter driving behavior or seek alternate routes when congestion occurs or when other conditions necessitate.

Fixed or permanent DMS are widely deployed in the Madison Metropolitan Area. For the purposes of this plan, the term DMS will encompass Variable Message Signs (VMS), Changeable Message Signs (CMS) and other electronic signage that can be operated dynamically. DMS are primarily used to provide en-route traveler information along freeways, arterials and at select transit transfers points.

WisDOT operates 27 existing permanent DMS within the Madison Metropolitan Area. Twenty-two of these signs are located along regional freeways and five along primary arterials. Dispatchers are able to use the signs to alert drivers of crashes or other hazards. DMS owned and operated by WisDOT are shown Figure 9. The locations of WisDOT permanent DMS within Dane County are listed in Table 6.

Figure 9: Location of Madison Metropolitan Area Dynamic Message Signs

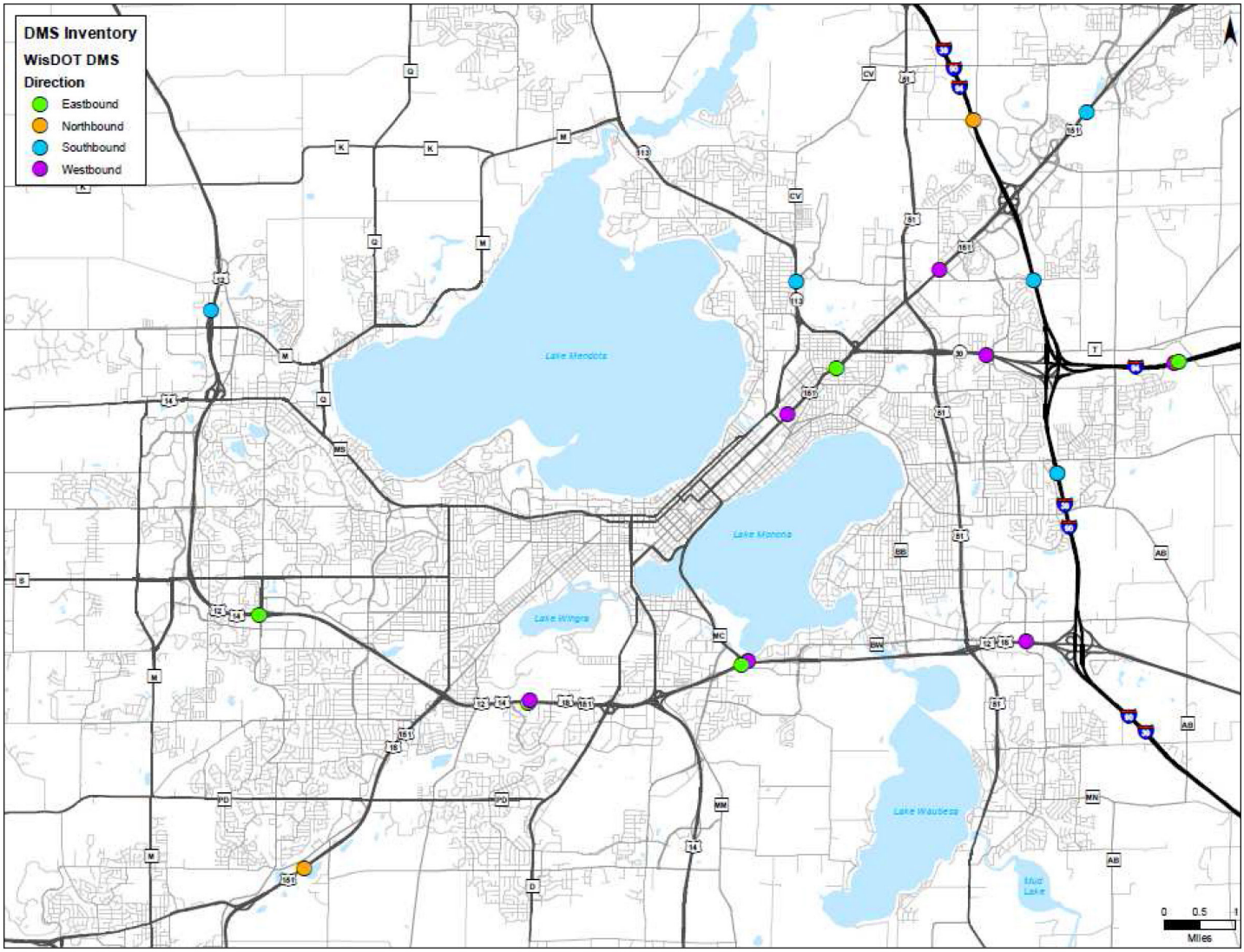


Table 6

WisDOT Permanent Dynamic Message Sign Locations (Dane County)

No.	WisDOT Device ID	Route	Location	Type	Direction
1	DMS-13-0004	WIS 30	at Fair Oaks Avenue	Daktronics 95 x 27 Full Matrix LED	EB
2	DMS-13-0010	East Washington Avenue	at Oak Street	Daktronics 80 x 24 NTCIP	EB
3	DMS-13-0019	East Washington Avenue	at Parkside Drive	Daktronics 80 x 24 NTCIP	WB
4	DMS-13-0020	East Washington Avenue	at 2nd Street	Daktronics 80 x 24 NTCIP	WB
5	DMS-13-0011	I-94	at Gaston Road	Daktronics 105 x 27 IP	WB
6	DMS-13-0012	I-94	at Gaston Road	Daktronics 105 x 27 IP	EB
7	DMS-13-0018	US 151	at American Parkway	Daktronics 105 x 27 IP	SB
8	DMS-13-0021	Packers Avenue	at International Lane	Daktronics 80 x 24 NTCIP	SB
9	DMS-13-0027	I-39/90	at Maple Grove Road	Daktronics 104 x 32 IP	SB
10	DMS-13-0039	I-39/90	at Church Street	NTCIP HD 256 x 80	NB
11	DMS-13-0040	I-39/90	at Lake Drive	NTCIP HD 256 x 80	SB
12	DMS-13-0041	I-39/90	at Lake Drive	NTCIP HD 256 x 80	NB
13	DMS-13-0043	I-39/90	at Cottage Grove Road	NTCIP HD 256 x 80	NB
14	DMS-13-0044	I-39/90	at Cottage Grove Road	NTCIP HD 256 x 80	SB
15	DMS-13-0023	I-39/90/94	at Hanson Road	Daktronics 105 x 27 IP	NB
16	DMS-13-0028	I-39/90/94	at Lien Road	Daktronics 105 x 27 IP	SB
17	DMS-13-0029	I-39/90/94	at Cuba Valley Road/N of WIS 19	Daktronics 105 x 27 IP	SB
18	DMS-13-0030	US 18/151 (Verona Road)	at Fitchrona Road	Daktronics 104 x 32 IP	NB
19	DMS-13-0031	US 12/14	at Gammon Road	NTCIP HD 336 x 96	EB
20	DMS-13-0032	US 12/14/18	at Landmark Pl (W of Todd Drive)	NTCIP HD 336 x 96	EB
21	DMS-13-0033	US 12/14/18	at Landmark Pl (W of Todd Drive)	NTCIP HD 336 x 96	WB
22	DMS-13-0034	US 12/18	at John Nolen Drive	NTCIP HD 336 x 96	EB
23	DMS-13-0035	US 12/18	at John Nolen Drive	NTCIP HD 336 x 96	WB
24	DMS-13-0036	US 12/18	at Agriculture Drive (Marsh Drive)	NTCIP HD 336 x 96	WB
25	DMS-13-0051	US 12/18	West of Agriculture Drive	NTCIP HD 256 x 80	EB
26	DMS-13-0037	US 12	North of Airport Road	NTCIP HD 256 x 80	SB
27	DMS-13-0050	WIS 73	North of WIS 106	NTCIP HD 256 x 80	SB

Metro Transit Digital Display Signs

Figure 10: Metro Transit Digital Display Sign

Metro Transit owns and operates digital display signs to provide real-time bus arrival and schedule information to transit users such as the one shown in Figure 10. Signs are located at four transfer points and nine heavily used transit shelters. Using programmed schedule information and live global positioning system (GPS) location data, buses send real-time arrival information to these signs on a continuous basis. Based on the remaining travel distance to the sign/bus stop location signs display the number of minutes until the bus is expected to arrive. For example, a message may read: "Route 2. Arriving in 5 minutes." Important service messages and notes will also be occasionally posted on these signs. The locations of Metro Transit digital display signs are shown Figure 11.

Floating Bike Lane Signs

The City of Madison has designated floating bike lanes around part of the outer loop of the Capitol Square. The floating bike lane changes positions in the street depending upon whether peak period parking restrictions are in effect or not. During "peak hours" (4:00pm-5:30pm, Monday-Friday) parking is not allowed, and the bike lane is next to the curb (see Figure 12). During "off peak hours" parking is allowed, and the bike lane shifts left, outside of the parking area (see Figure 13). The City operates overhead signs to dynamically change lane designations based on the time of day. This maximizes the use of available capacity by providing additional capacity to accommodate peak hour vehicular traffic while still accommodating bicycles in the peak period and providing additional parking in the off-peak period.

3.2.3 Portable Dynamic Message Signs

WisDOT also uses portable DMS on a project-by-project basis to provide warning and information to motorists in advance of construction zones, planned construction activity, special events and other locations where a safety concern exist, such as queuing or where road alignment changes. To this extent, portable DMS are used to supplement fixed DMS coverage to provide short-term information needs. Portable message signs may also be used to communicate information on detours and alternate routing allowing motorists to navigate around incident or construction activity. Often, portable DMS are set up in advance of planned construction activity to provide motorist notification that construction activity may soon impact their normal routines.

3.2.4 Ramp Meters

Ramp meters are perhaps WisDOT's best historic example of how technologies can be used to better manage traffic. WisDOT first began using ramp meters in the 1960's. Ramp meters are traffic signals located along freeway on-ramps that regulate the rate at which vehicles are permitted to enter the freeway. Ramp meters regulate traffic entering the freeway, preventing platoons of merging vehicles, which causes traffic flow on the freeway to break down. By allowing only one or two vehicles to enter the freeway at a time, traffic flow is maximized, speeds are more uniform and congestion-related crashes are reduced. Often, metered ramps include a bypass lane for high occupancy vehicles (HOVs), which provides an incentive for carpooling and transit.

Metered ramps with an HOV bypass lane were installed on the Beltline in July 2001 at three on-ramp locations (Whitney Way eastbound, Fish Hatchery Rd. westbound, Park St. westbound) as part of WisDOT's Southwest Wisconsin ITS Program. Since this time WisDOT has implemented ramp meters at four additional locations for a total of seven metered ramps. These ramp meters are used primarily to manage recurrent congestion and to manage traffic more effectively when incidents occur. Ramp meters may be controlled locally based on time-of-day and day-of-week or via traffic

Figure 11: Location of Metro Transit Digital Display Signs

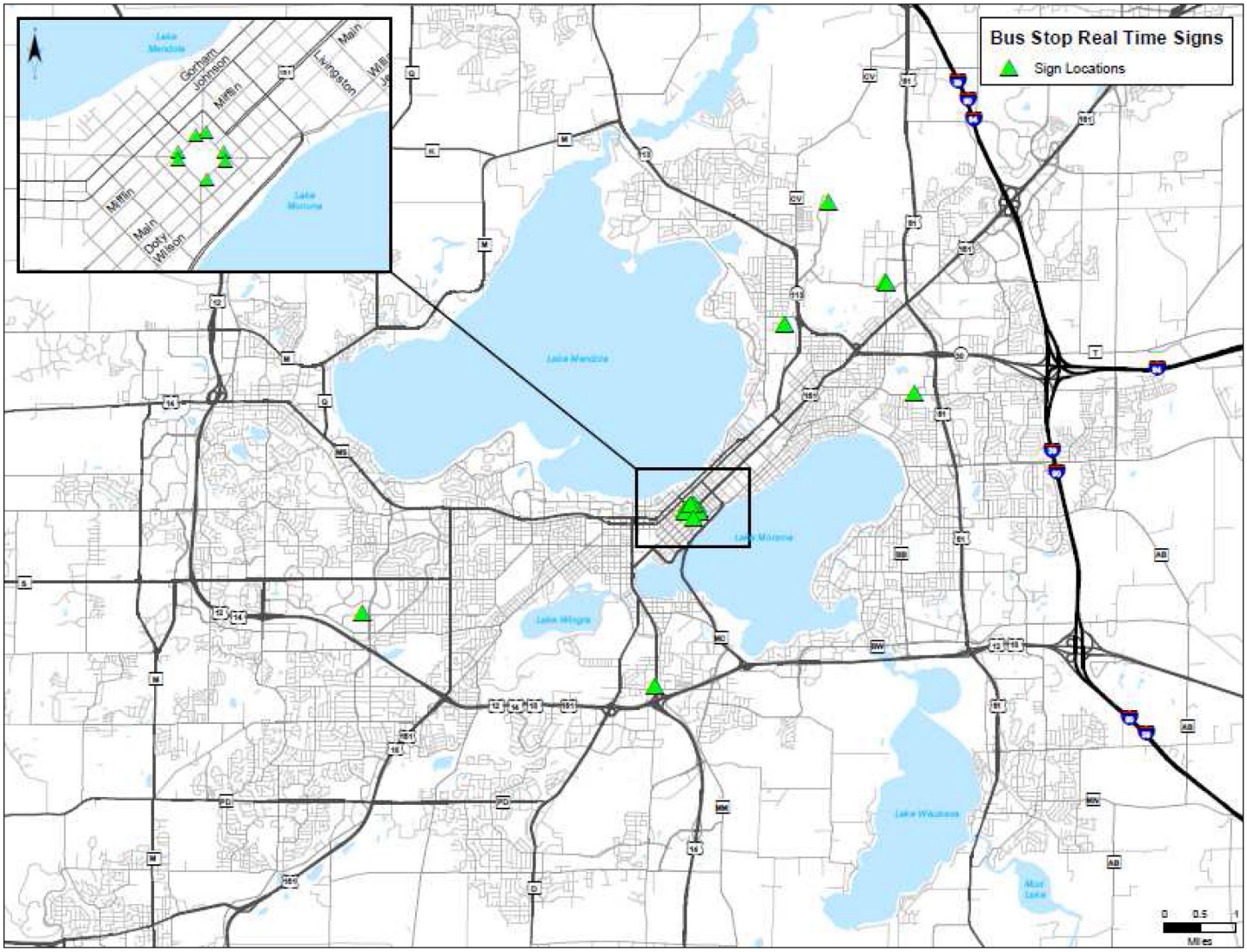


Figure 12: Dynamic Overhead Floating Bike Lane Sign (Peak-Period Condition)

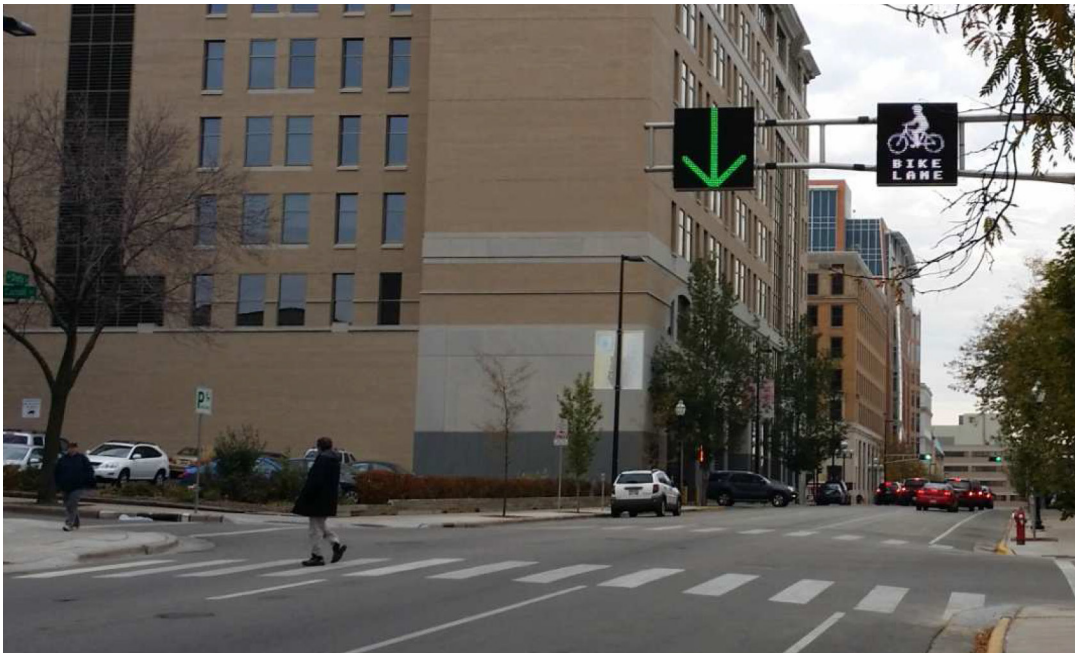


Figure 13: Dynamic Overhead Floating Bike Lane Sign (Off Peak-Period Condition)

responsive metering where metering is enacted based on volume, occupancy, or speed being obtained by local freeway detection. Ramp meter plans are stored in the controller in the same manner as surface street intersection traffic signals.

A study of the benefits of the Beltline ramp meters on nine freeway links near where they are located found the ramp meters resulted in a 3-8% average travel speed improvement and 1.5-3.0% travel volume improvement compared to conditions without them. A before-and-after study found a 50% reduction in crashes.

All ramp meters in the State of Wisconsin are controlled from the WisDOT STOC in Milwaukee. The location of WisDOT ramp meters within Dane county are listed in Table 7. Locations are shown Figure 14.

Table 7

WisDOT Ramp Meter Locations (Dane County)

No.	WisDOT Device ID	Route	Location	Year Installed
1	RM-13-0001	US 12/14	EB @ Whitney Way	2001
2	RM-13-0002	US 12/14	WB @ Fish Hatchery Road	2001
3	RM-13-0004	US 12/14	WB @ Park Street N-W (slip)	2001
4	RM-13-0005	US 12/14	WB @ Park Street S-W (loop)	2001
5	RM-13-0006	US 12/14/18	WB @ Todd Drive	2006
6	RM-13-0007	US 12/18	EB @ Park Street	
7	RM-13-0008	US 12/14	EB @ Gammon Road	2014

3.2.5 Traffic Signal Systems

Most of the signals in the Madison area are part of a coordinated traffic signal system that is operated and maintained by the City of Madison Traffic Engineering Division. The City has on ongoing program to evaluate and make adjustments to the traffic signal timing. Dane County and local jurisdictions reimburse the City for work on signals on county roadways and those located outside the City. The signals are programmed to maintain optimum traffic flow while also meeting other goals such as providing sufficient time for pedestrians to cross the street and to clear cross traffic on side streets as well as allowing for left-turning traffic. Signal timing is adjusted for different days of the week, times of the year and for special events (e.g., football Saturdays). Many traffic signals are connected via fiber and are able to be remotely controlled. However; there are many signals not currently connected to the City's fiber network where field visits to the signal control is needed to adjust traffic signal timing parameters. Communication improvements need to be made to bring these signals on line with the others so that adjustments to signal timing can be made more efficient.

The only traffic signals not maintained by the City of Madison Traffic Engineering Division are those along Stoughton Road (USH 51) and Verona Road (USH 18/151), the Beltline interchange signals in Monona at South Towne Drive and Monona Drive and the signals in the City of Middleton. WisDOT is currently in the process of trying to better coordinate the signals on Verona Road and Stoughton Road. The City of Middleton has coordinated the signals on Greenway Boulevard and Century Avenue, but not those on University Avenue. Ownership of Madison area traffic signals are shown in Figure 15, the location of traffic signals owned by the City of Madison in the downtown/campus area in Figure 16 and a detailed chart of non-Madison owned traffic signals can be found in Table 8.

Figure 14: Location of Madison Metropolitan Area Ramp Meters

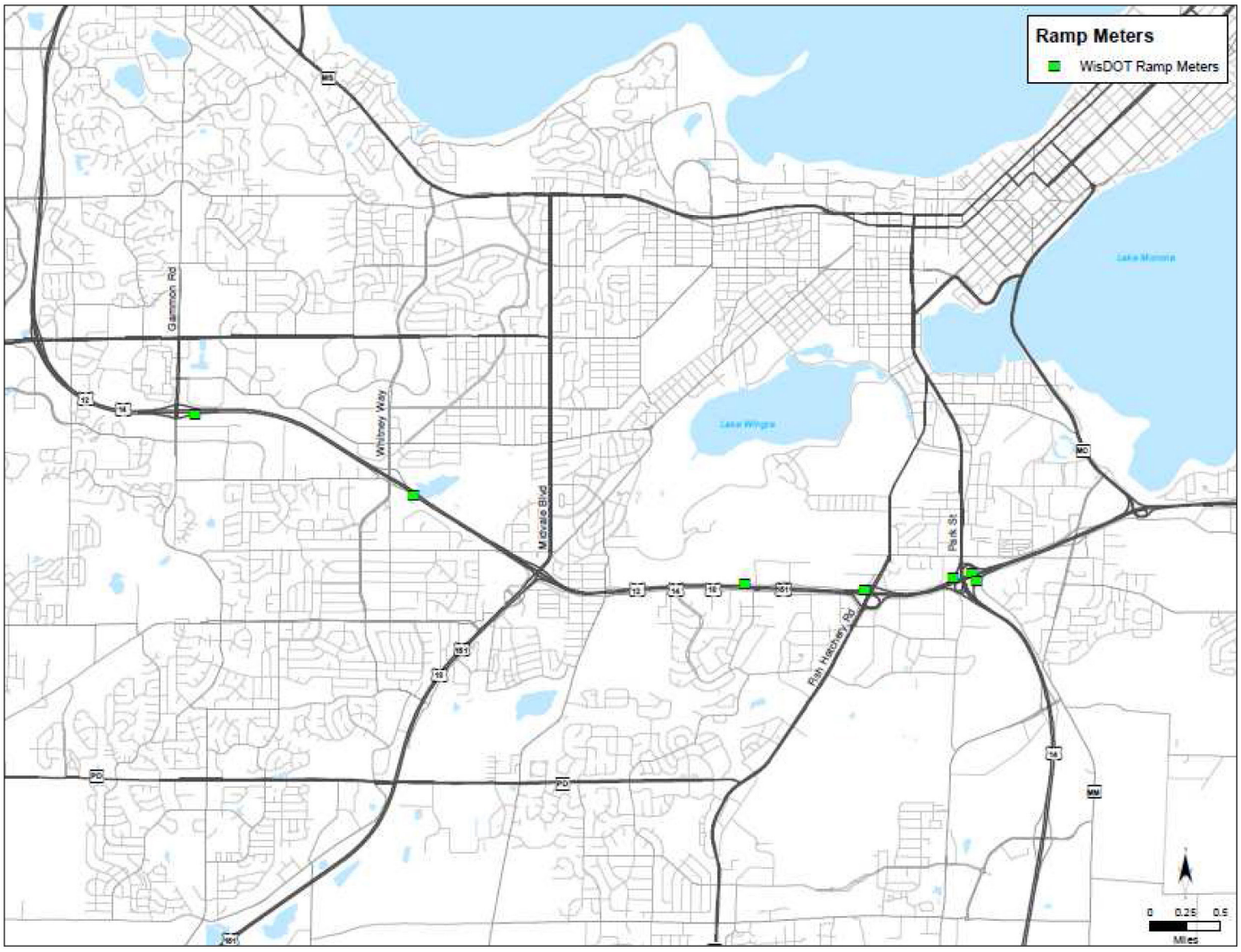


Figure 15: Location of Madison Area Traffic Signals and Ownership/Maintainer

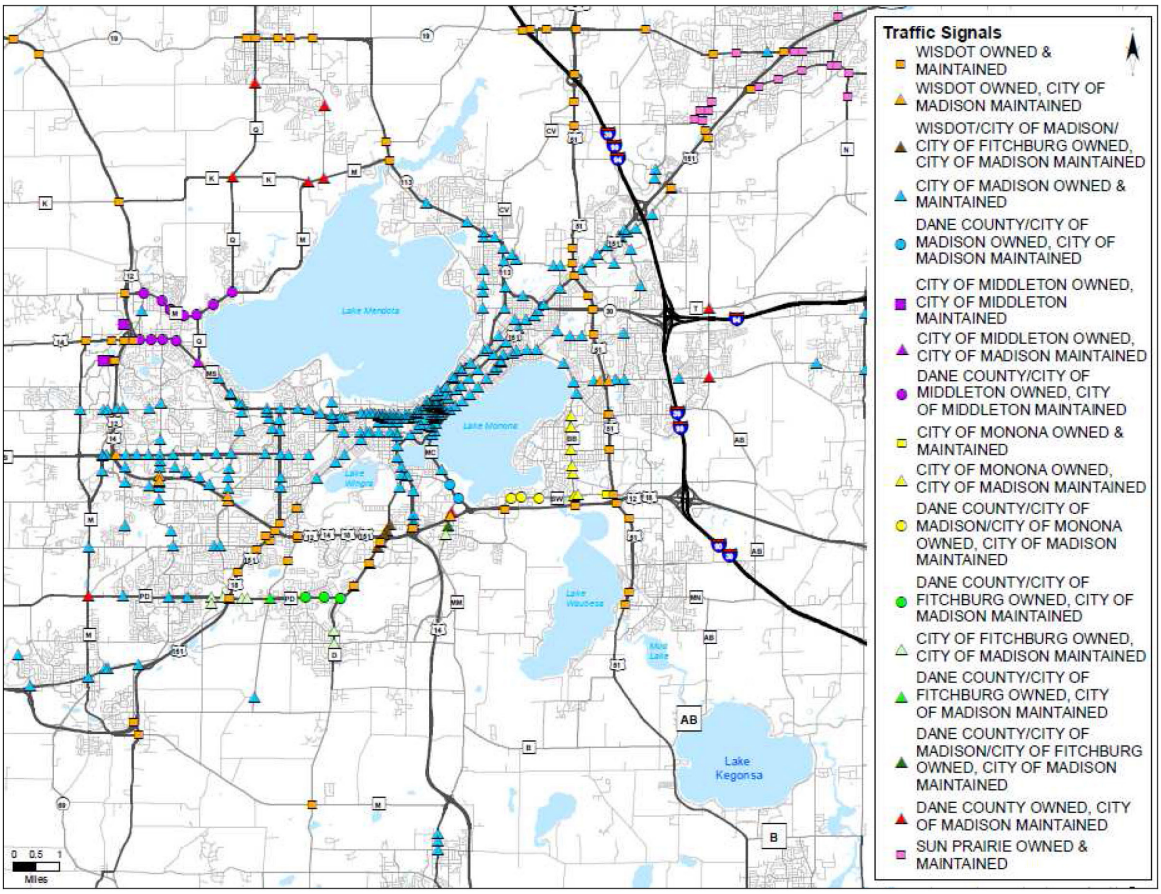


Figure 16: City of Madison Traffic Signals (UW Campus and Downtown Area)

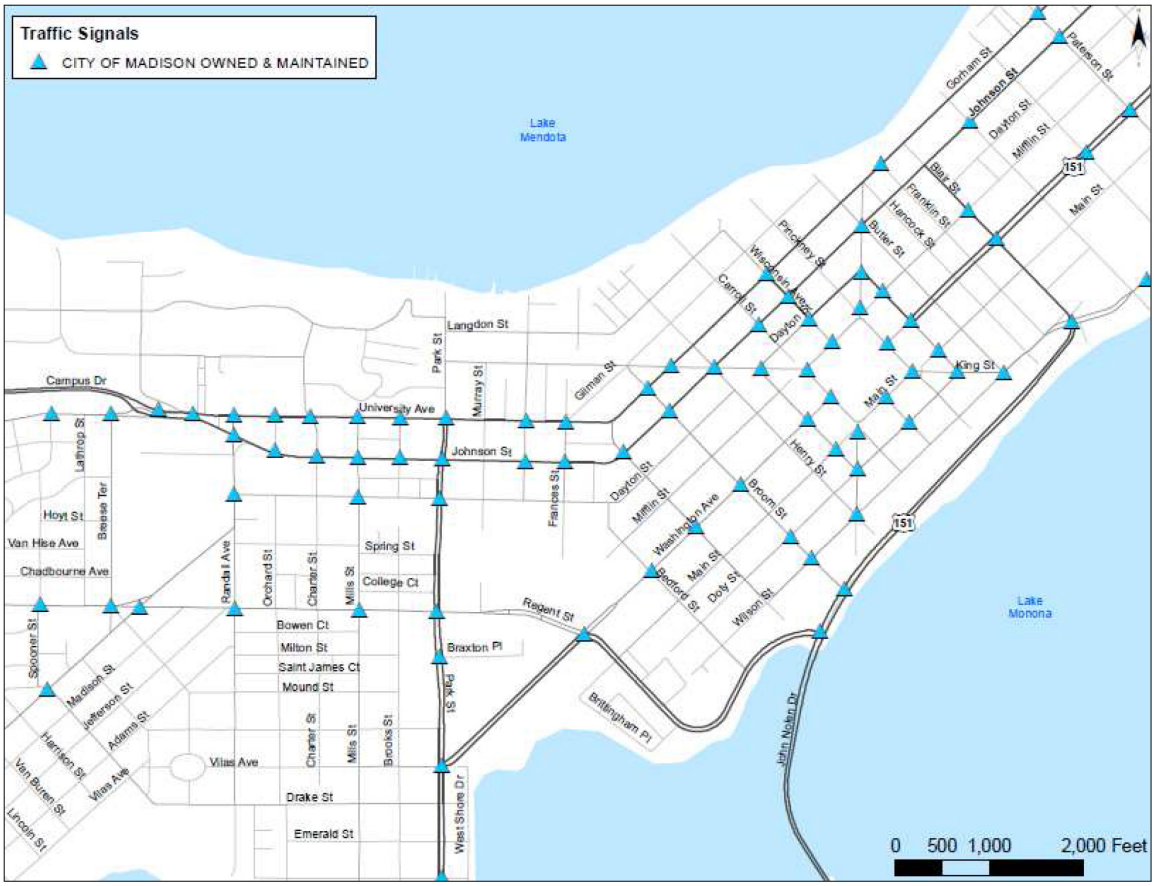


Table 8

Madison Metropolitan Area Traffic Signal Ownership (Excluding City of Madison)

No.	Municipality	Route	Location	Owner	Maintainer
1	Sun Prairie	USH 151	@ Grand Avenue ramps	WisDOT	WisDOT
2	Sun Prairie	USH 151	@ STH 19 ramps	WisDOT	WisDOT
3	Sun Prairie	USH 151	@ Main Street	WisDOT	WisDOT
4	Sun Prairie	STH 19	@ CTH C intersection	WisDOT	WisDOT
1	Middleton	Parameter	@ Donna	Middleton	Middleton
2	Middleton	Greenway	@ Deming	Middleton	Middleton
3	Middleton	Greenway	@ John Q. Hammons	Middleton	Middleton
4	Middleton	Deming	@ Discovery	Middleton	Middleton
5	Middleton	CTH MS	Park Street	Middleton*	Middleton*
6	Middleton	CTH MS	Branch Street / Public Alley	Middleton*	Middleton*
7	Middleton	CTH MS	Parmenter Street	Middleton*	Middleton*
8	Middleton	CTH MS	Bristol Street	Middleton*	Middleton*
9	Middleton	CTH M	Parmenter Street	Middleton*	Middleton*
10	Middleton	CTH M	Allen Blvd / Allen Court	Middleton*	Middleton*
11	Middleton	CTH M	CTH Q / Hedden Road	Middleton*	Middleton*
12	Middleton	CTH M	Park Street / High Road	Middleton*	Middleton*
13	Middleton	CTH M	Branch Street	Middleton*	Middleton*
14	Middleton	CTH M	Donna / Frank Lloyd Wright	Middleton*	Middleton*
15	Middleton	CTH M	Baskerville / Highland	Middleton*	Middleton*
16	Middleton	CTH MS	CTH Q	Middleton	City of Madison
17	Middleton	USH 12	USH 14 ramps	Middleton	WisDOT
18	Middleton	USH 12	Greenway Boulevard	Middleton	WisDOT
19	Middleton	USH 12	CTH M / Airport Road	Middleton	WisDOT
20	Middleton	USH 12 Ramp	CTH MS / Cayuga Street	Middleton	WisDOT
21	Middleton	USH 14	Pleasant View Road	WisDOT	WisDOT
22	Middleton	USH 14	Deming Way	WisDOT	WisDOT
1	Fitchburg	USH 18 / USH 151	@ CTH PD	WisDOT	WisDOT
2	Fitchburg	USH 18 / USH 151	@ Williamsburg Way	WisDOT	WisDOT
1	Madison	USH 51	@ USH 151	WisDOT	WisDOT
2	Madison	USH 51	@ Milwaukee Street	WisDOT	WisDOT
3	Madison	USH 51	@ Buckeye Road	WisDOT	WisDOT
4	Madison	USH 51	@ Pflaum	WisDOT	WisDOT
5	Madison	USH 12 / USH 14	USH 18 / USH 151 / Verona Road	WisDOT	WisDOT
6	Madison	USH 51	Broadway	WisDOT	WisDOT
7	Madison	USH 18 / USH 151	Verona Frontage Road	WisDOT	WisDOT
8	Madison	USH 18 / USH 151	Raymond Road	WisDOT	WisDOT
9	Madison	USH 51	STH 30	WisDOT	WisDOT
10	Madison	USH 51	Anderson Street	WisDOT	WisDOT
11	Madison	USH 12 / USH 18	Monona Drive	WisDOT	WisDOT
12	Madison	USH 12 / USH 18	USH 51	WisDOT	WisDOT
13	Madison	American Pkwy	High Crossing Boulevard & Nelson Road	WisDOT	WisDOT
14	Madison	USH 51	Lexington Avenue / Commercial Avenue	WisDOT	WisDOT
15	Madison	USH 51	Kinsman Boulevard	WisDOT	WisDOT
16	Madison	USH 12/14/151	Seminole Hwy EB	WisDOT	WisDOT

No.	Municipality	Route	Location	Owner	Maintainer
17	Madison	USH 12/14/151	Seminole Hwy WB	WisDOT	WisDOT
18	Madison	USH 12 / USH 14 / USH 18 / USH 151	Fish Hatchery Road (S)	WisDOT	WisDOT
19	Madison	USH 51	Hoepker Road	WisDOT	WisDOT
20	Madison	USH 12/18 EB Off Ramp	USH 14	WisDOT	WisDOT
1	Mc Farland	USH 51	CTH MN / Farwell Street	WisDOT	WisDOT
2	Mc Farland	USH 51	Voges Road / Terminal Drive	WisDOT	WisDOT
3	Mc Farland	USH 51	Larson Beach Road	WisDOT	WisDOT
1	Monona	USH 12 / USH 18	South Towne Drive	WisDOT	WisDOT
1	Stoughton	USH 51	CTH N	WisDOT	WisDOT
1	Verona	USH 18 / USH 151	CTH PB	WisDOT	WisDOT
1	Albion	USH 51	@ Albion/Haugen Rd	WisDOT	WisDOT
1	Burke	USH 51	@ CTH CV/ Anderson Rd	WisDOT	WisDOT
2	Burke	USH 51	@ STH 19	WisDOT	WisDOT
3	Burke	USH 51	@ I39/90/94 NB Off Ramp	WisDOT	WisDOT
4	Burke	STH 19	@ Pederson Crossing (future)	WisDOT	WisDOT
5	Burke	STH 19	@ Portage Rd	WisDOT	WisDOT
6	Burke	STH 19	@ IH39/94 NB Off Ramp	WisDOT	WisDOT
1	Cross Plains	USH 14	@ CTH P	WisDOT	WisDOT
2	Cross Plains	USH 14	@ CTH KP (East)	WisDOT	WisDOT
3	Cross Plains	USH 14	@ Brewery Road	WisDOT	WisDOT
1	Waunakee	STH 19	@ STH 113 & CTH Q	WisDOT	WisDOT
2	Waunakee	STH 19 / STH 113	@ Division St	WisDOT	WisDOT
3	Waunakee	STH 19 / STH 113	@ Madison St	WisDOT	WisDOT
4	Waunakee	STH 19 / STH 113	@ Raemisch Rd / Schumacher Rd	WisDOT	WisDOT
5	Waunakee	STH 19	@ Holiday Dr	WisDOT	WisDOT
1	Windsor	STH 19	@ CTH CV	WisDOT	WisDOT
1	Black Earth	USH 14	@ STH 78 (South)	WisDOT	WisDOT
1	Springfield	USH 12	@ CTH K	WisDOT	WisDOT
2	Springfield	USH 12	@ CTH P	WisDOT	WisDOT
3	Springfield	USH 12	@ STH 19	WisDOT	WisDOT
1	Westport	STH 113	@ CTH M	WisDOT	WisDOT
2	Westport	STH 113	@ River Rd	WisDOT	WisDOT
1	Marshall	STH 19	@ STH 73 / Deerfield Rd	WisDOT	WisDOT
1	Roxbury	USH 12	@ STH 78	WisDOT	WisDOT
1	DeForest	I-39/90/94	@ CTH V	WisDOT	WisDOT

3.2.6 Emergency Signal Pre-emption/Transit Signal Priority

Emergency vehicle (EV) signal pre-emption systems improve emergency response by giving EV a green signal indication as they approach a signalized intersection, reducing the need to slow down or stop. Signal emitters installed on EVs emit an infrared (IR) signal that is detected by a receiver (see Figure 17), which is tied into the traffic signal, and once detected interrupts the regular traffic signal cycle to give a "green" signal indication to the EV approaching the equipped intersection. If the signal indication is already green as the EV approaches, the pre-emption equipment will hold the green phase so the traffic signal phase does not change until the EV travels through the intersection.

Figure 17: Signal Pre-emption Receiver

The City of Madison and other surrounding communities have installed emergency signal preemption, with the majority of City of Madison traffic signals now equipped with this capability. Ninety-three signalized intersections within the City of Madison have emergency signal preemption capability for at least one approach. The City of Madison uses two types of emergency signal pre-emption equipment, Global Traffic Technologies' Opticom Infrared System and TOMAR Electronics' STROBECOM II optical pre-emption. These systems are producing cost savings for local jurisdictions in Dane County and for the public through reduced insurance, reduced medical costs and saved lives.

Figure 18 shows the signalized intersections where emergency signal preemption has been installed.

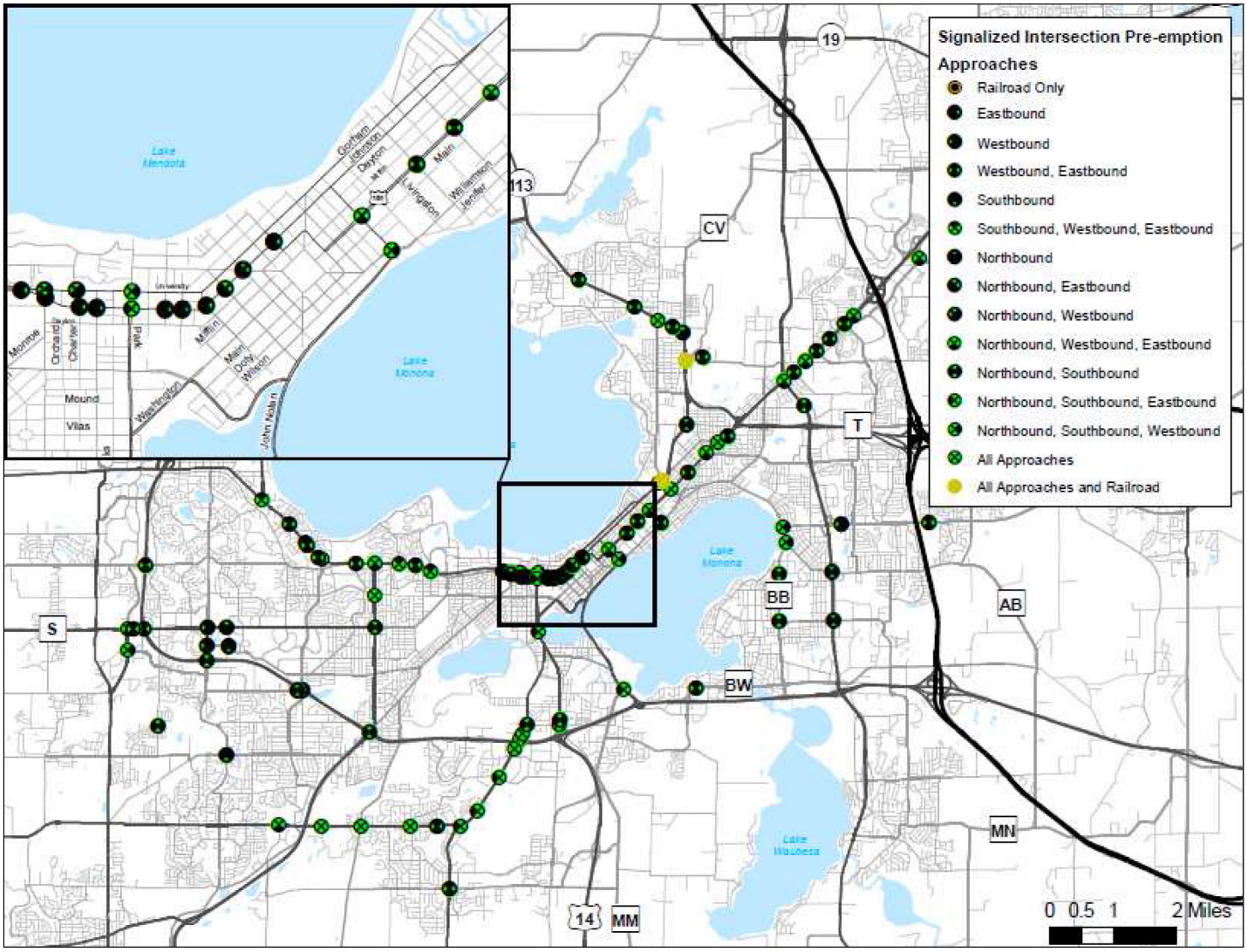
Similar to emergency signal pre-emption, equipment can be installed on transit vehicles to provide signal priority to these vehicles when approaching or waiting at a traffic signal. Equipment on-board the transit vehicle would communicate with a receiver installed in the traffic signal controller to make a request for signal priority. This capability would reduce transit delay at signalized intersections, improve the transit user experience and improve overall transit trip reliability. This technology has been identified as a potential improvement in a recent study that evaluated the potential for Bus Rapid Transit (BRT) in the City of Madison.

3.2.7 Adaptive Signal Control Technology

In 2014, WisDOT implemented adaptive signal control technology at 14 signalized intersections along CTH PD/McKee Road and County D/Fish Hatchery Road. This technology, which is operated by the City of Madison, was implemented in large part to reduce the impacts associated with traffic diversion expected to result from a major construction project along Verona Road from Raymond Road through the Beltline.

The adaptive signal control technology is Centracs. A before and after study of the Centracs system showed a travel time improvement of between 9 to 15% along the equipped corridors.

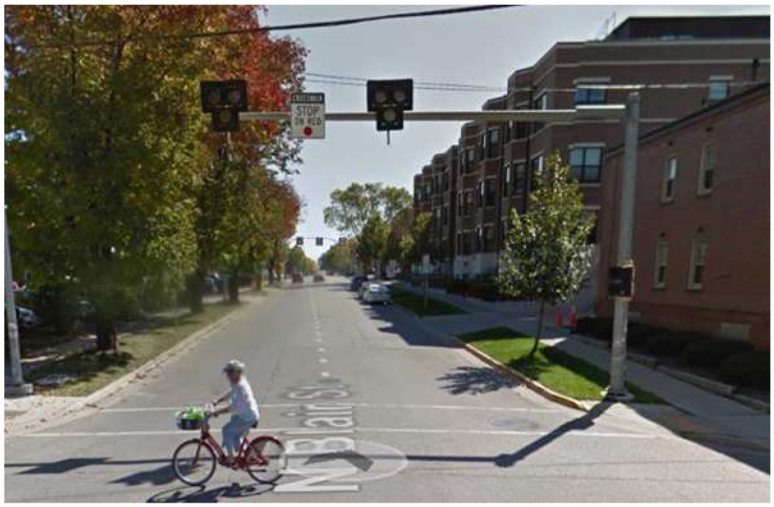
Figure 18: City of Madison Traffic Signalized Intersections Equipped with Signal Pre-Emption Technology



3.2.8 Pedestrian and Bicyclist Hybrid Beacons and Detection

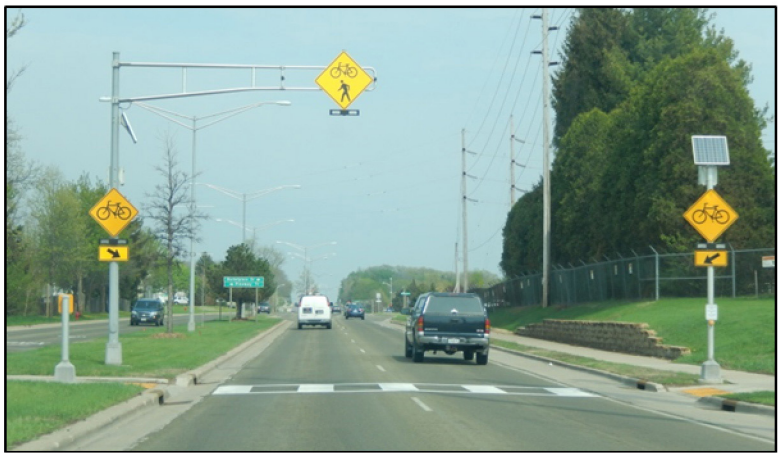
In recent years, the City of Madison has implemented a pedestrian and bicyclist hybrid beacon (see Figure 19) to help these classes of users safely cross busy streets. The beacon is different than a standard traffic signal in that the major street's signal is generally dark or off and there is no traffic signal for the cross street. Instead, pedestrians and bicyclists on the side street each have their own signals. To cross the street the pedestrian or bicyclist pushes a button to activate the beacon to stop the major street traffic. Currently, the only pedestrian and bicyclist hybrid beacon is located at the intersection of N. Blair Street and E. Mifflin Street. The City of Madison also operates bike signals like that shown in Figure 20 at Atwood Avenue and Dunning Street and Regent Street and Monroe Street intersections.

Figure 19: City of Madison Pedestrian and Bicyclist Hybrid Beacon



In addition to hybrid beacons, the City of Madison has implemented thermal imaging sensors to detect bicyclists approaching or waiting at traffic signals. These sensors, manufactured by FLIR, supplement traditional electro-magnetic coils embedded in the pavement that detect a vehicle's iron and steel. However, bicycles made of aluminum and carbon fiber; two common materials contained in newer bicycles, often do not contain enough metal to be detected by these transitional sensors. The thermal imaging sensors instead detect heat being generated by human bodies (i.e., bicyclists) as well as heat from vehicles and motorcycles. The thermal imaging sensors can differentiate between bicyclists, motorcycles and vehicles and can create detailed counts for each user type. This has been particularly useful in improving transportation studies and planning efforts. Their primary benefit however, is to hold a traffic signal's "green" phase to allow bicyclist to travel through the intersection without having to stop and wait. Those cyclists that must stop at the signal will benefit as well though automatic detection. This is opposed to the current need to get off their bikes to push the pedestrian crossing button. This has improved bicyclist safety and convenience and has improved equity among the various users of the City's surface transportation system.

Figure 20: City of Madison Bike Signal



3.2.9 Speed Display Signs

The City of Madison owns and operates four permanent speed display signs. These signs are essentially a light emitting diode (LED) sign synced with a radar speed gun that displays to motorists their current speed (see Figure 21). Speed Display signs encourage motorists to comply with posted speed limits. The City of Madison has deployed these signs in school zones to encourage safer driving within these locations. The school zones and roads where the four speed display signs are located are:

- Allis Elementary, Buckeye Road
- Crestwood School, Old Sauk Road
- Thoreau School, Nakoma Road
- Toki Middle School, Whitney Way

Figure 21: Madison Speed Display

The City of Madison and other surrounding municipalities also own and operate speed monitoring trailers that function similar to the permanent speed display signs but are portable and can be moved to deter aggressive driving at spot locations. In most instances, the speed monitoring trailers will heighten a driver's awareness of their current speed resulting in an immediate change in driving behavior. The frequent use of speed monitoring trailers may result in driver's ignoring the warning message. In these cases, or when excessive speeds are observed, law enforcement may be positioned near the trailer to increase their effectiveness.

3.2.10 Roadway Weather Information Systems

Road Weather Information Systems (RWIS) are meteorological systems consisting of a network of environmental sensor stations like the one shown in Figure 22 and communication devices. Specialized equipment and computer programs monitor air and pavement temperature to forecast how the weather may affect road surface conditions. Strategically located alongside the highway, RWIS data is used in the Madison Metropolitan Area for traveler information. However, it is more consistently used by operators to make maintenance decisions regarding anti-icing and deicing, as well as optimizing materials and staff.

Figure 22: WisDOT Environmental Sensor Station

Weather in Wisconsin has a significant impact on driving conditions. To help mitigate the impacts that weather has on travel, WisDOT integrates, analyzes and disseminates data collected from an environmental sensor station. The ESS continually monitors precipitation, temperature and pavements conditions. Data from the ESS is then funneled to the RWIS, which integrates the data and provides WisDOT with information needed to plan, evaluate resource needs and implement actions to clear snow and ice and warn motorists of fog or other severe weather conditions. This improves the efficiency and safety of maintenance operations and motorists.

WisDOT owns and operates a statewide RWIS that consists of 62 individual environmental sensor stations (ESS) located along roadways throughout the state. In Dane County, WisDOT owns and operates three ESS. The locations of these devices are listed in Table 9 and shown on the map in Figure 23. Data collected by the ESS are used to improve the safety and efficiency of travel and to support statewide maintenance operations. Each ESS collects the following types of atmospheric and pavement data:

- Ambient air temperature
- Relative humidity
- Dew point
- Wind speed and direction
- Wind gust speed

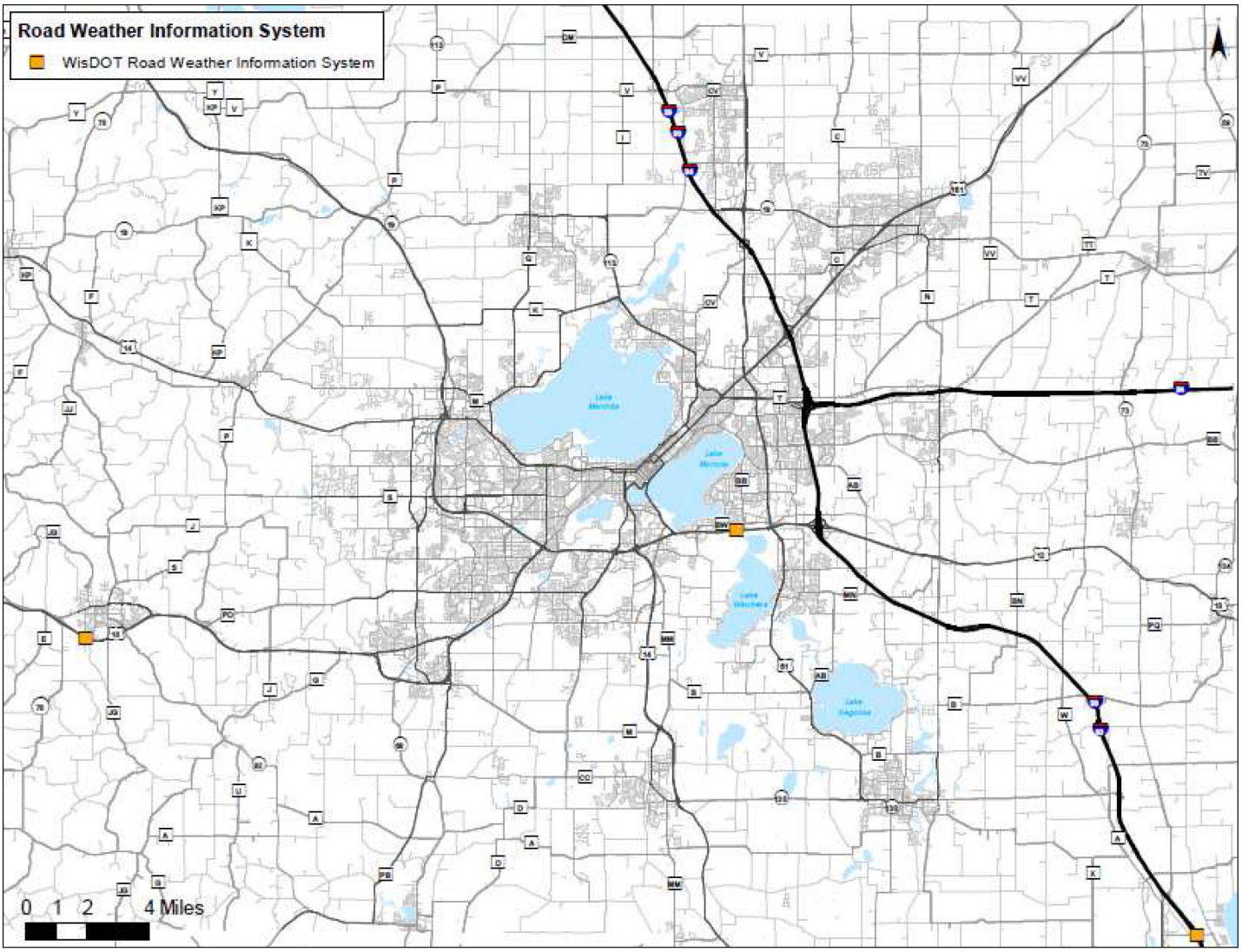
Table 9

WisDOT Road Weather Information System Environmental Sensor Stations (Dane County)

No.	WisDOT Device ID	Route	Location	Year Installed
1	RWIS-13-0000	USH 12/18	@ Mud Lake	1990
2	RWIS-13-0001	I-90	@ Lake Drive Rd	1990
3	RWIS-13-0008	USH 18/151	@ Sandrock Rd	1995

WisDOT's ESS network is included as part of the National Oceanic and Atmospheric Administration's (NOAA) Metrological Assimilation Data Ingest System (MADIS) datasets. Real-time ESS observations can be viewed on the MADIS website located at: https://madis-data.noaa.gov/sfc_display/

Figure 23: Madison Metropolitan Roadway Weather Information System Environmental Sensor Station Locations



3.2.11 Parking Management Systems

Figure 24: City of Madison Parking Automatic Pay Station

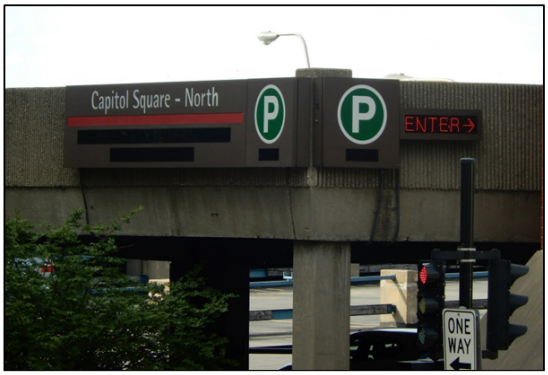
Parking management systems provide electronic monitoring and management of parking facilities (see Figure 24 & Figure 25). These systems in part electronically collect parking fees and provide guidance to potential patrons through dynamic signing of parking lot usage, availability and other general parking information. In other cases, parking management systems interface with third party financial institutions to process payments. The City of Madison, the UW Madison, Dane County and the Dane County Airport all operate parking management systems for their respective parking facilities.

City of Madison

The City of Madison Parking Utility's mission is to provide safe, convenient and affordable parking to the City's residents and visitors. The City of Madison provides over 5,000 public parking spaces through the following five parking garages and seven parking lots.

- Blair Lot
- Brayton Lot
- Buckeye Lot
- Capitol Square North Garage
- Evergreen Lot
- Government East Garage
- Lot 88
- Overture Center Garage
- State Street Campus Garage
- State Street Capitol Garage
- Wilson Lot
- Wingra Lot

Figure 25: City of Madison Parking Garage Electronic Signage



Real-time parking space availability for the above lots and garages is monitored by continually tracking the number of vehicles entering/existing parking facilities. When parking is not available, signage, like that shown in Figure 25 is used to alert en-route parking patrons before entering the parking garage so they can continue onto the next parking garage. Similarly, real-time parking information is provided to pre-trip users via the following website:

www.cityofmadison.com/parkingUtility/garagesLots/availability/

Parking garage parking fees are processed through automatic pay stations like that shown in Figure 26. These stations provide an easy to use interface with audio instructions to assist parking patrons. Multiple payment forms of payment are accepted at each of these stations.

In addition to the above listed garages and lots, the City of Madison provides more than 1,300 on-street, metered parking spaces. Payment for on-street metered spaces is often made through multi-space meters like that shown in Figure 26.

Figure 26: City of Madison Multi-Space Parking Meter

University of Wisconsin – Madison

UW Transportation Services serves a variety of customers with a diverse set of parking and transportation needs. The agency's mission is to provide innovative transportation solutions that serve and support the UW-Madison.

In 2013, the agency conducted a project that evaluated the benefits of converting UW-Madison parking permits from magnetic stripe (Magstripe) cards to Radio-Frequency Identification (RFID) enabled handing permits. The results of the project concluded that parking ramps and garages on the UW-Madison campus are able to significantly reduce idling time and resulting vehicle emissions at gates by switching from Magstripe permits to RFID permits. Users may also experience decreased waiting time for lot entry and exist, lowered fuel consumption and increased comfort and safety. The report states that "RFID is a convenient technology that has positively affected parking at University lots and could see continued use and implementation in the future".

The UW Transportation Services also provides real-time estimated parking availability information for the following university owned and operated parking garages/ramps:

- University Ave Ramp
- Nancy Nicholas Hall Garage
- Observatory Dr. Ramp
- Helen C. White Garage Lower
- Helen C. White Garage Upper
- Grainger Hall Garage
- North Park Street Ramp
- Lake and Johnson ramp
- Fluno Center Garage
- Engineering Drive Ramp
- Union South Garage
- University Bay Drive Ramp

Near real-time visitor parking availability at each of the above lots can be accessed by visiting the following website: http://transportation.wisc.edu/parking/lotinfo_occupancy.aspx

The UW has installed approximately 140 emergency phones on the UW campus, including the blue light phones (in areas like Picnic Point and the Lakeshore Path), phones in parking ramps (including elevators) and in many buildings. These phones dial 911 directly with the push of a button and the call is connected to the UW-Madison Police Department Communication Center. These phones are to be used for emergencies only. When the button is pressed, the dispatcher will receive the call, along with the location of the phone the call is coming from, and an officer will be sent to check the area. All emergency phones on campus are tested once per month to ensure they are working properly.

Dane County

Dane County operates the Capitol Square South Ramp located on the southernmost corner of the Outer Ring of The Capitol Square on South Fairchild Street between West Main and West Doty Streets in downtown Madison. The facility is a metered parking garage.

Dane County Regional Airport

The Dane County Regional Airport provides short-term (hourly) and long-term (daily) parking for airport patrons, as well as a free cell phone lot for persons waiting to pick up travelers at the terminal.

In recent years, the Dane County Regional Airport implemented its easyPark system; a ticketless payment system that allows patrons to enter Dane County Regional Airport's parking facilities using only a credit or debit card in lieu of having to take a ticket. This has sped up the process of entering and exiting the airport's parking facilities and added a level of convenience for patrons as they no longer have to keep track of a ticket to pay as they leave a parking facility.

The airport also operates a phone system (608) 246-3380 where interested parties can obtain parking availability information.

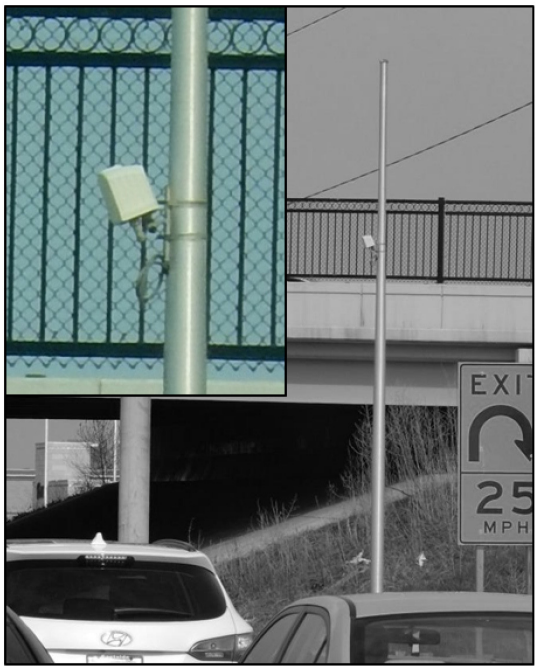
3.2.12 System Detector Stations

System detector stations (SDS) are sensors located along freeways that are used to collect real-time data on freeway traffic flow. SDSs provide a detailed estimate of volumes throughout the entire year and reliable estimates of Annual Average Daily Traffic (AADT). Furthermore, data generated by these sensors are used for traffic management functions such as detecting incidents, traffic flow information and archiving for planning and historical analysis. Along Madison Metropolitan Area freeways, SDS generated data are collected and sent to a nearby roadside controllers which then

sends the information to the Wisconsin STOC via fiber or leased line communication. The data are used to provide real-time information into a system; the SDS do not collect data for use on a closed system (e.g., signalized intersection). Each SDS is typically configured to measure and collect three standard traffic flow parameters on a lane-by-lane basis:

- Volume
- Occupancy
- Speed

Figure 27: Microwave Detector Station (Beltline)



System detector stations are typically spaced from 1/2 mile spacing in congested urban areas to one mile spacing for moderately congested areas to 2-3 mile spacing in rural areas. In Wisconsin and the Madison Metropolitan Area, SDS are typically owned and operated by WisDOT and are comprised of the following types of sensors, though this may change with evolution in technology. Table 10 lists all WisDOT SDS located in Dane County.

Loop Detector Stations

Loop detectors configured in a "trap" configuration, spaced at a consistent distance apart (typically 16 feet) leading edge to leading edge, are used for permanent detection statewide. Loop detectors require cuts be made into the existing pavement. For this reason, their used may be limited in newer pavement. Also, their operation is more susceptible to the effects of weather than non-intrusive detection.

Microwave Detector Stations

Microwave detectors are above-ground units mounted either over a traffic lane (e.g., on a bridge overpass), or along the side of the freeway mounted on a pole, in a "side-fire" configuration approximately 15 feet above the ground (See Figure 27). Microwave detectors are typically used for temporary installations to provide traffic data during construction projects or in a permanent configuration where the freeway pavement is relatively new.

WisDOT owned and operated microwave detector stations are listed in Table 10 and shown in Figure 29.

Bluetooth Wireless Detection Sensors

Figure 28: WisDOT Bluetooth Sensor

Bluetooth detection sensors have been installed within the Madison Metropolitan Area through the Verona Road (US 18/151) and I-39/90 projects. Bluetooth sensors are being used to generate near real-time vehicle travel times and to fill in gaps in existing freeway travel times. The sensors anonymously detect Bluetooth signals being actively emitted by Bluetooth enabled devices located within and installed on vehicles. These devices include, but are not limited to, mobile telephones, hands-free sets and personal navigation systems. The Bluetooth signals emitted by these devices are transmitted over relatively short distances ranging from a few feet to several hundred feet. The Bluetooth sensors (Figure 28) detect these signals from upwards of a quarter mile away. As a vehicle with a Bluetooth enabled device passes within proximity of a sensor, the sensor detects

the Bluetooth device and records its unique Media Access Control (MAC) address and the time the device was detected. The encrypted MAC address and timestamp data is transmitted to and stored within a database at the WisDOT STOC. As the vehicle with a Bluetooth enabled device continues to travel along the various equipped arterials, it will pass additional Bluetooth sensors that will collect and transmit the same information. Traffic data and analysis software then pairs all instances of a unique MAC address to calculate the travel time between a predetermined pair of Bluetooth sensors.

The Bluetooth system consists of traffic data monitoring system/software that is used to store, report and analyze the data collected by each Bluetooth sensor. Data is integrated into the state's existing Advanced Traffic Management System (ATMS) platform (TranSuite) so that travel times generated by the system can be seamlessly merged with freeway travel time data in order to calculate freeway travel times.

Calculated travel times will be shared in real-time with the public prior to departure to enable them to make more informed decisions when planning a trip or en-route for selecting the quickest routes to their destination. Because individual Bluetooth sensors are relatively inexpensive, the installation of Bluetooth sensors represents an excellent opportunity to generate useful information to display on existing and planned DMS and a means by which drivers can avoid delays that are likely to result from short-term construction activity and longer-term growing transportation demand.

Bluetooth sensors located within Dane County are listed in Table 11 and mapped in Figure 30.

Table 10

WisDOT System Detector Station Locations (Dane County)

No.	WisDOT Device ID	Route	Location
1	SDS-13-0001	US 12/14	@ Mineral Point Rd.
2	SDS-13-0002	US 12/14	@ Gammon Rd.
3	SDS-13-0004	US 12/14	@ Verona Rd.
4	SDS-13-0005	US 12/14	@ Seminole Hwy
5	SDS-13-0124	US 12/14	@ Mineral Point Rd.
6	SDS-13-0125	US 12/14	@ Old Sauk Rd.
7	SDS-13-0126	US 12/14	@ Greenway Blvd.
8	SDS-13-0010	US 12/18	@ Rimrock Rd.
9	SDS-13-0011	US 12/18	@ John Nolen Dr
10	SDS-13-0012	US 12/18	@ South Towne Dr.
11	SDS-13-0013	US 12/18	@ Monona Dr.
12	SDS-13-0014	US 12/18	@ Stoughton Rd.
13	SDS-13-003	US 12/18	@ Fish Hatchery Rd.
14	SDS-13-005	US 12/18	@ Park St.
15	SDS-13-006	US 12/18	@ Landmark Place
16	SDS-13-0015	I-39/90	@ US 12/18 NW
17	SDS-13-0016	I-39/90	@ US 12/18 SW
18	SDS-13-0017	I-39/90	@ US 12/18 SE
19	SDS-13-0031	I-39/90	@ S. Thompson Rd.
20	SDS-13-0032	I-39/90	@ Hwy BB (Cottage Grove Rd)
21	SDS-13-0033	I-39/90	@ Hwy AB (Buckeye Rd.)
22	SDS-13-0034	I-39/90	@ Railroad
23	SDS-13-0035	I-39/90	@ Ohmeda Dr.
24	SDS-13-0090	I-39/90	@ Dejope SB

No.	WisDOT Device ID	Route	Location
25	SDS-13-0091	I-39/90	@ Dejope NB
26	SDS-13-0051AB	I-39/90/94	@ N. of Hwy T (Salt Shed)
27	SDS-13-0021	I-39/90/94	@ Lien Rd.
28	SDS-13-0022	I-39/90/94	@ High Crossing Blvd.
29	SDS-13-0023	I-39/90/94	@ US 151 SE
30	SDS-13-0024	I-39/90/94	@ US 151 NW
31	SDS-13-0025	I-39/90/94	@ US 151 NE
32	SDS-13-0041	I-39/90/94	@ Portage Rd.
33	SDS-13-0044	I-39/90/94	@ US 51
34	SDS-13-0047	I-39/90/94	@ US 19
35	SDS-13-0087	I-39/90/94	@ Hoepker Rd.
36	SDS-13-0088	I-39/90/94 SB	@ Cuba Valley Rd. (N. of Hwy 19)
37	SDS-13-0089	I-39/90/94	@ Hwy V (Deforest)
38	SDS-13-0048AB	I-94	@ WIS 73
39	SDS-13-0064	I-94	@ Sprecher Rd.
40	SDS-13-0071	I-94	@ Gaston Rd
41	SDS-13-0074	I-94	@ Hwy N
42	SDS-13-0052	I-94	@ Ridge Rd
43	SDS-13-0053	I-94	@ Jacobs Rd.
44	SDS-13-0060	WIS 30	@ Thompson Dr. WB
45	SDS-13-0061	WIS 30	@ Thompson Dr. EB
46	SDS-13-0062AB	WIS 30	@ Fair Oaks Ave
47	SDS-13-0063	WIS 30	@ US 51
48	SDS-13-0080AB	US18/151 (Verona Rd.)	@ Carriage St.
49	SDS-13-0081AB	US18/151 (Verona Rd.)	@ Fitchrona Rd.
50	SDS-13-0120	WIS 73	@ N. of WIS 106
51	SDS-13-0121	WIS 73	@ N. of Hwy PQ

Figure 29: Madison Metropolitan Area Microwave Detector Stations

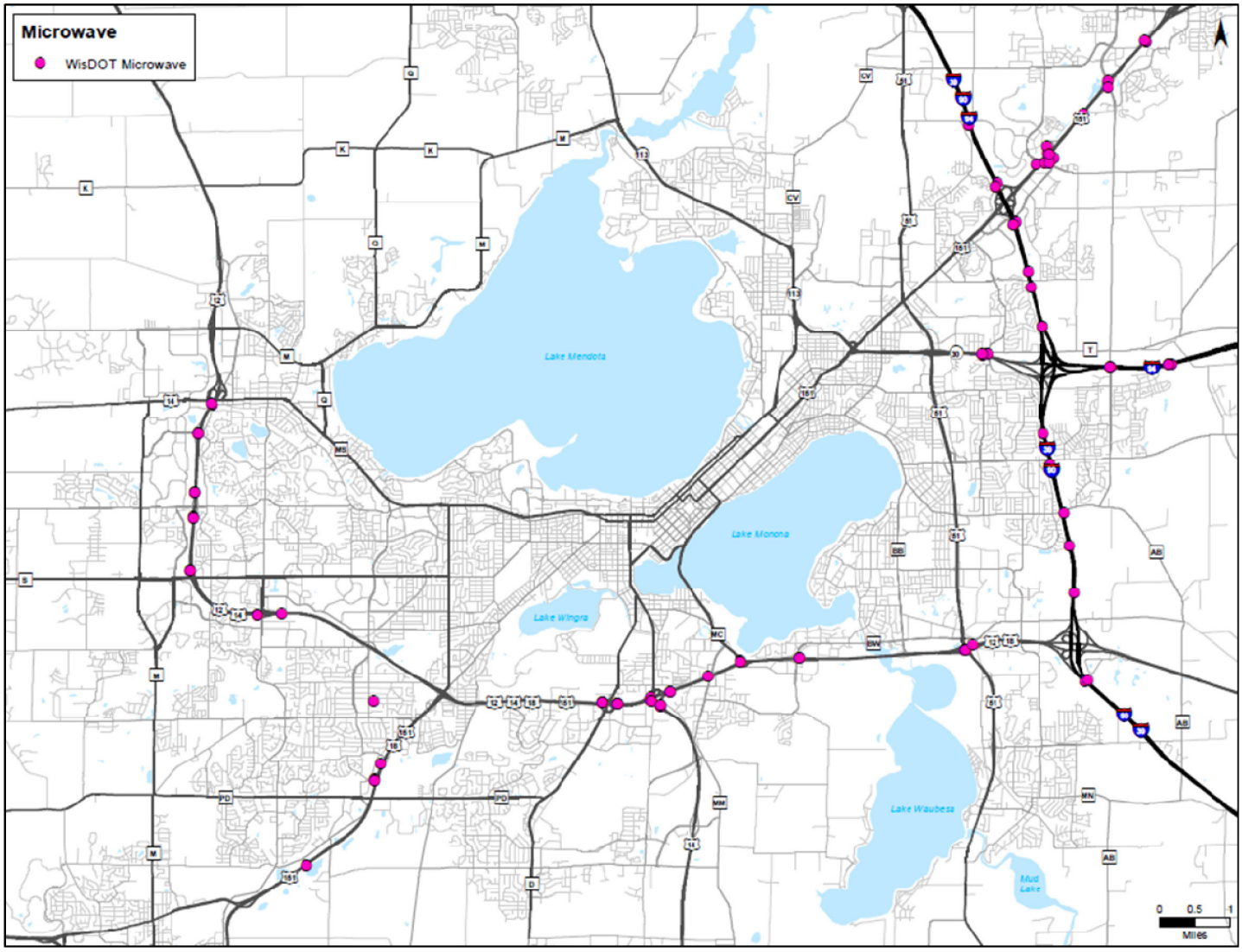
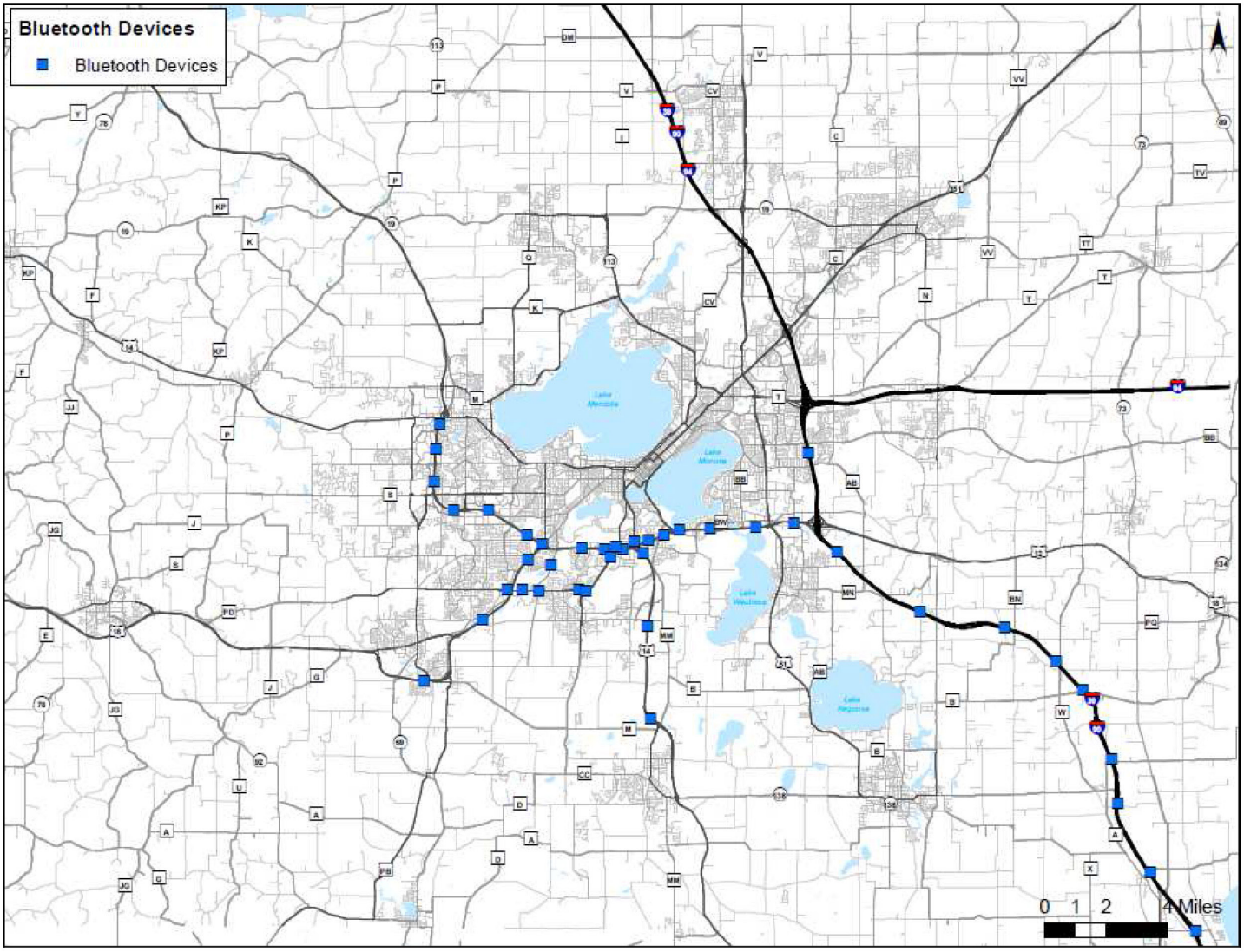


Table 11

WisDOT Bluetooth Wireless Detection Sensor Locations (Dane County)

No.	WisDOT Device ID	Route	Location
1	WDS-0054	US 12/18	at W of Stoughton Road
2	WDS-0052	US 12/18	at E of John Nolen Drive
3	WDS-0041	US 12/18	at E of Seminole Road
4	WDS-0051	US 12/18	at W of John Nolen Drive
5	WDS-0028	US 12/18	at Agriculture Drive
6	WDS-0029	US 12/14	at S of University Avenue
7	WDS-0034	US 12/14	at E of Whitney Way
8	WDS-0031	US 12/14	at Old Sauk Road
9	WDS-0030	US 12/14	at N of Sauk Road
10	WDS-0033	US 12/14	at E of Gammon Road
11	WDS-0032	US 12/14	at W of Gammon Road
12	WDS-0047	US 12/14/18	at W of Park Street
13	WDS-0044	US 12/14/18	at E of Fish Hatchery Road
14	WDS-0050	US 12/14/18	at E of Park Street
15	WDS-0053	US 12/14/18	at E of South Towne Road
16	WDS-0078	US 14	at Lacy Road
17	WDS-0077	US 14	at N of Hwy MM
18	WDS-0049	US 14/Park Street	at S of US 12/18
19	WDS-0037	Hwy PD	at W of Verona Road
20	WDS-0042	Hwy PD	at W of Fish Hatchery Road
21	WDS-0024	Hwy PD	at Seminole Highway
22	WDS-0035	Verona Road	at N of US 12/18
23	WDS-0038	Verona Road	at W of Fitchrona Road
24	WDS-0036	Verona Road	at S of Raymond Road
25	WDS-0043	Fish Hatchery Road	at S of Hwy PD
26	WDS-0045	Fish Hatchery Road	at S of US 12/18
27	WDS-0046	Fish Hatchery Road	at N of US 12/18
28	WDS-0040	Seminole Road	at Sentinal Road
29	WDS-0055	US 18/151	at W of Hwy M
30	WDS-0039	Offline - Hwy PD	at E of Verona Road
31	WDS-0048	Park Street	at N of US 12/14/18
32	WDS-0010	I-39/90	at Lake Drive
33	WDS-0008	I-39/90	at Maple Grove Road
34	WDS-0002	I-39/90	at Storck Road
35	WDS-0003	I-39/90	at Williams Drive
36	WDS-0004	I-39/90	at Church Street
37	WDS-0005	I-39/90	at Hwy W
38	WDS-0006	I-39/90	at N of Hwy B
39	WDS-0001	I-39/90	at S of Cottage Grove Road
40	WDS-0007	I-39/90	at Hwy A
41	WDS-0009	I-39/90	at WIS 106

Figure 30: Madison Metropolitan Area Bluetooth Sensors



3.2.13 Bike Counters

The City of Madison Traffic Engineering collects bicycle path traffic counts from 24-hour detection devices placed in paths at multiple street intersection locations and in the contra-flow bike lane on University Avenue at Mills Street. Recent bicycle counts in the City of Madison show that bicycling levels continue to increase as the growing and increasingly interconnected area bikeway network makes bicycling more convenient and enjoyable.

Figure 31: Madison Visual Bike Counter

In October 2014, the Madison Traffic Engineering and Parking Division implemented the city's first visual bike counter (See Figure 31). The counter, called the Eco-Totem by manufacturer Eco-Counter is located on the south side of the Southwest Path just northeast of the intersection of Regent and Monroe Streets. The counter displays the number of daily bicyclists and annual bicyclists who pass it.

Data from the Madison Visual Bike Counter are available to the public at http://Madison-monroe.visio-tools.com. Data is updated once per day.

3.2.14 Electronic Vehicle Charging Stations

The UW-Madison Transportation Services has installed electronic vehicle charging stations at the following six campus parking ramps/garages:

- Grainer Hall Garage (Lot 7)
- Engineering Drive Ramp (Lot 17)
- University Avenue Ramp (Lot 20)
- North Park Street Ramp (Lot 29)
- Observatory Drive Ramp (Lot 36)
- UW Hospital Ramp (Lot 75)

Permitted and paid visor parking customers can use the charging stations for free but are required to have an active ChargePoint card to use the stations. Transportation Services has contracted with ChargePoint to manage electric fueling.

Locations and status of ChargePoint charging stations on the UW Campus, in the Madison Region and throughout the US can be found at:

https://na.chargepoint.com/charge_point

3.3 Vehicle Based ITS Elements

Vehicle based ITS elements represent technologies that are installed on or within vehicles. Vehicle subsystems include general driver information and safety systems applicable to all vehicle types. There are four classes of vehicle subsystems: Transit, Emergency, Commercial and Maintenance and Construction Vehicles.

3.3.1 Automatic Passenger Counters

Metro Transit has Automatic Passenger Counters (APCs) installed on 74 fixed route buses. These devices, located in the stairwell at the front and rear doors, emit infra-red beams that count passengers as they board and alight. The cumulative data collected by these devices are frequently used in helping staff develop plans concerning location of bus shelters, analysis of boardings at the bus stop level, etc. While APCs have been shown to be accurate in boarding data, alighting data have been found to be inaccurate. Staff is working with the vendor of this technology to address issues. When those technical issues are worked out, staff will have access to passenger load information (i.e., how many people are on the bus at any one time for each segment of a route) which will be useful to route planning and operations purposes. These systems also provide Metro Transit with federally mandated ridership data.

3.3.2 Automatic Vehicle Location

Automatic vehicle location (AVL) systems are a fleet management tool that integrates several technologies to relay vehicle location and, in many cases, other vehicle activities such as snow plow status, chemical application rate or vehicle speed. Many AVL applications incorporate mobile data terminals (MDT) that allow operators to wirelessly access information or send and receive text messages. The combination of AVL and MDTs provide a central control system with immediate contact to vehicles. This helps reduce radio communication between drivers and dispatchers and automates some record-keeping functions.

Metro Transit's fixed route, paratransit and support vehicles are equipped with geographic positioning system (GPS) devices, providing real-time vehicle location information to Metro Transit's dispatch office. The location information is used to estimate bus arrival times, and this information is then made available to passengers via information signs at various locations. These data are also available on the Metro Transit website and in the GTFS real-time format. Location

data are sent every minute from the Integrated Vehicle Logic Unit (IVLU). Planning staff use the play-back feature of the AVL system to review on-time performance data for proposed revisions to bus schedules. The system generates automatic "Alerts" notifying operations supervisors of off-route, early and late buses. Operations staff also uses the playback feature as a tool in the investigation of passenger complaints. On-time performance standards will evolve from these efforts for inclusion in future monthly performance indicator reports. The AVL data are sent over an 800 MHz dedicated radio channel. The system was implemented in 2003. Primarily because of a requirement to replace the integrated analog voice radio equipment, as well as the age of the system, it will be considered for replacement in 2017. The AVL system includes the GPS antenna, IVLU, MDT and automated bus stop announcements (audible and visual). AVL systems are installed on 215 fixed route buses, 16 paratransit vehicles, and 18 support vehicles.

Dane County Highway Department's fleets of 58 snow plows are also equipped with AVL systems. These systems are used to track vehicles and to monitor material usage as part of the Highway Department's responsibility to plow over 1,250 lane miles of county highway and 1,300 lane miles of state and federal highways across Dane County. The AVL technology has allowed the Highway Department to facilitate quicker response to changing winter weather conditions and provide more accurate maintenance response. The County Highway Department is also in the process of procuring snowplow route optimization software that is intended to reduce travel time, distance traveled and provide a more even workload distribution.

3.3.3 Mobile Data Terminals/Mobile Data Computers

MDTs are essentially laptop computers installed in law enforcement, maintenance and transit vehicles that allow vehicle operators to communicate directly with their dispatch operators remotely within the vehicle. They are used for vehicle-to-vehicle (V2V) and vehicle-to-center communication. In doing so, they greatly reduce radio communications between the vehicle operator and dispatch personnel, freeing up radio communication for emergency situations. Specially, MDTs allow operators to directly query multiple databases and file reports electronically.

City of Madison police vehicles are equipped with MDTs and mobile data computers. Police officers use the MDT/laptop to note that they have been dispatched and are en route to a call for service.

3.3.4 Transit On-Board Fareboxes

Metro Transit uses on-board fareboxes to classify and collect fares when passengers board. New fareboxes were installed on all fixed-route buses in August 2014. New fareboxes will accept all of Metro Transit's current fare items including 31-day passes, 10-ride cards, etc. With this new technology, Metro Transit will be able to shift to the use of contactless smartcards rather than magnetic strip cards in future years. Data from new fare collection equipment are automatically downloaded when buses enter the garage and are routed to a computer for finance to use in reviewing, collating and summarizing fare collection data. The contactless farecards will have greater flexibility in storing monetary credit, purchased rides, passes and transfers. The new fareboxes could also allow riders to pay fares with smart phones because they come with an optical reader. Fareboxes have a proximity reader needed for contactless payment instruments. Eventually, location coordinates from the transit vehicle's GPS device will be stored with each farebox transaction allowing Metro Transit to collect passenger boarding data by bus stop, route, and time of day.

3.3.5 Transit On-Board Video Camera System

Metro Transit also has security cameras installed on all fixed route and directly operated paratransit buses. Vehicles have four, five, or six security cameras. Two to three cameras are oriented for internal viewing and are used primarily to enhance security on-board the transit vehicle. The remaining cameras are oriented for outward viewing and are used primarily to capture incidents in which the vehicle may be involved. All cameras are fixed in position and cannot be altered by the vehicle operator. When incidents do occur, the vehicle operator can flag the incident for later viewing by pressing a button. Recorded video must be downloaded by physically removing the digital recorder and downloading the video.

An indirect benefit of Metro Transit's on-board security cameras is that they serve as a deterrent, offering a sense of security to riders, which helps to preserve and increase ridership levels.

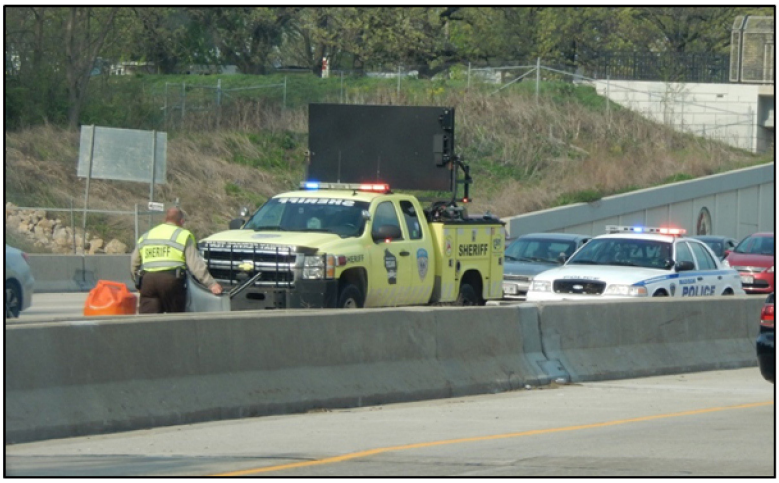
3.3.6 Metro Transit External Announcement System

Metro Transit's external announcements system plays audio messages inside and outside the bus. Announcements are triggered through data processed by the GPS satellite antenna on each bus, as well as schedule and spatial data associated with bus stop intervals.

3.3.7 Freeway Service Team

The Dane County Sheriff's Office Freeway Service Team (FST), (see Figure 32) provides free assistance to motorists involved in crashes or breakdowns along Hwy 12 (Beltline) between Interstate 90 and Old Sauk Road in Madison. The program, funded by WisDOT, operates Monday through Friday from 7am to 7pm, excluding holidays. The service's primary goal is to maintain safety and traffic flow by reducing the potential for secondary crashes.

Figure 32: Dane County Freeway Service Team Vehicle



The FST provides expedited relocation of disabled and crashed vehicles made possible by the presence of FST vehicles continuously patrolling designated segments of interstate and state highways during designated hours. This continuous patrol facilitates a much quicker response time to non-recurring traffic incidents such as breakdowns and traffic crashes, thus reducing the total time needed to clear the incident from the highway and restore normal traffic flow.

3.4 Centers and Center-Based ITS Elements

Centers and center-based ITS elements provide management, administrative and support functions for the Madison Metropolitan Area transportation system. Center ITS elements communicate with other centers to enable coordination between modes and across jurisdictions. Some examples of center ITS elements in the Madison Region include Traffic Management, Transit Management, Archived Data Management, Emergency Management and Information Service Provider.

3.4.1 Operations Center (STOC)

WisDOT's STOC, located in the city of Milwaukee, performs centralized incident and communications coordination every day of the year for all state-owned transportation systems. The STOC monitors, dispatches and assists field staff to better manage traffic. In addition, the STOC coordinates incident information with state, county and local law enforcement agencies, fire departments, FSTs and other agencies, contractors, the news media and the general public. The large monitor is shown in Figure 33.

Figure 33: WisDOT STOC Control Room Video Wall

The STOC monitors and provides operational support for state-owned and operated ITS devices. In the Madison Metropolitan Area these devices include:

- Fixed freeway and arterial DMS,
- Portable DMS,
- Freeway CCTV cameras,
- Freeway system detector stations (e.g., loop and microwave vehicle detection)
- Bluetooth sensors
- Ramp meters
- Environmental sensor stations
- Traffic signal systems including adaptive signal control technology
- Wisconsin 511 traveler information website and phone systems

STOC operator roles and responsibilities include:

- Monitor scanners, cameras and ATMS traffic map for incidents and delays
- Review the lane and ramp closure report for any lane and ramp closures
- Use the appropriate freeway traffic management system (FTMS) devices in the event of an incident, a lane and/or ramp closure, delays, or special event.
- Notify the appropriate media/law enforcement via phone, email and/or fax in the event of an incident, lane and/or ramp closure, or delays
- Report all region's FTMS device failures to the appropriate maintenance staff
- Monitor the ATMS map, Traveler information system and internet travel times for accuracy

The STOC recently upgraded its video wall (see Figure 33) and is in the process of replacing its ATMS software. The new ATMS is expected to be implemented by the fall of 2016.

3.4.2 City of Madison Traffic Operations Center

The City of Madison has a workstation from which the agency can monitor city owned and operated CCTV cameras and traffic signal systems. The workstation consists of several monitors that display the City's CCTV camera feeds (see Figure 34).

Figure 34: City of Madison Traffic Operations Center

3.4.3 Dane County Public Safety Communications Center

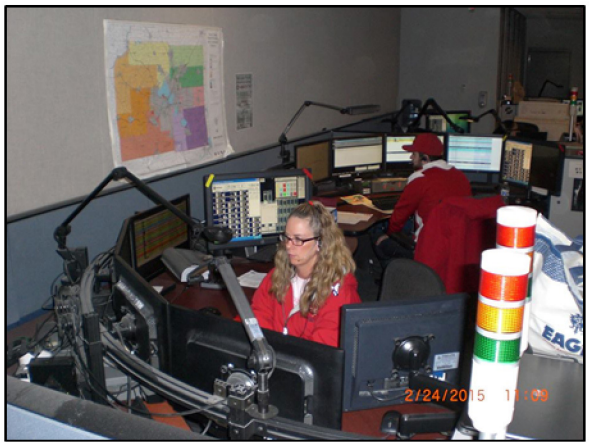
The Dane Public Safety Communications 9-1-1 Center is located in downtown Madison on the first floor of the City-County Building. The mission of the Center is to provide a fast, effective communications link between the citizens

of Dane County requesting public safety services and the public safety agencies charged with providing emergency and nonemergency services to those citizens. The 9-1-1 center operates 24 hours a day, 7 days a week and supports 85 agencies. The linked agencies primarily provide law enforcement, fire and EMS but also other services like animal control.

The center is approximately 2,900 square feet and is divided into the following 13 workstations.

- Madison law enforcement dispatch
- County law enforcement dispatch
- Madison fire and EMS dispatch
- County fire and EMS dispatch
- Madison data and records
- County data and records
- Parking and animals control (weekdays), call taking (weekend days) and Madison Police (evenings and nights) dispatch
- Telephone answering (five workstations)
- Shift supervisor

Figure 35: Dane County Public Safety Communications Center



Each workstation (see Figure 35) has computer and communications equipment that allows communicators to perform call taking, dispatch and records checking functions.

3.4.4 University of Wisconsin-Madison Communications Center

The UW-Madison Communications Center, operated by the UWPD provides emergency dispatch services for UW staff, students and visitors calling 911 from campus buildings. Dispatchers at the Center monitor radio traffic, alarms and the Center's video camera system. Dispatchers also coordinate response to campus alarms and lockouts from campus buildings. In 2014, the UWPD opened its new Emergency Operations Center (EOC) in the basement of the School of Nursing Building. The Center, which serves the west campus area, was funded through a grant received from the Department of Homeland security.

3.4.5 University of Wisconsin-Madison Traffic Operations & Safety (TOPS) Laboratory

In early summer 2003, the UW-Madison, in close coordination with WisDOT, took steps to form a laboratory to provide engineering-oriented services related to traffic operations and safety (TOPS) in Wisconsin and throughout the Midwest. The TOPS' mission is to "improve traffic operations and safety in Wisconsin and across the Midwest through a diverse balance of service partnerships, research and training." The TOPS Laboratory, based at the UW-Madison in the College of Engineering and the Department of Civil and Environmental Engineering, often works with public and private sector partners to achieve this mission. The initial, primary public sector partner, WisDOT, has been instrumental in the establishment of the TOPS Laboratory. TOPS Laboratory service areas include:

- Traditional TOPS engineering and technology/services development
- Traffic operations support services and knowledge management
- Transportation operations data management

The TOPS administers the WisTransPortal. This system provides centralized access to statewide TOPS data.

3.4.6 Metro Transit Computer Aided Dispatch System

Metro Transit's TransitMaster computer aided dispatch (CAD) system, manufactured by Trapeze Group, allows Metro Transit's dispatch operators to monitor and manage Metro Transit's vehicle fleet in real-time. The TransitMaster software

is designed to maximize dispatcher efficiency by providing data that are organized into key information and automatically coordinating real-time data by displaying highest priority to dispatchers. Furthermore, the software provides operators with fleet management, real-time AVL display, schedule adherence, event playback, emergency alarm monitoring, text messaging, incident reporting and off-line report generation.

3.4.7 Dane County Emergency Management

Dane County Emergency Management uses a combination of methods for alerting the public when a disaster strikes. The emergency warning system consists of multiple components, including:

- Outdoor sirens (owned and operated by the County). There are 134 outdoor warning sirens in the Dane County siren system. The County is responsible for testing and warning activation of all sirens. The primary activation point is the Dane County 911 Center, with backup capabilities in the County Emergency Management office.
- BAMBOX
- Reverse 911 system (emergency telephone notification)
- Smart phone wireless emergency alert system (EAS)
- E-mail, social media (Twitter and Facebook) and subscription-based messaging
- NOAA Weather Radio

3.5 Remote Traveler Support ITS Elements

Remote Traveler Support ITS Elements represent technologies used by travelers to access ITS services pre-trip and en-route. This includes technologies that are owned and operated by the traveler as well as technologies that are owned by transportation and information providers.

3.5.1 Wisconsin 511 (Phone and Website)

The country's traveler information number – 511 – was designated by the Federal Communications Commission in July 2000. Since its designation, most states have deployed 511 telephone services and in many cases, companion web sites to provide travelers with a variety of traveler related information including, but not limited to, construction, congestion and transit.

The Wisconsin 511 alerts provide travelers free, real-time traveler information. A service of the WisDOT, Wisconsin's 511 system is comprised of a website and telephony system. The Wisconsin 511 traveler information system is accessible on the web by visiting 511wi.gov and by calling 511 when in Wisconsin (or 866-511-WISC when out of state). 511 users have access to traffic and road conditions, road construction and lane closure, travel time, traffic incidents and other delays, as well as information of roadside services such as rest area locations. Both systems provide construction and road condition information for all freeways, major intercity highways and other heavily traveled routes.

The 511 system is available every day of the year. The website provides all of the information available through the phone system, plus maps detailing travel times and road conditions. Additional information is also available from roadway cameras and DMS.

WisDOT makes 511 traffic information available for third party providers to use upon request.

The 511 system provides information on:

- Major traffic issues and alerts
- Traffic conditions, camera images, speeds
- Work zones and construction reports
- Transit services
- Intercity bus and rail services
- Paratransit services
- Carpool and vanpool information
- Park-and-ride lot locations
- Airports and airport access services
- Ferries, tunnels and bridges
- Commercial vehicle (CV) information
- Bicycling

Traffic information is provided along the state highway network only. The information comes from many transportation and police agencies in Wisconsin and surrounding areas. Traffic management centers (TMCs) monitor and provide traffic conditions to the Wisconsin 511 system. At the center, staff receives highway conditions from law enforcement and transportation officials, FST operators, 911 calls, construction crews, traffic cameras and roadway sensors. Transit information comes from local transit providers.

3.5.2 Metro Transit Tracker Website

Metro Transit's Transit Tracker website provides estimated bus arrival times to transit users via the web or their smart phone. GPS and communication devices installed on Metro Transit buses provide the bus' location to the Metro Transit dispatch center, where it is then plotted to a map for easy viewing on Metro Transit's website. Users can also use their smart phones to obtain this information via mymetrobus.com/mobile, or alternatively they may opt into subscription based services that provide bus location and alerts via text or e-mail. In addition third party developers have developed systems to capture location data from the Metro Transit website and deliver it to users of third party developed mobile apps. Metro Transit is currently working with its AVL vendor to implement the availability, and hosting, of this transit service data in the GTFS-real-time format.

The availability of this service and the information it provides is making transit use more convenient for transit users and more attractive to those who may be considering it. Instead of waiting at transit shelters or transfer points for their buses, they can more effectively plan their arrival at the shelter/stop, reducing the time they need to wait for the bus. They can monitor their bus and arrive at the station just in time to board. This is especially beneficial for those patrons that have to wait in cold or inclement weather or when the patron has other activities to attend to which he or she would otherwise be interrupted by waiting for a bus.

3.5.3 University of Wisconsin Emergency Notification System (WiscAlerts)

WiscAlerts is UW–Madison's emergency notification system. The system, launched in 2008, provides information about an active emergency situation that requires the community to take immediate action in order to stay safe. The service is free, but users are responsible for normal short messaging service (SMS) charges from their cellular provider. WiscAlerts sends a consistent set of messages across a number of platforms in an effort to reach as many members of the campus community as possible and in as short an amount of time as possible. Depending on the exact nature of the situation, the system may utilize one or many of the components described below:

- Text messaging: UWPD will text subscribers in order to reach mobile users who may be away from their computers or offices. This is an opt-in service. Students, faculty and staff who have not yet enrolled in WiscAlerts-Text messaging can do so by logging into the My UW Portal and looking for the WiscAlerts logo or by visiting http://go.wisc.edu/wiscalerts.
- E-mail: WiscMail users may receive a mass e-mail warning message.
- Phone: Campus Centrex phone users are configured to receive a call with a recorded message providing information.

In all cases, more information will immediately be provided at www.wisc.edu.

3.5.4 Social Media

Over the last several years social media websites like Facebook and Twitter have played an important role in the dissemination of traveler information and the marketing of transportation agencies to the public. For example, WisDOT uses Twitter to send regional travelers information alerts to subscribers about incidents and severe road conditions. 511 Twitter currently consists of five different accounts, one for each region in the State of Wisconsin. With the growing interest in social media websites, this trend can be expected to continue and perhaps evolve as new innovations are developed. Recognizing this, many transportation, emergency and transit management agencies have established a social media presence using the aforementioned sites among others.

These sites have allowed these agencies to disseminate traveler information to users in a quick, cost effective manner. Not only have these sites allowed agencies to push information to users, but they have also enabled two-way communication between these agencies and the public providing these agencies a means to respond to the public's questions and concerns helping these agencies improve their relationship with the public. The benefits of social media in the Madison Metropolitan Area are often coupled with the benefits of other traditional means of disseminating traveler information and have broadened the reach of dissemination efforts to reach as many interested parties as possible using methods that are most often used by these parties.

3.5.5 Subscription Based Services

Subscription based services allow the public to opt-in to receiving traffic, transit and emergency alerts via text messaging and/or e-mail. These services often allow users to choose what types of information and alerts they would like to receive and times of day when they would like to receive them.

3.6 Communication Systems

3.6.1 Metropolitan Unified Fiber Network (MUFN)

The Metropolitan Unified Fiber Network (MUFN) is a public-private partnership to enhance capacity, affordability and access to broadband infrastructure. The partnership serves education, health, government and non-profit-organization anchor institutions in the Madison, Middleton and Monona area. It unifies and augments existing telecom resources to facilitate enhanced Internet, point-to-point connectivity and application sharing. The MUFN improves broadband access, economic development, public safety, education and community support programs. The MUFN was made possible through a $5.1 million grant provided by the Department of Commerce's National Telecommunications and Information Administration's (NTIA) in the first round of the Broadband Technologies Opportunities Program (BTOP) as part of the American Recovery and Reinvestment Act of 2009 (ARRA).

The Madison area organizations that comprise MUFN include:

- UW-Health (hospital & clinics, Med foundation, Medical School)
- Meriter Hospital
- Madison and Middleton municipal governments
- Madison Metropolitan, Monona Grove and Middleton-Cross Plains school districts
- Dane County
- South Central Library System
- UW-Madison
- Madison College (formerly MATC)
- State Lab of Hygiene
- UW Extension
- Geological and Natural History Survey
- DaneNet (28+ community groups serving seniors, low-income and vulnerable populations in Dane County)
- Xiocom / MadCity Broadband

The MUFN network includes over 110 miles of fiber-optic network in the greater Madison Metropolitan Area. This includes 1.8 miles of aerial fiber and 108.2 miles of underground fiber installed within the cities of Madison, Middleton, Monona, Fitchburg, the Village of Shorewood Hills and the townships of Madison, Middleton, Burke and Blooming Grove.

The MUFN project has enabled public and private entities to improve their broadband capacity by a factor of 10 to 100 times and improved affordability and access in the greater Madison Metropolitan Area to service public, business and residential groups. Additional information on the MUFN network, including policies on system connections using MUFN fiber network and management practices can be found on the MUFN website:

www.mufn.org/Policies.aspx

3.6.2 ITSNet

ITSNet is WisDOT's fiber network communication system of long longitudinal fiber located adjacent to major highway corridors. ITSNet used for ITS highway operations, traffic management and roadway security purposes. WisDOT is responsible for the physical maintenance of the fiber optic cable and it is shared with multiple divisions within DOT as well as several public agencies. ITSNet connects the major cities around the state, including Madison.

Public Safety Communications Systems

The WisDOT Division of State Patrol (DSP) owns and operates a VHF communication system. The system provides mobile voice communication services for the State Patrol and serves as the underlying transport mechanism for the statewide mobile data computer system used by over 150 local public safety organizations.

4 ITS USER NEEDS

4.1 Introduction

The first step to successful intelligent transportation system (ITS) deployment is the identification and proper consideration of transportation user needs (hereafter referred to as user needs). User needs specify the issues plaguing travelers and transportation operating agencies that may be satisfied through successful application of ITS elements. Identifying transportation user needs is important because they provide the foundation from which specific ITS operational strategies are formed and ultimately projects are developed to meet specified regional ITS goals and objectives. In other words, understanding user needs is a critical step for which future projects activities will be based. Firmly defining user needs early in the project helps reduce risks to schedule and budget that may have occurred from having to revisit this task.

The user needs that are identified in this chapter will be compared to the existing regional ITS asset inventory (see Chapter 3 – ITS Element Inventory) to determine the approach for ITS implementation and how new ITS elements can be meshed with existing ITS elements to meet regional transportation needs. In some cases, ITS may already be addressing some of the identified issues and needs, but perhaps not at a sufficient level and in other cases ITS may not be used at all. The strategic planning process also helps determine applications where ITS benefits can be maximized and is useful in setting project priorities. Therefore, the first step in developing a Regional ITS Strategic Plan for the Madison Metropolitan Area was to undergo a stakeholder driven process of identifying user needs and to understand the potential role that additional ITS investment could play in meeting those needs.

4.2 Purpose

This chapter summarizes user needs that may be remedied through application of ITS elements within the Madison Metropolitan Area. These needs were identified from discussions held with stakeholders and an extensive review of existing documentation. Discussions and questions directed at stakeholders focused on how ITS is used today and how it could be leveraged to enhance transportation within the region. Therefore, the results of this process (i.e., the identified user needs), do not focus solely on the planned or programmed projects for the region, but rather reflect a desired view of the role ITS could play in meeting regional needs. This “view” is broader in scope than what can be typically accomplished with tight transportation budgets, but provides the flexibility to implement projects in-line with National requirements, as funding becomes available. The user needs mentioned in the chapter will form the basis for more detailed discussion of potential projects and recommendations for project phasing.

4.3 Approach to Needs Identification

To identify user needs, the Project Team completed an intensive data collection effort. First, the team conducted a literature review of existing reports and studies for any previous statements of transportation system needs. Concurrent with literature collection and review, the Project Team conducted a User Needs Workshop to elicit needs from stakeholders. These efforts are further described below.

4.3.1 Review of Existing Documentation

The first step to identify user needs was a thorough review of existing documentation. Existing documentation provided the basic level of understanding of the transportation issues affecting the region. Existing sources of information that were reviewed and from which needs were identified include:

- MATPB Congestion Management Process (CMP) report
- MATPB's 2035 Regional Transportation Plan (RTP) Update for the Madison Metropolitan Area and Dane County
- Southwest Wisconsin ITS Architecture
- 2015-2019 Transportation Improvement Program (TIP) for the Madison Metropolitan Area and Dane County
- Wisconsin Traffic Operations Infrastructure Plan (TOIP)
- WisDOT Statewide ITS Infrastructure As-Built Plans
- 2013-2017 Transit Development Plan for the Madison Urban Area
- Statewide ITS Architecture/Turbo Architecture File
- City of Madison Transportation ITS Features Presentation
- Wisconsin 511 website
- Wisconsin TOPS Laboratory website
- Zoo Interchange Integrated Corridor Management System Operations Plan
- Wisconsin Statewide Freeway Ramp Control Plan
- Evaluation of Ramp Metering on Madison Beltline
- CARPC's 2010 Regional Trends
- City of Madison Parking Demand Management Study
- Beltline/Verona Road Adaptive Signal Control System Specifications

Needs collected from existing literature were brought forward into the planning for a stakeholder workshop and merged with needs elicited from stakeholders in attendance.

4.3.2 User Needs Workshop

On the afternoon of October 29th, 2014 a User Needs Workshop was conducted at the Union South Building on the campus of the UW, in the City of Madison. Stakeholders believed to have a role in, or possibly impacted by, ITS project implementation were invited to the workshop. The MATPB and the consultant team spearheaded the effort to identify stakeholders, and MATPB was responsible for inviting them to participate in development of the Regional ITS Strategic Plan. Stakeholder participation at the workshop included the following agencies:

- MATPB
- WisDOT, State Traffic Operations Center
- WisDOT, Southwest Region
- UW TOPS Laboratory
- Wisconsin State Patrol
- City of Madison Traffic Engineering
- City of Madison Parking Utility
- City of Madison Engineering
- City of Madison Metro Transit
- Union Cab
- Dane County Highway Department
- UW Transportation Services
- City of Madison Police Department
- SSTI
- City of Fitchburg Public Works Department

The Needs Workshop provided stakeholders with an overview of the project, including background and purpose, as well as an overview of the plan process and schedule, a brief understanding of ITS and its role. The consultant team walked stakeholders through a series of operational scenarios involving situations pertinent to the region. Stakeholders were asked a series of questions that were aimed at identifying needs affecting travel and operations within the region. The needs identified through this process are detailed in the following section.

4.4 Summary of Transportation User Needs

The following section identifies and describes the Madison Metropolitan Area's transportation user needs. User needs are categorized into high-level functional areas and sub areas to begin the process of mapping them to the National ITS Architecture – a nationally accepted and proven approach for defining possibilities for system integration for regions like the Madison Metropolitan Area. The high-level functional areas are as follows:

- Archived Data Management & Communication
- Public Transportation
- Traveler Information
- Traffic Management
- Vehicle Safety
- Emergency Management
- Maintenance and Construction Management (MCM)
- Other (non-classified)

The needs specific to each of these areas are further categorized into subareas within Table 12. These sub areas begin to map the needs to potential ITS solutions. Needs that fall into the "Other, non-classified" area represent transportation user needs that were identified but do not map directly to one of the ITS service areas defined by the National ITS Architecture. These needs are preserved here and should be considered for mapping whenever the National ITS Architecture is updated.

Following Table 12, each user need is defined in greater detail.

Table 12

Madison Metropolitan Area User Needs Mapped to National ITS Transportation Service Areas and Subareas

Service Area	Service Sub Area	Identified User Needs	
Archived Data Management & Communication	ITS Data Warehouse	AD1	Integrate and share data collected by multiple regional agencies to improve regional and individual agency operations.
		AD2	Improve regional data collection and make it more user friendly so that data can be easily used to monitor and establish performance measures.
		AD3	Identify/standardize data collection platforms and establish protocols to improve the exchange of information and data between existing and unique software platforms.
	Other (Non-Classified)	AD4	Collect and share bicycle origin-destination information to better plan and locate bicycle infrastructure.

Service Area	Service Sub Area	Identified User Needs	
Public Transportation	Transit Vehicle Tracking	PT1	Increase the processing speed and frequency of bus automatic vehicle location data so that transit vehicle arrival information is more accurate and timely.
	Transit Traveler Information	PT2	Collect and disseminate on-board bike rack availability in real-time and share this information with transit users prior to boarding.
		PT3	Expand the number of locations that have real-time information signs.
	Transit Passenger Counting	PT4	Collect bus-stop level boarding and alighting data and disseminate this information, in real-time, to transit users prior to boarding.
	Multi-modal Connection Protection	PT5	Improve the interconnectivity of transit services and routes and information about them.
	Other (Non-Classified)	PT6	Promote transit benefits to the traveling public to increase awareness and ridership.
		PT7	Enhance the transit traveler experience (i.e., increase the number of transit express routes).
Traveler Information	Interactive Traveler Information	TI1	Use social media, apps, text alerts and subscription based messaging to make traveler information more accessible and user friendly.
		TI2	Enhance the Game Day app by including additional types of static and dynamic traveler information (i.e., parking information, bikeshare stations, etc.).
		TI3	Provide information on where bicyclists can park their bikes or where they can meet a bike valet.
		TI4	Provide airport information at select locations in downtown Madison.
		TI5	Establish public/private partnerships to provide travelers with enhanced traveler information both pre-trip and en-route. Private entities such as Google, Waze and others can be effective means to push information to public users. Private agencies can provide these users with regional information to improve delivery of traveler information.
		TI6	Provide predictive traveler information to users based on historical data (e.g., parking and bicycle availability).
		TI7	Integrate additional types of information into the statewide 511 system (e.g., park and ride lots, parking ramps, bikeshare locations, etc.).
	Dynamic Route Guidance	TI8	Provide advance route planning and guidance based on real-time conditions. Specific needs include providing parking information while en-route to reduce traffic demand associated with motorists seeking available parking.
	ISP Based Trip Planning and Route Guidance	TI9	Establish systems that allow users to pre-pay for and reserve parking in advance of a trip.
	Transportation Operations Data Sharing	TI10	Improve multi-agency communication and data sharing during active incidents.
		TI11	Provide/expand multi-agency access and control of regional traffic cameras.
		TI12	Improve the speed by which agencies exchange information among each other and with the public.
	Dynamic Ridesharing	TI13	Establish systems that match users seeking to reserve a bike with available bikeshare services.
		TI14	Disseminate information on the available modes of travel within downtown Madison at selected other locations (special event venues) to improve trip reliability and reduce demand on the transportation network.
	Other (Non-Classified)	TI15	Improve awareness/guidance of one-way routes (directionality of travel) to reduce circulation on downtown streets.
		TI16	Provide information on when pedestrian congestion can be expected (e.g., when classes end, etc.).
		TI17	Use of social media and smartphones to deliver timely traveler information.

Service Area	Service Sub Area	Identified User Needs	
Traffic Management	Network Surveillance	TM1	Maximize the use of existing systems that may provide additional information and data that might benefit other agencies. (e.g., Video from cameras installed on buses).
		TM2	Expand/improve coverage of existing camera system to improve situational awareness.
		TM3	Detect and count bicycles to improve regional planning efforts.
		TM4	Expand camera coverage to include the UW campus and integrate camera feeds into the larger regional camera network.
	Traffic Signal Control	TM5	Accommodate the needs of bicyclists, pedestrians and persons with disabilities at signalized intersections so these groups can safely traverse the intersection (i.e., extend signal timing when these groups are detected within the intersection).
		TM6	Maintain the integrity of the transportation system for transit, bicyclists and pedestrians during periods of automobile congestion.
		TM7	Detect the presence of bicyclists and pedestrians waiting at signalized intersections and when detected provide visual notification to automobiles and bicyclists of their presence.
		TM8	Improve traffic signal timing for bicyclists to maintain progression along key bicycle corridors.
		TM9	Automatically detect traffic signal equipment malfunctions.
		TM10	Improve the progression of all modes (automobiles, transit, bicycles) along primary transportation corridors, regardless of jurisdictional control/ responsibility.
		TM11	Improve traffic signal operations so that they are more responsive to traffic during unexpected incidents and conditions.
		TM12	Extend fiber-optic communications to additional traffic signals to improve connectivity with signals already on the network.
		TM13	Increase agency staffing levels or use other agency staff to cover operations during weekends/nights/special events.
		TM14	Travel time collection in automated formats to provide performance measures and assist in planning efforts
	Traffic Information Dissemination	TM15	Enhance the dissemination of airport-related information on interstate routes leading to the airport.
		TM16	Provide smaller DMS along roadways on campus to help non-familiar drivers navigate to parking.
		TM17	Provide shuttle information upstream of special events to lessen traffic demand.
	Regional Traffic Management	TM18	Manage traffic during incidents and identify possible alternate routes (e.g., integrated corridor management).
	Traffic Incident Management System	TM19	Improve traffic incident management planning and response coordination at known trouble spots within the region (e.g., Beltline, other major arterials).
		TM20	Provide the Statewide Traffic Operations Center (STOC) with real-time information including the estimated duration of road closures due to traffic incidents.
		TM21	Foster/build relationships among emergency response and municipal agencies to improve regional emergency/traffic response.
		TM22	Provide Automatic notification from dispatch centers to Traffic Operations Managers within the region. Improve communication and situational awareness for Traffic managers, especially as it relates to impacts and operations of Arterial System
	Parking Facility Management	TM23	Provide advance notification (pre-trip and en-route) of parking availability, via web, apps, and/or roadside signage (hybrid DMS).
	Regional Parking Management	TM24	Implement parking demand management incentives/disincentives (e.g., variable pricing) for parking during events/periods of high demand.
		TM25	Improve the dissemination of parking related information and possibly seek involvement with the media or private 3rd parties (Google, Waze, etc.).

Service Area	Service Sub Area	Identified User Needs	
	Variable Speed Limits	TM26	Improve safety by managing/harmonizing traffic speeds heading into traffic queues.
	Mixed Use Warning Systems	TM27	Balance bicycle and pedestrian mobility and safety with that of automobile traffic.
	Other (Non-Classified)	TM28	Expand parking at the airport or promote transit to reduce parking demand.
		TM29	Increase the availability of bikeshare systems and promote their availability.
		TM30	Collect traffic and bicycle count information more often and at additional locations through automated methods (e.g., annual updates).
Vehicle Safety	Automated Vehicle Operations	VS1	Take steps to plan for driverless cars.
Emergency Management	Emergency Call-Taking and Dispatch	EM1	Integrate CAD/radio communications platforms so that multiple agencies can communicate effectively.
		EM2	Integrate camera feeds into the regional Emergency Operations Center (EOC).
		EM3	Improve emergency management coordination, especially around jurisdictional boundaries.
	Wide Area Alert	EM4	Alert residents of future winter weather events so they can remove their vehicles from the streets before snow falls and roads need to be plowed.
Maintenance and Construction Management	Weather Information Processing and Distribution	MC1	Improve the dissemination of existing Road Weather Information System (RWIS) data to regional agencies.
	Winter Maintenance	MC2	Improve sidewalk maintenance (especially during snow events) to improve accessibility to bus stops.
		MC3	Use existing vehicles as probes to collect and disseminate data back to the EOC.
		MC4	Monitor the application/application rate of materials stored on maintenance vehicles to maximize their use and to apply materials where they are most needed.
		MC5	Expand weather collection information for Arterial Corridors
	Maintenance and Construction Activity Coordination	MC6	Collect and provide real-time information related to campus construction events.
		MC7	Improve coordination with other construction projects to piggyback on their efforts or to be more strategic in implementing projects.
		MC8	Provide information on road closures on Arterial Streets, ideally this could be incorporated into one location for the region
Other	NA	OT1	Identify, through regional self-evaluation, a framework to improve the effectiveness of regional transportation system management and operations (TSMO) activities (i.e., implement and use a capability maturity model for building upon existing TSMO efforts).
		OT2	Train staff so that they have the knowledge/skills/abilities to analyze data and improve operations (e.g., STOC operators need additional understanding of regional agencies and events so they can assist in regional operations).
		OT3	Implement environmentally friendly improvements.
		OT4	Promote understanding and awareness of existing technologies and make information available to agencies within the region.
		OT5	Promote greater understanding of ITS within the region.

4.4.1 Archived Data Management and Communication Needs

Transportation technologies have the potential to produce significant amounts of information and data. As the number and sophistication of ITS technology grows, so too will the need to effectively manage the data generated by them. This is especially true for connected vehicle deployment which calls for automobiles to be equipped with advanced technologies that talk and exchange information and data with other vehicles and roadside infrastructure. This may produce a situation where every vehicle that uses the transportation system will become a potential source of information that needs to be collected and stored.

Today, many agencies that own and operate ITS elements within the Madison Metropolitan Area collect information from the elements they own, and use this information and data primarily for their own internal purposes. This working arrangement may not be the most desirable solution in terms of maximizing the value of collected data or for maximizing tax payer investment in systems that collect or generate this information. In many cases, multiple agencies may have a need for certain types of data that an individual agency is collecting. Furthermore, without taking steps to integrate data archives, multiple public agencies may implement redundant technologies to collect similar types of data. Stakeholder needs that fall into this category focus on integrating regional data collection efforts so that collected data can be shared and used more effectively among multiple agencies. This will maximize the value of collected data and the systems that generate this information, while helping to establish a common baseline from which agencies can base operational decisions and gauge performance of regional ITS investment.

ITS Data Warehouse

Agencies expressed a need to improve the manner in which they collect and exchange information and data. Agencies collect information and data that may benefit other agencies, but outside agencies do not know that this information exists and are therefore unable to benefit from it. Agencies also expressed a need to standardize data collection platforms and establish protocols in a proactive means to ensure that as many agencies as possible can benefit from the data collected. To fully integrate ITS systems and information, it is necessary that agencies migrate to standardized computing platforms. While it may not be practical or economical to replace existing systems with standardized ones prior to the time existing equipment reaches its designed life span, agencies should work to identify existing platforms and identify an approach for migrating toward a common platform.

Agencies would also like to make collected data more user friendly so that it can be more easily interpreted by existing staff and used in regional performance monitoring efforts. Data archiving efforts should seek platforms that make it easier to view and interpret data. Dashboard views that collect and present information and data in meaningful ways will benefit agency operations.

Other

Stakeholders identified a need to collect and share bicycle travel data including origin-destination and bicycle count information, to help plan and locate bicycle infrastructure and to determine where safety concerns exist. Bicycle traffic and origin and destination information can provide insights into where it is most advantageous to implement bicycle improvements/services (e.g., bike share stations, bike paths, etc.) and for prioritizing safety improvements.

4.4.2 Public Transportation Needs

Travel in and around the downtown Madison area is often made difficult due to lack of roadway capacity and geographic constraints that limit available routes to reach the downtown and the UW campus. To reduce travel demand, it is clear that solutions will need to focus on maximizing person throughput while at the same minimizing traffic demand in the area. To make public transportation more appealing the transit user needs additional information so he/she can better plan his/her trips. Additionally, stakeholders seek to improve the accuracy and timeliness of information provided to the public to increase confidence in public transportation systems. Needs that pertain to this functional area are described in greater detail in the following sections.

Transit Vehicle Tracking

In an effort to make transit information more timely and convenient for transit users and to help maintain on-time performance, transit agencies desire to improve the reporting speed of transit vehicle location information. For example, Metro Transit currently collects transit vehicle location information, which is updated on a per minute basis. While adequate for existing operations, stakeholders indicated that reporting on a more frequent basis (e.g., every second to every ten seconds, depending the ability to collect, store and process additional amounts of data) would improve the accuracy of real-time information collected by operators and provided to transit users. This may improve public perception and confidence of regional transit and may work towards increasing ridership.

Transit Traveler Information

There is a need to provide additional types of traveler information to transit users in an effort to make riding transit more convenient and to encourage trip chaining with other, non-motorized forms of transportation. Bicycle use is prevalent in and around downtown Madison and on the UW campus, and a specific need cited by stakeholders was disseminating real-time on-board bike rack availability information. Providing this information to transit users either at transit shelters or via personal communication devices may make trip planning more convenient for bicyclists seeking to use transit.

Transit Passenger Counting

On-board passenger boarding and alighting counting systems are needed to gain a better understanding of transit ridership and to make better investment and operational decisions. With accurate ridership information, transit agencies can allocate funding or other assets to routes that have the greatest need for improvement and/or the highest ridership levels. For day-to-day operations, real-time ridership and passenger loading information may be used to coordinate activities and assets with partner transit agencies in an effort to deliver timely services to the public when vehicles unexpectedly break down or are being repaired. Accurate passenger count information at the bus stop level can also be used in performance monitoring programs to demonstrate to decision makers that more funding is needed for transit projects that have successfully increased ridership.

Real-time passenger boarding and alighting count information may also serve to improve pre-trip transit planning if disseminated to potential transit users. This information can allow users to make decisions whether or not to take transit during periods of high demand; when seating may not be available or significantly limited. In turn, this information can shift excess transit demand to other travel modes or to other times of day. Indirectly, this will provide transit users with more control in planning their trips and will improve the transit trip experience.

Multi-modal Connection Protection

To make transit a more appealing travel option to existing and potential riders, stakeholders desire to improve transit service reliability, especially for those that have to make connections to other routes or other modes. To this extent, pre-trip and en-route users need access to information regarding their connections so they can make more informed decisions regarding their trip. Transit operators also need real-time schedule and operations information so that they can protect connections when running with a minor delay. This will help users make their connections, improving the perception and reliability of transit.

Other (Non-classified)

Other public transportation needs that do not specifically map to an identified ITS functional area include promoting the benefits of public transportation and improving existing operations to make riding transit more convenient. While ITS elements do not directly promote public transportation, ITS can be used to monitor operations and provide information that can be used to assess the performance of specific improvements. This information can then be communicated to the public and decision makers to market the benefits transit investments. Furthermore, ITS elements, including

on-board transit vehicle signage, can be used to promote the benefits of transit and/or transit related improvements alongside existing revenue generating advertising campaigns.

4.4.3 Traveler Information Needs

ITS equipment has the significant potential to enhance travel safety and efficiency. Equipment including but not limited to DMS, highway advisory radio (HAR) and websites are currently being used and have proven beneficial. A common theme among the identified issues, problems and needs in this category is making information readily and easily available to a diverse set of travelers. Currently, regional agencies employ a number of systems for collecting, processing and integrating data and for disseminating information to travelers. However, these systems are not integrated and may require that the public visit multiple sites to obtain the information needed to plan their trips. Integrating additional types of information for various modes into a single repository may address traveler information needs. Also, employing additional tools that deliver traveler information to users using methods these users already use may represent an inexpensive but effective means to provide traveler information. Specific traveler information needs identified are discussed in greater detail below.

Interactive Traveler Information

Stakeholders have a desire to improve the types of information and the methods of communication used to disseminate travel information to the public. This information includes, both static and dynamic information specific to parking availability and cost (on-street, off-street, park-and-ride), bikeshare, transit and the airport. The Wisconsin Statewide 511 system is an already established traveler information system and stakeholders desire to expand the content of this system to provide these additional types of information. This will make the system more robust and a one-stop source for disseminating real-time, multi-modal traveler information for the Madison Metropolitan Area.

Over the last several years social media websites like Facebook and Twitter have also played an important role in the dissemination of traveler information and for marketing public agency services to the public. With the growing interest in and use of social media, this trend can be expected to continue albeit the specific websites used may change in popularity with the public. Regardless of the specific sites used, the use of social media is a quick, user friendly and cost effective means to disseminate information to the public. Recognizing this, regional stakeholders would like to explore and leverage social media outlets to disseminate traveler information to the public.

Similar to social media, stakeholders indicated that subscription based traveler information services may also serve to alert the public to changes in travel conditions. These services allow the user to opt-in to receiving alerts by pre-registering and selecting the types of information they would like to receive. Furthermore, 3rd party information service providers (ISP) (e.g., Waze, Google, etc.) may be leveraged to push traveler information via personal computing devices.

Dynamic Route Guidance

This need area is similar to the Interactive traveler information service area, but providing the additional sophistication of taking into account real-time conditions in tailoring traveler information based on real-time conditions and the traveler's current position. Advanced route planning and guidance that is responsive to current conditions may assist en-route travelers in accessing desired transportation services and for navigating the transportation network more effectively. For example, stakeholders desire to match available parking information with drivers seeking available parking to limit time spent to find available parking and to reduce traffic demand circulating parking structures. Similarly, information may be provided to transit users to find bike share stations that have bicycles available for rent.

ISP Based Trip Planning and Route Guidance

The lack of available parking, while not the sole reason, contributes to congestion in downtown Madison. For this reason, stakeholders desire systems that allow users to pre-pay for and reserve parking in advance of making a trip. These systems will reduce the time users spend circulating downtown streets in order to finding available parking which will improve travel time reliability, reduce congestion near parking facilities and improve user satisfaction and convenience.

Transportation Operations Data Sharing

There is a need to make real-time transportation operations data available to transportation system operators so that they can manage their individual systems based on an overall view of the regional transportation network. Rather than a data archive, this transportation service area would facilitate the collection and dissemination of multi-agency, real-time data through a single information service (e.g., advanced traffic management or 511 system).

Dynamic Ridesharing

Matching travelers to available travel options based on real-time information will help improve trip reliability, reduce demand on the transportation network and enhance the travel experience. Travelers should have the capability to find travel options and to make trip plans based on their current location and desired destination, in real-time. Locations that should be targeted for providing this information include Downtown and special event venues. This service could be extended to match potential bicyclists to available bike share services, including stations that have available bicycles or bicycle valets.

Other (Non-classified)

Stakeholders have a need to improve awareness/guidance of one-way routes (directionality of travel) to reduce circulation on downtown streets. This need applies mainly to the unfamiliar traveler so that they know which one way streets they need to take to effectively and efficiently travel to their destination. Without active guidance, unfamiliar drivers often must circulate along one-way streets to navigate to their destination. The additional time needed to determine the correct one-way street to take results in additional traffic demand being placed on the transportation network which in turns increases the incidence of congestion.

Stakeholders also expressed the need to provide travelers with information on when higher than normal pedestrian congestion can be expected (e.g., when classes let out) to limit pedestrian/automobile interaction on campus.

4.4.4 Traffic Management Needs

Traffic management needs focus on the ability to detect and respond to traffic conditions as they are occur. System operators need access to accurate, real-time information to make more informed operational decisions. In some instances, this means deploying or enhancing additional ITS infrastructure and in other cases it means sharing information that is currently collected so that is can be used more efficiently to improve regional transportation operations. Specific traffic management needs are discussed in greater depth below.

Network Surveillance

Existing CCTV camera coverage within the region should be expanded to improve situational awareness of conditions occurring on the transportation network. Furthermore, cameras need to be implemented to monitor roadways on the University of Madison campus. These improvements will allow operators to monitor additional roadways within the region and to implement an appropriate response to incidents versus having to rely and confirm eyewitness accounts. Stakeholders indicated a need and willingness to share video or video images with other agencies to improve operations and emergency response.

While network surveillance applies primarily to devices installed in the field, there are other applications that can supplement these devices. For example, cameras are installed on Metro Transit vehicles and can be used as probe information since one of the cameras is oriented facing outward from the vehicle cab. Stakeholders desire to use these cameras as a means to make more informed decisions regarding operations when incidents occur. These cameras may be used to monitor environmental and roadway conditions and incidents (e.g., crashes) immediately outside the transit vehicle. For instance, cameras may be controlled by an operator at a transit management center to determine the extent and nature of incidents and based on these visual observations make more informed decisions regarding whether or not to implement temporary changes to fixed route operations, or to cease operation (in case of severe weather).

Traffic Signal Control

Traffic signal operations need to balance the needs of various users that travel through the signalized intersection during normal conditions as well as periods of unusual congestion due to events or other incidents. This includes automobiles, bicyclists, abled pedestrians and pedestrians with disabilities. Traffic signal control improvements are also needed to better manage the flow of traffic between Madison's central business district and the freeway. There are just a few arterials that provide direct access to the freeway. Signalized operations need to be improved along these routes to provide efficient flow and improve safety.

Traffic Information Dissemination

Non-familiar drivers need real-time, en-route information on parking availability in and around campus and downtown Madison. This group of drivers, as well as familiar drivers, also need advance notification of available shuttle information that can take them from remote lots to special event venues. Stakeholders cited the possibility of using smaller scale DMS signs to meet these needs.

Stakeholders also stated the need to provide en-route travelers with dynamic airport information in advance of the airport. Interstate DMS located in advance of the airport was considered a viable means to communicate this information to airport travelers.

Regional Traffic Management

When incidents and/or weather events occur, particularly those that are unexpected, operations along signalized corridors can be adversely impacted. Impacts may be further exasperated if they overlap jurisdictional boundaries. ITS technologies implemented in the region should focus on mitigating the adverse impacts of unexpected incidents at signalized intersections and along arterial corridors so as to minimize the impacts that these incidents/events have on congestion and corridor progression. Technologies that give traffic signals greater flexibility to address incidents in real-time are desired. Furthermore, these technologies should attempt to improve or balance progression of all modes of transportation along equipped corridors. Improvements should span and overlap jurisdictional boundaries.

Traffic Incident Management System

This need area aligns closely with emergency management needs discussed below. While the emergency management need area focuses on improving the speed of emergency response so that individuals involved in incidents can receive more timely medical treatment, this area focuses primarily on mitigating the impact that traffic incidents have on the transportation network so that additional incidents do not occur and to minimize the impact incidents have on regional mobility. Stakeholders, seek to identify locations that are known trouble spots (e.g., Beltline and key arterials) and to develop an appropriate response in coordination with multiple agencies to improve traffic operations when incidents at these locations occur. To that extent, stakeholders seek to develop alternate route plans so traffic can keep moving. Furthermore, stakeholders desire to build relationships with both local and statewide agencies to disseminate information to the public as quickly as possible. Multi-agency integration for meeting this need area may occur, either

now or in the future, though a common CAD software platform. Furthermore, traffic incident management software needs to be improved to automate responses as much as possible and to allow operators to attend to more pressing tasks.

Parking Facility Management

Information related to parking space availability is desired to limit the time needed to find available parking. Traditionally, commuters find out that a lot or garage is full only after they arrive at the respective facility. Access to this information before or during a trip will allow the commuter to navigate to parking facilities with available parking before arriving at the full facility. This information makes it easier and more convenient for automobile users to park their vehicles while reducing traffic demand that would otherwise occur if this information was not made available and traffic had to navigate between parking facilities.

Stakeholders desire technologies that may be used to detect parking space occupancy and that can communicate to the automobile drivers but pre-trip and en-route. These technologies include but may not be limited to the internet, smartphone applications and/or roadside signage. Stakeholders are also open to sharing parking information with the media and private 3rd parties (e.g., Google, Waze, etc.) to get this into traveler information streams/devices that may be easily accessible and already being used by motorists.

Regional Parking Management

Incentives/disincentives such as raising or lowering the cost of parking was offered as a potential strategy for balancing parking demand among parking facilities and for ensuring that motorists can always have access to parking located nearby their intended destinations. Parking incentives/disincentives was also viewed as a possible means to shift event driven traffic demand to locations further away from the special event venue or to implement travel demand management program policies.

Variable Speed Limit System

The onset of congestion increases the chance for incidents to occur as motorists approach the back of the traffic queue. This is because motorists are expected to change driving behavior rapidly and with little advance notification. Variable speeds limits are needed upstream of locations where congestion is known to frequently occur to improve safety and reduce the impact that these types of incidents have on operations. When congestion does occur, variable speed limits can be activated either manually or automatically to smooth vehicle speeds heading into the congested segment.

Mixed Use Warning Systems

Due to the relative large number of bicyclists and pedestrians that interact with automobile traffic in and around downtown Madison and the UW campus, special technologies are needed to sense these groups and warn automobile traffic to their presence. These technologies can provide advance warning to the driver and increase safety for bicyclists and pedestrians.

Other (Non-Classified)

To plan for the growth and interconnectivity of sophisticated traffic management applications, such as adaptive traffic signals and cameras, stakeholders desire to extend the existing fiber communication network to cover additional traffic signals and roadways. Additional fiber optic cable will also help the region to keep up with the intensive data transmission needs expected with the pending roll-out of connected vehicle applications and technologies and will provide additional capacity to allow the regional ITS to grow over time.

Other traffic management related needs expressed by stakeholders that do not fit within one of the sub areas above, are noted below:

- Increase agency staffing levels or use other agency staff to monitor operations and implement appropriate strategies during weekend/nights/special events.
- Expand parking at the airport and/or promote transit to reduce demand for existing parking capacity.
- Increase the availability of bike share systems and promote their availability to help offset traffic demand and encourage non-motorized transportation.

4.4.5 Vehicle Safety Needs

Vehicle safety needs citied by stakeholders pertain directly to connected and autonomous vehicle technologies. The need and desire to implement these technologies are gaining momentum among transportation and ITS professionals nationally. Other states and regions have started to test these technologies through pilot programs. While still years away, the need exists to consider how ITS applications available today will interface with these new technologies in the future. Any planned implementation of ITS projects in the short- to mid-term should support and lay the foundation for connected and autonomous vehicles where practicable and applicable, while remaining cognizant that these technologies are years away from being mainstreamed and can evolve rapidly.

Automated Vehicle Operations

Stakeholders identified a general need to monitor developments in the connected and autonomous vehicle arena and take steps to plan for these technologies as they become more mainstream. Specific applications were not mentioned; however, one-on-one interviews with stakeholders suggest that there is interest among some agencies in demonstrating the benefits of these technologies through pilot projects within the region. This interest parallels interest among other jurisdictions and agencies within the state. This need will likely evolve with the research and developments made to connected and autonomous vehicle technologies and applications.

4.4.6 Emergency Management Needs

Public safety, emergency management and other allied emergency entities that support incident management response need to collect, compile and analyze data in real-time and in a timely manner to initiate a quick and effective response to incidents. Because time to complete these actions is of critical importance to those involved in incidents, the need to collect and then disseminate information to emergency responders can be impeded by the number of systems the emergency operator must manage to complete these activities. Therefore, emergency management needs expressed by stakeholders focus primarily on integrating computing and communications platforms to simplify workload and ease communication.

Emergency Call-taking and Dispatch

Transportation, law enforcement, fire and emergency management agencies operating within the Madison Metropolitan Area realize that significant improvements to incident detection, preparation and response can be made when information and data are shared across organizations. Presently, these agencies rely on various types of advanced traffic management systems to help manage mobility, congestion and incident response. Furthermore, many of these agencies have deployed an extensive network of remote cameras, traffic sensing equipment and other ITS devices that assist traffic and emergency management functions. These systems are primarily operated independently of each other with little sharing among agencies. Stakeholders have a need to integrate ITS equipment and CAD/radio platforms so that the operations of each agency can benefit from the information and data being collected by other agencies. For example, when an incident occurs notification to other impacted agencies needs to automatically occur so that a multi-agency coordinated response can occur.

Wide Area Alert

Snow removal during moderate to heavy snow events is made more difficult when snow plows must navigate around vehicles parked along city streets. Not only are operations made more difficult, but the effectiveness of snow removal is diminished as well. Stakeholders indicated that they need to alert residents in advance of snow storms so that they residents can move their cars from city streets.

4.4.7 Maintenance and Construction Management (MCM) Needs

Weather can significantly affect transportation operations and traveler safety in the Madison Metropolitan Area. Weather can also make transportation less convenient and could erode the attractiveness of non-motorized travel and transit. Maintenance supervisors need accurate, real-time weather and road condition data to proactively develop and implement appropriate strategies for prevailing weather and pavement conditions. MCM needs primarily focus on approaches to plan, identify and alert the public and other agencies to maintenance and construction activities and needs. Specific MCM needs are presented in the following sections.

Weather Information Processing and Distribution

To support wide area alerting of winter weather, stakeholders stated a need to integrate weather information with existing maintenance decision support systems (MDSS) so that they have the information from which to make accurate weather forecasts. Winter weather information is needed both prior to the storm (forecast) and real-time. Real-time weather information from roadway weather information systems (RWIS) and in pavement sensors are desired and need to be shared among agencies responsible for winter weather maintenance operations and to other agencies that have a need or desire to analyze this data.

Winter Maintenance

Significant effort and resources are often applied and used to treat snow and ice covered roadways. These resources include; maintenance staff (time and wages), snowplows and chemicals or other materials (sand and salt) used to treat roadways. In many cases, these resources can be used more effectively. For instance, snowplow operators may treat roadways based on visual observations in the field and/or correspondence with other drivers. This method lends itself to over-treating segments of roadways and undertreating others. There is a need to improve the tracking of maintenance vehicles and the use of chemicals and other materials used to treat roadways. Meeting this need will result in operators positioning resources where they are needed most based on historical vehicle movement data and real-time conditions. This tracking of materials would also help in developing benefit cost analysis of various strategies and providing more compelling data for budgets and soliciting funds.

Stakeholders also indicated that city/state vehicles can be equipped with surveillance and sensing equipment and used as probes to collect and disseminate data back to central location/facility. Additionally, city streets can be outfitted with in pavement sensors to collect and transmit pavement surface conditions.

Currently, Metro Transit vehicles are equipped with outward facing cameras that could be used to remotely monitor field conditions in real-time; however, the cameras are only capable of recording video to on-board storage devices and are fixed in position, but enhancements may be made to enable desired functionality. Remote video monitoring and control of cameras located on Metro Transit buses (or other city owned vehicles) may help to identify non-roadway winter maintenance needs such as sidewalks with heavy snow accumulation located adjacent to transit shelters. If winter maintenance response extended to bus shelters, it may make public transportation more accessible or convenient to riders.

Maintenance and Construction Activity Coordination

On-going or planned construction activity may serve as ideal occasions to implement ITS technologies, assuming that the corresponding infrastructure is in place to immediately use ITS technologies once they are installed. To this extent, it may be sensible to give programmed projects a higher priority for implementation if they can be coordinated with on-going or planned construction activities associated with other projects. This may reduce the combined cost of the two separate construction efforts while reducing the overall impact or duration of construction activity on the public. For these reasons, stakeholders would like to take steps to coordinate ITS implementation with construction activity as practice and feasible.

Stakeholders have an immediate need to share UW campus construction activities with surrounding communities and vice versa so that traffic management strategies that are implemented by surrounding communities do not conflict with maintenance and construction activities of an adjacent jurisdiction. To this end, a desired improvement would be to provide a map that shows on-going, multi-jurisdictional construction activity where additional details about construction activity can be easily obtained. This effort is expected to improve regional and corridor operations and improve the dissemination of construction based traveler information to the public.

4.4.8 Other Needs

Stakeholders identified several needs that lie on the periphery of ITS activity that do not fall directly within one of the aforementioned high-level ITS functional areas. These needs also do not map directly to a specific technology but may be taken into consideration when planning for and ensuring the success of ITS improvements. These needs include:

- Promoting greater understanding and awareness of the benefits of a regional ITS and the various technologies that fall under this umbrella. This should include updating agencies on regional ITS efforts when they occur and as early as possible so that multi-agency integration opportunities can be explored before systems are planned, designed and implemented.
- Implementing environmental friendly improvements. No specific applications where mentioned, but generally ITS strategies that promote the use of non-motorized or transit can meet this need. Additionally, ITS strategies that improve progression and reduce delay can reduce fuel consumption and vehicle emissions released into the environment. These types of improvements may be candidates for receiving greater weight during the project development, recommendation and prioritization stage.
- Training transportation operators so that they have the knowledge, skills and abilities to analyze data and implement innovative strategies as they become more prevalent within the region. This need extends to operators working in centers located outside the region, but who are responsible for operating systems located within the region. These operators need additional training to become familiar with the region and intricacies of the transportation network so they can take leadership roles in regional operations.
- Identifying through regional self-evaluation, a framework to improve the effectiveness of regional TSMO activities. Stakeholders would like to build momentum for building upon past, present and future ITS related activities so that knowledge is retained and expanded upon, in an interactive fashion, to develop a fully functional and integrated regional ITS.

5 ITS VISION, GOALS, OBJECTIVES AND PERFORMANCE MEASURES

Understanding what an intelligent transportation system (ITS) is, let alone how ITS deployment should occur, is often difficult when undertaken in a single step. Developing this understanding is best completed in a series of small, manageable steps. The first of these steps was documented in the previous two chapters, where an understanding of Madison's existing ITS inventory and User Needs was documented. This Chapter builds upon that work and begins to define how existing ITS elements can be leveraged and new ITS elements integrated to satisfy user needs.

Although the Vision for ITS in the Madison Metropolitan Area is predominantly based on user needs, it must also embrace the outcome of existing local and statewide planning. In other words, this plan should not stand alone from other existing plans, but rather should embrace and, ultimately, build from them. Such an approach – which aligns the Madison ITS Vision with other regional and statewide plans – not only ensures that ITS projects proposed for the region help satisfy regional and statewide transportation goals, but also makes it easier to secure funding for ITS projects. This is attributed to the fact that the Madison Region must compete for funding with other projects in the region and state and will be viewed more favorably if multiple goals and objectives are satisfied.

Therefore, state and regional transportation goals and objectives were considered alongside the transportation related needs expressed by stakeholders when regional ITS goals and objectives were defined. These ITS goals and objectives were then used to develop a Vision for implementing ITS within the Madison Region.

5.1 Existing State and Regional Guidance

As mentioned above, there are several existing transportation plans and documents that provide insight into defining how ITS should evolve and how ITS investment should be made. One such document – the 2035 RTP Update (developed by the MATPB and adopted March 2012) – provides the overall framework for transportation planning and investment decision making in the region. Specifically, the 2035 RTP Update identifies transportation projects and strategies or actions to be implemented.

The goals and policy objectives contained in the 2035 RTP generally set the direction for transportation system development, with some being more relevant than others for ITS development and deployment. The goals stated in the 2035 RTP that may impact the direction of ITS implementation are listed below.

- Develop an integrated, balanced and sustainable land use and transportation system (Overall Transportation System Goal #1)
- Achieve a transportation system that is balanced, accessible, efficient, safe, reliable, equitable, interconnected, environmentally responsible, supportive of compact and efficient patterns of development, promotes economic development and prosperity of the region, fosters community and neighborhood health and vitality, and is economically viable and financially stable (Overall Transportation System Goal #2)
- Develop and maintain a safe, efficient and complete street/roadway system that meets the combined needs of all users for travel within and through the region and enhances community and economic vitality (Street/Roadways Goal #1)
- Develop and maintain a safe, effective and efficient transit system that provides a viable transportation alternative to the automobile for trips within the Madison Metropolitan Area. (Public Transit Goal #1)
- Balance the needs of commuters to the downtown/UW campus area with people dependent on transit for basic mobility and people using transit for other trip purposes and to other areas. (Public Transit Goal #2)

- Provide high-quality paratransit service consistent with the Americans with Disabilities Act (ADA) for people who are unable to utilize accessible fixed-route bus service and supplementary specialized transportation services (particularly outside the Metro service area) that provide basic mobility and allow people to access essential services. (Paratransit/Specialized Transportation Goal #1)
- Provide for safe, convenient and enjoyable travel by bicyclists throughout the region. (Bicycle Transportation Goal #1)
- Provide for safe, convenient and enjoyable pedestrian travel throughout the region. (Pedestrian Transportation Goal #1)
- Make the most efficient use of the existing transportation system through TDM strategies. (TDM/Ridesharing Goal #1)
- Encourage ridesharing, particularly for trips to work and school, and for trips not conveniently served by the public transit system. (TDM/Ridesharing Goal #2)
- Provide a system of quality, safe, interregional transportation options for the region's residents and visitors, maximizing connections to the local and regional transportation systems. (Inter-regional Travel Goal #1)
- Provide for the safe, efficient and reliable movement of goods within and through the region in order to support the region's economy and residents' quality of life. (Freight/Goods Movement Goal #1)
- Preserve rail corridors and provide safe and convenient rail facilities and service to meet rail passenger and freight transportation needs for the region. (Rail Transportation Goal #1)
- Provide safe and convenient airport facilities and service to meet air passenger and freight transportation needs for the region. (Air Transportation Goal #1)
- Provide for the maintenance and construction of parking facilities as part of an integrated and balanced land use and transportation system. (Parking Goal #1)

In addition to the 2035 RTP Update, there are several regional and state plans that set a direction for how transportation improvements are to be made within the region/state. These plans, and their important goals, objectives and/or recommendations include:

- 2004-2008 Transit Development Plan (developed by the MATPB in cooperation with Metro Transit)
  - o ITS specific recommendations identified in this plan are outlined below.
    - Conduct a pilot study to test a transit signal priority system.
    - Use intelligent transportation system (ITS) to improve on-time performance.
- 2013-2017 Transit Development Plan (developed by MATPB in cooperation with metro Transit, and approved in April 2013)
  - o The goals outlined in this plan include the following.
    - Meet people's daily mobility needs.
    - Increase transit ridership to mitigate congestion in constrained corridors.
    - Increase transit's mode share to achieve sustainability goals and reduce climate change.
    - Maintain cost efficiency and effectiveness of transit service.
    - Maintain reliability of transit service that is convenient, comfortable, and affordable.
    - Provide for the safety and security of transit passengers, operators and facilities.
    - Maximize connections to other transportation modes, including intercity rail and bus lines.
    - Provide transportation that is accessible.
    - Support land use and development that maximizes the safety and efficiency of the transportation system.
    - Provide service that increases access to jobs.
  - o ITS specific recommendations identified in this plan are outlined below.
    - Develop concept for Bus Rapid Transit (BRT) and plan for its implementation in the next five to ten years pending the outcome of the Transit Corridor Study.
    - Improve transit service performance monitoring by maintaining area-specific ridership information and adding on-time performance as part of the monitoring program.

- Develop a comprehensive bus stop inventory to identify and track facilities such as boarding platforms, benches, shelters, schedule information and signage, along with information on pedestrian access and significant nearby land uses. Use the inventory, boarding information, and socioeconomic data to help prioritize facility improvements.
- Coordinate with the City of Madison Engineering Department, City of Madison Traffic Engineering Division, and other local jurisdictions to implement pedestrian facility improvements and transit-supportive roadway changes. These include bus lanes, in-lane bus stops, relocation of near-side bus stops to far-side, and traffic signal and other operational changes to reduce unnecessary delay for buses and to improve mobility.
- Replace the current fare boxes with modern units. The existing fare boxes have reached their life expectancy. New fare boxes are expected to reduce Metro's maintenance cost and to increase its fare revenue due to fewer instances of fare boxes being out of order. Replacement fare boxes should include the ability to deploy contactless smart cards that have greater flexibility in storing monetary credit, purchased rides, passes, and transfers. New technology also could allow riders to pay fares with smart phones.

- Transit Corridor Study (led by the MATPB as part of the Capital Region Sustainable Communities Initiative, and approved in May 2013)
  - The goals outlined in this plan include the following.
    - Reduce travel times.
    - Attract new transit riders.
    - Improve connection between low income and/or transit dependent neighborhoods and centers of employment and activity.
    - Provide expanded carrying capacity.
    - Improve operational efficiencies.
    - Provide an enhanced image for transit service.
    - Improve the comfort and convenience of the transit experience.
    - Integrate will with the existing and planned transit system.
    - Enhance opportunities for transit oriented development.

In addition to the aforementioned plans, the Madison Area Transportation Planning Board (MATPB) is required to maintain a Congestion Management Process (CMP) as part of its on-going transportation planning process. The CMP is intended to address congestion based on a cooperatively developed and implemented metropolitan-wide strategy that provides for the safe and effective management and operation of the multi-modal transportation system. Strategies that manage travel demand, reduce single occupant vehicle (SOV) travel, and improve transportation system management and operations are all to be considered, as well as those that explicitly address bicycling and walking. While strategies and projects developed through the CMP are to be included in the MPO's long-range RTP and Transportation Improvement Program (TIP), there has been little coordination within the region to develop a process by which to identify ITS strategies and projects that reduce congestion nor have there been coordinated efforts to identify technologies by which to gauge the performance of these types of projects. Therefore, a key consideration of this Regional ITS strategic Plan is to develop a framework by which to establish a program to identify ITS projects, including needed infrastructure to monitor their performance. The types of projects to be considered generally fall within one or more of the following project categories.

- Demand management initiatives that seek to provide information and incentive to reduce travel during and demand for transportation facilities during peak periods.
- Transportation system management initiatives that actively manage the regional transportation system to effectively mitigate congestion by maximizing the use of physical capacity.
- Operational improvements that seek to improve the operation of the existing roadway system, making it more efficient for all users
- Promoting alternatives to SOV travel, such as transit and non-motorized transportation.

5.2 Looking Ahead - National ITS Initiatives

Besides existing statewide and RTPs and documents which offer guidance on how ITS should be deployed today, there are several national ITS initiatives that should be considered when setting the direction for ITS growth and development in the Madison Metropolitan Area. Aligning the Madison area ITS goals and objectives with National ITS initiatives may make it easier to secure federal funding for ITS, as it is likely that additional funding opportunities will be made available to support these national efforts.

The USDOT's Research and Innovative Technology Administration (RITA) has developed a Plan for Research, Development and Technology (RD&T Strategic Plan) for fiscal years 2013-2018. The RD&T Strategic Plan is required by Congress, Section 52013 of Moving Ahead for Progress in the 21st Century (MAP-21). This Plan addresses the DOT's primary research and development areas. At a minimum, these areas include:

- Promoting safety
- Reducing congestion and improving mobility
- Preserving the environment
- Preserving existing transportation systems
- Improving the durability and extending the life of transportation infrastructure
- Improving goods movement

Additionally, the USDOT recently released its ITS Strategic Plan covering the years 2015-2019. The Plan presents the next set of priorities, strategic themes and program categories under which ITS research, development and adoption activities will take place. The strategic themes, as documented within the ITS Strategic Plan are:

- **Enable Safer Vehicles and Roadways** – Develop better crash avoidance for all road vehicles, performance measures and other notification mechanisms; commercial motor vehicle safety consideration; and infrastructure-based and cooperative safety systems.
- **Enhance Mobility** – Explore methods and management strategies that increase system efficiency and improve individual mobility.
- **Limit Environmental Impacts** – Better manage traffic flow, speeds and congestion and using technology to address other vehicle and roadway operational practices.
- **Promote Innovation** – Foster technological advancement and innovation across the ITS Program, continuously pursuing a visionary/exploratory research agenda and aligning the pace of technology development, adoption and deployment to meet future transportation needs.
- **Support Transportation System Information Sharing** – Develop standards and system architectures and apply advanced wireless technologies to enable communications among and between vehicle of all types, the infrastructure and portable devices.

While the aforementioned themes provide the high-level framework for the national ITS program, the Strategic ITS Plan details program categories that provide the structure for research, development and adoption of ITS technologies. The program categories, as documented within the ITS Strategic Plan are:

- **Connected Vehicles**: The USDOT will focus much of its connected vehicle (CV) program activities on adoption and eventual deployment of CV systems. CV research, development and adoption fall into two areas based on activities in the USDOT, including National Highway Transportation Safety Administration plans to issue a proposal by 2016 on V2V safety messaging. These include V2V communication based on dedicated short-range communications (DSRC) technology and other CV technologies and communications that are enabled by either DSRC or other networks such as cellular, WI-FI, or satellite. As CV technology advances from research to implementation, there will be increased focus on test beds and pilots. This may represent an opportunity for the Madison Region to receive funding for CV applications that address identified needs.
- **Automation**: The automation program will focus on research about the automated road-vehicle system and related technologies that transfer some amount of vehicle control from the driver to the vehicle. The focus of the ITS program in this area will be on the advancement of technologies to enable smooth and safe introduction of automated features into the nation's vehicles and transportation systems.

- **Emerging Capabilities**: The USDOT's emerging capabilities program will focus on future generations of transportation systems. As the scale of CV implementation grows and automation of transportation systems increases, vehicle manufacturers, infrastructure providers, innovators and entrepreneurs will discover new opportunities to use the technologies and data generated, while also protecting consumer privacy. To this regard, it may be advantageous and cost effective, for public agencies within the Madison region to implement strategies that generate data for external applications but stop short of competing directly with third party developers in developing methods to disseminate the information to transportation users.
- **Enterprise Data**: With increased connectivity among vehicles, organizations, system and people, unprecedented amounts of data are being generated. New methods to collect, transmit/transport, sort, store, share, aggregate, fuse, analyze and apply these data will be needed for management and operations of transportation systems. Enterprise data management initiatives focus on enabling effective data capture from ITS-enabled technologies, including CVs (automobiles, transit and commercial vehicles), mobile devices and infrastructure in ways that protect the privacy of users. These activities also focus on enhancing the creation of data environments that enable integration and data from multiple sources for use in transportation research, management and performance measurements.
- **Interoperability**: Interoperability is essential to ensure connectivity among devices and systems. Interoperability focuses on enabling ITS elements in vehicles, devices, infrastructure and application to effectively communicate with other parts of the system as needed, regardless of where they are built and where or when they are used.

5.3 ITS Vision

With an understanding of existing statewide and regional transportation needs and influencing national ITS initiatives, the future of ITS in the Madison Metropolitan Area becomes more clear. With that said, the ITS Vision sets forth a clear, concise statement that defines what ITS should become or, in other words, what it should look like from the perspective of the user (e.g., drivers and operators). The Vision is critical to the development of ITS with the region because it represents a consensus based view of the role ITS should have in the region. It is purposely a forward looking statement agreed to by stakeholders that guides ITS deployment over a specified number of years. Due to the rapid evolution of ITS-related technology, this period is capped at 10 years.

Because technologies are constantly changing and new methods are consistently being introduced to improve travel, the Vision will likely never be completely fulfilled; however, this should be expected and does not negate its purpose. In the future, as technology changes and desires evolve, this plan and ITS Vision should be updated to reflect current issues and priorities of the Madison Metropolitan Area.

The Vision for the Madison Metropolitan Area is articulated below.

> *"ITS in the Madison Metropolitan Area will further maximize the safety, efficiency, reliability and overall performance of the multi-modal transportation system through inter-agency coordination and implementation of interconnected and sustainable technologies."*

Implementing this vision will help achieve the overall goals for the regional transportation system, including enhancement of the environment, promoting economic prosperity and fostering community vitality.

5.4 ITS Goals, Objectives & Performance Measures

ITS goals are broad statements of the actions that need to be taken to satisfy the ITS Vision. ITS objectives are specific, achievable and measureable statements of the actions that need to occur to achieve a specific goal. ITS performance measures are metrics used to evaluate progress made toward achieving each objective. Defining ITS goals, objectives and performance measures is not only important for laying the groundwork for future activities, it is critical for bridging the gap between stated needs and the ITS strategies that satisfy them. Each goal, objective and performance measure presented in this section is prepared with the intent of promoting inter-agency discussion and fostering region wide consensus. Goals, objectives and performance measures were written to be clear and easily understood to ensure common understanding of the actions that need to be performed to successfully satisfy the ITS vision. Since this is the

first ITS Strategic Plan for the Madison Metropolitan Area, this list of ITS goals, objectives and performance measures represent a "start small" approach. This approach focuses on successfully demonstrating ITS performance in the short-term so as to help the region gain traction in developing a larger performance monitoring program and to build from successful projects. To that end, projects that will be proposed will in part be based on implementing the infrastructure needed to collect data to measure performance. These actions will help the region build momentum for additional ITS investment. By achieving consensus on goals, objectives and performance measures, the resulting ITS Strategic Plan will better meet the specific needs of the region and will over time lead to a process of continual improvement.

The project team followed a top-down approach to developing the goals, objectives and performance measures. Each underwent multiple reviews ultimately resulting in the set of goals, objectives and performance measures outlined in the following sections. Regional needs were reviewed and based on this review goals were identified and are listed below.

- Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel
- Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing
- Goal C: Enhance Transportation System Efficiency and Reliability and Reduce its Impact on the Environment
- Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes
- Goal E: Preserve the Transportation System

A mapping of regional needs, initially identified in Chapter 4, to the above bulleted goals is provided in Table 13. While several regional transportation needs may pertain to more than one ITS goal area, needs are mapped to a single goal area representing the best fit. Regional ITS-Related Needs are identified by their corresponding user need identifier.

Following Table 13, a brief description of each goal is provided along with the applicable objectives and corresponding performance measures.

Table 13

Mapping of Madison Regional ITS-Related Needs to Identified Goals

Regional ITS-Related Need		ITS Goal Area
TI10	Improve multi-agency communication and data sharing during active incidents.	**Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/ Maintenance Personnel**
TM2	Expand/improve coverage of existing camera system to improve situational awareness.	
TM4	Expand camera coverage to include the UW campus and integrate camera feeds into the larger regional camera network.	
TM5	Accommodate the needs of bicyclists, pedestrians and persons with disabilities at signalized intersections so these groups can safely traverse the intersection (i.e., extend signal timing when these groups are detected within the intersection).	
TM7	Detect the presence of bicyclists and pedestrians waiting at signalized intersections and when detected provide visual notification to automobiles and bicyclists of their presence.	
TM18	Manage traffic during incidents and identify possible alternate routes.	
TM19	Improve traffic incident management planning and response coordination at known trouble spots within the region (e.g., Beltline, other major arterials).	
TM21	Foster/build relationships among emergency response and municipal agencies to improve regional emergency/traffic response.	
TM26	Improve safety by managing/harmonizing traffic speeds heading into traffic queues.	
TM30	Collect traffic and bicycle count information more often and at additional locations (e.g., annual updates).	

Regional ITS-Related Need		ITS Goal Area
AD1	Integrate and share data collected by multiple regional agencies to improve regional and individual agency operations.	**Goal B: Enhance and/ or Enable Multiagency Communication, Coordination and Data Sharing**
AD3	Identify and standardize data collection platforms and establish protocols to improve the exchange of information and data between existing and unique software platforms.	
EM2	Integrate camera feeds into the regional EOC.	
TI11	Provide/expand multi-agency access and control of regional traffic cameras.	
TI12	Improve the speed by which agencies exchange information among each other and with the public.	
TM13	Increase agency staffing levels or use other agency staff to cover operations during weekends/nights/ special events.	
TM14	Travel time collection in automated formats to provide performance measures and assist in planning efforts.	
TM20	Provide the STOC with real-time information, including the estimated duration of road closures due to traffic incidents.	
TM25	Improve the dissemination of parking related information and possibly seek involvement with the media or private third parties (Google, Waze, etc.).	
EM1	Integrate CAD/radio communications platforms so that multiple agencies can communicate effectively.	
EM3	Improve emergency management coordination, especially around jurisdictional boundaries.	
MC1	Improve the dissemination of existing RWIS data to regional agencies.	
MC3	Use existing vehicles as probes to collect and disseminate data back to the EOC.	
MC7	Improve coordination with other construction projects to piggyback on their efforts or to be more strategic in implementing projects.	
OT2	Train staff so that they have the knowledge, skills and abilities to analyze data and improve operations (e.g., STOC operators need additional understanding of regional agencies and events so they can assist in regional operations).	
OT4	Promote understanding and awareness of existing technologies and make information available to agencies within the region.	
OT5	Promote greater understanding of ITS within the region.	
PT5	Improve the interconnectivity of transit services and routes and information about them.	**Goal C: Enhance Transportation System Efficiency and Reliability**
TI8	Provide advance route planning and guidance based on real-time conditions. Specific needs include providing parking information while en-route to reduce traffic demand associated with motorists seeking available parking.	
TI14	Disseminate information on the available travel modes within downtown Madison at selected other locations (special event venues) to improve trip reliability and reduce demand on the transportation network.	
TI16	Provide information on when pedestrian congestion can be expected (e.g., when classes end, etc.).	
TM1	Maximize the use of existing systems that may provide additional information and data that might benefit other agencies (e.g., video from cameras installed on buses).	
TM3	Detect and count bicycles to improve regional planning efforts.	
TM6	Maintain the integrity of the transportation system for transit, bicyclists and pedestrians during periods of automobile congestion.	
TM8	Improve traffic signal timing for bicyclists to maintain a progression along key bicycle corridors.	
TM9	Automatically detect traffic signal equipment malfunctions.	
TM10	Improve the progression of all modes (automobiles, transit, bicycles) along primary transportation corridors, regardless of jurisdictional control/responsibility.	
TM11	Improve signal operations so that they are more responsive to traffic during unexpected incidents and conditions.	
TM24	Implement parking demand management incentives/disincentives (e.g., variable pricing) for parking during events/periods of high demand.	
TM27	Balance bicycle and pedestrian mobility and safety with that of automobile traffic.	
MC4	Monitor the application/application rate of materials stored on maintenance vehicles to maximize their use and to apply materials where they are most needed.	

Regional ITS-Related Need		ITS Goal Area
AD4	Collect and share bicycle origin-destination information to better plan and locate bicycle infrastructure.	**Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes**
PT1	Increase the processing speed and frequency of bus AVL data so that transit vehicle arrival information is more accurate and timely.	
PT2	Collect and disseminate on-board bike rack availability in real-time and share this information with transit users prior to boarding.	
PT3	Expand the number of locations that have real-time information signs.	
PT4	Collect bus stop level boarding and alighting data and disseminate this information, in real-time, to transit users prior to boarding.	
PT6	Promote transit benefits to the traveling public to increase awareness and ridership.	
PT7	Enhance the transit traveler experience (i.e., increase the number of transit express routes).	
TI1	Use social media, apps, text alerts and subscription based messaging to make traveler information more accessible and user friendly.	
TI2	Enhance the Game Day app by including additional types of static and dynamic traveler information (i.e., parking information, bikeshare stations, etc.).	
TI3	Provide information where bicyclists can park their bikes or where they can meet a bike valet.	
TI4	Provide airport information at select locations in downtown Madison.	
TI5	Establish public/private partnerships to provide travelers with enhanced traveler information both pre-trip and en-route.	
TI6	Provide predictive traveler information to users based on historical data (e.g., parking and bicycle availability).	
TI7	Integrate additional types of information into the statewide 511 system (e.g., park and ride lots, parking ramps, bikeshare locations, etc.).	
T13	Establish systems that match users seeking to reserve a bike with available bikeshare services.	
TI15	Improve awareness/guidance of one-way routes (directionality of travel) to reduce circulation on downtown streets.	
TI17	Use of social media and smartphones to deliver timely traveler information.	
TI9	Establish systems that allow users to pre-pay for and reserve parking in advance of a trip.	
TM15	Enhance the dissemination of airport-related information on interstate routes leading to the airport.	
TM16	Provide smaller DMS along roadways on campus to help non-familiar drivers navigate to parking.	
TM17	Provide shuttle information upstream of special events to lessen traffic demand.	
TM23	Provide advance notification (pre-trip and en-route) of parking availability, via web, apps and/or roadside signage (hybrid DMS).	
TM29	Increase the availability of bikeshare systems and promote their availability.	
EM4	Alert residents of future winter weather events so they can remove their vehicles from the streets before snow falls and roads need to be plowed.	
MC2	Improve sidewalk maintenance (especially during snow events) to improve safety and accessibility to bus stops.	
MC6	Collect and provide real-time information related to campus construction events.	
MC8	Provide information on road closures on arterial streets. Ideally this could be incorporated into one location for the region.	
AD2	Improve regional data collection and make it more user friendly so that data can be easily used to monitor and establish performance measures.	**Goal E: Preserve the Transportation System**
TM12	Extend fiber-optic communications to additional traffic signals to improve connectivity with signals already on the network.	
TM28	Expand parking at the airport or promote transit to reduce parking demand.	
VS1	Take steps to plan for driverless cars.	
MC5	Expand weather collection information for arterial corridors.	
OT1	Identify, through regional self-evaluation, a framework to improve the effectiveness of TSMO activities (i.e., implement and use a capability maturity model for building upon existing TSMO efforts).	
OT3	Implement environmentally friendly improvements.	

5.4.1 Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel

One of the most important of all government functions is that of ensuring the safety and security of the public. In the context of this ITS Plan, this goal works toward implementing ITS improvements that enhance the safety and security of the multi-modal regional transportation network and its users. This includes the safety of both motorized and non-motorized users. In doing so, users can gain confidence that they can safely travel about the transportation system. This goal, in part, is focused on promoting safe and quick traffic incident response and clearance. Incident response is a multi-disciplinary effort to clear traffic incidents and return the transportation system to its full capacity. All responders need to be properly trained to communicate and to work together in order to safely and quickly clear the incident scene. Ultimately, improving traffic incident response will promote the safety of both responders and transportation system users.

Objectives:

1. Improve detection of, response to and management of hazardous roadway conditions, traffic incidents and other emergencies on freeways and major arterials
2. Improve detection of, response to and management of transit related incidents (e.g., vehicle crashes, passenger security incidents, etc.)

Performance Measures:

1. Roadway clearance time
2. Incident clearance time
3. Number of secondary incidents, including injuries and fatalities to emergency responders and construction/ maintenance personnel
4. Incident/emergency response time
5. Number and percentage of emergency responders receiving formal Traffic Incident Management (TIM) training

5.4.2 Goal B: Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing

The purpose of this goal is to implement technologies and protocols that allow agencies to share information and data so the operations of the participating agencies as well as the overall transportation network can be improved. To date, individual agency operations have been largely independent of other agency operations. By communicating, sharing information and data, the operations of all agencies can be positively impacted, reducing the capital costs associated with duplication in projects that fulfill common needs. The success of this goal will hinge on individual agencies willingness to equitably share their information.

Objectives:

1. Establish a platform, including policies, procedures and protocols, for collection, management, integration and application of multiagency transportation data for planning and operations
2. Improve multiagency communications in preparing for and during incidents, emergencies and planned events to enhance management capabilities
3. Conduct routine incident after-action reviews

Performance Measures:

1. Deployment of data “hub”.
2. Percentage of incidents identifying communication issues (through routine incident after-action reviews)

5.4.3 Goal C: Enhance Transportation System Efficiency and Reliability and Reduce its Impact on the Environment

Transportation agencies are faced with the challenge of doing more with less. Advanced technologies can help in this regard and may be paramount in meeting the public's increasing demands for safe and reliable transportation. This goal will address solutions that cost effectively meet growing demand for transportation without increasing capacity. Technologies implemented under this goal will focus on maximizing throughput along congested corridors either through operational improvements or encouraging mode shift to reduce the number of vehicles on roadways.

Promoting the benefits and encouraging the use of non-motorized transportation options and transit is key to reducing congestion and its impacts on the transportation system and environment. By encouraging non-motorized transportation and transit, regional stakeholders hope to improve the efficiency of the regional transportation network. ITS can support this goal by implementing technologies that enhance travel via these modes. Furthermore, agencies can make better use of existing technologies such as on-board and shelter DMS to advertise improvements and their benefits. Social media can be leveraged to convey benefits and provide information on new technologies so that travelers are aware of them. In some instances, the use of incentives (reduced transit fares) and disincentives (demand based pricing for parking) may encourage travelers to shift from SOV use to more efficient modes.

Objectives:

1. Improve timeliness, accuracy and access of traveler information for/during:
   - Traffic incidents
   - Planned events
   - Construction
   - Transit
   - Parking
   - Trip planning
2. Reduce recurring traffic delay during peak periods consistent with other transportation system goals as identified in the CMP
3. Reduce non-recurring delay on arterials and freeways due to traffic incidents, construction and planned events
4. Improve traffic and transit operations and overall regional corridor performance, thereby reducing fuel use and improving air quality

Performance Measures:

1. Number of visitors to specific traveler information websites
2. Number of notification users for traveler information (e.g., e-mail, text message)
3. Number of social media (e.g., Twitter, Facebook) followers
4. Freeway and urban arterial travel time index
5. Freeway and urban arterial congestion duration
6. Urban arterial street intersection level of service (LOS)
7. Transit on-time performance
8. Number of transit missed trips

5.4.4 Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes

This goal area will identify technologies and solutions that link travelers to available transportation options. For instance, traveler information exists in many forms, many of which are unknown to the traveler. This goal addresses the need to improve the dissemination of travel information to the public. Providing accurate and complete information to the public will enhance user opinion and improve the safety and efficiency of the transportation network. For example, the integration of existing and new sources of traveler information into one-stop-shop solutions may promote awareness of available travel options, thereby making these options more accessible to those seeking to make a trip. Another example may be informing non-familiar travelers of parking options/availability at locations upstream of parking areas thereby reducing the need to circumnavigate parking garages in search for available parking. This will lessen demand on the transportation system, reduce driver frustration and improve regional mobility for all users that must compete for fixed, limited capacity.

Objectives:

1. Improve transit operations and services through ITS
2. Improve bicycle and pedestrian detection and awareness
3. Improve trip planning tools
4. Promote/support travel demand management (TDM) strategies and services
5. Reduce SOV mode share

Performance Measures:

1. Transit on-time performance
2. Transit travel times
3. Transit ridership per capita
4. Number of transit complaints/compliments
5. SOV commute mode share
6. Per capita vehicle miles traveled (VMT)
7. Bicycle volumes or estimated bicycle miles traveled per capita

5.4.5 Goal E: Preserve the Transportation System

This goal seeks to preserve previous and future regional investment the region has made and will make in its regional transportation system, particularly with regard to ITS infrastructure. Future ITS deployment should maintain and build from existing assets to increase the level of sophistication and to make the ITS system more robust. Objectives linked to this goal will focus on filling in gaps or expanding coverage of ITS elements. Additionally, the region will obtain greater value on the information and data collected by existing or expanded ITS networks.

One of the primary goals of the Regional ITS Strategic Plan is to initiate a program for monitoring, measuring and reporting on the performance of ITS investments. Development of performance measures will provide decision makers with the needed information to quantify progress towards meeting goals, to evaluate the overall effectiveness of ITS investments and to take incremental steps toward preserving and improving the system. This will allow decision makers and agency representatives to make informed decisions with regard to how future ITS investment should occur and to make changes so as to maximize the benefits of ITS investment. Monitoring and reporting performance will also ensure the transportation and ITS systems are functioning in the desired manner. Without regularly monitoring the systems, it is difficult to understand how the system is operating. In addition to monitoring the system, each of the key performance components should be measured and reported on. This will allow users to improve the system and set goals on how the system should be operating. The results of performance measures will also demonstrate return on investment and may be an effective means of securing additional funding to support future ITS investment and to expand successful efforts.

Objectives:

1. Implement tools and technologies to enhance the maintenance of transportation system elements. Include real-time monitoring and alerting functionality for:
   - Weather and road conditions
   - ITS devices (including communication networks and traffic signals)
   - Transit fleet vehicles
2. Design roadway and transit ITS to future expansion, deployment and operations of emerging technologies

Performance Measures:

1. Percentage of devices and transit fleet with real-time monitoring functionality
2. ITS device mean time between failure (MTBF)

5.5 Next Steps

As mentioned earlier, the ITS Vision and supporting goals and objectives set a course of action for developing and deploying ITS in the Madison Metropolitan Area. ITS strategy development can commence by using this foundation. In the next chapter, ITS concepts will be grouped by the specific functions or transportation services that can be delivered through application of ITS strategies and presented at a high level to further encourage stakeholder engagement and to define responsibilities for system(s) operations. In later chapters, the operational concepts will be used to develop a "blue-print" that shows how ITS components come together to operate a single system composed of smaller, individual agency owned subsystems. This will lead to recommendations of ITS-related strategies that will evolve to actual projects phased for implementation over the short- (0-2 years), mid- (2-5 years) and long-term (5-10 years).

6 ITS OPERATIONAL CONCEPT

6.1 Introduction

An ITS Operational Concept is a high-level understanding of how agencies, through the various ITS elements they own and operate, interconnect to form an integrated "system of systems". This understanding includes the specific transportation functions agencies need to collectively perform and their roles and responsibilities with respect to deploying, operating and maintaining ITS elements. Due to the relatively high number of stakeholders in the Madison Metropolitan Area, the operational concept focuses on key agencies, where stakeholder participation and input has been sufficient to clearly articulate agency ITS roles and responsibilities. Key agencies can be defined as those that have a major role in transportation operations, which are both providers and receivers of information. Input used to develop the Operational Concept was collected primarily through stakeholder participation at the User Needs and Operational Concept Workshops (October 2014 and January 2015, respectively), phone and e-mail correspondence and an extensive review of existing documentation made available since the initial development of this document.

6.2 Purpose

The purpose of this Operational Concept is to provide a high-level overview of the types of functions ITS will support in the region and to explain these functions in a manner that each stakeholder can understand. This will further understanding and achieve consensus on how to proceed with building the Regional ITS so user needs are not overlooked, the need for ongoing operations is recognized and that quality is built into the system. The Operational Concept represents the transitional step that occurs between the time user needs are identified and when project recommendations are developed. The Operational Concept begins to answer "who, what, where, why and how" questions that surround the proposed concept moving the concept forward so that specific requirements can be developed which will feed into the concept's design. Because the Operational Concept acts as the transitional step between regional user needs and proposed solutions/strategies (i.e., projects) it is important that the high-level characteristics of the regional ITS are fleshed-out and that these characteristics are communicated to all stakeholders impacted by its implementation. In this regard, the Operational Concept is written in a non-technical, easy to understand manner that allows each stakeholder, regardless of their background, to understand how the concept will impact their day-to-day activities and operations. This provides stakeholders the opportunity and ability to provide feedback at this stage of the concept's development, rather than at a point later in the process where decisions have already been made and may need to be revisited. Therefore, the Operational Concept is not intended to be a design document, but rather it addresses the high-level questions that are associated with regional ITS deployment that need to be addressed prior to project identification, programming and implementation. This reduces the risk of overlooking critical stakeholder feedback and having to revisit this stage when the system is being designed and implemented. It also creates an environment where stakeholders can easily exchange ideas and input fostering inter-agency consensus and buy-in reducing potential adverse stakeholder reactions that may occur when they are not provided an opportunity to provide comments.

Additionally, the ITS Operational Concept accomplishes the following:

- Identifies possibilities for institutional cooperation and coordination, laying the foundation for institutional agreements or memoranda of understanding for operations.
- Ensures conformance with 23 Code of Federal Regulations Part 940.9 Section D of the Federal Highway Administration (FHWA) Final Rule (referred to herein as "Rule 940") and a similar Federal Transit Authority (FTA) Policy covering transit ITS projects (the "FTA ITS Policy").
- Supports project design by providing a starting point that systems engineers can reference when designing systems, which is also a Rule 940 requirement.

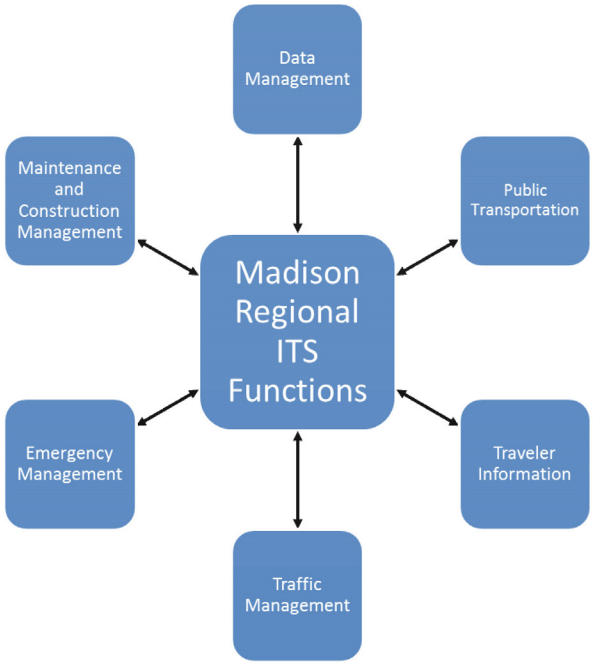
Although the Operational Concept begins to provide details needed to develop the physical ITS architecture, it is not intended to provide the specific details needed to implement ITS at the specific strategy or project level. The Operational Concept should be considered as the initial step taken to begin this process and foster inter-agency agreement and understanding. Together, the Operational Concept and ITS Architecture (Chapter 7), provide the information needed to develop the ITS Implementation Plan. The ITS Architecture will build upon interconnections identified in this chapter and will identify various types of information that flow through them and the systems required to complete this communication. Conversely, the ITS Implementation Plan will present a phased approach for implementing ITS within the state over the next 10 years or as funding permits.

6.3 Operational Concept Approach

To mitigate complexities inherent to developing an ITS Operational Concept for a region as large as the Madison Metropolitan Area and to ease understanding and facilitate an environment where inter-agency consensus can be more easily achieved, the Madison Metropolitan Area ITS Operational Concept has been prepared and presented as a series of functional concepts that represent "bite-sized" pieces of the overall or complete ITS concept for the Madison Metropolitan Area. These functional concepts have been developed from previously identified user needs and map directly to National ITS Architecture Service Packages. Service Packages simply represent the physical infrastructure that corresponds with and is needed to implement a particular transportation service. By using National ITS Architecture Service Packages, it is not only easier for stakeholders to understand where they fit in terms of regional ITS activity, but it also links Madison's Strategic ITS Plan to the National ITS Architecture – a common, consistent and required (if Federal funds are used) approach for planning and implementing ITS. This alignment ensures consistency with a nationally accepted and proven approach, helping to ensure that public investment is used in the most effective manner. Core functions that comprise the ITS Operational Concept in the Madison Metropolitan Area are illustrated in Figure 36.

The intent of this operational concept is to demonstrate region-wide, multi-agency integration of ITS elements. Therefore, transportation services that pertain to the operations of one or a few agencies that require little to no integration are not discussed (for example an isolated traffic signal operated by a local municipality). However, a more comprehensive listing of the transportation services (Service Packages) applicable to the region can be found in the Chapter 7 - ITS Architecture.

Figure 36: Madison Metropolitan Area ITS Core Functions



6.4 Short- and Mid-term Functional Concepts

This section provides relevant short- to mid-term operational concepts for the Madison Metropolitan Area derived from the National ITS Architecture. The concepts generally represent functional areas that can be supported through existing technologies in the marketplace though these technologies may not yet be present or implemented within the Madison region. In many cases, near- and mid-term concepts lay the foundation for more sophisticated concepts that may be implemented to address regional needs in the long-term. National ITS Architecture Concepts that are applicable to the Madison Metropolitan Area are identified in Table 14 and described in greater detail in the subsequent sections. Market package descriptions have been modified from national definitions and tailored with Madison-specific information.

Table 14

National ITS Architecture Services Areas and Service Packages Applicable to the Madison Metropolitan Area

Archived Data Management Service Area	Traffic Management
ITS Data Mart	Network Surveillance
ITS Data Warehouse	Traffic Signal Control
Public Transportation Service Area	Traffic Metering
Transit Vehicle Tracking	Traffic Information Dissemination
Transit Fixed-Route Operations	Regional Traffic Management
Demand Response Transit Operations	Traffic Incident Management System
Transit Fare Collection Management	Transportation Decision Support and Demand Mngt.
Transit Security	Parking Facility Management
Multimodal Coordination	Regional Parking Management
Transit Traveler Information	Mixed Use Warning Systems
Transit Signal Priority	**Maintenance & Construction Management**
Transit Passenger Counting	Maint. & Constr. Vehicle and Equipment Tracking
Multimodal Connection Protection	Road Weather Data Collection
Emergency Management	Weather Information Processing and Distribution
Emergency Call-Taking and Dispatch	Roadway Automated Treatment
Emergency Routing	Winter Maintenance
Roadway Service Patrols	Roadway Maintenance and Construction
Wide-Area Alert	Maintenance and Construction Activity Coordination
Traveler Information	**Vehicle Safety**
Broadcast Traveler Information	Automated Vehicle Operations
Interactive Traveler Information	
Dynamic Route Guidance	
ISP Based Trip Planning and Route Guidance	
Transportation Operations Data Sharing	
Dynamic Ridesharing	

6.4.1 Archived Data Management and Communication Concept

The Archived Data Management and Communication concept system involves the collection, archival, management and distribution of data generated by regional ITS elements. Data is typically utilized for transportation administration, policy evaluation, safety, planning, performance monitoring, program assessment and operations. The data collected by this service concept may be formatted and tagged with attributes that define the data source, conditions under which it was collected, data transformations and other information (i.e., meta data) necessary to interpret the data. The concept may consist of fusing ITS generated data with data from non-ITS sources and other archives to generate information products utilizing data from multiple functional areas, modes and jurisdictions. The service concept allows data products to be

prepared that serve as inputs to federal, state and local data reporting systems. This concept may be implemented in different ways. It may reside within an operational center and provide focused access to a single agency's data archives. Alternatively, it may operate as a distinct center that collects data from multiple agencies and sources and provides a general data warehouse service for a region. The latter concept would require a champion agency to serve as the data administrator/maintainer for regional data collected by agencies within the Madison Metropolitan Area.

Based on stated user needs, Madison regional archived data management and communication will likely evolve from being largely a collection of individual, agency-focused archives to a single archive, or limited number of archives that integrate data from multiple sources (i.e., centralized database).

In the Madison Metropolitan Area this concept will consist of two service packages. Table 15 identifies these two service packages and maps them to the Regional ITS Goals they work to address. Following the Table 15 each service package is described in further detail.

Table 15

Regional ITS Goals Met by Archived Data Management and Communication Service Packages

Service Package	Regional ITS Goals				
	Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/ Maintenance Personnel	Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing	Enhance Transportation System Efficiency and Reliability	Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes	Preserve the Transportation System
ITS Data Mart		+			
ITS Data Warehouse		+			+

ITS Data Mart

This service package provides a focused archive that houses data collected and owned by a single agency. In other words, a data mart is the term given to the data archive corresponding to a single agency. Similarly, it could represent an archive owned and operated by a private sector provider, a research institution, or other organization. Currently in the Madison region, this concept consists of multiple individual data archives owned and operated by multiple agencies. In the majority of cases, these individual archives are not integrated with other agency archives, leading to inefficient use of data collected among agencies. An isolated data mart owned and operated by an individual agency may still be fruitful for housing data that the agency does not wish to share with other agencies, particularly if the data is sensitive. While the ITS Data Mart concept is not likely to go away, the concept for data archival in the Madison Metropolitan Area will likely evolve to one where multiple agencies contribute to a single archive and share data with outside agencies (e.g., ITS Data Warehouse concept). High-level agency roles and responsibilities for performing this service package are provided in Table 16.

Table 16

Agency High-Level Roles and Responsibilities Corresponding to ITS Data Mart

Participating Agency	Role
Entities that own and operate a data archive (assumed to be all transportation agencies operating within the Madison Metropolitan Area)	• **Traffic and Roadside Data Archival** - Control and operate roadside ITS equipment to archive traffic, roadway and environmental information for use in off-line planning, research and analysis. • **ITS Data Repository** - Operate/maintain ITS data repository – collect data from one or more data sources and store in a data repository that is suited to particular set of ITS data users. • **Government Reporting Systems Support** - Format ITS archive data to facilitate local, state and federal government data reporting requirements. • **Traffic Data Collection** – Collect traffic management data such as operational data, event logs, equipment failures, maintenance records, data requests, etc.

ITS Data Warehouse

This service package includes all the data collection and management capabilities provided by the ITS Data Mart service package 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 these 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. In the future, as connected vehicle technologies come on-line it is expected that data needs will exponentially increase requiring a more sophisticated approach to warehouse collected data. Prior to implementing this concept, participating Madison stakeholders will need to establish policies and memorandum of understanding agreements for sharing, using, and distributing data so that shared data can benefit agency operations without the risk of inadvertently sharing sensitive data. Additionally, proprietary hardware may need to be swapped out to enable agencies to effectively share data. High-level agency roles and responsibilities for performing this service package are provided in Table 17.

6.4.2 Public Transportation Concept

The Madison regional public transportation system concept is largely focused on the operations of individual transit agencies. For example, this concept will manage transit vehicle fleets and coordinate with other modes and transportation services to improve transit agency operations. The concept provides operations, maintenance, customer information, planning and management functions for the transit agency. It spans distinct central dispatch and garage management systems and supports the spectrum of fixed route, flexible route and paratransit services. A BRT service currently being discussed for the Madison region would also be addressed by this concept. The concept will allow for communication between transit departments and with other operating entities such as emergency response services and traffic management systems by providing interfaces between Metro Transit vehicles and Metro Transit operators and/or emergency response agencies to report emergencies within or near the transit vehicle. This will enable quick response to emergencies, improving safety of transit passengers, while helping to restore transit operations more quickly. In addition to Metro Transit, this concept extends to all transit management agencies within the Madison Metropolitan Area.

Table 17

Agency High-Level Roles and Responsibilities Corresponding to ITS Data Warehouse

Participating Agency	Role
Madison Area Transportation Planning Board	• **ITS Data Repository** - Operate/maintain a regional ITS Data repository. Collect data from one or more data sources and store them in a data repository that is suited to particular set of ITS data users. • **Government Reporting Systems Support** - Format ITS archive data to facilitate local, state and federal government data reporting requirements.
TOPS Lab	• **Traffic and Roadside Data Archival** - Control and operate roadside ITS equipment to archive traffic, roadway and environmental information for use in off-line planning, research and analysis. • **ITS Data Repository** - Operate/maintain a regional ITS Data repository. Collect data from one or more data sources (e.g., WIsDOT) and store them in a data repository that is suited to particular set of ITS data users. • **Government Reporting Systems Support** - Format ITS archive data to facilitate local, state and federal government data reporting requirements.
City of Madison – Metro Transit	• **Transit Data Collection** – Collect, filter and store transit information that is collected in the course of transit operations (e.g., transit fares, passenger use, vehicle maintenance data and others as identified).
Other Transit Agencies	• **Transit Data Collection** – Collect, filter and store transit information that is collected in the course of transit operations (e.g., transit fares, passenger use, vehicle maintenance data and others as identified).
City of Madison Traffic Engineering	• **Traffic Data Collection** - Collect, filter and store traffic information that is collected in the course of traffic operations (e.g., operational data, event logs, device locations and characteristics and others as identified). • **Traffic and Roadside Data Archival** - Control and operate roadside ITS equipment to archive traffic, roadway and environmental information for use in off-line planning, research and analysis.
Other City Traffic Engineering	• **Traffic Data Collection** - Collect, filter and store traffic information that is collected in the course of traffic operations (e.g., operational data, event logs, device locations and characteristics and others as identified). • **Traffic and Roadside Data Archival** - Control and operate roadside ITS equipment to archive traffic, roadway and environmental information for use in off-line planning, research and analysis.
City of Madison Parking Utility	• **Traffic Data Collection** - Collect, filter and store traffic information that is collected in the course of parking operations (e.g., parking rates, occupancy, locations and others as identified). • **Traffic and Roadside Data Archival** - Control and operate roadside ITS equipment to archive traffic, roadway and environmental information for use in off-line planning, research and analysis.
WisDOT STOC	• **Traffic Data Collection** - Collect, filter and store traffic information that is collected in the course of traffic operations (e.g., operational data, event logs, device locations and characteristics and others as identified). • **Traffic and Roadside Data Archival** - Control and operate roadside ITS equipment to archive traffic, roadway and environmental information for use in off-line planning, research and analysis.

This concept also receives special event and real-time incident data from traffic management agencies/departments and provides these agencies with current transit operations data. The Transit Management concept collects and stores ridership levels and implements fare structures for use in electronic fare collection. It collects operational and maintenance data from transit vehicles, manages vehicle service histories and assigns vehicle operators and maintenance personnel to vehicles and routes. This concept may also provide the capability for automated planning and scheduling of public transit operations, furnishing travelers with real-time travel information, continuously updated schedules, schedule adherence information, transfer options and transit routes and fares. In addition, the subsystem supports transit security features including transit vehicle silent alarms.

In the long–term this concept may evolve from providing consistent, fixed-route services to providing variable services based on real-time information collected and exchanged between vehicle, roadside and personal communications devices. Additionally, transit will serve a larger role for reducing demand along Madison's surface transportation network, especially in and around the campus and downtown area where congestion levels are more problematic.

In the Madison Metropolitan Area this concept will consist of ten service packages. Table 18 identifies these ten service packages and maps them to the Regional ITS Goals they work to address. Following the Table 18 each service package is described in further detail.

Table 18

Regional ITS Goals Met by Public Transportation Service Packages

Service Package	Regional ITS Goals				
	Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/ Maintenance Personnel	Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing	Enhance Transportation System Efficiency and Reliability	Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes	Preserve the Transportation System
Transit Vehicle Tracking			+	+	
Transit Fixed-Route Operations		+	+	+	
Demand Response Transit Operations				+	
Transit Fare Collection Management		+	+	+	
Transit Security	+			+	
Multimodal Coordination		+	+	+	
Transit Traveler Information			+	+	
Transit Signal Priority			+	+	
Transit Passenger Counting				+	
Multimodal Connection Protection		+	+		

Transit Vehicle Tracking

This service package monitors current transit vehicle location using an automated vehicle location system. The location data may be used to determine real-time schedule adherence and update the transit system's schedule in real-time. Vehicle position may be determined either by the vehicle (e.g., through GPS) and relayed to the infrastructure or may be determined directly by the communications infrastructure. A two-way wireless communication link with Transit Management is used for relaying vehicle position and control measures. The Transit Management agency processes this information, updates the transit schedule and makes real-time schedule information available to ISPs and the public through existing and planned dissemination mechanisms. High-level agency roles and responsibilities for performing this service package are provided in Table 19.

Table 19

Agency High-Level Roles and Responsibilities Corresponding to Transit Vehicle Tracking

Participating Agency	Role
Metro Transit	• **Transit Center Vehicle Tracking** – Operate and maintain center-based equipment to monitor and collect transit vehicle location. Determine real-time schedule adherence to update transit schedules and provide real-time transit information to third party ISPs and the public users. • **On-board Transit Trip Monitoring** – Operate and maintain on-board transit vehicle equipment to track and disseminate transit vehicle location information.
Other Regional Transit Providers	• **Transit Center Vehicle Tracking** – Operate and maintain center-based equipment to monitor and collect transit vehicle location. Determine real-time schedule adherence to update transit schedules and provide real-time transit information to third party ISPs and the public users. • **On-board Transit Trip Monitoring** – Operate and maintain on-board transit vehicle equipment to track and disseminate transit vehicle location information.

Transit Fixed Route Operations

This service package performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. Additionally, this service determines the transit vehicle trip performance against the schedule using AVL data and provides information displays at the Transit Management agency. Static and real-time transit data are exchanged with ISPs. High-level agency roles and responsibilities for performing this service package are provided in Table 20.

Demand Response Transit Operations

This service package performs automated dispatch and system monitoring primarily for demand responsive transit services. This service performs scheduling activities as well as operator assignment. In addition, this service package performs similar functions to support dynamic features of flexible-route transit services such as monitoring the current status of the transit fleet and supporting allocation of these fleet resources to service incoming requests for transit service while considering traffic conditions. Transit Management provides the necessary data processing and information display to assist the transit operator in making optimal use of the transit fleet. This service includes the capability for a traveler request for personalized transit services to be made through the Information Service Provider Subsystem. The ISP may either be operated by a transit management center or be independently owned and operated by a separate service provider. In the first scenario, the traveler makes a direct request to a specific paratransit service. In the second scenario, a third party service provider determines that the paratransit service is a viable means of satisfying a traveler request and makes a reservation for the traveler. High-level agency roles and responsibilities for performing this service package are provided in Table 21.

Table 20

Agency High-Level Roles and Responsibilities Corresponding to Transit Fixed Route Operations

Primary Agency	Role
Metro Transit	• **Transit Center Fixed Route Operations** – Monitor/operate/maintain owned CAD systems to effectively dispatch and schedule fixed-route transit vehicles to transit routes. Collect and process transit vehicle loading data and other types of transit operational data. Provide ISPs and public users with transit and fare schedules. Collect traffic condition information from regional traffic management agencies and disseminate pertinent information to transit vehicle operators and public users. As required, implement corrective actions to maintain operations. • **On-board Schedule Management** – Monitor/operate/maintain transit vehicle equipment to provide two-way communication between the transit vehicle and the transit center.
Other Regional Transit Providers	• **Transit Center Fixed Route Operations** – Monitor/operate/maintain owned CAD systems to effectively dispatch and schedule fixed-route transit vehicles to transit routes. Collect and process transit vehicle loading data and other types of transit operational data. Provide ISPs and public users with transit and fare schedules. Collect traffic condition information from regional traffic management agencies and disseminate pertinent information to transit vehicle operators and public users. As required, implement corrective actions to maintain operations. • **On-board Schedule Management** – Monitor/operate/maintain transit vehicle equipment to provide two-way communication between the transit vehicle and the transit center.
City of Madison Streets and Engineering	• Provide regional transit agencies with winter maintenance activity information and status and construction work zone activities and status affecting the road network.
Dane County Highway Department	• Provide regional transit agencies with winter maintenance activity information and status and construction work zone activities and status affecting the road network.
City of Madison Traffic Engineering	• Provide regional transit agencies with arterial road network conditions and incident information. Provide access to and/or control of City owned and operated CCTV cameras (per agreement).
Other City Traffic Engineering	• Provide regional transit agencies with arterial road network conditions and incident information. Provide access to and/or control of City owned and operated CCTV cameras (per agreement).
WisDOT STOC	• Provide regional transit agencies with freeway road network conditions and incident information. Provide access to and/or control of State owned and operated CCTV cameras (per agreement).

Table 21

Agency High-Level Roles and Responsibilities Corresponding to Demand Response Transit Operations

Participating Agency	Role
Metro Transit	• **Transit Center Paratransit Operations** - Monitor/operate/maintain CAD systems to effectively dispatch and schedule paratransit vehicles to transit routes. Process paratransit trip requests and provide users with real-time operational data. • **On-board Paratransit Operations** - Monitor/operate/maintain paratransit vehicle equipment to provide two-way communication between the transit vehicle and the transit center.
Other Regional Transit Providers	• **Transit Center Paratransit Operations** - Monitor/operate/maintain CAD systems to effectively dispatch and schedule paratransit vehicles to transit routes. Process para-transit trip requests and provide users with real-time operational data. • **On-board Paratransit Operations** - Monitor/operate/maintain paratransit vehicle equipment to provide two-way communication between the transit vehicle and the transit center.
City of Madison Streets and Engineering	• Provide regional transit agencies with winter maintenance activity information and status and construction work zone activities and status affecting the road network.
Dane County Highway Department	• Provide regional transit agencies with winter maintenance activity information and status and construction work zone activities and status affecting the road network.

Participating Agency	Role
City of Madison Traffic Engineering	• Provide regional transit agencies with arterial road network condition and incident information. Provide access to and/or control of City owned and operated CCTV cameras (per agreement).
Other City Traffic Engineering	• Provide regional transit agencies with arterial road network condition and incident information. Provide access to and/or control of City owned and operated CCTV cameras (per agreement).
WisDOT STOC	• Provide regional transit agencies with freeway road network condition and incident information. Provide access to and/or control of State owned and operated CCTV cameras (per agreement).

Transit Fare Collection Management

This service package manages electronic transit fare collection on-board transit vehicles and at transit stops by means of a traveler card or other electronic payment device. Readers located either in the infrastructure or on-board the transit vehicles enable electronic fare payment. Data are processed, stored and displayed on the transit vehicle and communicated as needed to the Transit Management Subsystem. High-level agency roles and responsibilities for performing this service package are provided in Table 22.

Table 22

Agency High-Level Roles and Responsibilities Corresponding to Transit fare Collection Management

Participating Agency	Role
Metro Transit	• Transit Center Fare Management – Operate and maintain center based systems and software that support transit fare collection and reconciliation with financial institutions and enforcement agencies. Notify law enforcement of payment violations. • On-board Transit Fare Management – Operate and maintain transit vehicle fare collection systems. This includes systems that detect fare cards and communications that send collected fare data to the center. Archive the number of payment transactions for use in reporting and confirming transit vehicle boarding and alighting.
Other Regional Transit Providers	• Transit Center Fare Management – Operate and maintain center based systems and software that support transit fare collection and reconciliation with financial institutions and enforcement agencies. Notify law enforcement of payment violations. • On-board Transit Fare Management – Operate and maintain transit vehicle fare collection systems. This includes systems that detect fare cards and communications that send collected fare data to the center. Archive the number of payment transactions for use in reporting and confirming transit vehicle boarding and alighting.

Transit Security

This service package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment, including video (e.g., CCTV cameras), audio systems and/or event recorded system is deployed to perform surveillance. Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are monitored with similar surveillance equipment and equipped with transit user activated alarms. In addition this service package provides surveillance and sensor monitoring (video and/or audio) of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as BRT guideways.

The surveillance and sensor information is transmitted to the Emergency Management Subsystem, as are transit user activated alarms in public secure areas. On-board alarms, activated by transit users or transit vehicle operators are transmitted to both the Emergency Management Subsystem and the Transit Management Subsystem, illustrating two possible approaches to implementing this service package. High-level agency roles and responsibilities for performing this service package are provided in Table 23.

Multimodal Coordination

This service package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Transit transfer information is shared between multimodal transportation service providers and transit agencies to improve connections between modes. This coordination between transit and traffic agencies could also occur through co-location in a multi-agency traffic operations facility. High-level agency roles and responsibilities for performing this service package are provided in Table 24.

Table 23

Agency High-Level Roles and Responsibilities Corresponding to Transit Security

Participating Agency	Role
Metro Transit	• **Transit Center Security** – Monitor systems (i.e., panic buttons or alarms) on-board the transit vehicle to receive reports of emergencies that occur on the transit vehicle. Exchange emergency data (including transit vehicle location) with emergency response agencies, traffic management agencies, the media, third party ISPs and the public. • **On-board Transit Security** – Operate and maintain on-board transit vehicle cameras and download and provide recorded video to law enforcement (immediately upon detected emergency). • **Center Secure Area Surveillance** – Remotely monitor and control video images collected by CCTV cameras located at transit facilities. Download video from CCTV cameras installed onboard transit vehicles and provide pertinent video information to law enforcement agencies upon request.
Other Regional Transit Providers	• **Transit Center Security** – Monitor systems (i.e., panic buttons or alarms) on-board the transit vehicle to receive reports of emergencies that occur on the transit vehicle. Exchange emergency data (including transit vehicle location) with emergency response agencies, traffic management agencies, the media third party ISPs and the public. • **On-board Transit Security** – Operate and maintain on-board transit vehicle cameras and download and provide recorded video to law enforcement (immediately upon detected emergency).
City of Madison Police	• **Emergency Response Management** - Coordinate a response to emergencies reported by transit management agencies.
Other Local Law Enforcement	• **Emergency Response Management** - Coordinate a response to emergencies reported by transit management agencies.
Dane County Public Safety Communications Center	• **Emergency Response Management** - Dispatch appropriate emergency services, resources and vehicles to respond to incidents. Remotely monitor and/or control field equipment normally under the control of traffic management agencies (e.g., CCTV cameras) per agreement.

Table 24

Agency High-Level Roles and Responsibilities Corresponding to Multi-Modal Coordination

Participating Agency	Role
Madison Metro Transit	• **Transit Center Multi-Modal Coordination** – Coordinate transit schedule and services between transit agencies. Provide other transit agencies with transit vehicle running times, locations, estimated time of arrival so as to allow transfers to be made between routes operated by two or more transit agencies. Coordinate with special event venues to provide transit services for special events. • **On-board Schedule Management** – Monitor, operate and maintain transit vehicle equipment to provide two-way communication between the transit vehicle and the transit center.
Other Regional Transit Providers	• **Transit Center Multi-Modal Coordination** – Coordinate transit schedule and services between transit agencies. Provide other transit agencies with transit vehicle running times, locations, estimated time of arrival so as to allow transfers to be made between routes operated by two or more transit agencies. Coordinate with special event venues to provide transit services for special events. • **On-board Schedule Management** – Monitor, operate and maintain transit vehicle equipment to provide two-way communication between the transit vehicle and the transit center.

Transit Traveler Information

This service package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs and real-time transit schedule displays that are of general interest to transit users. Public and private systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package. High-level agency roles and responsibilities for performing this service package are provided in Table 25.

Table 25

Agency High-Level Roles and Responsibilities Corresponding to Transit Traveler Information

Participating Agency	Role
Metro Transit	• Transit Center Information Services – Operate and maintain systems that collect and distribute real-time and static transit service information to transit customers and other ISPs, including the media. • On-board Transit Information Services – Operate and maintain systems located on the transit vehicle that provide general annunciation and/or display of transit information of general interest to the transit user. • ISP Traveler Data Collection – Collect, process and store transit routes and schedules, transit transfer options, transit fares and real-time schedule adherence information. • Personal Interactive Information Reception – Provide transit information to travelers in formats that permit information to be accessed and read from personal computing devices (i.e., smartphones, computers, etc.).
Other Regional Transit Providers	• **Transit Center Information Services** – Operate and maintain systems that collect and distribute real-time and static transit service information to transit customers and other ISPs, including the media. • **On-board Transit Information Services** – Operate and maintain systems located on the transit vehicle that provide general annunciation and/or display of transit information of general interest to the transit user. • ISP Traveler Data Collection – Collect, process and store transit routes and schedules, transit transfer options, transit fares and real-time schedule adherence information. • **Personal Interactive Information Reception** – Provide transit information to travelers in formats that permit information to be accessed and read from personal computing devices (i.e., smartphones, computers, etc.).

Transit Signal Priority

This service package determines the need for transit priority on routes at certain intersections and requests transit vehicle priority at these locations. The signal priority may result from limited local coordination between the transit vehicle and the individual intersection for signal priority or may result from coordination between transit management and TMCs, though the former is more likely option for the Madison Metropolitan Area. Due to fixed timed signals located in the downtown Madison area, transit signal priority, if implemented, would primarily be implemented along BRT corridors. High-level agency roles and responsibilities for performing this service package are provided in Table 26.

Table 26

Agency High-Level Roles and Responsibilities Corresponding to Transit Signal Priority

Participating Agency	Role
Metro Transit	• **On-board Transit Signal Priority** - Operate and maintain transit vehicle systems that provide the capability to request signal priority at equipped signalized intersections. • **Transit Center Signal Priority** – Monitor transit vehicle schedule adherence and communicate with transit vehicle operators to implement corrective actions.
Other Regional Transit Providers	• **On-board Transit Signal Priority** - Operate and maintain transit vehicle systems that provide the capability to request signal priority at equipped signalized intersections. • **Transit Center Signal Priority** – Monitor transit vehicle schedule adherence and communicate with transit vehicle operators to implement corrective actions.
City of Madison Traffic Engineering	• **Roadway Signal Priority** – Operate and maintain traffic signal equipment that is capable of receiving signal priority requests from transit signal priority equipment installed on transit vehicles. • **TMS Signal Control** – Operate and maintain traffic signal equipment to monitor operational status of transit signal priority equipment and to detect fault data.
Other City Traffic Engineering	• **Roadway Signal Priority** – Operate and maintain traffic signal equipment that is capable of receiving signal priority requests from transit signal priority equipment installed on transit vehicles. • **TMS Signal Control** – Operate and maintain traffic signal equipment to monitor operational status of transit signal priority equipment and to detect fault data.

Transit Passenger Counting

This service package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops. This information in turn can be used in performance monitoring and reporting and/or to identify locations where transit improvements can be strategically implemented. High-level agency roles and responsibilities for performing this service package are provided in Table 27.

Multimodal Connection Protection

This service package will support the coordination of multimodal services to minimize the travel time of travelers as they move from mode to mode (or to different routes within a single mode). Implementation of this service package in Madison would likely begin with protecting connections of routes of a single agency and evolving to include routes between transit agencies. High-level agency roles and responsibilities for performing this service package are provided in Table 28.

Table 27

Agency High-Level Roles and Responsibilities Corresponding to Transit Passenger Counting

Participating Agency	Role
Metro Transit	• **Transit Center Passenger Counting** - Operate and maintain center based equipment and software that is capable of receiving and processing transit vehicle loading data. Calculate transit ridership data by route, route segment, transit stop, time of day and day of week. • **On-board Passenger Counting** – Operate and maintain transit vehicle equipment that is capable of collecting, timestamping and transmitting transit vehicle loading data to the transit management center.
Other Regional Transit Providers	• **Transit Center Passenger Counting** - Operate and maintain center based equipment and software that is capable of receiving and processing transit vehicle loading data. • **On-board Passenger Counting** – Operate and maintain transit vehicle equipment that is capable of collecting, timestamping and transmitting transit vehicle loading data to the transit management center. Calculate transit ridership data by route, route segment, transit stop, time of day and day of week.

Table 28

Agency High-Level Roles and Responsibilities Corresponding to Multi-Modal Connection Protection

Participating Agency	Role
Metro Transit	• **Transit Center Connection Protection** – Implement and operate center-based systems and software that manage the coordination of transit transfers between routes. This includes receiving travel profiles and requests for transfers. Share transit schedule coordination information with other regional transit providers. • **On-board Transit Fare Management** – Operate, maintain and manage a fare collection card capable of storing transit rider profiles, including a rider's desired routing and connections. • **On-board Connection Protection** – Operate and maintain transit vehicle equipment that is capable of monitoring vehicle schedule performance in real-time and transmitting this information to the transit management center for processing. Provide operators via on-board equipment with instructions on how to protect connections based on traveler profiles.
Other Regional Transit Providers	• **Transit Center Connection Protection** – Implement and operate center-based systems and software that manage the coordination of transit transfers between routes. This includes receiving travel profiles and requests for transfers. Share transit schedule coordination information with other regional transit providers. • **On-board Transit Fare Management** – Operate, maintain and manage a fare collection card capable of storing transit rider profiles, including a rider's desired routing and connections. • **On-board Connection Protection** – Operate and maintain transit vehicle equipment that is capable of monitoring vehicle schedule performance in real-time and transmitting this information to the transit management center for processing. Provide operators via on-board equipment with instructions on how to protect connections based on traveler profiles.

6.4.3 Traveler Information Concept

The Traveler Information service concept will collect, process, store and disseminate transportation information to system operators and the traveling public. The concept will involve two primary functions. First, it will collect, fuse and repackage traveler information collected by an individual agency and will disseminate this information to other operators for use in their operations. Second, it will disseminate traveler information to subscribers and the public. Information that will be provided include basic advisories, traffic and road conditions, transit schedule information, ridematching information (including bikeshare information) and parking information. The subsystem also provides the capability to provide specific directions to travelers by receiving origin and destination requests from travelers, generating route plans and returning the calculated plans to the users. In addition to general route planning for travelers, the ISP also supports specialized route planning for vehicle fleets. In this third role, the ISP function may be dedicated to, or even embedded within, the dispatch system. Reservation services are also provided in advanced implementations. Depending on the application, the information is provided by the concept may be delivered through personal and mobile computing devices, kiosks, or through systems installed within the vehicle. Both basic one way (broadcast) and personalized two-way information provision may be supported. The ISP is most commonly implemented as an Internet web site (e.g., 511 traveler information website), but it represents any traveler information distribution service including systems that broadcast digital transportation data (e.g., satellite radio networks) and systems that support distribution through Field-Vehicle Communications networks.

In the Madison Metropolitan Area this concept will consist of six service packages. Table 29 identifies these six service packages and maps them to the Regional ITS Goals they work to address. Following Table 29 each service package is described in further detail.

Broadcast Traveler Information

This service package collects traffic conditions, advisories, general public transportation, parking information, incident information, roadway maintenance and construction information, and weather information and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts and Internet web casts. The information may be provided directly to travelers or provided to merchants and other traveler service providers so that they can better inform their customers of travel conditions. Overall, this service provides a wide area digital broadcast service. Successful deployment of this service package relies on availability of real-time traveler information from roadway instrumentation, probe vehicles or other sources. High-level agency roles and responsibilities for performing this service package are provided in Table 30.

Table 29

Regional ITS Goals Met by Traveler Information Service Packages

Service Package	Regional ITS Goals				
	Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/ Maintenance Personnel	Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing	Enhance Transportation System Efficiency and Reliability	Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes	Preserve the Transportation System
Broadcast Traveler Information			+	+	
Interactive Traveler Information	+		+	+	
Dynamic Route Guidance			+	+	
ISP Based Trip Planning and Route Guidance			+	+	
Transportation Operations Data Sharing		+	+	+	
Dynamic Ridesharing			+	+	

Table 30

Agency High-Level Roles and Responsibilities Corresponding to Broadcast Traveler Information

Participating Agency	Role
City of Madison Traffic Engineering	• **Basic Information Broadcast** - Disseminate arterial traffic and road condition information to travelers, including incident information, detours and road closures, event information, recommended routes.
City of Madison Parking Utility	• **Basic Information Broadcast** – Disseminate parking information to travelers, including location, availability and fees.
City of Madison Streets and Engineering	• **Basic Information Broadcast** - Disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.
Dane County Highway Department	• **Basic Information Broadcast** - Disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.
Metro Transit	• **Basic Information Broadcast** – Disseminate transit routes and schedules, transit transfer options, transit fares and real-time schedule adherence information to travelers.
Other Regional Transit Operators	• **Basic Information Broadcast** – Disseminate transit routes and schedules, transit transfer options, transit fares and real-time schedule adherence information to travelers.
WisDOT STOC	• **Basic Information Broadcast** - Disseminate freeway traffic and road condition information to travelers, including incident information, detours and road closures, event information, recommended routes. Disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.
Dane County Public Safety Communications (911)	• Provide incident information to traffic and transit management agencies.
3rd Party Information Sources	• **Basic Information Broadcast** - Disseminate arterial traffic and road condition information to travelers, including incident information, detours and road closures, event information, recommended routes. Disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities. Disseminate weather information to travelers. Disseminate event information to travelers.

Interactive Traveler Information

This service package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications between the traveler and ISP. A variety of interactive devices may be used by the traveler to access information prior to a trip or en-route including phone via a 511-like portal and web pages via kiosk, personal digital assistant, personal computer and a variety of in-vehicle devices. This service package also allows value-added resellers to collect transportation information that can be aggregated and be available to their personal devices or remote traveler systems to better inform their customers of transportation conditions. Successful deployment of this service package relies on availability of real-time transportation data from roadway instrumentation, transit, probe vehicles or other means. A traveler may also input personal preferences and identification information via a "traveler card" that can convey information to the system about the traveler as well as receive updates from the system so the card can be updated over time. High-level agency roles and responsibilities for performing this service package are provided in Table 31.

Table 31

Agency High-Level Roles and Responsibilities Corresponding to Interactive Traveler Information

Participating Agency	Role
City of Madison Parking Utility	• **Interactive Infrastructure Information** – Disseminate customized parking information to travelers and other ISPs (per agreement), including location, availability and fees upon request.
City of Madison Traffic Engineering	• **Interactive Infrastructure Information** – Disseminate customized traffic information to travelers and other ISPs (per agreement), including road network conditions, incident information and traffic images upon request.
Other City Traffic Engineering	• **Interactive Infrastructure Information** – Disseminate customized traffic information to travelers and other ISPs (per agreement), including road network conditions, incident information and traffic images upon request.
WisDOT STOC	• **ISP Traveler Data Collection** – Collect traveler-information data from other centers, quality check the data and disseminate it to the public (via 511 web and telephony). Information includes but may not be limited to traffic and highway condition information, maintenance and construction information, parking information and current and forecast weather conditions. • **Interactive Infrastructure Information** – Disseminate customized traveler freeway information to travelers and other ISPs (per agreement). Provide traveler and incident information to the media.
City of Madison Streets and Engineering	• **Basic Information Broadcast** - Disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.
Metro Transit	• **Basic Information Broadcast** – Disseminate transit routes and schedules, transit transfer options, transit fares and real-time schedule adherence information to travelers.
Dane County Highway Department	• **Basic Information Broadcast** - Disseminate maintenance and construction information to travelers, including scheduled maintenance and construction work activities and work zone activities.
Dane County Public Safety Communications (911)	• Provide incident information to traffic and transit management agencies.

Autonomous Route Guidance

This service package relies on in-vehicle sensory, location determination, computational, map database and interactive driver interface equipment to enable route planning and detailed route guidance based on static, stored information. No communication with the infrastructure is assumed or required. Identical capabilities are available to the traveler outside the vehicle by integrating a similar suite of equipment into portable devices. This service package would represent functions similar to a personal electronic navigation device. To this extent, the primary roles and responsibilities for implementing this concept fall directly on private entities (automobile and smart device manufacturers), although public agencies such as WisDOT may ultimately enter into partnerships with private entities to share and integrate state static road data with private entity databases for the purpose of providing the public with a more robust dataset.

Dynamic Route Guidance

This service package offers advanced route planning and guidance that is responsive to current conditions. The package combines the autonomous route guidance user equipment with a digital receiver capable of receiving real-time traffic, transit and road condition information, which is considered by the user equipment in provision of route guidance. High-level agency roles and responsibilities for performing this service package are provided in Table 32.

Table 32

Agency High-Level Roles and Responsibilities Corresponding to Dynamic Route Guidance

Participating Agency	Role
WisDOT STOC	• **ISP Traveler Data Collection** – Collect traveler-information data from other centers, quality check the data and disseminate it to the public (via 511 web and telephone). Information includes but may not be limited to traffic and highway condition information, maintenance and construction information, parking information and current and forecast weather conditions. Share information with private ISPs (per agreement).
City of Madison Transit	• **ISP Traveler Data Collection** – Collect transit traveler-information data and disseminate them to the public (via website, apps and third party ISPs). Information includes but may not be limited to transit fares, schedules and schedule adherence information.

ISP Based Trip Planning and Route Guidance

This service package offers the user trip planning and en-route guidance services. It generates a trip plan, including a multimodal route and associated service information (e.g., parking information), based on traveler preferences and constraints. Routes may be based on static information or reflect real-time network conditions. The trip plan may be confirmed by the traveler and advanced payment and reservations for transit and alternate mode (e.g., airline, rail and ferry) trip segments and ancillary services (e.g., parking reservations) are accepted and processed. The confirmed trip plan may include specific routing information that can be supplied to the traveler as general directions or as turn-by-turn route guidance depending on the level of user equipment. High-level agency roles and responsibilities for performing this service package are provided in Table 33.

Table 33

Agency High-Level Roles and Responsibilities Corresponding to ISP Based Trip Planning and Route Guidance

Participating Agency	Role
City of Madison Parking Utility	• **Infrastructure Provided Trip Planning** – Monitor, operate and maintain systems that receive requests to reserve parking spaces and to collect payment for them. Monitor, operate and maintain systems that provide users with a trip plan containing parking reservation information. Provide users with directions to parking facilities.
UW-Madison Transportation Services	• **Infrastructure Provided Trip Planning** – Monitor, operate and maintain systems that receive requests to reserve parking spaces and to collect payment for them. Monitor, operate and maintain systems that provide users with a trip plan containing parking reservation information. Provide users with directions to parking facilities.
Metro Transit	• **Infrastructure Provided Trip Planning** – Monitor, operate and maintain systems that receive requests for transit information and data. Coordinate with and provide data to third party information service providers so that their respective users can plan transit trips. Monitor, operate and maintain systems that provide users with a trip plan containing transit service and schedule information.
City of Madison Maintenance	• Provide parking management agencies with transportation restrictions that may temporality restrict access to parking facilities.

Transportation Operations Data Sharing

This service package makes real-time transportation operations data available to transportation system operators. The ISP collects, processes and stores current information on traffic and travel conditions and other information about the current state of the transportation network and makes this information available to transportation system operators, facilitating the exchange of qualified, real-time information between agencies. Using the provided information, transportation system operators can manage their individual systems based on an overall view of the regional transportation system. The regional transportation operations data resource represented by the ISP may be implemented as a web application that provides a web-based access to system operators, an enterprise database that provides a network interface to remote center applications, or any implementation that supports regional sharing of real-time transportation operations data. High-level agency roles and responsibilities for performing this service package are provided in Table 34.

Dynamic Ridesharing

This service package provides dynamic ridesharing/ride matching services to travelers. This service could allow near real-time ridesharing reservations to be made through the same basic user equipment used for Interactive Traveler Information. This ridesharing/ride matching capability also includes arranging connections to transit or other multimodal services. This service, if implemented within the Madison Metropolitan Area, would likely be implemented by a private entity through an app or similar mechanism. Therefore, public agency roles and responsibilities for implementing this service are not defined and at most will be limited to data and information coordination with private entities.

Table 34

Agency High-Level Roles and Responsibilities Corresponding to Transportation Operations Data Sharing

Participating Agency	Role
WisDOT STOC	• **ISP Traveler Data Collection** – Collect traveler-information data from other centers, quality check the data and disseminate it to the public (via 511 web and telephony). Information includes but may not be limited to freeway traffic and highway condition information, maintenance and construction information and current and forecast weather conditions. Share information with private ISPs (per agreement). • **ISP Operational Data Repository** – Collect and disseminate real-time information on the state of the regional freeway system including current traffic and road conditions, maintenance and construction information, incidents and weather conditions. Operate and maintain a web-side (e.g., 511) where real-time transportation data can be broadcast to system operators within the region.
City of Madison Streets and Engineering	• **MCM Transportation Operations Data Collection** – Collect real-time information on the state of the City transportation system including current traffic and road conditions and maintenance and construction work plans and activities.
Dane County Highway Department	• **MCM Transportation Operations Data Collection** – Collect real-time information on the state of the County transportation system including current traffic and road conditions and maintenance and construction work plans and activities.
City of Madison Traffic Engineering	• **TMC Transportation Operations Data Collection** - Collect real-time information on the state of the City transportation system including current traffic and road conditions, incident information and traffic images.
Other City Traffic Engineering	• **TMC Transportation Operations Data Collection** - Collect real-time information on the state of the City transportation system including current traffic and road conditions, incident information and traffic images.
Dane County Public Safety Communications (911)	• **Emergency Transportation Operations Data Collection** - Collect real-time information on regional incidents including incident severity, location, time and nature of the incident. Update the information as the incident evolves.

6.4.4 Traffic Management

The Traffic Management service concept will allow agencies to monitor and control traffic and the road network. This will be achieved through direct communication with ITS field elements that monitor and manage traffic flow (e.g., traffic detection) and monitor the condition of the roadway (e.g., CCTV cameras). It will include communication with maintenance and construction agencies and departments to maintain the road network and coordinate and adapt to maintenance activities, closures and detours. Incidents will be detected, verified and incident information provided to other agencies, drivers and public and private ISPs. This concept will also support response to and recovery from, incidents ranging from minor traffic incidents through major disasters. Demand management policies, that can alleviate congestion and influence mode selection, will also be considered. Communication will be exchanged with other Traffic Management agencies to coordinate traffic information and control strategies in neighboring jurisdictions.
In the Madison Metropolitan Area this concept will consist of ten service packages. Table 35 identifies these ten service packages and maps them to the Regional ITS Goals they work to address. Following Table 35 each service package is described in further detail.

Table 35

Regional ITS Goals Met by Traffic Management Service Packages

Service Package	Regional ITS Goals				
	Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel	Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing	Enhance Transportation System Efficiency and Reliability	Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes	Preserve the Transportation System
Network Surveillance			+	+	
Traffic Signal Control			+	+	
Traffic Metering			+		
Traffic Information Dissemination	+		+	+	
Regional Traffic Management					
Traffic Incident Management System		+	+		
Transportation Decision Support and Demand Mngt.			+	+	
Parking Facility Management			+	+	
Regional Parking Management			+	+	
Mixed Use Warning Systems	+				

Network Surveillance

This service package includes traffic detectors, other surveillance equipment, the supporting field equipment and fixed-point to fixed-point communications to transmit collected data back to traffic management agencies (e.g., STOC). The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV camera system transmits video to a remote facility). The data generated by this service package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations and collect needed data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and provided to ISPs. High-level agency roles and responsibilities for performing this service package are provided in Table 36.

Table 36

Agency High-Level Roles and Responsibilities Corresponding to Network Surveillance

Participating Agency	Role
Metro Transit	• **Collect Traffic Surveillance** - Monitor, operate and maintain CCTV cameras. • Traffic Equipment Maintenance – Monitor the operational status of ITS equipment and report failures to Maintenance. Archive equipment failure data for use in performance monitoring programs.
City of Madison Traffic Engineering	• **Collect Traffic Surveillance** - Monitor, operate, maintain traffic sensors and store collected data (speed, volume, occupancy). Monitor, operate and maintain CCTV cameras. Provide CCTV camera images and video to local agencies upon request and to the public. Monitor road conditions and identify, verify and disseminate incident information to other allied agencies. • **Traffic Equipment Maintenance** – Monitor the operational status of ITS equipment and report failures to Maintenance. Archive equipment failure data for use in performance monitoring programs.
WisDOT STOC	• **Collect Traffic Surveillance** - Monitor, operate, maintain traffic sensors and store collected data (speed, volume, occupancy). Monitor, operate and maintain CCTV cameras. Provide CCTV camera images and video to local agencies upon request and to the public. Monitor road conditions and identify, verify and disseminate incident information to other allied agencies. • **Traffic Equipment Maintenance** – Monitor the operational status of ITS equipment and report failures to Maintenance. Archive equipment failure data for use in performance monitoring programs.

Traffic Signal Control

This service package provides the central control and monitoring equipment, detectors, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This service package is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real-time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems. High-level agency roles and responsibilities for performing this service package are provided in Table 37.

Table 37

Agency High-Level Roles and Responsibilities Corresponding to Traffic Signal Control

Participating Agency	Role
City of Madison Traffic Engineering	• **Collect Traffic Surveillance** - Monitor, operate, maintain traffic sensors and store collected data (speed, volume, occupancy). Monitor, operate and maintain CCTV cameras. Monitor road conditions and identify, verify and disseminate incident information to other allied agencies. • **TMC Signal Control** – Monitor, operate and remotely control traffic signal controllers. Define, store and modify control plans to coordinate signalized intersections. • **Traffic Equipment Maintenance** – Monitor the operational status of ITS equipment and report failures to Maintenance. Archive equipment failure data for use in performance monitoring programs.
Other City Traffic Engineering	• **Collect Traffic Surveillance** - Monitor, operate, maintain traffic sensors and store collected data (speed, volume, occupancy). Monitor, operate and maintain CCTV cameras. Monitor road conditions and identify, verify and disseminate incident information to other allied agencies. • **TMC Signal Control** – Monitor, operate and remotely control traffic signal controllers. Define, store and modify control plans to coordinate signalized intersections. • **Traffic Equipment Maintenance** – Monitor the operational status of ITS equipment and report failures to Maintenance. Archive equipment failure data for use in performance monitoring programs.
WisDOT SW Region	• **Collect Traffic Surveillance** - Monitor, operate, maintain traffic sensors and store collected data (speed, volume, occupancy). Monitor, operate and maintain CCTV cameras. Monitor road conditions and identify, verify and disseminate incident information to other allied agencies. • **TMC Signal Control** – Monitor, operate and remotely control traffic signal controllers. Define, store and modify control plans to coordinate signalized intersections. • **Traffic Equipment Maintenance** – Monitor the operational status of ITS equipment and report failures to Maintenance. Archive equipment failure data for use in performance monitoring programs.

Traffic Metering

This service package provides central monitoring and control, communications and field equipment that support ramp metering. This package incorporates the instrumentation included in the Network Surveillance service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter. High-level agency roles and responsibilities for performing this service package are provided in Table 38.

Table 38

Agency High-Level Roles and Responsibilities Corresponding to Traffic Metering

Participating Agency	Role
WisDOT STOC	• TMC Traffic Metering – Monitor, operate and remotely control ramp meters. Collect operational status of ramp meters. • Traffic Equipment Maintenance – Monitor the operational status of ITS equipment and report failures to Maintenance. Archive equipment failure data for use in performance monitoring programs.

Traffic Information Dissemination

This service package provides driver information using roadway equipment such as DMS. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. High-level agency roles and responsibilities for performing this service package are provided in Table 39.

Table 39

Agency High-Level Roles and Responsibilities Corresponding to Traffic Information Dissemination

City of Madison Traffic Engineering	• **TMC Traffic Information Dissemination** – Disseminate traffic and road condition, closure, incident and other traffic-related data (i.e., traffic images, video and data) to allied agencies, media and the public. Distributed traffic information can be either filtered or raw, depending on the audience. Communicate with MCM entities to collect roadway restrictions stemming from maintenance and construction activity.
Other City Traffic Engineering	• **TMC Traffic Information Dissemination** – Disseminate traffic and road condition, closure, incident and other traffic-related data (i.e., traffic images, video and data) to allied agencies, media and the public. Distributed traffic information can be either filtered or raw, depending on the audience. Communicate with MCM entities to collect roadway restrictions stemming from maintenance and construction activity.
WisDOT STOC	• **TMC Traffic Information Dissemination** – Disseminate traffic and road condition, closure, incident and other traffic-related data (i.e., traffic images, video and data) to allied agencies, media and the public. Monitor, operate and remotely control DMS, HAR for dissemination of traffic and other information to drivers. Distributed traffic information can be either filtered or raw, depending on the audience. Communicate with MCM entities to collect roadway restrictions stemming from maintenance and construction activity • **Roadway Traffic Information Dissemination** –Monitor, operate and maintain freeway and arterial DMS as well as HAR. This includes any supporting equipment (i.e., beacons and static signing).

Regional Traffic Management

This service package provides for the sharing of traffic information and control among TMCs to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This service package provides the communications links and integrated control strategies that enable integrated, inter-jurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. Several levels of coordination are supported from sharing of information through sharing of control between TMCs. High-level agency roles and responsibilities for performing this service package are provided in Table 40.

Table 40

Agency High-Level Roles and Responsibilities Corresponding to Regional Traffic Management

Participating Agency	Role
City of Madison Traffic Engineering	• **TMC Regional Traffic Management** - Exchange traffic information, including congestion data, traffic data, incident information, signal timing plans and real-time signal control information with other traffic management agencies. Share control of cameras with allied agencies per mutual agreement. • **TMC Signal Control** – Monitor, operate and maintain center based equipment and software that enables remote control of traffic signal controllers. Monitor the operational status of traffic signal controls and document and respond to identified malfunctions and failures. Modify control plans and coordinate traffic signals based on collected historical data and in response to special events and incidents.
Other City Traffic Engineering	• **TMC Regional Traffic Management** - Exchange traffic information, including congestion data, traffic data, incident information, signal timing plans and real-time signal control information with other traffic management agencies. • **TMC Signal Control** – Monitor, operate and maintain center based equipment and software that enables remote control of traffic signal controllers. Monitor the operational status of traffic signal controls and document and respond to identified malfunctions and failures. Modify control plans and coordinate traffic signals based on collected historical data and in response to special events and incidents.
WisDOT STOC	• **TMC Regional Traffic Management** - Exchange traffic information, including congestion data, traffic data, signal timing plans and real-time signal control information with other traffic management agencies. Share control of cameras with allied agencies per mutual agreement.

Traffic Incident Management System

This service package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The service package includes incident detection capabilities through roadside surveillance devices (e.g., CCTV cameras) and through regional coordination with other traffic and incident management agencies. Information from these agencies are collected and correlated by this service package to detect and verify incidents and implement an appropriate response. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, MCM, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between center subsystems. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination service package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information service packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.

WisDOT has recognized the importance of Traffic Incident Management in maintaining the operational safety and efficiency of the state's roadways. In 1995, WisDOT established the Traffic Incident Management Enhancement (TIME) Program as a multi-agency, multi-discipline program, dedicated to:

- Improving responder safety
- Enhancing the safe, quick clearance of traffic incidents
- Supporting prompt, reliable, interoperable communications.

The TIME program should continue to serve as a cornerstone for TIM efforts in the Madison Metropolitan Area and for conducting similar efforts for arterial and local road networks.

High-level agency roles and responsibilities for performing this service package are provided in Table 41.

Table 41

Agency High-Level Roles and Responsibilities Corresponding to Traffic Incident Management System

Participating Agency	Role
City of Madison Traffic Engineering	• **TMC Incident Detection** – Monitor, operate and maintain traffic sensor and surveillance systems that support incident detection and verification. Monitor regional alerting and advisory systems to disseminate severe weather or other emergency situation information to other allied agencies and the public. Monitor the operational status sensor and surveillance systems and notify maintenance when devices need repair. • **TMC Incident Dispatch Coordination/Communication** – Dispatch emergency response and service vehicles to incidents. Collect performance measures such as incident response and clearance times. Provide road network conditions and traffic images/ video (and control to these systems per agreement) to emergency management, maintenance and construction and travel ISPs. Coordinate with emergency management and MCM on resources required to aid in incident management response.
Other City Traffic Engineering	• **TMC Incident Detection** – Monitor, operate and maintain traffic sensor and surveillance systems that support incident detection and verification. Monitor regional alerting and advisory systems to disseminate severe weather or other emergency situation information to other allied agencies and the public. Monitor the operational status sensor and surveillance systems and notify maintenance when devices need repair. • **TMC Incident Dispatch Coordination/Communication** – Dispatch emergency response and service vehicles to incidents. Collect performance measures such as incident response and clearance times. Provide road network conditions to emergency management, maintenance and construction and travel ISPs. Coordinate with emergency management and MCM on resources required to aid in incident management response.
WisDOT STOC	• **TMC Incident Detection** – Monitor, operate and maintain traffic sensor and surveillance systems that support incident detection and verification. Monitor regional alerting and advisory systems to disseminate severe weather or other emergency situation information to other allied agencies and the public. • **TMC Incident Dispatch Coordination/Communication** – Dispatch emergency response and service vehicles to incidents. Collect performance measures such as incident response and clearance times. Provide road network conditions and traffic images/ video (and control to these systems per agreement) to emergency management, maintenance and construction and travel ISPs. Coordinate with emergency management and MCM on resources required to aid in incident management response.
City of Madison Streets and Engineering	• **Maintenance and Construction Management Incident Management** - Coordinate with emergency, traffic and other maintenance management agencies to provide maintenance and construction resources to implement response plans, assist in clean up and verify an incident. Provide these agencies with road network status assessment and on-going work zone information including damage sustained to the road, estimate of remaining capacity, required closures, alternate routes, necessary restrictions and timeframe for repair and recovery.
Dane County Highway Department	• **Maintenance and Construction Management Incident Management** - Coordinate with emergency, traffic and other maintenance management agencies to provide maintenance and construction resources to implement response plans, assist in clean up and verify an incident. Provide these agencies with road network status assessment and on-going work zone information including damage sustained to the road, estimate of remaining capacity, required closures, alternate routes, necessary restrictions and timeframe for repair and recovery.
City of Madison Police/Fire	• **Incident Command** – Provide tactical decision support, resource coordination and communication integration for local management of incidents. Communicate incident, traffic, road condition and possible evacuation route information to other law enforcement, emergency management, transportation and other allied agencies. Monitor, operate and maintain on-board EV equipment to track EV location in real-time. • **Emergency Response Management** - Implement a response to reported emergencies and coordinate activities with traffic, transit, maintenance and construction and other emergency management agencies. Control CCTV camera systems typically operated by regional traffic management agencies, per mutual agreement. Provide information to the media concerning the status of an emergency response.

Participating Agency	Role
Other City Police/Fire	• **Incident Command** – Provide tactical decision support, resource coordination and communication integration for local management of incidents. Communicate incident, traffic, road condition and possible evacuation route information to other law enforcement, emergency management, transportation and other allied agencies. Monitor, operate and maintain on-board EV equipment to track EV location in real-time. • **Emergency Response Management** - Implement a response to reported emergencies and coordinate activities with traffic, transit, maintenance and construction and other emergency management agencies. Control CCTV camera systems typically operated by regional traffic management agencies, per mutual agreement. Provide information to the media concerning the status of an emergency response.
Dane County Sheriff's Department	• **Incident Command** – Provide tactical decision support, resource coordination and communication integration for local management of incidents. Communicate incident, traffic, road condition and possible evacuation route information to other law enforcement, emergency management, transportation and other allied agencies. Monitor, operate and maintain on-board EV equipment to track EV location in real-time. • **Emergency Response Management** - Implement a response to reported emergencies and coordinate activities with traffic, transit, maintenance and construction and other emergency management agencies. Control CCTV camera systems typically operated by regional traffic management agencies, per mutual agreement. Provide information to the media concerning the status of an emergency response.

Transportation Decision Support and Demand Management

This service package recommends courses of action to traffic operations personnel based on an assessment of current and forecast road network performance. Recommendations may include predefined incident response plans and regional surface street and freeway control strategies that correct network imbalances. This service package may also recommend transit and parking strategies to influence traveler route and mode choices to support travel demand management (TDM) programs and policies. Traffic data is collected from sensors and surveillance equipment as well as other transportation management centers. Forecasted traffic loads are derived from historical data and route plans supplied by the ISP Subsystem. High-level agency roles and responsibilities for performing this service package are provided in Table 42.

Table 42

Agency High-Level Roles and Responsibilities Corresponding to Transportation Decision Support and Demand Management

Participating Agency	Role
City of Madison Parking Utility	• Implement variable parking rates to increase/decrease demand for parking facilities based on expected traffic volumes adjacent to parking structures.
UW-Madison Transportation Services Parking Department	• Implement variable parking rates to increase/decrease demand for parking facilities based on expected traffic volumes adjacent to parking structures.
City of Madison Traffic Engineering	• **TMC Traffic Management Decision Support** – Define incident management plans and signal timing plans for location specific incidents. Monitor, operate and maintain DMS/HAR for incident routing. Provide allied agencies with recommendations as to the routes to take in response to location specific incidents. Disseminate road network conditions and traffic images to allied agencies (per agreement) and the public. Collect special event plans for special event venues in an effort manage traffic demand during special events. • **TMC Traffic Network Performance Evaluation** – Monitor, operate and maintain traffic sensors and analyze collected data to support overall network performance evaluations and to predict travel demand patterns. Exchange traffic information with other traffic management agencies, including incidents, congestion data, traffic data, signal timing plans and real-time signal control information. • **TMC Demand Management Coordination** – Send requests to parking management agencies to change the current parking lot charging structure in an effort to manage overall transportation demand.

Participating Agency	Role
Other City Traffic Engineering	• **TMC Traffic Management Decision Support** – Define incident management plans and signal timing plans for location specific incidents. Monitor, operate and maintain DMS/HAR for incident routing. Provide allied agencies with recommendations as to the routes to take in response to location specific incidents. Disseminate road network conditions and traffic images to allied agencies (per agreement) and the public. Collect special event plans for special event venues in an effort manage traffic demand during special events. • **TMC Traffic Network Performance Evaluation** – Monitor, operate and maintain traffic sensors and analyze collected data to support overall network performance evaluations and to predict travel demand patterns. Exchange traffic information with other traffic management agencies, including incidents, congestion data, traffic data, signal timing plans and real-time signal control information. • **TMC Demand Management Coordination** – Send requests to parking management agencies to change the current parking lot charging structure in an effort to manage overall transportation demand.
WisDOT STOC	• **TMC Traffic Management Decision Support** – Define incident management plans and signal timing plans for location specific incidents. Monitor, operate and maintain DMS/HAR for incident routing. Provide allied agencies with recommendations as to the routes to take in response to location specific incidents. • **TMC Traffic Network Performance Evaluation** – Monitor, operate and maintain traffic sensors and analyze collected data to support overall network performance evaluations and to predict travel demand patterns. Exchange traffic information with other traffic management agencies, including incidents, congestion data and traffic data.
WisDOT SW Region	• **TMC Traffic Network Performance Evaluation** – Monitor, operate and maintain traffic sensors and analyze collected data to support overall network performance evaluations and to predict travel demand patterns. Exchange signal timing plans and real-time signal control information with traffic management agencies.

Parking Facility Management

This service package provides enhanced monitoring and management of parking facilities. It assists in the management of parking operations, coordinates with transportation authorities and supports electronic collection of parking fees. This service package collects current parking status, shares this data with ISPs and Traffic Management and collects parking fees using the same in-vehicle equipment utilized for electronic toll collection or contact or proximity traveler cards used for electronic payment. High-level agency roles and responsibilities for performing this service package are provided in Table 43.

Table 43

Agency High-Level Roles and Responsibilities Corresponding to Parking Facility Management

Participating Agency	Role
City of Madison Parking Utility	• **Parking Management** - Monitor, operate and maintain ITS sensors that have the capability to detect, count and classify vehicles at entrance, exits and designated locations within a parking facility. Monitor, operate and maintain DMS that display message to travelers such as the parking lot state, number of spaces available and current charges. • **Parking Electronic Payment** – Monitor, operate and maintain parking payment instruments (field devices and payment cards) that collect payment and data on payment transactions including payment violations, images of the violator and vehicle registration data. Provide information on the financial transaction (success/failure, violations and payment instruments) to users, law enforcement and financial institutions. Provide users the option of paying to reserve parking in advance of arriving at the parking facility. Provide payment requests and collect transaction status information from financial institutions. • **Vehicle /Parking Interface** – In the future, provide dedicated short range communications (DSRC) upstream of parking facilities to provide parking information to on-board vehicle equipment and to collect payment from instruments installed within the vehicle.
Dane County Public Works, Highway & Transportation Department	• **Parking Management** - Monitor, operate and maintain ITS sensors that have the capability to detect, count and classify vehicles at entrance, exits and designated locations within a parking facility. Monitor, operate and maintain DMS that display message to travelers such as the parking lot state, number of spaces available and current charges. • **Parking Electronic Payment** – Monitor, operate and maintain parking payment instruments (field devices and payment cards) that collect payment and data on payment transactions including payment violations, images of the violator and vehicle registration data. Provide information on the financial transaction (success/failure, violations payment requests and payment instruments) to users, law enforcement and financial institutions. Provide users the option of paying to reserve parking in advance of arriving at the parking facility. Provide payment requests and collect transaction status information from financial institutions. • **Vehicle /Parking Interface** – In the future, provide DSRC upstream of parking facilities to provide parking information to on-board vehicle equipment and to collect payment from instruments installed within the vehicle.
UW Transportation Services Department	• **Parking Management** - Monitor, operate and maintain ITS sensors that have the capability to detect, count and classify vehicles at entrance, exits and designated locations within a parking facility. Monitor, operate and maintain DMS that display message to travelers such as the parking lot state, number of spaces available and current charges. • **Parking Electronic Payment** – Monitor, operate and maintain parking payment instruments (field devices and payment cards) that collect payment and data on payment transactions including payment violations, images of the violator and vehicle registration data. Provide information on the financial transaction (success/failure, violations and payment instruments) to users, law enforcement and financial institutions. Provide users the option of paying to reserve parking in advance of arriving at the parking facility. Provide payment requests and collect transaction status information from financial institutions. • **Vehicle /Parking Interface** – In the future, provide DSRC upstream of parking facilities to provide parking information to on-board vehicle equipment and to collect payment from instruments installed within the vehicle.

Regional Parking Management

This service package supports communication and coordination between equipped parking facilities and traffic management systems. This service package also shares information with ISPs 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. High-level agency roles and responsibilities for performing this service package are provided in Table 44.

Table 44

Agency High-Level Roles and Responsibilities Corresponding to Regional Parking Management

Participating Agency	Role
City of Madison Parking Utility	• **Parking Coordination** – Disseminate parking information and data with regional traffic management agencies in support of demand management programs implemented within the region. Disseminate parking information and availability with the public and to third party ISPs to support travel planning and parking reservations.
Dane County Public Works, Highway & Transportation Department	• **Parking Coordination** –Disseminate parking information and availability with the public and to third party ISPs to support travel planning and parking reservations.
UW Transportation Services Department	• **Parking Coordination** – Disseminate parking information and data with regional traffic management agencies in support of demand management programs implemented within the region. Disseminate parking information and availability with the public and to third party ISPs to support travel planning and parking reservations.

Mixed Use Warning Systems

This service package supports the sensing and warning systems used to interact with pedestrians, bicyclists and other vehicles that operate on the main vehicle roadways, or on pathways which intersect the main vehicle roadways. These systems could allow automated warning or active protection for this class of users. High-level agency roles and responsibilities for performing this service package are provided in Table 45.

Table 45

Agency High-Level Roles and Responsibilities Corresponding to Mixed Use Warning Systems

Participating Agency	Role
City of Madison Traffic Engineering	• **Roadway Mixed Use Sensing** - Monitor, operate and maintain technologies that detect and respond to the presence of pedestrians or bicyclists that need to cross arterials at non-signalized intersections. • **Roadway Warning** – Monitor, operate and maintain technologies that warn drivers to the downstream presence of pedestrians or bicyclists that have requested to cross the arterial. • **TMC Roadway Warning** – Monitor the operational status of roadway warning equipment and maintain a log of fault reports. • **TMC Signal Control** – Remotely control traffic signal controllers and implement timing plans in response to incidents. Collect traffic signal controller operational status.
Other City Traffic Engineering	• **Roadway Mixed Use Sensing** - Monitor, operate and maintain technologies that detect and respond to the presence of pedestrians or bicyclists that need to cross arterials at non-signalized intersections. • **Roadway Warning** – Monitor, operate and maintain technologies that warn drivers to the downstream presence of pedestrians or bicyclists that have requested to cross the arterial. • **TMC Roadway Warning** – Monitor the operational status of roadway warning equipment and maintain a log of fault reports. • **TMC Signal Control** – Remotely control traffic signal controllers and implement timing plans in response to incidents. Collect traffic signal controller operational status.
WisDOT SW Region	• **Roadway Mixed Use Sensing** - Monitor, operate and maintain technologies that detect and respond to the presence of pedestrians or bicyclists that need to cross arterials at non-signalized intersections. • **Roadway Warning** – Monitor, operate and maintain technologies that warn drivers to the downstream presence of pedestrians or bicyclists that have requested to cross the arterial. • **TMC Roadway Warning** – Monitor the operational status of roadway warning equipment and maintain a log of fault reports. • **TMC Signal Control** – Remotely control traffic signal controllers and implement timing plans in response to incidents. Collect traffic signal controller operational status.

6.4.5 Emergency Management

The Emergency Management system concept consists of those functions or service packages that support public safety, emergency management, incident management, disaster response and evacuation, security monitoring and other security and public safety-oriented ITS applications. The concept will include functions associated with public safety communications centers including public safety call taker and dispatch centers operated by police (including university police), fire and emergency medical services (EMS). It includes the functions associated with EOC that are activated at local, regional, state and federal levels for emergencies. This concept also represents other allied systems including centers associated with towing and recovery, freeway service patrols, HAZMAT response teams and mayday service providers.

This concept will include sensor and surveillance equipment used to enhance transportation security of the roadway infrastructure and the public transportation system. It will also monitor alerts, advisories and other threat information and prepare for and respond to identified emergencies. The concept tracks and manages EV fleets using real-time road network status and routing information from the other center subsystems to aide in selecting the EV(s) and routes that will provide the timeliest response. Interface with the Traffic Management Subsystem allows strategic coordination in tailoring traffic control to support EV ingress and egress, implementation of special traffic restrictions and closures, evacuation traffic control plans and other special strategies that adapt the transportation system to better meet the unique demands of an emergency.

In the Madison Metropolitan Area this concept will consist of four service packages. Table 46 identifies these four service packages and maps them to the Regional ITS Goals they work to address. Following the Table 46 each service package is described in further detail.

Table 46

Regional ITS Goals Met by Emergency Management Service Packages

Service Package	Regional ITS Goals				
	Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel	Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing	Enhance Transportation System Efficiency and Reliability	Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes	Preserve the Transportation System
Emergency Call-Taking and Dispatch	+	+	+	+	
Emergency Routing	+	+	+		
Roadway Service Patrols	+	+	+	+	
Wide-Area Alert	+				

Emergency Call-Taking and Dispatch

This service package provides basic public safety call-taking and dispatch services. It includes EV equipment, equipment used to receive and route emergency calls and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Subsystems supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Subsystem and an EV supports dispatch and provision of information to responding personnel. High-level agency roles and responsibilities for performing this service package are provided in Table 47.

Table 47

Agency High-Level Roles and Responsibilities Corresponding to Emergency Call-Taking and Dispatch

Participating Agency	Role
Dane County Public Safety Communication Center	• **Emergency Dispatch** – Monitor, operate and maintain technologies that are used to track the real-time location of and dispatch allied agency EVs to an incident location. Initiate request for viewing or remote control of outside agency traffic surveillance devices. • **Emergency Call-taking** - Monitor, operate and maintain technologies that are able to receive incident information from motorist call boxes, mayday service providers, general calls made by the public.
UW-Madison Police Department Communications Center	• **Emergency Dispatch** – Monitor, operate and maintain technologies that are used to track the real-time location of and dispatch allied agency EVs to an incident location. Initiate request for viewing or remote control of outside agency traffic surveillance devices. • **Emergency Call-taking** - Monitor, operate and maintain technologies that are able to receive incident information from motorist call boxes, mayday service providers and general calls made by the public.
City of Madison Police Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the EV that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
City of Madison Fire Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the EV that tracks the emergency vehicle's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
UW-Madison Police Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the emergency vehicle that tracks the emergency vehicle's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
Other City Police Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the emergency vehicle that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
Other Fire Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the EV that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
City of Madison Traffic Engineering	• Provide allied emergency management agencies with access to arterial CCTV images and/or control of owned CCTV cameras (per agreement).
Other City Traffic Engineering	• Provide allied emergency management agencies with access to arterial CCTV images and/or control of owned CCTV cameras (per agreement).
WisDOT STOC	• Provide allied emergency management agencies with access to freeway CCTV images and/or control of owned CCTV cameras (per agreement).

Emergency Routing

This service package supports automated vehicle location and dynamic routing of EVs by providing traffic information, road conditions and suggested routing information. Special priority or other specific emergency traffic control strategies can be coordinated to improve the safety and time-efficiency of responding vehicle travel on the selected route(s). The Emergency Management Subsystem provides the routing for the emergency fleet based on real-time conditions and has the option of requesting a route from the Traffic Management subsystem. The EV may also be equipped with DSRC for local signal preemption and the transmission of alerts to surrounding vehicles. High-level agency roles and responsibilities for performing this service package are provided in Table 48.

Table 48

Agency High-Level Roles and Responsibilities Corresponding to Emergency Routing

Participating Agency	Role
City of Madison Traffic Engineering	• **TMC Signal Control** – Monitor, operate and control traffic signal pre-emption equipment located at signalized intersections. • **TMC Incident Dispatch Coordination/Communication** – Exchange incident and road condition information to emergency management agencies. Support requests for CCTV camera images and or provide control of CCTV cameras per mutual agreement with allied agencies. Coordinate in the planning for incidents with emergency management agencies.
WisDOT SW Region	• **TMC Signal Control** – Monitor, operate and control traffic signal pre-emption equipment located at signalized intersections. • **TMC Incident Dispatch Coordination/Communication** – Exchange incident and road condition information to emergency management agencies. Support requests for CCTV camera images and or provide control of CCTV cameras per mutual agreement with allied agencies. Coordinate in the planning for incidents with emergency management agencies.
Other City Traffic Engineering	• **TMC Signal Control** – Monitor, operate and control traffic signal pre-emption equipment located at signalized intersections.
Dane County Public Safety Communication Center	• **Emergency Routing** – Collect traffic, road condition and road construction information from traffic and maintenance management agencies. Calculate and communicate EV routes based on real-time traffic, road and construction information.
City of Madison Police Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the EV that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
City of Madison Fire Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the EV that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
UW-Madison Police Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the emergency vehicle that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
Other City Police Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the EV that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.
Other Fire Department	• **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the EV that tracks the EV's location and that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs, radio communications and traffic signal pre-emption equipment.

Roadway Service Patrols

This service package supports roadway service patrol vehicles that monitor roads that aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The service package will monitor Dane County FST vehicle locations and support vehicle dispatch to identified incident locations. Incident information collected by the FST is shared with traffic, maintenance and construction and traveler information systems. High-level agency roles and responsibilities for performing this service package are provided in Table 49.

Table 49

Agency High-Level Roles and Responsibilities Corresponding to Roadway Service Patrols

Participating Agency	Role
WisDOT STOC	• **Service Patrol Management** – Monitor, operate and maintain technologies that are used to track the real-time location of and dispatch freeway service patrol vehicles. Share incident information collected by the service patrol with allied agencies and to ISPs for public consumption. • **On-board EV En Route Support** – Monitor, operate and maintain technologies located on the service patrol vehicle that track the vehicle's location in real-time. • **On-board EV Incident Management Communication** – Monitor, operate and maintain technologies that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs and radio communications.
Dane County FST	• **On-board EV En route Support** – Monitor, operate and maintain FST on-board technologies. These technologies include those that allow the FST driver and TMC operator to communicate, in real-time as well as those that track the FST vehicle location so that TMC operators can dispatch and route vehicles to incidents. • **On-board EV Incident Management Communication** - Monitor, operate and maintain technologies that allow communication to occur between the vehicle and the center and between the vehicle and roadway equipment. This includes MDTs and radio communications.

Wide Area Alert

This service package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the EAS. When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, ISPs and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as DMS, HARs, in-vehicle displays, transit displays, 511 traveler information systems and traveler information web sites. High-level agency roles and responsibilities for performing this service package are provided in Table 50.

Table 50

Agency High-Level Roles and Responsibilities Corresponding to Wide Area Alert

Participating Agency	Role
WisDOT STOC	• **Roadway Traffic Information Dissemination** - Monitor, operate and maintain field devices that are used to provide information to drivers. This includes DMS and HAR. Monitor operational status of field devices and record device fault data for performance monitoring.
City of Madison Engineering	• **MCM Incident Management** – Provide work zone activities affecting the road network to traffic management and emergency management agencies. Assist in incident recovery, clean-up and notification.
Dane County Highway Department	• **MCM Incident Management** – Provide work zone activities affecting the road network to traffic management and emergency management agencies. Assist in incident recovery, clean-up and notification.
Metro Transit	• **Transit Center Information Services** – Monitor, operate and maintain ITS devices that collect transit advisory data and transit traveler service information and provide this information to the media, other ISPs and the general public. • **Transit Center Security** - Provide law enforcement with incident information including recorded video from cameras installed on-board transit vehicles and located at transit shelters. Monitor, operate and maintain transit vehicle ITS devices. This includes the aforementioned cameras as well as MDTs and operator alarms. • **Remote Transit Information Services** – Monitor, operate and maintain ITS information systems located either on the transit vehicle or at transit shelters that provide users with real-time transit and travel related information and alerts.
Other Regional Transit Agencies	• **Transit Center Information Services** – Monitor, operate and maintain ITS devices that collect transit advisory data and transit traveler service information and provide this information to the media, other ISPs and the general public. • **Transit Center Security** - Provide law enforcement with incident information including recorded video from cameras installed on-board transit vehicles and located at transit shelters. Monitor, operate and maintain transit vehicle ITS devices. This includes the aforementioned cameras as well as MDTs and operator alarms. • **Remote Transit Information Services** – Monitor, operate and maintain ITS information systems located either on the transit vehicle or at transit shelters that provide users with real-time transit and travel related information and alerts.

6.4.6 Maintenance and Construction Management

The Maintenance and Construction Management Subsystem concept will monitor and manage roadway infrastructure construction and maintenance activities. Representing both public agencies and private contractors that provide these functions, this concept manages fleets of maintenance, construction, or special service vehicles (e.g., snow and ice control equipment). Systems falling under this concept receive a wide range of status information from these vehicles and perform vehicle dispatch, routing and resource management for the vehicle fleets and associated equipment. The subsystem participates in incident response by deploying maintenance and construction resources to an incident scene, in coordination with other center subsystems. The subsystem manages equipment at the roadside, including environmental sensors and automated systems that monitor and mitigate adverse road and surface weather conditions. The subsystem manages the repair and maintenance of both non-ITS and ITS equipment including the traffic controllers, detectors, DMS, signals and other equipment associated with the roadway infrastructure. Additional interfaces to weather information providers (the weather service and surface transportation weather service providers) provide current and forecast weather information that can be fused with other data sources and used to support advanced

decision support systems that increase the efficiency and effectiveness of maintenance and construction operations.

Maintenance and construction systems remotely monitor and manage ITS capabilities in work zones, gathering, storing and disseminating work zone information to other systems. It manages traffic in the vicinity of the work zone and advises drivers of work zone status (either directly at the roadside or through an interface with the Information Service Provider or Traffic Management subsystems.) It schedules and manages the location and usage of maintenance assets (such as portable DMS).

In the Madison Metropolitan Area this concept will consist of seven service packages. Table 50 identifies these seven service packages and maps them to the Regional ITS Goals they work to address. Following the table each service package is described in further detail.

Maintenance and Construction Vehicle and Equipment Tracking

This service package will track the location of maintenance and construction vehicles (MCV's) and other equipment to ascertain the progress of their activities. These activities can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations. High-level agency roles and responsibilities for performing this service package are provided in Table 51.

Table 51

Agency High-Level Roles and Responsibilities Corresponding to Maintenance and Construction Vehicle and Equipment Tracking

Participating Agency	Role
City of Madison Streets and Engineering	• **MCM Vehicle Tracking** – Monitor, operate and maintain center based ITS equipment and software that is used to automatically locate and map the location of maintenance vehicles. • **MCV Vehicle Location Tracking** – Monitor, operate and maintain vehicle-based ITS equipment that is used to track the real-time location of the maintenance vehicle.
Dane County Highway Department	• **MCM Vehicle Tracking** – Monitor, operate and maintain center based ITS equipment and software that is used to automatically locate and map the location of maintenance vehicles. • **MCV Vehicle Location Tracking** – Monitor, operate and maintain vehicle-based ITS equipment that is used to track the real-time location of the maintenance vehicle.

Road Weather Data Collection

This service package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway (or guideway in the case of transit related rail systems). In addition to fixed sensor stations at the roadside, sensing of the roadway environment can also occur from sensor systems located on MCVs. The collected environmental data is used by the Weather Information Processing and Distribution service package to process the information and make decisions on operations. The collected environmental data may be aggregated, combined with data attributes and sent to meteorological systems for data qualification and further data consolidation. The service package may also request and receive qualified data sets from meteorological systems. High-level agency roles and responsibilities for performing this service package are provided in Table 52.

Table 52

Agency High-Level Roles and Responsibilities Corresponding to Road Weather Data Collection

Participating Agency	Role
WisDOT STOC	• **TMC Environmental Monitoring** – Monitor, operate and maintain center-based equipment and software used to control environmental sensors. This includes sensors located along the roadside that measure road pavement and atmospheric environmental conditions. • **Roadway Environmental Monitoring** - Monitor, operate and maintain environmental sensors to measure and analyze environmental conditions. Monitor the status of sensors and report fault data for on-going maintenance and performance reporting.
City of Madison Streets and Engineering	• **MCM Environmental Information Collection** - Monitor, operate and maintain center-based equipment and software used to control environmental sensors. This includes sensors located along the roadside that measure road pavement and atmospheric environmental conditions as well as those located on maintenance vehicles. • **MCV Environmental Monitoring** - Monitor, operate and maintain environmental sensors to measure and analyze environmental conditions. Monitor the status of sensors located on the maintenance vehicle or along the roadside and report fault data for on-going maintenance and performance reporting.
Dane County Highway Department	• **MCM Environmental Information Collection** - Monitor, operate and maintain center-based equipment and software used to control environmental sensors. This includes sensors located along the roadside that measure road pavement and atmospheric environmental conditions as well as those located on maintenance vehicles. • **MCV Environmental Monitoring** - Monitor, operate and maintain environmental sensors to measure and analyze environmental conditions. Monitor the status of sensors located on the maintenance vehicle or along the roadside and report fault data for on-going maintenance and performance reporting.

Weather Information Processing and Distribution

This service package processes and distributes the environmental information collected from the Road Weather Data Collection service package. It uses environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so system operators and decision support systems can make decisions on corrective actions to take. The continuing updates of road condition information and current temperatures can be used by system operators to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers using the Traffic Information Dissemination service package and aid operators in scheduling work activity. High-level agency roles and responsibilities for performing this service package are provided in Table 53.

Table 53

Agency High-Level Roles and Responsibilities Corresponding to Weather Information Processing and Distribution

Participating Agency	Role
WisDOT STOC	• **MCM Environmental Information Processing** - Monitor, operate and maintain center-based equipment and software used to process and assimilate freeway environmental sensor information and data and to disseminate it to allied agencies.
City of Madison Streets and Engineering	• **MCM Environmental Information Processing** - Monitor, operate and maintain center-based equipment and software used to process and assimilate arterial environmental sensor information and data and to disseminate it to allied agencies.
Dane County Highway Department	• **MCM Environmental Information Processing** - Monitor, operate and maintain center-based equipment and software used to process and assimilate freeway and county environmental sensor information and data and to disseminate it to allied agencies.
City of Madison Traffic Engineering	• **TMC Environmental Monitoring** - Monitor, operate and maintain center-based equipment and software used to collect environmental sensor data and information from allied agencies.
Other City Traffic Engineering	• **TMC Environmental Monitoring** - Monitor, operate and maintain center-based equipment and software used to collect environmental sensor data and information from allied agencies.
Dane County Public Safety Communication Center	• **Emergency Environmental Monitoring** - Monitor, operate and maintain center-based equipment and software used to collect environmental sensor data and information from allied agencies.

Participating Agency	Role
UW-Madison Police Department Communications Center	• **Emergency Environmental Monitoring** - Monitor, operate and maintain center-based equipment and software used to collect environmental sensor data and information from allied agencies.
Metro Transit	• **Transit Environmental Monitoring** - Monitor, operate and maintain center-based equipment and software used to collect environmental sensor data and information from allied agencies.

Roadway Automated Treatment

This service package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The service package includes the environmental sensors that detect adverse conditions, the automated treatment system itself and driver information systems (e.g., DMS) that warn drivers when the treatment system is activated. High-level agency roles and responsibilities for performing this service package are provided in Table 54.

Table 54

Agency High-Level Roles and Responsibilities Corresponding to Roadway Automated Treatment

Participating Agency	Role
City of Madison Streets and Engineering	• **Roadway Automated Treatment** – Monitor, operate and maintain automated roadway treatment systems based on environmental and atmospheric conditions. • **Maintenance and Construction Management Automated Treatment System Control** – Monitor, operate and maintain center based equipment and software to remotely control automated roadway treatment systems. Monitor the status of treatment systems and report fault data for on-going maintenance and performance reporting.
Dane County Highway Department	• **Roadway Automated Treatment** – Monitor, operate and maintain automated roadway treatment systems based on environmental and atmospheric conditions. • **Maintenance and Construction Management Automated Treatment System Control** – Monitor, operate and maintain center based equipment and software to remotely control automated roadway treatment systems. Monitor the status of treatment systems and report fault data for on-going maintenance and performance reporting.
WisDOT STOC	• **Roadway Automated Treatment** – Monitor, operate and maintain automated roadway treatment systems based on environmental and atmospheric conditions. • **Maintenance and Construction Management Automated Treatment System Control** – Monitor, operate and maintain center based equipment and software to remotely control automated roadway treatment systems. Monitor the status of treatment systems and report fault data for on-going maintenance and performance reporting.

Winter Maintenance

This service package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications) and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response and track and manage response operations. High-level agency roles and responsibilities for performing this service package are provided in Table 55.

Table 55

Agency High-Level Roles and Responsibilities Corresponding to Winter Maintenance

Participating Agency	Role
City of Madison Streets and Engineering	• **Maintenance and Construction Management Maintenance Decision Support** – Collect external weather information and integrate it into MDSSs. Provide information to MCV operators based on the outputs of the decision support system, including recommended roadway treatment actions. • **Maintenance and Construction Management Winter Maintenance Management** – Determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies. Track and control snow plow operations, roadway treatment (e.g., salt spraying and other material applications) and other snow and ice control operations. Monitor environmental conditions and weather forecasts and use the information to schedule winter maintenance activities, determine the appropriate snow and ice control response and track and manage response operations. Provide dispatch instructions for vehicle operators based on observed winter conditions. This could include a treatment route, treatment application rates, start and end times and other treatment instructions. • **MCV Winter Maintenance**– Monitor, operate and maintain systems that track the use snow and ice fighting materials used onboard the maintenance vehicle. Collect and archive the types and quantities of materials used for construction and maintenance activities as well as the actual work performed.
Dane County Highway Department	• **Maintenance and Construction Management Maintenance Decision Support** – Collect external weather information and integrate it into MDSSs. Provide information to MCV operators based on the outputs of the decision support system, including recommended roadway treatment actions. • **Maintenance and Construction Management Winter Maintenance Management** – Determine the need for roadway treatment based on current and forecasted weather information, current usage of treatments and materials, available resources, requests for action from other agencies. Track and control snow plow operations, roadway treatment (e.g., salt spraying and other material applications) and other snow and ice control operations. Monitor environmental conditions and weather forecasts and use the information to schedule winter maintenance activities, determine the appropriate snow and ice control response and track and manage response operations. Provide dispatch instructions for vehicle operators based on observed winter conditions. This could include a treatment route, treatment application rates, start and end times and other treatment instructions. • **MCV Winter Maintenance** – Monitor, operate and maintain systems that track the use snow and ice fighting materials used onboard the maintenance vehicle. Collect and archive the types and quantities of materials used for construction and maintenance activities as well as the actual work performed.
WisDOT STOC	• **TMC Incident Dispatch Coordination/Communication** – Request maintenance and construction resources in response to environmental conditions on freeways. Collect performance measures such as incident response and clearance times. Provide road network conditions and traffic images/video (and control to these systems per agreement) to MCM agencies.
City of Madison Traffic Engineering	• **TMC Incident Dispatch Coordination/Communication** – Request maintenance and construction resources in response to environmental conditions on arterials. Collect performance measures such as incident response and clearance times. Provide road network conditions and traffic images/video (and control to these systems per agreement) to MCM agencies.
Other City Traffic Engineering	• **TMC Incident Dispatch Coordination/Communication** – Request maintenance and construction resources in response to environmental conditions on arterials. Collect performance measures such as incident response and clearance times. Provide road network conditions and traffic images/video (and control to these systems per agreement) to MCM agencies.

Roadway Maintenance and Construction

This service package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services would include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting) and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, DMS, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities. High-level agency roles and responsibilities for performing this service package are provided in Table 56.

Table 56

Agency High-Level Roles and Responsibilities Corresponding to Roadway Maintenance and Construction

Participating Agency	Role
City of Madison Traffic Engineering	• **Traffic Equipment Maintenance** – Monitor, operate and maintain center and field based equipment and software used to collect and store information and data pertaining to the operational status of agency owned and operated ITS field devices (e.g., traffic, pavement and weather sensors, CCTV cameras and signal equipment). Coordinate and exchange information and data with allied agencies and/or internal departments to repair failed or malfunctioning equipment in a timely manner.
Other City Traffic Engineering	• **Traffic Equipment Maintenance** – Monitor, operate and maintain center and field based equipment and software used to collect and store information and data pertaining to the operational status of agency owned and operated ITS field devices (e.g., traffic, pavement and weather sensors, CCTV cameras and signal equipment). Coordinate and exchange information and data with allied agencies and/or internal departments to repair failed or malfunctioning equipment in a timely manner.
WisDOT STOC	• **Traffic Equipment Maintenance** – Monitor, operate and maintain center and field based equipment and software used to collect and store information and data pertaining to the operational status of agency owned and operated ITS field devices (e.g., traffic, pavement and weather sensors, CCTV cameras, signal equipment, DMS). Coordinate and exchange information and data with allied agencies and/or internal departments to repair failed or malfunctioning equipment in a timely manner.
City of Madison Streets and Engineering	• **Maintenance and Construction Management Maintenance Decision Support** – Monitor, operate and maintain center based MDSSs. Schedule municipal work activities based on outputs of the decision support system and dispatch maintenance crews accordingly. • **Maintenance and Construction Management Roadway Maintenance and Construction** – Monitor the operational status of field equipment under agency control (e.g., pavement sensors). Coordinate with allied agencies to respond to requests for hazard removal, field equipment repair and other roadway maintenance (i.e., maintenance issues caused by weather, incidents or other activity). Monitor, operate and maintain center and vehicle based equipment that allows operators to dispatch field crews and determine the status of maintenance activity. Notify traffic management agencies of equipment failures and maintenance status. Collect and integrate third party weather information into daily operations and decision making processes.
Dane County Highway Department	• **Maintenance and Construction Management Maintenance Decision Support** – Monitor, operate and maintain center based MDSSs. Schedule county and freeway work activities based on outputs of the decision support system and dispatch maintenance crews accordingly. • **Maintenance and Construction Management Roadway Maintenance and Construction** – Monitor the operational status of field equipment under agency control (e.g., pavement sensors). Coordinate with allied agencies to respond to requests for hazard removal, field equipment repair and other roadway maintenance (i.e., maintenance issues caused by weather, incidents or other activity). Monitor, operate and maintain center and vehicle based equipment that allows operators to dispatch field crews and determine the status of maintenance activity. Notify traffic management agencies of equipment failures and maintenance status. Collect and integrate third party weather information into daily operations and decision making processes.

Maintenance and Construction Activity Coordination

This service package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to the ISPs who can provide the information to travelers. High-level agency roles and responsibilities for performing this service package are provided in Table 57.

Table 57

Agency High-Level Roles and Responsibilities Corresponding to Maintenance and Construction Activity Coordination

Participating Agency	Role
City of Madison Streets and Engineering	• **Maintenance and Construction Management Work Activity Coordination** – Monitor, operate and maintain systems that track assets and work activity and provide allied agencies with information and status of current and planned maintenance and/or construction activities. Operate and maintain center based equipment and software including maintenance and decision support systems. Coordinate with other city streets and maintenance departments on planned work activity. Disseminate maintenance and construction work plan information to Traffic Management agencies whose operations will be impacted by these activities.
Dane County Highway Department	• **Maintenance and Construction Management Work Activity Coordination** – Monitor, operate and maintain systems that track assets and work activity and provide allied agencies with information and status of current and planned maintenance and/or construction activities. Operate and maintain center based equipment and software including maintenance and decision support systems. Coordinate with other city streets and maintenance departments on planned work activity. Disseminate maintenance and construction work plan information to Traffic Management agencies whose operations will be impacted by these activities.
Other City Streets/Public Works Departments	• **Maintenance and Construction Management Work Activity Coordination** – Monitor, operate and maintain systems that track assets and work activity and provide allied agencies with information and status of current and planned maintenance and/or construction activities. Operate and maintain center based equipment and software including maintenance and decision support systems. Coordinate with other city streets and maintenance departments on planned work activity. Disseminate maintenance and construction work plan information to Traffic Management agencies whose operations will be impacted by these activities.
WisDOT SW Region	• **Maintenance and Construction Management Work Activity Coordination** – Monitor, operate and maintain systems that track assets and work activity and provide allied agencies with information and status of current and planned maintenance and/or construction activities. Operate and maintain center based equipment and software including maintenance and decision support systems.
City of Madison Traffic Engineering	• **TMC Work Zone Traffic Management** – Analyze construction work plans to provide possible alternate route plans and diversions to support construction work activity. Disseminate alternate route plans and traffic diversions to the public via available outlets.
Other City Traffic Engineering	• **TMC Work Zone Traffic Management** – Analyze construction work plans to provide possible alternate route plans and diversions to support construction work activity. Disseminate alternate route plans and traffic diversions to the public via available outlets.
WISDOT STOC	• **TMC Work Zone Traffic Management** – Analyze construction work plans to provide possible alternate route plans and diversions to support construction work activity. Disseminate alternate route plans and traffic diversions to the public via available outlets. Operate and maintain driver information systems (such as DMS, HAR and 511) to advise drivers of activity around a work zone.
Metro Transit	• **Transit Center Multi-modal Coordination** – Coordinate with allied traffic management agencies to divert transit routes around work zones. Monitor, operate and maintain systems that disseminate transit traveler information to transit users in support of maintenance and construction activity. Coordinate with maintenance and construction activities on impacts to agency operations and ways to mitigate adverse impacts.
Other Transit Agencies	• **Transit Center Multi-modal Coordination** – Coordinate with allied traffic management agencies to divert transit routes around work zones. Monitor, operate and maintain systems that disseminate transit traveler information to transit users in support of maintenance and construction activity. Coordinate with maintenance and construction activities on impacts to agency operations and ways to mitigate adverse impacts.
Dane County Public Safety Communication Center	• **Emergency Response Management** - Monitor real-time information on the state of the regional transportation system including road conditions. Track the availability of resources and assists in the appropriate routing of EVs around work activity.

6.5 Long-term/Connected Vehicle Operational Concepts

Long-term/Connected Vehicle Operational Concepts are similar to short- and mid-term operational concepts with the exception of their technical feasibility and implementation timeline. Long-term/Connected Vehicle Operational Concepts are based on newer innovative technologies and concepts, most of which have yet to be standardized. These concepts were identified based on the various research activities underway and/or completed as part of the Research and Innovative Technology Administration's (RITA) Connected Vehicle research program. Currently, these Concepts are being used by regions and transportation agencies as an interim guidance for developing ITS project architectures for pilots, test beds and early deployments. It is likely that these concepts will evolve over the short- to mid-term as data from these initial deployments is collected, analyzed and used to develop standards to support these concepts. For this reason, long-term/Connected Vehicle Operational Concepts should be viewed as fluid until such time they are proven effective and formally accepted into the National ITS Architecture. Long-term/Connected Vehicle Operational Concepts that may be applicable to the Madison Metropolitan Area are described below; however, because they are likely to evolve, it would be premature to define agency roles and responsibilities. It is recommended that these concepts be monitored periodically in the future as this plan is updated to access their applicability at the time of the update and to add pertinent details as they are formalized and accepted into the National ITS Architecture.

6.5.1 Environmental Concepts

Electric Charging Stations Management

The Electric Charging Station Management concept provides an exchange of information between vehicle and charging station to manage the charging operation. The agency or company operating the charging station can use vehicle information such as the capability of the vehicle (e.g., operational status of the electrical system, how many amps can the vehicle handle and % charge complete) to determine that the charge is being properly applied and determine an estimated time to complete.

Madison Gas and Electric has provided 8 electric charging stations in the City of Madison parking facilities as part of pilot program to study their use and reliability. These stations are located in the following parking facilities:

- Overture Center Garage
- Capitol Square North Garage
- State Street Campus Garage
- Wingra Parking Lot

Despite having implemented electric charging stations, this concept has been designated as a long-term concept due to rapid evolution of this technology and limited penetration into the automobile market. It is recommended that progress be monitored with regard to public acceptance of electric vehicles prior to implementing additional stations.

Enhanced Maintenance Decision Support System

The Enhanced Maintenance Decision Support System concept incorporates the additional information that can come from collecting road weather data from connected vehicles into the existing MDSS capabilities. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks and other agency pool vehicles). The raw data will be processed, either at the field or in a controlling center, to generate road segment-based data outputs. The processed (and quality checked) data is used by the MDSS to generate improved plans and recommendations to maintenance personnel.

Road Weather Advisories and Warnings for Motorists

The Road Weather Advisories and Warnings for Motorists application provides the capability of collecting road weather data from connected vehicles and using that data to develop short-term warnings or advisories that can be provided to individual motorists. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing may also include a road weather motorist alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial service providers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.

Road Weather Information and Routing Support for Emergency Responders

The Road Weather Information and Routing Support for Emergency Responders application provides the capability of collecting road weather data from connected vehicles and other sources and using that data to develop short-term warnings or advisories that can be provided to individual emergency response vehicles or to emergency response dispatchers. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather vehicle alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to emergency response dispatchers. The short time horizon alerts that are pushed to EV drivers and dispatchers will include information on high winds, standing water and flooding of roadways. This information will be acquired from other fixed and remote observation systems and will be provided with as much geographic precision as possible. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.

Road Weather Information for Maintenance and Fleet Management Systems

The Road Weather Information for Maintenance and Fleet Management Systems Application can be viewed as either a stand-alone application or as an adjunct to the Enhanced-MDSS. Vehicle data is collected both from vehicles used during winter maintenance and from other maintenance vehicles and equipment used year round. The data collected is road weather data as well as specialized maintenance information such as status of vehicle systems, material distribution rate and materials remaining. The data collected can be used by maintenance or fleet dispatchers to monitor the status of the maintenance operations, or the data can be used as an input to the Enhanced-MDSS application.

6.5.2 Mobility Concepts

Ad Hoc Messages

Ad Hoc Messages provide the capability to transfer general data between the infrastructure and the vehicle. This application enables vehicle manufacturers and fleet operators to transmit customized data to and from specific vehicles. For example, snow plows may want to send plow and material status, fleet operators may wish to collect data from vehicle data buses, and vehicle manufacturers may transmit software updates as part of vehicle servicing. These messages are meant to be unique to the group providing them (e.g., a specific vehicle manufacturer) and are not interoperable outside of the particular group.

Performance Monitoring and Planning

The Performance Monitoring and Planning concept uses information collected from connected vehicles to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g., environmental data and infrastructure conditions monitoring data. This application supports archiving of all types of data either directly from the connected vehicles or processed by the infrastructure.

A limit form of this concept will be implemented in the short-term and evolve into the desired functionality described above. Performance monitoring and planning will focus on existing roadside infrastructure that transfers data with a center in the short-term, eventually integrating data captured by vehicle subsystems in the future.

Advanced Automatic Crash Notification Relay

The Advanced Automatic Crash Notification Relay concept provides the capability for a vehicle to automatically transmit an emergency message when the vehicle has been involved in a crash or other distress situation. This concept would be similar to General Motor's OnStar service but without the involvement of a third party provider. An automatic crash notification feature transmits key data on the crash recorded by sensors mounted in the vehicle (e.g., deployment of airbags) without the need for involvement of the driver. The emergency message is broadcast to passing connected vehicles, who can relay the message to other connected vehicles as well as roadside "hotspots." Once received by emergency response services (either through EVs or through the roadside equipment), the appropriate response to the vehicle situation can be carried out by emergency response services. This application allows a vehicle to forward mayday requests even in areas where no V2I infrastructure exists.

Incident Scene Pre-Arrival Staging Guidance for Emergency Responders

The Incident Scene Pre-Arrival Staging Guidance for Emergency Responders concept will provide situational awareness to and coordination among emergency responders - upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets and afterward if circumstances require additional dispatch and staging. The application collects a variety of data from emergency, traffic and maintenance centers. The application includes a vehicle and equipment staging function that supplies the en-route responders with additional information about the scene of an incident which can be used to determine where to stage personnel and equipment prior to their arrival on-scene. The application also includes a dynamic routing function which provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures and snowplow reports if needed. In addition the application includes an emergency responder status reporting function which continuously monitors the location of the en-route responder vehicles as well as the vehicles already on-scene. The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA) to other applications.

Queue Warning

The Queue Warning (Q-WARN) application utilizes connected vehicle technologies, including vehicle-to-infrastructure (V2I) and V2V communications, to enable vehicles within the queue to automatically broadcast their queued status information (e.g., rapid deceleration, disabled status, lane location) to nearby upstream vehicles and to infrastructure-based central entities (such as the TMC) in order to minimize or prevent rear-end or other secondary collisions. The Q-WARN application is not intended to operate as a crash avoidance system (e.g., like the forward collision warning [FCW] safety application). In contrast to such systems, Q-WARN will engage well in advance of any potential crash situation, providing messages and information to the driver in order to minimize the likelihood of needing to take crash avoidance or mitigation actions later. The Q-WARN application performs two essential tasks: queue determination

(detection and/or prediction) and queue information dissemination. In order to perform these tasks, Q-WARN solutions can be vehicle-based or infrastructure-based or utilize a combination of each.

Speed Harmonization

The Speed Harmonization concept determines speed recommendations based on traffic conditions and weather information. The speed recommendations can be regulatory (e.g. variable speed limits) or advisory. The purpose of speed harmonization is to change traffic speed on links that approach areas of traffic congestion, bottlenecks, incidents, special events and other conditions that affect flow. Speed harmonization assists in maintaining flow, reducing unnecessary stops and starts, and maintaining consistent speeds. The application utilizes connected vehicle V2I communication to detect the precipitating roadway or congestion conditions that might necessitate speed harmonization, to generate the appropriate response plans and speed recommendation strategies for upstream traffic and to broadcast such recommendations to the affected vehicles. The speed recommendations can be provided in-vehicle for connected vehicles, or through roadside signage for non-connected vehicles.

Vehicle Data for Traffic Operations

The Vehicle Data for Traffic Operations (VDTO) concept uses probe data information obtained from vehicles in the network to support traffic operations, including incident detection and the implementation of localized operational strategies. The implantation of incident detection enables transportation agencies to determine the location of potential incidents so the agencies can respond more quickly to the incident and mitigate any negative impacts to the transportation network. Vehicle data that can be used to detect potential incidents include changes in vehicle speeds indicating the disruption of traffic flow, when a vehicle's safety systems have been activated or deployed, or sudden vehicle turns or deceleration at a specific location (indicating a potential obstacle in the roadway). Operational strategies might include altering signal timing based on traffic flows or using vehicle data collected on the freeway mainline to employ speed harmonization or to optimize ramp metering rates.

Emergency Vehicle Preemption

The Emergency Vehicle Preemption (EVP) concept is a very high level of priority for emergency first responder vehicles. Historically, priority for EVs has been provided by special traffic signal timing strategies called preemption. The goal of EVP is to facilitate safe and efficient movement through intersections. As such, clearing queues and holding conflicting phases can facilitate EV movement. For congested conditions, it may take additional time to clear a standing queue, so the ability to provide information in a timely fashion is important. In addition, transitioning back to normal traffic signal operations after providing EVP is an important consideration since the control objectives are significantly different.

Intelligent Traffic Signal System

The Intelligent Traffic Signal System (ISIG) concept uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The application utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow including allowing platoon flow through the intersection. The application serves as an over-arching system optimization application, accommodating transit or freight signal priority, preemption and pedestrian movements to maximize overall arterial network performance. In addition, the interface (i.e., traffic flow) between arterial signals and ramp meters can be a part of the application.

Pedestrian Mobility

The Pedestrian Mobility concept will integrate traffic and pedestrian information from roadside or intersection detectors and new forms of data from wirelessly connected, pedestrian (or bicyclist) carried mobile devices (nomadic devices) to request dynamic pedestrian signals or to inform pedestrians when to cross and how to remain aligned with the crosswalk based on real-time Signal Phase and Timing (SPaT) and MAP information. In some cases, priority will be given to pedestrians, such as persons with disabilities that need additional crossing time, or in special conditions (e.g., weather) where pedestrians may warrant priority or additional crossing time. This application will enable a "pedestrian call" to be routed to the traffic controller from a nomadic device of a registered person with disabilities after confirming the direction and orientation of the roadway that this pedestrian is intending to cross.

This concept has particular benefit to the Madison Metropolitan Area, which has a large contingent of pedestrians and bicyclists that interact with motorized traffic. This concept could provide greater safety and security for bicyclists that must cross traffic while making their trip more convenient since they may not have to stop or slow to cross traffic.

Transit Signal Priority

The Transit Signal Priority application uses transit vehicle to infrastructure communications to allow a transit vehicle to request priority at one or a series of intersections. The application includes feedback to the transit driver if the signal priority has been granted or not. This application can contribute to improve operating performance of the transit vehicles by reducing the time spent stopped at a red light.

Dynamic Ridesharing

The Dynamic Ridesharing concept allows travelers to arrange carpool trips through a stand-alone personal device with a wireless connection similar to UBER and/or an automated ridematching system (e.g., call center or web-based application loaded on a personal computer or kiosk at a transit facility). The application uses inputs from both passengers and drivers pre-trip, during the trip and post-trip. These inputs are then translated into "optimal" pairings between passengers and drivers to provide both with a convenient route between their two origin and destination locations. After the trip, information is provided back to the application to improve the user's experience for future trips and monitor use of high-occupancy lanes.

While applications like UBER exist today, these are still very controversial and have inherent safety issues (i.e., background checks on people providing the service or whom rides are being shared) that still need to be resolved. While it is unlikely that public agencies will be directly involved in providing the dynamic ridesharing service, they may still impact it though legislation and promotion.

Intermittent Bus Lanes

The Intermittent Bus Lane (IBL) concept provides dedicated bus lanes during peak demand times to enhance transit operations mobility. IBL consists of a lane that can change its status from regular lane (accessible for all vehicles) to bus lane, for the time strictly necessary for a bus or set of buses to pass. The status of the IBL is communicated to drivers using roadside message signs and through in-vehicle signage. The creation and removal of dedicated bus lanes is managed through coordination between traffic and transit centers.

This concept would be an extension of the City of Madison's floating bike lanes that covert from on curb to off curb when parking restrictions are in place.

Route ID for the Visually Impaired

The Route ID for the Visually Impaired (RVI) concept assists visibly impaired travelers to identify the appropriate bus and route to their intended destination. The application provides information from bus stop infrastructure to visually impaired travelers portable devices that can be converted to audible information regarding the appropriate bus and route. The application could allow the visually impaired traveler to query the portable device to identify route options.

Transit Connection Protection

The Transit Connection Protection application allows travelers to initiate a request for connection protection anytime during the trip using a personal mobile device, or potentially via transit vehicle or personal automobile onboard equipment / interface and receive a confirmation indicating whether the request is accepted. Connection protection uses real-time data to examine the arrival status of a transit vehicle and to transmit a hold message to a vehicle or other mode of transportation (e.g. rail) in order for the traveler to make a successful transfer from one vehicle to another. Connection protection can be performed within a single agency, across multiple agencies and across multiple modes. In order to make this application viable a central transfer request brokerage system for processing transfer requests could be created. This tool would be particularly important in an intermodal, multimodal or interagency environment since the existing computer-aided dispatch/ automated vehicle location (CAD/AVL) systems at individual agencies may not have the ability to share or process real-time data available from various external sources (e.g., multi-agency and multimodal operational subsystems) to determine the feasibility of a connection protection request. The system will first determine the feasibility of a transfer based on fixed-schedule and then monitor the real-time status using input from the control center(s).

Transit Stop Request

The Transit Stop Request concept allows a transit passenger to send a stop request to an approaching transit vehicle. This application allows a transit vehicle to know that a passenger has requested a transit stop from an infrastructure device.

Advanced Traveler Information Systems

The Advanced Traveler Information Systems concept provides for the collection, aggregation and dissemination of a wide range of transportation information. The collection of information includes traffic, transit, road weather, workzone and connected vehicle related data. All the sources of data are aggregated into data environments that can be used to drive data portals allowing dissemination of the entire spectrum of transportation information to travelers via mobile devices, in vehicle displays, web portals, 511 systems and roadside signage.

Traveler Information – Smart Parking

The Traveler Information -Smart Parking concept provides users with real-time location, availability, type (e.g., street, garage, AFV only) and the price of parking. The parking information can be provided via DSRC or wide area communications. The application reduces time required for drivers to search for a parking space, which can have eco benefits such as reducing emissions. The application also supports dynamic pricing of parking based on factors such as demand, emissions, or vehicle type.

6.5.3 Safety Concepts

Transit Pedestrian Indication

The Transit Pedestrian Indication Concept provides vehicle to device communications to inform pedestrians at a station or stop about the presence of a transit vehicle. In addition, this application would inform the transit vehicle operator about the presence of pedestrians nearby and those waiting for the bus. It would help prevent collisions between transit vehicles and pedestrians.

Pedestrian in Signalized Crosswalk Warning

The Pedestrian in Signalized Crosswalk Warning concept provides to the connected vehicle information from the infrastructure that indicates the possible presence of pedestrians in a crosswalk at a signalized intersection. The infrastructure based indication could include the outputs of pedestrian sensors or simply an indication that the pedestrian call button has been activated. This application has been defined for transit vehicles, but can be applicable to any class of vehicle.

7 ITS ARCHITECTURE

7.1 Introduction

The Madison Regional ITS Architecture is a high-level representation or framework that illustrates and describes how existing and planned ITS elements within the region interconnect to exchange information and data. To this extent the Regional ITS Architecture can be portrayed as a "blue print" that illustrates the existing and future state of ITS integration. It identifies the individual pieces (i.e., ITS elements) that have been identified for the Madison Metropolitan Area, the functions these pieces perform, and the information and data that are exchanged. The Regional ITS Architecture is not intended to serve as the detailed design of the system, but rather it gives guidance to those individuals involved in the design and implementation of ITS elements. Furthermore, the Architecture does not define how pieces of the Regional ITS Architecture will be implemented but rather defines the interactions these pieces have among each other. This helps agencies easily visualize where in the "big picture" their ITS elements fit, and with what other elements they communicate. The Architecture should be revisited immediately prior to project implementation to obtain details needed to begin detailed design and to document changes in understanding at this time.

7.2 ITS Architecture Overview and Understanding

An ITS Architecture describes and illustrates how existing and planned ITS elements interconnect to exchange information to collectively deliver the transportation services or functions identified in the ITS Operational Concept (Chapter 6). The architecture is illustrated through a series of diagrams that show how individual elements connect. Diagrams can be oriented in two ways. First, diagrams can be developed to show the various interfaces a single ITS element has with respect to all other ITS elements. This view allows agencies to easily understand how their respective ITS elements interconnect with other ITS elements and how information is shared among agencies. Conversely, diagrams can be developed to show how various ITS elements, owned and operated by multiple agencies, work together to deliver a specific transportation service (e.g., network surveillance). In this view, only the ITS elements and the applicable information flows that are required to deliver the specified transportation service are shown. Both views of the architecture ease the understanding of ITS integration and serve as a guide to effectively implement systems in coordination with other regional ITS activities and deliver a greater return on investment.

Besides these benefits, an ITS architecture also provides high level details needed to understand what must be built. In this manner the architecture helps to support RFP development and the design process. Furthermore, the architecture can serve as an additional resource to bidders and system designers giving them clear understanding of the scope of the project and the various system-to-system interfaces that need to be developed. There are several types of architectures that can provide guidance and additional details that may be helpful in the systems planning and design process. These include the Wisconsin Statewide ITS Architecture, other Regional ITS Architectures and project-specific ITS architectures. All these architectures are subsets of the National ITS Architecture.

In early 2001, the United States Department of Transportation (USDOT) announced the release of the Federal Highway Administration's (FHWA) final rule and Federal Transit Authority's (FTA) policy for applying the National Intelligent Transportation System (ITS) Architecture at the regional level. The FHWA rule/FTA policy on ITS Architecture and Standards (23 CFR Part 940) requires that all federally funded ITS projects conform to a Regional ITS Architecture and undergo a systems engineering (SE) analysis to qualify for, or remain eligible to receive financial assistance. If a project is not federally funded it is consequently not subject to the 23 CFR Part 940 requirements. However, in the absence of federal funding it is still good practice to follow a structured approach for designing ITS systems so that risk is minimized and that quality can be built into the system. This will work toward developing systems in a structured fashion where their associated benefits are maximized and allocated funding is used effectively and efficiently. A systems engineering analysis and compliance checklist is provided in Appendix B. Project sponsors seeking to fund projects with federal appropriations will be required to follow this process prior to these projects being funded within the TIP.

The definition of projects includes both standalone ITS projects and those that include ITS elements. Section 23 CFR 904.11 specifically states that a SE analysis should be developed to an extent similar to the project scope and meets the seven requirements/activities identified in below.

1. Identify portions of the regional architecture being implemented
2. Identify participating agency roles and responsibilities
3. Identify requirements definitions
4. Analyze alternative system configurations and technology options to meet requirements
5. Identify procurement options
6. Identify applicable ITS standards and testing procedures
7. Outline procedures and resources necessary for operations and maintenance

7.2.1 National ITS Architecture

ITS Architecture development is guided by the National ITS Architecture. The National ITS Architecture, developed and maintained by FHWA, is a common, mature framework for planning, defining, and integrating ITS elements. The National ITS Architecture reflects the contributions of a broad cross-section of the ITS community and specifically defines:

- The functions that are required of ITS to perform transportation services,
- The physical entities or subsystems where these functions reside, and
- The information and data flows that connect these functions and physical subsystems together into an integrated system.

The listing of functions, subsystems and flows contained in the National Architecture is comprehensive and is intended to serve as the underlying standardized framework from which ITS projects and their corresponding project architectures are to be developed. For this reason, any locally developed architecture, including the Madison Regional ITS Architecture, will reflect only a sub-set of all the possible functions, subsystems, and information flows brought forward by the National ITS Architecture.

7.2.2 Connected Vehicle Reference Architecture

The U.S. DOT Research and Innovative Technology Administration (RITA) ITS Joint Program Office (ITS JPO) recently released V.2 of its Connected Vehicle Reference Implementation Architecture (CVRIA). This Architecture is similar to the National ITS Architecture but focuses on the large set of connected vehicle applications. Whereas the National ITS Architecture is relatively mature, the CVRIA is new, and highly dynamic due to the evolution of connected vehicle applications. Because of the highly dynamic nature of connected vehicle applications and due to the fact that connected vehicle applications have yet to be clearly defined for the Madison Metropolitan Area, the CVRIA was not used to develop the Madison Regional ITS Architecture. However, applications where connected vehicle technology could be used to address stated needs have been called out in the ITS Operational Concept Chapter (Chapter 6). It is recommended that as the Madison Regional ITS Architecture is updated, and as additional details emerge on connected vehicle projects, those individuals responsible for updating this documentation refer to the CVRIA to use a standardized process for developing connected vehicle projects. The Connected Vehicle Reference Implementation Architecture can be found at: www.iteris.com/cvria/index.

7.2.3 Wisconsin Statewide ITS Architecture

In 2010, the Wisconsin Statewide ITS Architecture was consolidated and updated using previously developed Regional ITS Architectures. Subsequently, the regional ITS Architectures were eliminated leaving only the Wisconsin Statewide ITS Architecture as the only architecture being maintained within the state. As a result, the Statewide ITS Architecture represents the corresponding parent architecture for the Madison ITS Architecture. The Statewide ITS Architecture is maintained, updated and hosted by the Wisconsin TOPS Lab.

7.2.4 Turbo Architecture Software Tool

The Madison ITS Architecture was developed using FHWA's Turbo Architecture (Version 7.0.5.2) software (hereafter referred to as Turbo) and is consistent with the National ITS Architecture v.7. Turbo is a software application that supports development of ITS architectures using the most recent version of the National ITS Architecture as an underlying, standardized framework. Turbo is a database that retains attributes of an architecture including stakeholders, existing and planned ITS elements, high-level system requirements, information flows, and standards.

The Madison ITS Architecture was developed within the most recent Statewide ITS Architecture Turbo database file, but it has yet to be merged with the Statewide Architecture database. Until the Madison ITS Architecture is merged with the Statewide ITS architecture, the complete extent of integration will not be shown. Since the TOPS Lab maintains the Statewide ITS Architecture, the merging of the Regional ITS Architecture with the Statewide ITS Architecture is best left to the maintaining agency. This document provides the necessary information needed to easily merge the Regional ITS Architecture with the Statewide ITS Architecture. Upon review and acceptance of the Regional ITS Architecture database, the owner/maintainer of the Statewide ITS Architecture can perform this task with one single click of a mouse within the Turbo program.

7.3 Physical ITS Architecture

The physical ITS architecture identifies the various entities that comprise the physical world in which ITS activities take place, and which are required to deliver desired transportation services. Entities are classified by the National ITS Architecture as either a subsystem or a terminator. Subsystems and terminators that are applicable to the Madison Metropolitan Area are identified in the following sections.

7.3.1 Subsystems

As its name implies, a subsystem is a standalone, independent component of a larger system – in this case the Madison Regional Intelligent Transportation System. Subsystems are critical components of the larger system and in some regards can be viewed as systems themselves. Subsystems are composed of related, yet smaller groups of technologies referred to in the National Architecture as Equipment Packages that together can be bundled to deliver specific transportation services. Subsystems represent the primary building blocks of a system's architecture. The National ITS Architecture v 7.0 identifies 22 possible subsystems grouped into four classes: Travelers, Centers, Vehicles, and Field.

Traveler Subsystems: These are systems that are used by travelers to access ITS services pre-trip and en-route. This includes services that are owned and operated by the traveler as well as services that are owned by transportation and information providers. Examples of traveler subsystems include but are not limited to; kiosks, personal digital assistants and cell phones. National Architecture Traveler Subsystems are listed below:

- Remote Traveler Support
- Personal Information Access

Center Subsystems: These are systems that provide management, administration, and support functions for the transportation system. Center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions. National ITS Architecture Center Subsystems are listed below:

- Traffic Management
- Transit Management
- Commercial Vehicle Administration
- Archived Data Management
- Emissions Management
- Toll Administration
- Emergency Management
- Information Service Provider
- Fleet and Freight Management

Vehicle Subsystems: These are systems located on or within vehicle platforms. Vehicle subsystems include general driver information and safety systems applicable to all vehicle types. National Architecture Vehicle Subsystems are listed below:

- Vehicle
- Emergency Vehicle
- Commercial Vehicle
- Transit Vehicle
- Maintenance and Construction Vehicle

Field Subsystems: These are systems that are located along the roadway, or in the field, which perform surveillance, collect or provide information, or carry out maintenance or management functions. Field subsystems are primarily controlled by center subsystems; however, field elements may also interface directly with other field or vehicle subsystems. National Architecture Field Systems are listed below.

- Roadway
- Security Monitoring
- Toll Collection
- Parking Management
- Commercial Vehicle Check

National ITS subsystems are grouped by their applicable class in Figure 37 - in what is known as the National Architecture Sausage Diagram. The various ITS elements that comprise the Madison Regional ITS Architecture fall under one or more of the following subsystems shown in Figure 37 as subsystems that are not shaded. This includes:

- Remote Traveler Support (Travelers Class)
- Personal Information Access (Travelers Class)
- Traffic Management (Centers Class)
- Emergency Management (Centers Class)
- Maintenance and Construction Management (Centers Class)
- Information Service Provider (Centers Class)
- Transit Management (Centers Class)
- Archived Data Management (Centers Class)
- Vehicle (Vehicles Class)
- Emergency Vehicle (Vehicles Class)
- Transit Vehicle (Vehicle Class)
- Maintenance and Construction Vehicle (Vehicle Class)
- Roadway (Field Class)
- Security Monitoring (Field Class)
- Parking Management (Field Class)

The mapping of project-related ITS elements to their applicable National ITS Architecture subsystem(s) is provided in Table 58. In some cases an individual ITS element may be mapped to more than one subsystem (e.g., WisDOT_DTSD_BTO_STOC_ATMS). A description of each ITS element is provided later in the document.

Figure 37: National ITS Architecture Subsystems Relevant to the Madison Metropolitan Area (Not Shaded)

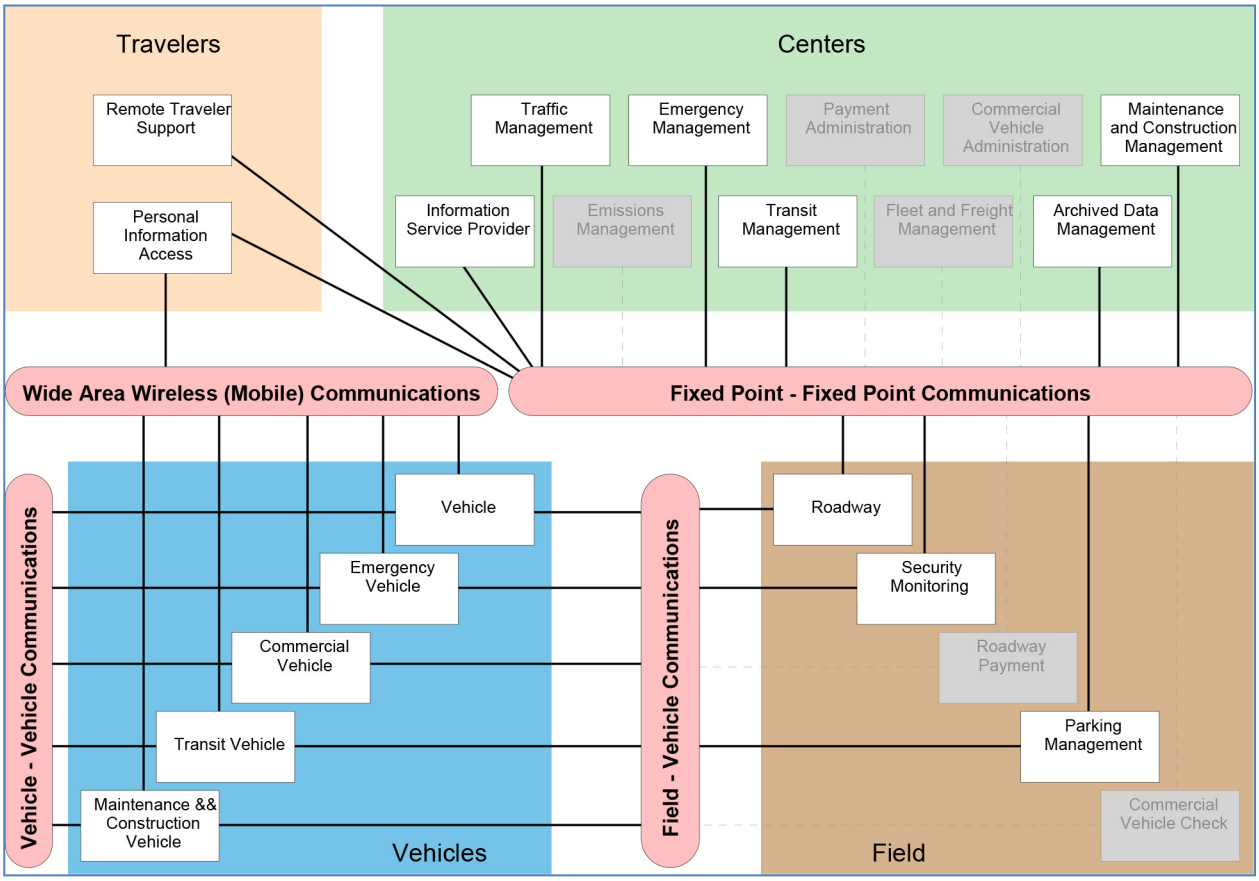


Table 58

Mapping of ICM ITS Elements to National ITS Architecture Subsystems

National ITS Architecture Subsystem	Corresponding Project ITS Element(s) Mapping
Remote Traveler Support	x-Kiosks
	Madison Metro Transit_Kiosks
	Madison Metro Transit_Internal Message Board
	Madison Metro Transit_Building and Transfer Point Cameras
	Madison Metro Transit_Bus Shelter Signage
Personal Information Access	User Personal Computing Devices - WisDOT_DTSD_BTO_STOC_ATMS
Traffic Management	City_Madison_Traffic Engineering Division_Traffic Operations Center Software
	Madison Metro Transit_TransitMaster CAD
	WisDOT_DTSD_SW Region_Madison_Regional Offices
Emergency Management	WisDOT_DTSD_BTO_STOC_ATMS
	City_Madison_Traffic Engineering Division_Traffic Operations Center Software
	UW-Madison_Police Dept_Communications Center (Dispatch)
	County_Dane_Public Safety Comm Center
	Madison Metro Transit_TransitFleet Software
	County_Dane_Emergency Warning System
	Madison Metro Transit_Building and Transfer Point Camera System Software
	City_Non Specified_Communications Center (Dispatch)

National ITS Architecture Subsystem	Corresponding Project ITS Element(s) Mapping
Maintenance and Construction Management	WisDOT_DTSD_BTO_STOC_ATMS
	City_Madison_Traffic Engineering Division_Traffic Operations Center Software
	City_Madison_Streets and Recycling_Maintenance Decision Support System (MDSS)
Information Service Provider	x-Media
	WisDOT_DTSD_BTO_STOC_ATMS
	City_Madison_Traffic Engineering Division_Traffic Operations Center Software
	WisDOT_DTSD_BTO_STOC_511 System
	WisDOT_DTSD_BTO_STOC_511 Website
	County_Dane_Public Safety Comm Center
	WisDOT_DTSD_BTO_STOC_CCTV Cameras
	WisDOT_DTSD_BTO_STOC_511 Twitter Accounts
	Transit Agency_Non Specified_Website
	Madison Metro Transit_Website
	3rd Party Information Sources
	UW-Madison_Police Dept_Emergency Notification System (WiscAlerts)
	Social Media and Subscription Based Services
Transit Management	Madison Metro Transit_TransitFleet Software
	Madison Metro Transit_FuelMaster
	Madison Metro Transit_TransitMaster CAD
	Transit Agency_Non Specified_CAD
Archived Data Management	WisDOT_DTSD_BTO_STOC_ATMS
	Data Archives (Individual Agency)
	Data Archive (Regional)
Vehicle **Emergency Vehicle**	Vehicles Emergency Vehicle On-Board Equipment
	WisDOT_DTSD_BTO_STOC_Freeway Service Team Vehicles
	Emergency Vehicle Signal Pre-Emption On-Board Equipment
Commercial Vehicle **Transit Vehicle**	x-Commercial Vehicles Madison Metro Transit_TransitMaster Integrated Vehicle Logic Unit (IVLU)
	Madison Metro Transit_Automatic Vehicle Location (AVL)
	Madison Metro Transit_Mobile Data Terminal (MDT)
	Madison Metro Transit_External Announcement
	Madison Metro Transit_Automatic Passenger Counters (APC)
	Madison Metro Transit_On-Board Fareboxes
	Madison Metro Transit_Transit Signal Priority On-Board Equipment
Maintenance and Construction Vehicle	City_Madison_Streets and Recycling_Maintenance Vehicles

National ITS Architecture Subsystem	Corresponding Project ITS Element(s) Mapping
Roadway	WisDOT_DTSD_BTO_STOC_ATMS
	WisDOT_DTSD_BTO_STOC_CCTV Cameras
	WisDOT_DTSD_BTO_STOC_DMS (Fixed and Portable)
	City_Madison_Traffic Engineering Division_CCTV Cameras
	WisDOT_DTSD_BTO_STOC_Ramp Meters
	WisDOT_DTSD_BTO_STOC_System Detector Stations
	WISDOT_DTSD_BTO_STOC_Environmental Sensor Stations
	City_Madison_Traffic Engineering Division_Pedestrian and Bicyclist Hybrid Beacons
	City_Madison_Traffic Engineering Division_Signal Pre-emption/Priority Equipment
	City_Madison_Traffic Engineering Division_Signal Pre-emption/Priority Equipment
	WisDOT_DTSD_SW Region_Madison_Traffic Signal Systems
	City_Non Specified_Traffic Signal Systems
	City_Madison_Traffic Engineering Division_Traffic Signal Systems
	City_Non Specified_Signal Preemption/Priority Equipment
	City_Madison_Streets and Recycling_In Pavement Sensors/Treatment Systems
	WisDOT_DTSD_SW Region_Madison_Signal Preemption/Priority Equipment
	Transit Agency_Non Specified_Transit Signal Priority On-Board Equipment
Security Monitoring	Madison Metro Transit_On-Board Video Cameras
	City_Madison_Parking Utility_Parking Garage Cameras
	UW-Madison_Police Dept_Cameras
Parking Management	City_Madison_Parking Utility_Parking Management System
	County_Dane_Airport_easyPark
	UW-Madison_Parking Management System
	County_Dane_Parking Management System

7.3.2 Terminators

Terminators are similar to subsystems in that they also comprise the physical world in which ITS services take place. However, unlike subsystems, terminators are not key to delivering desired transportation services but are still important in that they are involved in these services albeit to a much lesser degree. Terminators are generally defined as the people, systems and general environment that lie outside the boundary of ITS but still impact ITS systems. The National ITS Architecture includes interfaces between terminators and subsystems but does not allocate functional requirements to terminators. To this extent understanding the role of terminators is less critical than subsystems; however, where possible it is still important to illustrate the connections with terminators to complete the picture of ITS activity and information flow. The mapping of project-related ITS elements to their applicable National ITS Architecture terminator classification is provided in Table 59.

Table 59

Mapping of ITS Elements to National ITS Architecture Terminators

National ITS Architecture Terminator	Corresponding ICM ITS Element(s) Mapping
Alerting and Advisory Systems	x-Alerting and Advisory Systems
Archived Data Administrator	x-MATPB Personnel
	x-Archived Data Administrator
Archived Data User Systems	User Personal Computing Devices
Basic Maintenance and Construction Vehicle	x-Maintenance Vehicle On-Board Equipment
Basic Transit Vehicle	x-Transit Vehicles
	x-Madison Metro Transit_On-Board Fuel Usage Sensors
Basic Vehicle	x-Public_In-vehicle Equipment
x-Public_In-vehicle Equipment	x-Driver
Emergency Personnel	x-Emergency Response Personnel
Emergency System Operator	x-County_Dane_Public Safety Comm Center_Personnel
	x-Emergency Operations Personnel
Emergency Telecommunications System	x-UW-Madison_Police Dept_Emergency Phones
Enforcement Agency	x-Enforcement Agency
Event Promoters	x-Special Event Venues
Financial Institution	x-Financial Institution
Government Reporting Systems	x-MATPB Performance Reporting System
Location Data Source	x-Madison Metro Transit_GPS Receiver/Antenna
	x-Madison Maintenance Vehicle AVL
	x-WisDOT Freeway Service Patrol_GPS Receiver/Antenna
	x-Emergency Vehicles_GPS receiver/Antenna
	x-Public Devices and Vehicles_GPS Receiver/Antenna
Maintenance and Construction Center Personnel	x-Maintenance and Construction Personnel
Map Update Provider	WisDOT_DTSD_BTO_STOC_511 Website
	Transit Agency_Non Specified_Website
	Madison Metro Transit_Website
Media	x-Media
Other ISP	WisDOT_DTSD_BTO_STOC_511 System
	WisDOT_DTSD_BTO_STOC_511 Website
	3rd Party Information Sources
Other Roadway	WisDOT_DTSD_SW Region_Madison_Traffic Signal Systems
	City_Non Specified_Traffic Signal Systems
	City_Madison_Traffic Engineering Division_Traffic Signal Systems
Other Traffic Management	WisDOT_DTSD_BTO_STOC_ATMS
	City_Madison_Traffic Engineering Division_Traffic Operations Center Software
	x-Traffic Management Center
	WisDOT_DTSD_SW Region_Madison_Regional Offices
	Transit Agency_Non Specified_CAD
Parking Operator	x-Parking Operator
Pedestrians	x-Pedestrians
Roadway Environment	x-Roadway Environment
Telecommunications System for Traveler Information	x-WisDOT_DTSD_BTO_STOC_511 Telephony

National ITS Architecture Terminator	Corresponding ICM ITS Element(s) Mapping
Traffic	x-Traffic
Traffic Operations Personnel	x-Traffic Operations Personnel
Transit Operations Personnel	x-Transit Operations Personnel
Transit Vehicle Operator	x-Transit Vehicle Operators
Traveler	x-Traveler
Traveler Card	x-Transit Contactless Smart Fare Cards
	x-Fare Card
Vehicle Characteristics	Vehicles

7.3.3 ITS Element Inventory

An ITS element inventory is a collection of existing and planned ITS technologies that comprise the building blocks of an ITS architecture. It consists of only the elements that show potential for being integrated with other ITS elements and are in themselves part of the larger system. ITS elements that are stand alone and cannot be integrated are not reflected in the ITS element inventory. For example, integrated traffic signals that can be remotely controlled or that communicate with other adjacent traffic signals would be included. However, an isolated traffic signal that must be controlled from the field and is not integrated with other traffic signals would not.

Table 60 provides a listing and description of ITS elements included in the Madison Regional ITS Architecture as well as their status (existing or planned). If an element's status is shown as existing it means that the element current exists within the region; however, additional devices may be planned. If the element's status is shown as planned that means the element does not currently exist within the Madison Metropolitan Area. The ITS inventory was derived in part using the WisDOT Statewide ITS Architecture. The Statewide ITS Architecture provides a comprehensive listing of ITS elements in the state including SW Wisconsin. These elements were reviewed and those that mapped to the project were pulled out as being applicable the Regional ITS Architecture.

Table 60

Madison Metropolitan Area ITS Elements, Descriptions and Status

ITS Element	ITS Element Description	Status
3rd Party Information Sources	3rd Party information sources include those operated by private companies that do not have a role in the operation of the transportation network. Examples of thee sources include Google, WAZE, and others.	Existing
City_Madison_Parking Utility_Parking Garage Cameras	This element represents security cameras that are located within parking garages that are operated by the City of Madison Parking Authority. These cameras are used primarily for surveillance.	Existing
City_Madison_Parking Utility_Parking Management System	The City of Madison Parking Utility provides electronic monitoring and management of their parking facilities. This includes electronic collection of parking fees and dynamic signing of parking lot usage and availability. Parking availability is monitored through continual tracking of entering/exiting patrons. Real-time parking availability information provided to pre-trip users via the following website: www.cityofmadison.com/parkingUtility/garagesLots/availability/ Parking garage parking fees are processed through automatic pay stations.	Existing
City_Madison_Streets and Recycling_In Pavement Sensors/Treatment Systems	This element represents a future deployment of arterial in pavement sensors and/or anti-icing system that will be used to detect real-time pavement conditions to support winter maintenance operations.	Planned
City_Madison_Streets and Recycling_Maintenance Decision Support System (MDSS)	MDSS is a tool that is used prior to or upon onset of adverse winter weather conditions, integrating relevant road weather forecasts, maintenance rules of practice, and maintenance resource data to provide winter maintenance manager with recommended road treatment strategies.	Existing
City_Madison_Streets and Recycling_Maintenance Vehicles	City of Madison Maintenance Department Madison, WI 53703 608-266-4767	Existing

ITS Element	ITS Element Description	Status
City_Madison_Traffic Engineering Division_CCTV Cameras	The City of Madison operates a network of 48 arterial CCTV cameras, located primarily at signalized intersections. Both standard and high-definition cameras have been installed and are currently being operated. The standard definition camera used by the City is the P5522-E PTZ Dome Network Camera manufactured by AXIS Communications. This camera has an 18x optical zoom with autofocus. The High Definition camera is the Q6045_E Mk II PTZ Dome Network Camera also manufactured by AXIS. This camera is capable of producing HDTV 1080p video and has a 32x optical zoom. The public is able to view real-time video from any the City of Madison CCTV cameras through the City's web client software located at following website: https://cameras.cityofmadison.com/advanced.webs=0;#eyJsIjowLCJpdGVtcyI6W10sInNiIjoxLCJtIjoxfQ== The City of Madison's video management system vendor is ExacqVision.	Existing
City_Madison_Traffic Engineering Division_Floating Bike Lane Signs	The City of Madison has designated floating bike lanes around part of the outer loop of the Capitol Square. The floating bike lane changes positions in the street depending on the time of day and when parking is allowed or not allowed. During "peak hours" (4:00pm-5:30pm, Monday-Friday) parking is not allowed and the bike lane is next to the curb. During "off peak hours" parking is allowed and the bike lane shifts left, outside of the parking area. The City operates overhead signs to dynamically change lane designations based on the time of day.	Existing
City_Madison_Traffic Engineering Division_ Pedestrian and Bicyclist Hybrid Beacons	The City of Madison has a pedestrian and bicyclist hybrid beacon located at the intersection of N. Blair Street and E. Mifflin Street. This is a relatively new technology used to help pedestrians and bicyclists safely cross busy streets. The beacon is different from a standard traffic signal in that the major street's signal is generally dark, or off, and there is no traffic signal for cross street motorists so cut through traffic is not encouraged on the side street. Pedestrians and bicyclists on the side street each have their own signals.	Existing
City_Madison_Traffic Engineering Division_Signal Preemption/Priority Equipment	Emergency vehicle signal pre-emption allows emergency vehicles to intervene in the normal operation of traffic signals through wireless technologies. The regular cycle of the traffic signal is interrupted to either change the traffic signal to the green phase or to hold the green phase, allowing the emergency vehicle to pass through the intersection without delay. Most of the Madison area signals are equipped with emergency vehicle pre-emption equipment. Ninety-three signalized intersections within the City of Madison have emergency signal preemption capability for at least one approach. The City of Madison uses two types of emergency signal pre-emption equipment; Global Traffic Technologies' Opticom Infrared (IR) System and TOMAR Electronics' STROBECOM II optical pre-emption.	Existing
City_Madison_Traffic Engineering Division_Traffic Operations Center Software	The City of Madison has a workstation from which the agency can monitor city owned and operated CCTV cameras and traffic signal systems. The workstation consists of several monitors that display the City's CCTV camera feeds. The City of Madison would like to upgrade their center to become a more regional traffic management center.	Existing
City_Madison_Traffic Engineering Division_Traffic Signal Systems	Most of the signals in the Madison area are part of a coordinated traffic signal system that is operated and maintained by the City of Madison Traffic Engineering Division. The City has on ongoing program to evaluate and make adjustments to the timing of the traffic signals. Dane County and local jurisdictions reimburse the City for work on signals on county roadways and those located outside the City. The signals are programmed to maintain optimum traffic flow while also meeting other goals such as providing sufficient time for pedestrians to cross the street and to clear cross traffic on side streets as well as allowing for left-turning traffic. The timing of the signals is adjusted for different days of the week, times of the year, and for special events (e.g., football Saturdays). The only traffic signals not maintained by the City of Madison Traffic Engineering Division are those along Stoughton Road (USH 51) and Verona Road (USH 18/151), the Beltline interchange signals in Monona at South Towne Drive and Monona Drive, and the signals in the City of Middleton. WisDOT is currently in the process of trying to better coordinate the signals on Verona Road and Stoughton Road. The City of Middleton has coordinated the signals on Greenway Boulevard and Century Avenue, but not those on University Avenue.	Existing
City_Non Specified_ Communications Center (Dispatch)	This is a placeholder element that represents other, non-defined dispatch centers.	Existing
City_Non Specified_Signal Preemption/Priority Equipment	Emergency vehicle signal pre-emption allows emergency vehicles to intervene in the normal operation of traffic signals through wireless technologies. The regular cycle of the traffic signal is interrupted to either change the traffic signal to the green phase or to hold the green phase, allowing the emergency vehicle to pass through the intersection without delay. This element represents signal preemption/priority equipment that is operated by cities other than the City of Madison within the Madison Metropolitan Area.	Existing

ITS Element	ITS Element Description	Status
City_Non Specified_Traffic Signal Systems	Most, but not all, of the traffic signals in the Madison area are part of a coordinated traffic signal system that is operated and maintained by the City of Madison Traffic Engineering Division. The City has on ongoing program to evaluate and make adjustments to the timing of the traffic signals. Dane County and local jurisdictions reimburse the City for work on signals on county roadways and those located outside the City. This element represents the traffic signal operated by cities other than the City of Madison.	Existing
County_Dane_Airport_ easyPark	easyPark is a paperless ticketing system that allows you to enter Dane County Regional Airport's parking facilities using only your credit or debit card. As one enters the parking facilities, he/she simply inserts his/her credit or debit card rather than taking a paper ticket. As one exits the parking facility, the individual just inserts the same credit or debit card he/she used upon entry in order to complete the payment process. The airport also operates a phone system (608) 246-3380 where interested parties can obtain parking availability information.	Existing
County_Dane_Emergency Warning System	The Dane County uses a combination of methods for alerting the public when disaster strikes. The emergency warning system consists of multiple components, including: -outdoor sirens (owned and operated by the county). There are 134 outdoor warning sirens in the Dane County siren system. The county is responsible for testing and warning activation of all the sirens in the system. The primary activation point of the county sirens is the Dane County 911 Center, with backup capabilities in the County Emergency Management office. -BAMBOX -reverse 911 system (emergency telephone notification) -smart phone wireless emergency alert system -e-mail, social media (twitter and Facebook) and subscription based messaging -NOAA Weather Radio .	Existing
County_Dane_Parking Management System	The Dane County Parking Ramp, renamed Capitol Square South Ramp, in the mid 1990's is located on the southernmost corner of the Outer Ring of The Capitol Square on South Fairchild Street between West Main and West Doty Streets in downtown Madison. The facility is a metered parking garage. The facility is a metered parking garage.	Existing
County_Dane_Public Safety Comm Center	The Dane Public Safety Communications 9-1-1 Center is located in downtown Madison on the first floor of the City/County Building. The mission of the Center is to provide a fast, effective communications link between the citizens of Dane County requesting public safety services and the public safety agencies charged with providing emergency and nonemergency services to those citizens. The 9-1-1 center operates 24 hours a day, 7 days a week, and supports 85 agencies. These agencies primarily provide law enforcement, fire, and EMS but also other services like animal control. The center is approximately 2,900 square feet and is divided into the following 13 workstations. Madison law enforcement dispatch County law enforcement dispatch Madison fire and EMS dispatch County fire and EMS dispatch Madison data and records County data and records Parking and animals control (weekdays), call taking (weekend days), and Madison Police (evenings and nights) dispatch Telephone answering (five workstations) Shift supervisor Each workstation has computer and communications equipment that allows communicators to perform call taking, dispatch, and records checking functions.	Existing
Data Archive (Regional)	This is a placeholder element representing a regional ITS data archive shared among multiple regional agencies.	Planned
Data Archives (Individual Agency)	This is a placeholder element representing the private data archives that are owned and operated by individual agencies.	Existing
Emergency Vehicle On-Board Equipment	Emergency vehicles include ITS equipment that provides the sensory, processing, storage, and communications functions necessary to support safe and efficient emergency response.	Existing
Emergency Vehicle Signal Pre-Emption On-Board Equipment	This element represents the vehicle on-board equipment that communicates directly with companion equipment installed at the traffic signal that pre-empts traffic signal timing to provide a green signal to approaching emergency vehicles.	Existing
Madison Metro Transit_ Automatic Passenger Counters (APC)	On-board devices that count passengers as they board and alight. 215 fixed route buses. The cumulative data collected by APC is frequently used in helping staff develop plans concerning location of bus shelters, analysis of boardings to the bus stop level, etc. While APCs have been shown to be accurate in boarding data, alighting data has been found to be inaccurate. Staff is working with Siemens on this. It is an element which other transit systems with this same equipment are having trouble with as well. When those technical issues are worked out, staff will have access to passenger load information (i.e. how many people are on the bus at any one time for each segment of a route) which will be very useful to route planning and operations purposes. Infra-red beams are located in stairwell at front and rear doors. Provides federal mandated ridership data.	Existing

ITS Element	ITS Element Description	Status
Madison Metro Transit_ Automatic Vehicle Location (AVL)	Metro Transit fixed route, paratransit, and support vehicles are equipped with geographic positioning system (GPS) devices providing real-time vehicle location information to Metro Transit's Dispatch Center. The location information is used to estimate bus arrival times, and this information is available to passengers via information signs at the bus transfer points and UW and MATC campuses. Location data is sent every minute from IVLU. 215 fixed route buses, 16 Para-transit vehicles, and 18 support vehicles. Planning staff use the play-back feature of the AVL system to review run-time data and revise bus schedules. The system generates automatic "Alerts" notifying Operations Supervisors of off-route, early and late buses. Planning Unit personnel review on-time performance through a play-back feature of our new AVL system, in order to develop improved passenger schedules and to obtain further information for route planning purposes. On-time performance standards will evolve from these efforts for inclusion in future monthly performance indicator reports. Operates on 800 MHz trucked voice radio system. The system was implemented in 2001 and is nearly at the end of its useful life. The AVL system includes the GPS antenna, Integrated Vehicle Logic Unit (IVLU) and mobile data terminal.	Existing
Madison Metro Transit_ Building and Transfer Point Camera System Software	This element represents the center-based software used to remotely view and control Metro Transit security cameras.	Existing
Madison Metro Transit_ Building and Transfer Point Cameras	These are cameras installed at transfer points for security purposes. City of Madison Traffic Engineering Department and Madison Police Department are able to access video if granted permission. Cameras are fixed position. Pan/Zoom/Tilt is a capability that is desired in the future. This capability can give dispatchers and maintenance personnel the ability to view messages on transfer point DMS signs.	Existing
Madison Metro Transit_Bus Shelter Signage	Electronic messages at heavily used bus shelters. 4 transfer points and 9 shelters. Using programmed schedule information and live GPS location data, buses send on-time performance updates to these signs approximately once every minute. Based on the remaining travel distance to the sign/bus stop location, signs then display when the bus is expected to arrive. A sample message would read: "Route 2. Arriving in 5 minutes." Important service messages and notes will also be occasionally posted on these signs.	Existing
Madison Metro Transit_ External Announcement	Audio messages within and outside the bus. 215 fixed route buses. Announcements are triggered through data processed by the GPS satellite antenna on each bus, as well as schedule and spatial data associated with bus stop intervals	Existing
Madison Metro Transit_ FuelMaster	Software that monitors vehicle fluid usage. Metro Transit and City offices.	Existing
Madison Metro Transit_ Internal Message Board	Signage within bus. 215 fixed route buses	Existing
Madison Metro Transit_ Kiosks	Kiosks are public informational displays supporting various levels of interaction and information access and systems which provide security in public areas.	Existing
Madison Metro Transit_ Mobile Data Terminal (MDT)	On-board driver interface device for TransitMaster and radio system. Mobile Data Terminal provides operator schedule information as well as voice radio control and passenger messaging. Allows driver to send emergency signal to Dispatch. Enables driver and dispatcher to have voice contact in emergency situations. If warranted, dispatcher can contact 9-1-1. 9-1-1 can then communicate directly with Metro driver. Enables driver to make automated transfer requests. Allows driver to receive text messages from Dispatch and then reply back to Dispatch. Plays pre-recorded informational messages. Exchanges information (to & from) the IVLU.	Existing
Madison Metro Transit_On-Board Fareboxes	Classify and collect fares when passengers board. New fareboxes were implemented on all fixed route buses in August 2014. New fareboxes will accept all of Metro Transit's current fare items including 31-day passes, 10-ride cards, etc. New boxes allow cash bills to be inserted. With this new technology, Metro Transit will be able to shift to the use of contactless smartcards rather than magnetic strip cards in future years. Data from new fare collection equipment are automatically downloaded when buses enter the garage and are routed to a computer for planning to use in reviewing, collating, and summarizing fare collection and schedule data. The contactless farecards will have greater flexibility in storing monetary credit, purchased rides, passes, and transfers. New fare boxes could also allow riders to pay fares with smart phones. Fareboxes have a proximity reader needed for contactless payment instruments. Fareboxes also have an optical reader that can read bar codes from smart phones. The fareboxes are tied into the vehicle's AVL unit.	Existing
Madison Metro Transit_On-Board Fuel Usage Sensors	This element represents that on-board diagnostic equipment used to detect fuel usage and status.	Existing

ITS Element	ITS Element Description	Status
Madison Metro Transit_On-Board Video Cameras	REI Bus Watch/ On-board camera system installed on 215 fixed route buses and 16 para-transit vehicles. Data are shared when there is an open records request. Each transit vehicle has 4, 5, or 6 security cameras on board. 2 to 3 cameras are internal viewing for security. 2 to 3 cameras are outward viewing. Cameras are fixed position. Driver can press a button to bookmark events on the recorded video. Video must be downloaded by physically taking out the digital recorder and downloading the video.	Existing
Madison Metro Transit_ Transit Signal Priority On-Board Equipment	Per 2013-2017 Transit Development Plan there was a recommendation to test a transit signal priority system. Per the report the transit signal priority system has not been implemented, but it is now being evaluated as part of the BRT study.	Planned
Madison Metro Transit_ TransitFleet Software	Software used to track maintenance data on vehicles and buildings forMetro Transit and City of Madison offices. Madison Metro Transit uses TransitFleet to capture and track all vehicle maintenance work, daily fuel and mileage, tire activity, inventory activity, and purchasing for maintenance; to schedule all maintenance work; to reorder parts; and for performance and cost reporting. Maintenance supervisors initiate and close out work orders. Parts issues, purchase orders, and receivings are entered by stock room personnel. Tire activity is entered by the tire guy. Maintenance and stock room personnel make extensive use of on-line lookups for maintenance and inventory information and scheduling. TransitFleet automatically loads daily fuel and mileage from the FuelMaster fueling system. StarTran Software worked with Metro Transit's IT staff to add a custom report for the maintenance supervisors.	Existing
Madison Metro Transit_ TransitMaster CAD	TransitMaster CAD/AVL is designed to maximize dispatcher efficiency by providing them with data that are organized into key information. The solution automatically coordinates real-time data by displaying the top priorities to dispatchers so they always know what needs to be done. CAD provides the dispatch operators with fleet management, real-time AVL display, schedule adherence, event playback, emergency alarm monitoring, text messaging, incident reporting, and off-line report generation.	Existing
Madison Metro Transit_ TransitMaster Integrated Vehicle Logic Unit (IVLU)	The IVLU is the on-board processor that contains the on-board system software for managing or processing data from systems such as the APC, MDTs, vehicle engine, TSP and farebox. The IVLU also includes the embedded GPS processor, radio modem, and a WLAN module for uploading and downloading data while in the maintenance garage. The IVLU is connected by wire to other in-vehicle equipment and installed out of sight. This is the primary on-board unit that communicated information and data with Operation's Center CAD system.	Existing
Madison Metro Transit_ Website	Real-time arrival estimates and bus locator map information for every stop. View text-based arrival time information or track actual bus location on Google Maps or Virtual Earth	Existing
Social Media and Subscription Based Services	This is a placeholder element representing any social media or subscription based service by which a user may opt in.	Existing
Transit Agency_Non Specified_CAD	This is a placeholder for other transit agency center-based computer aided dispatch systems.	Existing
Transit Agency_Non Specified_Transit Signal Priority On-Board Equipment	This is a placeholder element representing other transit agencies on-board transit signal priority equipment.	Planned
Transit Agency_Non Specified_Website	Website used to find out where a bus is at any time. Go to TransLoc website for a real-time locator map (http://monona.transloc.com/). One can also download a TransLoc app for an Ipad, android, or blackberry from the website above.	Existing
User Personal Computing Devices	User Personal Computing Devices refers to equipment an individual owns and can personalize with their choices for information about transportation networks. Computers used to access traveler information websites. Over 50 users are able to view and move DOT cameras via the LINKs website. This element also includes personal cell phones that are likely to use the 511 system that is being planned for the State of Wisconsin.	Existing

ITS Element	ITS Element Description	Status
UW-Madison_Parking Management System	The University of Wisconsin-Madison Parking Management system is operated by the UW-Madison Transportation Services. Transportation Services collects parking availability information and posts estimated parking availability information on their website. Transportation Services has installed electric vehicle charging stations in six campus parking ramps and garages. Use of the charging stations will be cost free to permit and paid visitor parking customers. The charging stations are located near the entrance/exit of the following ramps and garages: • Grainer Hall Garage (Lot 7) • Engineering Drive Ramp (Lot 17) • University Avenue Ramp (Lot 20) • North Park Street Ramp (Lot 29) • Observatory Drive Ramp (Lot 36) • UW Hospital Ramp (Lot 75)	Existing
UW-Madison_Police Dept_ Cameras	In February 2014, various departments within the University of Wisconsin including, division of information technology, facilities planning and management, and the University of Wisconsin Police Department secured a $8 million to replace approximately 1,400 analog cameras on campus with internet protocol (IP) cameras. The project also implemented a centralized video management system that placed all UW cameras on one system so cameras could be more efficiently managed. As of the end of 2014, 260 cameras had been installed as part of this project.	Existing
UW-Madison_Police Dept_ Communications Center (Dispatch)	University of Wisconsin-Madison Police Department 1429 Monroe Street Madison, WI 53711 608-262-2957 The UWPD Communications Center handles 911 calls from campus buildings. Law Enforcement Dispatchers work 24 hours a day, 7 days a week, and are trained in handling emergency situations and day-today activities for the staff, students, and visitors on campus. The UWPD Communications Center also coordinates the response to campus alarms, tradesmen notifications, and lockouts from buildings.	Existing
UW-Madison_Police Dept_ Emergency Notification System (WiscAlerts)	WiscAlerts is the name for UW-Madison's emergency notification system. The system is designed to provide information about an active emergency situation that requires the community to take immediate action in order to stay safe. The system may use one or many of the following components: - Text messaging (opt-in service) - e-mail (no registration required) - phone (campus centrex users, no registration required) - website (www.wisc.edu) To sign up for WiscAlerts go to http://go.wisc.edu/wiscalerts	Existing
Vehicles	User vehicles on the roadway that interact with roadway equipment.	Existing
WisDOT_DTSD_BTO_ STOC_511 System	The 511 Traveler Information System provides information to the 511 telephony system and to the 511 website for information dissemination. Provides real-time traveler information on the state's major highways, including the Interstate system. Provides incident reports, lane closure information, winter road conditions, and travel times. Provides transfers to transit services, state patrol, county sheriff departments, airports, DMV, and other state's 511 systems. Emergency alert feature allows all users (or only users in a targeted area) to hear a special message - i.e., AMBER alerts or emergency weather closures.	Existing
WisDOT_DTSD_BTO_ STOC_511 Twitter Accounts	Twitter is being used to send regional traveler information alerts to subscribers about incidents and severe road conditions. 511 Twitter currently consists of five different accounts, one for each region in the state of Wisconsin.	Existing
WisDOT_DTSD_BTO_ STOC_511 Website	This represents the website interface for 511 that disseminates information to the public via internet enabled devices.	Existing
WisDOT_DTSD_BTO_STOC_ ATMS	WisDOT's STOC, located in the City of Milwaukee, performs centralized incident and communications coordination 24/7/365 for entire state-owned transportation system. This is achieved through the Center's Advanced Traffic Management System (ATMS) software. The vendor of the ATMS software is currently, TransCore (TranSuite) but the system is expected to be replaced in Fall/Winter 2016.	Existing

ITS Element	ITS Element Description	Status
WisDOT_DTSD_BTO_STOC_ CCTV Cameras	The Wisconsin Department of Transportation (WisDOT) operates a network of 45 freeway CCTV cameras in Dane County. CCTV camera images and video provide WisDOT and other first responders a valuable tool, not only for monitoring traffic conditions, but also for monitoring activities at major incident scenes. The State Traffic Operations Center (STOC) has primary control of the cameras. Agencies other than the STOC (i.e., Wisconsin State Patrol) have the ability to control WisDOT cameras. Camera images are shared real-time via a direct communication link with key local agencies. These agencies can view cameras as part of a routine scan, select a specific camera to view, or control the pan, tilt, zoom, or focus of a camera. The STOC, however, retains ultimate control of their camera network and can override a local agencies attempt to control a camera. For agencies without direct communication links, the STOC allows secured internet-based access to video. Local agencies can log on with a secure ID and password to view full-motion video; however, the application does not allow control of the camera. During winter storms the City's Streets Department and Metro Transit are heavy users of the cameras. With these cameras, agencies like these can easily determine which street needs more attention or whether buses will be able to operate. WisDOT shares video feeds with local media, including WISC-TV (Madison Channel 3) and these feeds are provided to the public via media broadcasts. The public are able to view images from any of WisDOT CCTV camera through the State's 511 traveler information website located at: http://www.511wi.gov/web/traffic/cameras.aspx WisDOT's video management system vendor is Teleste. Most cameras are recorded on a 72 hour loop. Real-time streaming camera video, incident reports and travel time information is available to first responders via the TOPS Lab WIsTransPortal System.	Existing
WisDOT_DTSD_BTO_STOC_ DMS (Fixed and Portable)	The element represents any type of dynamic message sign (DMS) that is deployed over or along a roadway for the purpose of disseminating en-route traffic and travel information to drivers. Both full matrix and hybrid static/dynamic DMS are represented by this element. Some Portable DMS can be remotely programmed by STOC operators. WisDOT operates 27 existing permanent DMS within the Madison Metropolitan Area. 22 of these signs are located along regional freeways, and five along primary arterials. WisDOT also uses portable DMS on a project-by-project basis to provide warning and information to motorists in advance of construction zones, planned construction activity, special events, and other locations where a safety concern exists, such as queuing or where road alignment changes. To this extent, portable DMS are used to supplement fixed DMS coverage to provide short-term information needs. Portable message signs may also be used to communicate information on detours and alternate routing allowing motorists to navigate around incident or construction activity. Often, portable DMS are set up in advance of planned construction activity to provide motorist notification that construction activity may soon impact their normal routines.	Existing
WISDOT_DTSD_BTO_STOC_ Environmental Sensor Stations	WisDOT owns and operates a statewide RWIS that consists of 62 individual environmental sensor stations (ESS) located along roadways throughout the state. In Dane County, WisDOT owns and operates 3 ESS at the following locations: USH 12/18 at Mud Lake I-90 at Lake Drive Road USH 18/151 at Sandrock Road Each ESS collects the following types of atmospheric and pavement data: ambient air temperature, relative humidity, dew point, wind speed and direction, wind gust speed WisDOT's ESS network is included as part of the National Oceanic and Atmospheric Administration's (NOAA) Metrological Assimilation Data Ingest System (MADIS) datasets. Real-time ESS observations can be viewed on the MADIS website located at: https://madis-data.noaa.gov/sfc_display/	Existing
WisDOT_DTSD_BTO_STOC_ Freeway Service Team Vehicles	The Dane County Sheriff's Office Freeway Service Team operates on US 12/14/18/151, Madison's Beltline, between I-39 and Mineral Point Road in Dane County. Freeway Service Team (FST) provides free assistance to motorists involved in crashes or breakdowns along Hwy 12 (Beltline) between Interstate 90 and Old Sauk Road in Madison. The program, which is funded by WisDOT, operates Monday through Friday from 7am to 7pm, excluding holidays. The service's primary goal is to maintain safety and traffic flow by reducing the potential for secondary crashes. The FST provides expedited relocation of disabled and crashes vehicles made possible by the presence of FST vehicles continuously patrolling designated segments of interstate and state highways during designated hours. This continuous patrol facilitates a much quicker response time to non-recurring traffic incidents such as breakdowns and traffic crashes, thus reducing the total time needed to clear the incident from the highway and restore normal traffic flow. There are no fees charged to motorists for patrol services. Gateway Patrols relocate disabled vehicles from the highway to safer areas, or crash investigation sites, where the motorist can contact a private towing service for further help. They also provide small amounts of fuel and handle minor repairs such as changing flat tires and taping hoses. Call law enforcement officers to the scene of crashes. Remove debris from the freeway. Aid law officers and other responders by blocking lanes when necessary	Existing

ITS Element	ITS Element Description	Status
WisDOT_DTSD_BTO_STOC_ Ramp Meters	Ramp metering has been under the exclusive control of WisDOT since its inception. There was coordination with the local jurisdictions, but ongoing operations have been solely the responsibility of WisDOT. This includes all maintenance and operations. The deployed systems are generally on the high end of the design spectrum. This is due to some dual lane control and HOV bypasses. Control is centralized through a developed traffic management system in Milwaukee and a standalone in Madison. Red and green lights are used to manage the traffic with one vehicle allowed per green. The long term intent of WisDOT is that all ramp meters will be controlled through the Milwaukee Traffic Operations Center (TOC). Used to regulate traffic entering a freeway facility. There are 120 meters in operation in Milwaukee and Madison. In July 2001 WisDOT implement ramp metering along the US-12/18 Beltline freeway in Dane County. There are a total of 7 metered ramps in the Madison Metropolitan Area.	Existing
WisDOT_DTSD_BTO_STOC_ System Detector Stations	System detector stations (microwave and loops) are used to collect traffic speed, occupancy and volume data. Data that is collected is used to create travel times and populate the WisDOT 511 congestion map. System detector stations are typically spaced from 1/2 mile spacing in congested urban areas to 1 mile spacing for moderately congested areas to 2-3 mile spacing in rural areas. This element also includes Bluetooth wireless detection sensors. Sensors have been installed within the Madison Metropolitan Area through the Verona Road (US 18/151) and I-39/90 projects. Bluetooth sensors are being used to generate near real-time vehicle travel times and to fill in gaps in existing freeway travel times.	Existing
WisDOT_DTSD_SW Region_ Madison_Regional Offices	The Wisconsin Department of Transportation Signal Operations Group is responsible for state highway traffic signal operation in Southwestern Wisconsin. However, not all signals on state highways in southeastern Wisconsin are maintained and operated by the Signal Operations Group.	Existing
WisDOT_DTSD_SW Region_ Madison_Signal Preemption/ Priority Equipment	Emergency vehicle signal pre-emption allows emergency vehicles to intervene in the normal operation of traffic signals through wireless technologies. The regular cycle of the traffic signal is interrupted to either change the traffic signal to the green phase or to hold the green phase, allowing the emergency vehicle to pass through the intersection without delay. This element represents signal preemption/priority equipment that is operated by WisDOT within the Madison Metropolitan Area.	Existing
WisDOT_DTSD_SW Region_ Madison_Traffic Signal Systems	In the Madison Metro Area, WisDOT is currently in the process of trying to better coordinate the signals on Verona Road and Stoughton Road. The City of Middleton has coordinated the signals on Greenway Boulevard and Century Avenue, but not those on University Avenue.	Existing
x-Alerting and Advisory Systems	This element represents the federal, state, and local alerting and advisory systems that provide alerts, advisories, and other potential threat information that is relevant to surface transportation systems. This terminator also represents the early warning and emergency alert systems operated by federal, state, county, and local agencies that provide advisories and alerts regarding all types of emergencies including natural hazards (floods, hurricanes, tornados, earthquakes), accidents (chemical spills, nuclear power plant emergencies) and other civil emergencies such as child abduction alerts that impact transportation system operation and/ or require immediate public notification. Note that weather related watches and warnings, such as those issued by the National Hurricane Center, are provided by both this terminator and the Weather Service terminator since many alerting and advisory systems and the National Weather Service both provide severe weather and related hazards information. The alerts and advisories that are provided by the systems represented by this terminator are based on analysis of potential threat information that is collected from a variety of sources, including information collected by ITS systems. The bidirectional interface with this terminator allows potential threat information that is collected by ITS systems to be provided to the alerting and advisory systems to improve their ability to identify threats and provide useful and timely information. The types of information provided by this terminator include general assessments and incident awareness information, advisories that identify potential threats or recommendations to increase preparedness levels, alerts regarding imminent or in-progress emergencies, and specific threat information such as visual imagery used for biometric image processing.	Existing
x-Archived Data Administrator	This element represents the human operator who provides overall data management, administration, and monitoring duties for an integrated ITS data archive. Unlike the manager of the operational databases, the archive data administrator's role is focused on the archive and covers areas such as establishing user authentication controls, monitoring data quality, and initiating data import requests.	Planned
x-Commercial Vehicles	Represents the commercial vehicles on the roadway.	Existing
x-County_Dane_Public Safety Comm Center_Personnel	Represents the emergency system operators working at the Public Safety Communications Center.	Existing

ITS Element	ITS Element Description	Status
x-Driver	This element represents the human entity that operates a licensed vehicle on the roadway. Included are operators of private, Transit, Commercial, and Emergency vehicles where the data being sent or received is not particular to the type of vehicle. Thus this terminator originates driver requests and receives driver information that reflects the interactions which might be useful to all drivers, regardless of vehicle classification. The Driver is the operator of the Basic Vehicle terminator.	Existing
x-Emergency Operations Personnel	This element represents the human entity that monitors all ITS emergency requests, (including those from the E911 Operator) and sets up pre-defined responses to be executed by an emergency management system. The operator may also override predefined responses where it is observed that they are not achieving the desired result. This element includes dispatchers who manage an emergency fleet (police, fire, ambulance, HAZMAT, etc.) or higher order emergency managers who provide response coordination during emergencies.	Existing
x-Emergency Response Personnel	This element represents personnel that are responsible for police, fire, emergency medical services, towing, service patrols, and other special response team (e.g., hazardous material clean-up) activities at an incident site. These personnel are associated with the Emergency Vehicle Subsystem during dispatch to the incident site, but often work independently of the Emergency Vehicle Subsystem while providing their incident response services. Emergency personnel may include an Officer in Charge (OIC) and a crew.	Existing
x-Emergency Vehicles_GPS receiver/Antenna	This element represents the GPS receiver that is used to track and locate emergency vehicles in real-time. This element communicates directly with automatic vehicle location equipment that is located on-board the emergency vehicle.	Existing
x-Enforcement Agency	This element represents the systems that receive reports of violations detected by various ITS facilities including excessive speed in work zones, etc.	Existing
x-Fare Card	This element represents the entity that enables the actual transfer of electronic information from the user of a service (I.e. a traveler) to the provider of the service. This may include the transfer of funds through means of an electronic payment instrument. The device, like a smart card, may also hold and update the traveler's information such as personal profiles or trip histories.	Planned
x-Financial Institution	This element represents the organization that handles all electronic fund transfer requests to enable the transfer of funds from the user of the service to the provider of the service. The functions and activities of financial clearinghouses are subsumed by this entity.	Existing
x-Kiosks	Roadside rest stops or convenience store locations, information kiosks; traveler information, yellow page information, etc.	Existing
x-Madison Maintenance Vehicle AVL	This element provides accurate position information. Systems which use GPS, terrestrial trilateration, or driver inputs are all potential examples of Location Data Sources. This element contains sensors such as radio position receivers (e.g. GPS) and/or dead reckoning sensors (e.g. odometer, differential odometer, magnetic compass, gyro, etc.).	Existing
x-Madison Metro Transit_ GPS Receiver/Antenna	The GSP Receiver/Antenna receives data transmitted from satellites. The GPS antenna receives the satellite signals and sends the data to the IVLU for processing. Location data is transmitted to/from IVLU and Metro offices. 215 fixed route buses, 16 para-transit vehicle and 18 support vehicles.	Existing
x-Maintenance and Construction Personnel	This element represents the people that directly interface with the systems in the Maintenance and Construction Management subsystem. These personnel interact with fleet dispatch and management systems, road maintenance systems, incident management systems, work plan scheduling systems, and work zone management systems. They provide operator data and command inputs to direct system operations to varying degrees depending on the type of system and the deployment scenario. All functionality associated with these services that might be automated in the course of ITS deployment is modeled as internal to the architecture.	Existing
x-Maintenance Vehicle On-Board Equipment	This element represents a specialized form of the Basic Vehicle used by maintenance fleets. It supports the on-board equipment that control the non-ITS systems such as the actual operation of the snow plow, as well as any non-ITS sensor equipment that monitors the amount of materials (e.g., sand or salt) on-board. The monitoring of the Basic Maintenance and Construction Vehicle mechanical condition and mileage provides the major inputs for maintenance vehicle activity scheduling.	Existing
x-MATPB Performance Reporting System	System represents the equipment and associated personnel that prepare the inputs to support the various local, state, and federal government transportation data reporting requirements (e.g. Performance Monitoring Reports) using data collected by ITS systems. This element represents a system interface that would provide access to the archived data that is relevant to these reports. In most cases, this terminator would manually combine data collected from the ITS archives with data from non ITS sources to assemble and submit the required information.	Planned
x-MATPB Personnel	This element represents MATPB staff that interface with ITS elements.	Existing

ITS Element	ITS Element Description	Status
x-Media	The Media element represents the information systems that provide traffic reports, travel conditions, and other transportation-related news services to the traveling public through radio, TV, and other media.	Existing
x-Parking Operator	This element is the human entity that may be physically present at the parking lot facility to monitor the facility's operational status.	Existing
x-Pedestrians	This element provides input (e.g. a request for right of way at an intersection) from a specialized form of the Traveler who is not using any type of vehicle (including bicycles) as a form of transport. Pedestrians may comprise those on foot and those in wheelchairs.	Existing
x-Public Devices and Vehicles_GPS Receiver/ Antenna	This element represents the GPS receiver that is installed and used within mobile personal communication s and computing devices to determine geographic location.	Existing
x-Public_In-vehicle Equipment	This element represents the basic vehicle platform that interfaces with and hosts ITS electronics. This interface allows general vehicle systems (e.g., the stereo speaker system) to be shared by ITS and non-ITS systems. It also allows monitoring and control of the vehicle platform for advanced vehicle control system applications. This element will be used as the audio interface through which Highway Advisory Radio messages are communicated to the driver.	Planned
x-Roadway Environment	Roadway equipment that communicates to both the roadway users and to operation centers.	Existing
x-Special Event Venues	This element represents various Special Event venues that have knowledge of events that may impact travel on roadways or other modal means. Examples of special event venues include sporting events, conventions, motorcades/parades, and public/political events. These elements interface to the ITS to provide event information such as date, time, estimated duration, location, and any other information pertinent to traffic movement in the surrounding area.	Existing
x-Traffic	This element represents the collective body of vehicles that travel on surface streets, arterials, highways, expressways, tollways, freeways, or any other vehicle travel surface. Traffic depicts the vehicle population from which traffic flow surveillance information is collected (average occupancy, average speed, total volume, average delay, etc.), and to which traffic control indicators are applied (intersection signals, stop signs, ramp meters, lane control barriers, variable speed limit indicators, etc.). All sensory and control elements that interface to this vehicle population are internal to ITS.	Existing
x-Traffic Management Center	This element represents a peer (e.g. inter-regional) traffic management center (e.g., STOC or other center/facility where information is exchanged). This element enables traffic management activities to be coordinated across different jurisdictional areas. In the Physical Architecture, this terminator is a reciprocal Traffic Management Subsystem (TMS).	Existing
x-Traffic Operations Personnel	This element represents the human entity that directly interfaces with vehicle traffic operations. These personnel interact with traffic control systems, traffic surveillance systems, incident management systems, work zone management systems, and travel demand management systems to accomplish ITS services. They provide operator data and command inputs to direct systems operations to varying degrees depending on the type of system and the deployment scenario. All functionality associated with these services that might be automated in the course of ITS deployment is modeled as internal to the architecture.	Existing
x-Transit Contactless Smart Fare Cards	The Metro Transit Commute Card is an annual unlimited ride pass program for area businesses and organizations. The only cost associated is the per ride fee of $1.25. The program is a great way to take advantage of tax benefits, provide a valuable service to your employees, and support a healthier, more sustainable environment. Each card is tracked per employee by a serial number. Every month an organization or business will receive an invoice showing the number of rides and cost per serial number. Cards can be easily deactivated in case of an employee departure or loss of card. There are no minimum requirements in terms of usage or participants.	Planned
x-Transit Operations Personnel	This element represents the human entities that are responsible for fleet management, maintenance operations, and scheduling activities of the transit system. This element actively monitors, controls, and modifies the transit fleet routes and schedules on a day to day basis (dynamic scheduling). The modifications will be to take account of abnormal situations such as vehicle breakdown, vehicle delay, detours around work zones or incidents (detour management and service restoration), and other causes of route or schedule deviations. This entity may also be responsible for demand responsive transit operation and for managing emergency situations within the transit network such as silent alarms on board transit vehicles or the remote disabling of the vehicle. In addition, the Transit Operations Personnel may be responsible for assigning vehicle operators to routes, checking vehicle operators in and out, and managing transit stop issues. Finally, the Transit Operations Personnel terminator represents the people responsible for planning, development, and management of transit routes and schedules.	Existing

ITS Element	ITS Element Description	Status
x-Transit Vehicle Operators	This element represents the human entity that receives and provides additional information that is specific to operating the ITS functions in all transit vehicle types. The information received by the operator would include status of on-board systems. Additional information received depends upon the transit vehicle type. In the case of fixed route transit vehicles, the Transit Vehicle Operator would receive operator instructions that might include actions to correct schedule deviations. In the case of flexible fixed routes and demand response routes the information would also include dynamic routing or passenger pickup information.	Existing
x-Transit Vehicles	This element represents a specialized form of the Basic Vehicle that interfaces with and hosts ITS electronics. The Basic Transit Vehicle may be a bus, paratransit vehicle, light rail vehicle, or other vehicle designed to carry passengers. The Basic Transit Vehicle includes the non-ITS on-board systems (e.g., engine, brakes, drive train, and odometer). The monitoring of the Basic Transit Vehicle mechanical condition and mileage provides the major inputs for vehicle maintenance activity scheduling. The Transit Vehicle element can also accept disable commands resulting from a remote vehicle disable command or from a failure of the vehicle operator to be properly authenticated.	Existing
x-Traveler	This element represents any individual who uses transportation services. The interfaces to the traveler provide general pre-trip and en-route information supporting trip planning, personal guidance, and requests for assistance in an emergency that are relevant to all transportation system users. The element represents users of a public transportation system and addresses interfaces these users have within a transit vehicle or at transit facilities such as roadside stops and transit centers. This element is supplemented in the architecture by the specific Driver" element that supports interfaces that are specific to drivers."	Existing
x-UW-Madison_Police Dept_ Emergency Phones	There are approximately 140 emergency phones on the UW campus, including the blue light phones (in areas like Picnic Point and the Lakeshore Path), phones in parking ramps (including elevators), and in many buildings. These phones dial 911 directly with the push of a button, and the call is connected to the UW-Madison Police Department Communication Center. These phones are to be used for emergencies only. When the button is pressed, the dispatcher will receive the call, along with the location of the phone the call is coming from, and an officer will be sent to check the area whether or not you speak with the dispatcher. If you accidentally push the button, please remain on the phone to inform the dispatcher there is no emergency. All emergency phones on campus are tested once per month to ensure they are working properly. If you have additional questions regarding emergency/blue light phones on campus, please contact UW-Madison Police Department Communication Manager LeAnn Krieg at (608) 265-9531.	Existing
x-WisDOT Freeway Service Patrol_GPS Receiver/ Antenna	The GPS Receiver/Antenna receives data transmitted from satellites. The GPS antenna receives the satellite signals and sends the data to the center for processing.	Existing
x-WisDOT_DTSD_BTO_ STOC_511 Telephony	Phone based 511 information that can be accessed by any land-line phone or cellular phone by dialing 511. Utilizes an interactive voice recognition (IVR) phone system.	Existing

7.3.4 ITS Service/Functional Areas

ITS Service Packages (i.e., service/functional areas) are tailored groupings of subsystems, terminators, and information flows that are needed to deliver a desired transportation service (e.g., Network Surveillance). Service Packages work separately, or in combination, to address real-world transportation needs and desires.

The National ITS Architecture identifies 97 service packages that are categorized into the following eight general services areas:

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

Table 61 shows all 97 service packages defined by the National ITS Architecture. This represents all possible service areas that ITS technologies could potentially support at present time. The Statewide ITS Architecture and the Madison Regional ITS Architecture can be viewed as subsets of the National ITS Architecture. The (●) in Table 61 indicates that the service package is applicable to the Regional ITS Architecture. The Madison Regional ITS Architecture is a sub set of the Statewide ITS Architecture. The (●) indicates the service packages that are applicable to the Madison Regional ITS Architecture. Service packages that are applicable to the Madison Metropolitan Area are described below.

Table 61

National ITS Architecture Service Areas and Service Packages Applicable to the Madison Metropolitan Area

	Archived Data Management Service Area		Traffic Management
●	ITS Data Mart	●	Network Surveillance
●	ITS Data Warehouse		Traffic Probe Surveillance
	ITS Virtual Data Warehouse	●	Traffic Signal Control
	Public Transportation Service Area	●	Traffic Metering
●	Transit Vehicle Tracking		HOV Lane Management
●	Transit Fixed-Route Operations	●	Traffic Information Dissemination
●	Demand Response Transit Operations	●	Regional Traffic Management
●	Transit Fare Collection Management	●	Traffic Incident Management System
●	Transit Security	●	Transportation Decision Support and Demand Mngt.
●	Transit Fleet Management		Electronic Toll Collection
●	Multi-modal Coordination		Emissions Monitoring and Management
●	Transit Traveler Information		Roadside Lighting System Control
●	Transit Signal Priority		Standard Railroad Grade Crossing
●	Transit Passenger Counting		Advanced Railroad Grade Crossing
●	Multimodal Connection Protection		Railroad Operations Coordination
	Traveler Information	●	Parking Facility Management
●	Broadcast Traveler Information	●	Regional Parking Management
●	Interactive Traveler Information		Reversible Lane Management
	Autonomous Route Guidance		Speed Warning and Enforcement
●	Dynamic Route Guidance		Drawbridge Management
●	ISP Based Trip Planning and Route Guidance		Roadway Closure Management
●	Transportation Operations Data Sharing		Variable Speed Limits
	Traveler Services Information and Reservation		Dynamic Lane Management and Shoulder Use
●	Dynamic Ridesharing		Dynamic Roadway Warning
	In Vehicle Signing		VMT Road User Payment
	Short Range Communications Traveler Information	●	Mixed Use Warning Systems
	Vehicle Safety		**Commercial Vehicle Operations**
	Vehicle Safety Monitoring		Carrier Operations and Fleet Management
	Driver Safety Monitoring		Freight Administration
	Longitudinal Safety Warning		Electronic Clearance
	Lateral Safety Warning		CV Administration Processes
	Intersection Safety Warning		International Border electronic Clearance
	Pre-crash Restraint Deployment		Weigh-In-Motion
	Driver Visibility Improvement		Roadside CVO Safety
	Advanced Vehicle Longitudinal Control		On-board CVO Safety
	Advanced Vehicle Lateral Control		CVO Fleet Maintenance
	Intersection Collision Avoidance		HAZMAT Management
	Automated Vehicle Operations		Roadside HAZMAT Security Detection and Mitigation

	Cooperative Vehicle Safety Systems		CV Driver Security Authentication
			Freight Assignment Tracking
●	Maint. & Constr. Vehicle and Equipment Tracking	**Emergency Management**	
	Maint. & Constr. Vehicle Maintenance	●	Emergency Call-Taking and Dispatch
●	Road Weather Data Collection	●	Emergency Routing
●	Weather Information Processing and Distribution		Mayday and Alarms Support
●	Roadway Automated Treatment	●	Roadway Service Patrols
●	Winter Maintenance	●	Transportation Infrastructure Protection
●	Roadway Maintenance and Construction	●	Wide-Area Alert
	Work Zone Management		Early Warning System
	Work Zone Safety Monitoring		Disaster Response and Recovery
●	Maintenance and Construction Activity Coordination		Evacuation and Reentry Management
	Environmental Probe Surveillance		Disaster Traveler Information
	Infrastructure Monitoring		
●	Currently Reflected within the Regional ITS Architecture		

7.3.5 High-level ITS Functional Requirements

ITS Functional Requirements drive development of ITS elements by specifically stating what ITS elements must do to deliver transportation services and satisfy user needs and issues. The High-level ITS Functional Requirements listed in Appendix C provide a starting point for defining projects and developing detailed functional requirements for projects. Requirements are also used to verify that ITS elements are built correctly. Besides in Appendix C, high-level ITS functional requirements are documented in the Madison Regional ITS Architecture Turbo Architecture Database. As an example of how functional requirements are written, the high-level functional requirements for the element "City_Madison_Traffic Engineering Division_Traffic Signal Systems" are provided in Table 62.

Table 62

Example of High-level Functional Requirements

Element Name	Functional Area	ID	Requirement
City_Madison_Traffic Engineering Division_Traffic Signal Systems	Roadway Signal Controls	1	The field element shall control traffic signals under center control.
		2	The field element shall respond to pedestrian crossing requests by accommodating the pedestrian crossing.
		3	The field element shall provide the capability to notify the traffic management center of pedestrian calls and pedestrian accommodations.
		4	The field element shall report the current signal control information to the center.
		5	The field element shall report current preemption status to the center.
		6	The field element shall return traffic signal controller operational status to the center.
		7	The field element shall return traffic signal controller fault data to the center.
		8	The field element shall report current transit priority status to the center.
	Roadway Signal Priority	1	The field element shall respond to signal priority requests from transit vehicles.
	Roadway Signal Preemption	1	The field element shall respond to signal preemption requests from emergency vehicles.
	Roadway Equipment Coordination	1	The field element shall include sensors that provide data and status information to other field element devices, without center control.
		2	The field element shall include sensors that receive configuration data from other field element devices, without center control.

Element Name	Functional Area	ID	Requirement
		3	The field element shall include devices that provide data and status information to other field element devices without center control.
		4	The field element shall include devices that receive configuration data from other field element devices, without center control.
	Roadway Field Device Monitoring	1	The field element shall monitor the operational status (state of the device, configuration, and fault data) of connected sensors (such as traffic, infrastructure, environmental, security, speed) and devices (such as highway advisory radio, dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals, ramp meters, short range communications equipment, security surveillance equipment).
		2	The field element shall send operational status of connected field equipment to the maintenance center.
		3	The field element shall send collected fault data to the maintenance center for repair.
		4	The field element shall include a local interface that provides operational status and fault data for connected field equipment to field personnel.
		5	The field element shall include a local interface that allows field personnel to command diagnostic tests on connected field equipment.

7.3.6 System Interconnects

System interconnects are the communications paths that carry information between subsystems and terminators. A system-to-system interface may consist of one or many information flows, and communication may occur via one or more of the following methods:

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

Since the project ITS architecture is a high-level planning document, it does not specify a design for the system or how communication will occur.

In terms of ITS architecture development, the term “stakeholder” includes only those agencies that have a role in the installation, operation or maintenance of an ITS element(s). This includes any agency that may collect, contribute, convey, process, or distribute information associated with the system. The key stakeholders in the Madison Metropolitan Area include:

- City of Madison Traffic Engineering Division
- City of Madison Parking Utility
- City of Madison Metro Transit
- Madison Area Transportation Planning Board
- WisDOT SW Region
- WisDOT Division of Transportation System Development, Bureau of Traffic Operations, Statewide Traffic Operations Center
- University of Wisconsin - Madison
- Cities, Towns, and Villages located within the Madison Metropolitan Area.

Because there are several local entities that own, operate and maintain similar systems within the region, a many-to-one relationship was defined within the Regional ITS architecture. For example, a single ITS element (City_Non Specified_ Traffic Signal Systems) was defined to represent traffic signal systems operated by non-critical stakeholders within the Madison Metropolitan area. Defining this many-to-one relationship reduces complexity and simplifies understanding and maintainability of the architecture. All project stakeholders and their associated mapping to ITS elements are identified in Table 63. Where feasible, existing naming conventions used in the Statewide ITS Architecture were carried forth to this project to name stakeholders and their associated ITS elements. ITS elements labeled with an "x-"represent those that map only to National ITS Architecture Terminators.

Table 63

Project Stakeholder and Project Architecture Mapping

Stakeholder Name	Stakeholder Description	Associated ITS Element Mapping(s)
Terminators	No specific stakeholder. This stakeholder represents the boundaries of the regional ITS architecture and may not have an associated stakeholder.	x-Commercial Vehicles
		x-Kiosks
		x-Media
		x-Roadway Environment
		x-Public_In-vehicle Equipment
		x-Pedestrians
		x-Driver
		x-Traffic Operations Personnel
		x-Traffic
		x-Financial Institution
		x-Parking Operator
		x-Emergency Response Personnel
		x-Maintenance and Construction Personnel
		x-Maintenance Vehicle On-Board Equipment
		x-Emergency Operations Personnel
		x-Transit Vehicles
		x-Transit Vehicle Operators
WisDOT_DTSD_BTO_STOC	Statewide Traffic Operations Center Milwaukee-Area Traffic Operations Center 633 W. Wisconsin Avenue, Suite 1200 Milwaukee, Wisconsin 53203 Phone: (414) 227-2166	WisDOT_DTSD_BTO_STOC_ATMS
		WisDOT_DTSD_BTO_STOC_Freeway Service Team Vehicles
		WisDOT_DTSD_BTO_STOC_511 System
		x-WisDOT_DTSD_BTO_STOC_511 Telephony
		WisDOT_DTSD_BTO_STOC_511 Website
		WisDOT_DTSD_BTO_STOC_CCTV Cameras
		WisDOT_DTSD_BTO_STOC_511 Twitter Accounts
		WisDOT_DTSD_BTO_STOC_DMS (Fixed and Portable)
		WisDOT_DTSD_BTO_STOC_Ramp Meters
		WisDOT_DTSD_BTO_STOC_System Detector Stations
		WISDOT_DTSD_BTO_STOC_Environmental Sensor Stations
		x-WisDOT Freeway Service Patrol_GPS Receiver/Antenna

Stakeholder Name	Stakeholder Description	Associated ITS Element Mapping(s)
WisDOT_DTSD_SW Region_ Madison	WisDOT Southwest Region, Madison Office (formerly District 1) 2101 Wright Street Madison, WI 53704-2583 608-246-3800	WisDOT_DTSD_SW Region_Madison_Traffic Signal Systems
		WisDOT_DTSD_SW Region_Madison_Signal Preemption/Priority Equipment
		WisDOT_DTSD_SW
		Region_Madison_Regional Offices
City_Madison_Metro Transit	Transit service for the greater Madison area including fixed-route bus service and paratransit service. City of Madison Transit 1245 East Washington Avenue, Suite 201 Madison, WI 53703 608-267-8787 http://www.cityofmadison.com/metro/	Madison Metro Transit_Kiosks
		Madison Metro Transit_TransitMaster Integrated Vehicle Logic Unit (IVLU)
		x-Madison Metro Transit_GPS Receiver/ Antenna
		Madison Metro Transit_Automatic Vehicle Location (AVL)
		Madison Metro Transit_Mobile Data Terminal (MDT)
		Madison Metro Transit_Internal Message Board
		Madison Metro Transit_External Announcement
		Madison Metro Transit_Automatic Passenger Counters (APC)
		Madison Metro Transit_On-Board Fareboxes
		Madison Metro Transit_TransitFleet Software
		Madison Metro Transit_FuelMaster
		Madison Metro Transit_Building and Transfer Point Cameras
		Madison Metro Transit_Bus Shelter Signage
		Madison Metro Transit_Transit Signal Priority On-Board Equipment
		x-Transit Contactless Smart Fare Cards
		Madison Metro Transit_Website
		x-Transit Operations Personnel
		Madison Metro Transit_TransitMaster CAD
		Madison Metro Transit_On-Board Video Cameras
		Madison Metro Transit_Building and Transfer Point Camera System Software
		Madison Metro Transit_On-Board Fuel Usage Sensors
WisDOT_DSP	Wisconsin Department of Transportation - Division of State Patrol Hill Farms State Transportation Building 4802 Sheboygan Avenue, Room 551 P.O. Box 7912 Madison, WI 53707-7912	
TOPS Laboratory	www.topslab.wisc.edu	
City of Monona Express Transit	The City of Monona contracts with a private provider to operate one fixed-route transit route, called the Monona Express. Monona Express makes four loops each morning and four loops each afternoon to take riders to downtown Madison, the UW Campus, and UW, VA, Meriter, and St. Marys Hospitals. Point deviation service is provided within Monona and to downtown Madison during midday hours.	

Stakeholder Name	Stakeholder Description	Associated ITS Element Mapping(s)
City_Madison_Streets and Recycling	Streets and Recycling is responsible for keeping 1,742 lane miles of streets, 150 miles of sidewalks and bike paths, clear of snow and ice. The Department is also responsible for clearing snow from 887 priority bus stops after most snow storms and another 800 bus stops after major storms. During snowy weather, the City of Madison Streets Department works hard to clear streets, roadways, and bus stops as quickly as possible for commuter travel. Residents can report snow and ice problems using the following website. www.cityofmadison.com/reportaproblem/snowremoval.cfm	City_Madison_Streets and Recycling_ Maintenance Vehicles
		City_Madison_Streets and Recycling_ Maintenance Decision Support System (MDSS)
		x-Madison Maintenance Vehicle AVL
		City_Madison_Streets and Recycling_In Pavement Sensors/Treatment Systems
City_Madison_Parking Utility	It is our mission to provide safe, convenient and affordable parking to the City's citizens and visitors. The Parking Utility provides over 5,000 public parking spaces through our 5 parking garages, 7 parking lots and more than 1300 on-street, metered, parking spaces. Among our responsibilities are the maintenance of these garages, lots and street meters. We also administer the sale of a variety of daily, monthly and annual permits including an extensive residential parking permit program.	City_Madison_Parking Utility_Parking Management System
		x-Fare Card
		City_Madison_Parking Utility_Parking Garage Cameras
City_Madison_Traffic Engineering Division	Design, construct, maintain and operate 348 traffic signals for the City of Madison, State of Wisconsin, UW, Dane County, and outlying municipalities.	City_Madison_Traffic Engineering Division_ Traffic Operations Center Software
		City_Madison_Traffic Engineering Division_ CCTV Cameras
		City_Madison_Traffic Engineering Division_ Pedestrian and Bicyclist Hybrid Beacons
		City_Madison_Traffic Engineering Division_ Signal Preemption/Priority Equipment
		City_Madison_Traffic Engineering Division_ Floating Bike Lane Signs
		City_Madison_Traffic Engineering Division_ Traffic Signal Systems
UW-Madison Transportation Services_Parking Dept	UW Transportation Services issues parking citations on campus and is not affiliated with the UW-Madison Police Department.	UW-Madison_Parking Management System
UW-Madison_Police Dept	1429 Monroe Street Madison, WI 53711 UW-Madison Police Department is not responsible for coordinating or enforcing parking on the UW campus.	UW-Madison_Police Dept_Communications Center (Dispatch)
		UW-Madison_Police Dept_Emergency Notification System (WiscAlerts)
		x-UW-Madison_Police Dept_Emergency Phones
		UW-Madison_Police Dept_Cameras
City_Non Specified	This is a placeholder representing other towns, villages and cities within the Madison Metropolitan Area.	Transit Agency_Non Specified_Website
		x-Traffic Management Center
		Data Archives (Individual Agency)
		Social Media and Subscription Based Services
		City_Non Specified_Traffic Signal Systems
		City_Non Specified_Signal Preemption/Priority Equipment
		Transit Agency_Non Specified_CAD
		x-Emergency Vehicles_GPS receiver/Antenna
		Transit Agency_Non Specified_Transit Signal Priority On-Board Equipment
		City_Non Specified_Communications Center (Dispatch)

Stakeholder Name	Stakeholder Description	Associated ITS Element Mapping(s)
County_Dane_Airport		County_Dane_Airport_easyPark
County_Dane_Public Safety Communications (911)	The Public Safety Communications Center of Dane County provides 911 emergency call-taking services. The County 911 Center provides dispatching and centralized communications services for the Dane County Sheriff's Department, Madison Police and Fire Departments as well as 21 local law enforcement agencies. The 911 Center also provides communications and dispatching services to 26 local fire departments and 21 local EMS agencies.	County_Dane_Public Safety Comm Center
		x-County_Dane_Public Safety Comm Center_ Personnel
County_Dane_Emergency Management	Room 2107 Public Safety Building 115 West Doty Street Madison, WI 53703-3202	County_Dane_Emergency Warning System
		x-Alerting and Advisory Systems
County_Dane_Public Works, Highway and Transportation	The Highway & Transportation Maintenance Division maintains all Interstate and State Highways (designated by numbers) and all County Trunk Highways (designated by letters). The County does not maintain local roads.	
The Public	This is a placeholder stakeholder representing users of the multi-modal transportation network.	Vehicles User Personal Computing Devices
		x-Traveler
		x-Public Devices and Vehicles_GPS Receiver/ Antenna
City_Madison_Fire Dept.	The Madison Fire Department is prepared to handle all emergencies, including major disasters that may occur in the community. The Madison Fire Department operates out of 12 Fire Stations throughout the City with a staff of 78 on duty each day. There are 10 engine companies, 5 ladder companies, 8 paramedic units, and 1 command vehicle.	
Special Event Venues	This is a placeholder stakeholder representing the various special event organizations whose operations have the potential to impact traffic operations within the Madison Metropolitan Area.	x-Special Event Venues
Madison Area Transportation Planning Board	The Madison Area Transportation Planning Board is the federally designated Metropolitan Planning Organization (MPO) for the Madison Urban Area. As the MPO, it is the policy body responsible for cooperative, comprehensive regional transportation planning and decision making for the Madison Metropolitan Planning Area.	x-MATPB Personnel
		x-Archived Data Administrator
		x-MATPB Performance Reporting System
		Data Archive (Regional)
3rd Party Information Service Providers	This is a placeholder that represents all non-transportation agencies that collect or disseminate traffic and/or travel information.	3rd Party Information Sources
County_Dane_Parking Dept.	Parking management and enforcement for Dane County	County_Dane_Parking Management System
Madison Area Emergency Responder Agencies	Stakeholder group representing all Madison area emergency responder agencies.	Emergency Vehicle On-Board Equipment
		Emergency Vehicle Signal Pre-Emption On-Board Equipment
Madison Area Law Enforcement Agencies	Stakeholder group representing all Madison area law enforcement agencies.	City_Madison_Police Department
		County_Dane_Sheriff Dept
		UW-Madison_Police Dept
		x-Enforcement Agency

7.3.7 Architecture Flows

Architecture flow is the term given to the specific type of information and/or data that are exchanged between the various ITS elements within the Madison Regional ITS Architecture. An architecture flow is one set of data that satisfies a particular transportation need. For instance, the architecture flow "incident data" provides data and imagery collected at the roadside to support incident detection and verification. Each architecture flow originates at one ITS element and flows to another. For instance, the flow "incident data" may originate at a roadway subsystem and flow to a traffic management subsystem. A single architecture interconnect may consist of several unique architecture flows. Similarly, each architecture flow is defined in terms of its status (i.e., existing or planned).

Several standards development organizations have issued standards (documented agreements containing technical specifications or other precise criteria to be used consistently as rules, guidelines, or definitions of characteristics for the interchange of data) for several of the architecture flows planned between systems within the region. This ensures that interfaces between subsystems are common between unique ITS architectures. For example, if the flow "incident data" were in the Madison ITS Architecture, standards associated with this flow would then set forth the same interface requirements for this flow if implemented in a different state or region and vice versa. The standards development process is still on-going, and not all flows in the National ITS Architecture have standards associated with them (see Section 6.2 for additional details).

The Architecture flows relevant to Madison Regional ITS elements are illustrated in the element-to-element Architecture flow diagrams in Appendix D. For the purpose of understanding how the architecture flows will satisfy unique transportation needs and desires, flows are also shown by their applicable National ITS Architecture Market Packages in Appendix E. Each Market Package diagram is customized to reflect only those flows needed to deliver desired transportation services. Architecture flows are also provided in a tabular format in Appendix F. National ITS Architecture flow definitions are provided in Appendix G.

7.4 ITS Standards

ITS systems should be developed and designed using USDOT approved standards. Standards must be identified prior to implementing projects funded by the National Highway Trust Fund. The FHWA Rule and FTA Policy on Regional ITS Architectures states that "…federally funded projects use, where appropriate, USDOT adopted ITS standards". Standards define how ITS elements will interconnect and interact with each other. The underlying principal behind standards is that they enable subsystems to be designed using "open" platforms. In other words, standards allow subsystems to be designed or easily replaced when they fail, or otherwise become interoperable. Before the introduction of standards, subsystems were often developed using proprietary software and equipment that could not be replaced with a similar subsystem or product other than those made by the same manufacturer. This led to higher project costs and resulted in less innovative systems.

To find more information on ITS-related standards, visit: www.standards.its.dot.gov/

ITS standards applicable to Madison Metropolitan Area ITS elements are identified in Table 64. The Turbo ITS Architecture Database file identifies the specific standard that applies to each system to system interconnect and information flows.

Table 64

ITS Standards Applicable to Madison Metropolitan Area ITS Elements and Information Flows

Standard Development Org.	Standard Title	Standard Doc ID	Standard Type
AASHTO/ITE	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)	ITE TMDD	Message/Data
AASHTO/ITE/NEMA	NTCIP Center-to-Center Standards Group	-	Group
AASHTO/ITE/NEMA	NTCIP Center-to-Field Standards Group	-	Group
AASHTO/ITE/NEMA	Global Object Definitions	NTCIP 1201	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Actuated Traffic Signal Controller (ASC) Units	NTCIP 1202	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Dynamic Message Signs (DMS)	NTCIP 1203	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Environmental Sensor Stations (ESS)	NTCIP 1204	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Closed Circuit Television (CCTV) Camera Control	NTCIP 1205	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Data Collection and Monitoring (DCM) Devices	NTCIP 1206	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Ramp Meter Control (RMC) Units	NTCIP 1207	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Closed Circuit Television (CCTV) Switching	NTCIP 1208	Message/Data
AASHTO/ITE/NEMA	Data Element Definitions for Transportation Sensor Systems (TSS)	NTCIP 1209	Message/Data
AASHTO/ITE/NEMA	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters	NTCIP 1210	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Signal Control and Prioritization (SCP)	NTCIP 1211	Message/Data
AASHTO/ITE/NEMA	Object Definitions for Conflict Monitor Units (CMU)	NTCIP 1214	Message/Data
APTA	Standard for Transit Communications Interface Profiles	APTA TCIP-S-001 3.0.4	Message/Data
ASTM	Dedicated Short Range Communication at 915 MHz Standards Group	-	Group
ASTM	Standard Practice for Metadata to Support Archived Data Management Systems	ASTM E2468-05	Other
ASTM	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data	ASTM E2665-08	Message/Data
ASTM/IEEE/SAE	Dedicated Short Range Communication at 5.9 GHz Standards Group	-	Group
IEEE	Incident Management Standards Group	-	Group
IEEE	Standard for Message Sets for Vehicle/Roadside Communications	IEEE 1455-1999	Message/Data
IEEE	Standard for Wireless Access in Vehicular Environments (WAVE) - Over-the-Air Data Exchange Protocol for Intelligent Transportation Systems (ITS)	IEEE P1609.11	Communications Protocol
SAE	Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group	-	Group
SAE	Advanced Traveler Information Systems (ATIS) General Use Standards Group	-	Group
SAE	ITS In-Vehicle Message Priority	SAE J2395	Other
SAE	Definitions and Experimental Measures Related to the Specification of Driver Visual Behavior Using Video Based Techniques	SAE J2396	Other
SAE	Adaptive Cruise Control (ACC) Operating Characteristics and User Interface	SAE J2399	Other
SAE	Human Factors in Forward Collision Warning Systems: Operating Characteristics and User Interface Requirements	SAE J2400	Other
SAE	Dedicated Short Range Communications (DSRC) Message Set Dictionary	SAE J2735	Message/Data

7.5 Agreements

Each interconnect shared between ITS elements represents a potential need for an agreement to support the effective exchange of information between elements. While it may not be imperative that Interconnects between ITS elements owned and operated by the same agency be defined, the opposite is true for interconnects shared by elements owned and operated by different agencies. In these instances agreements are needed to define agency roles and responsibilities for funding, implementing, operating, maintaining or other associated cooperative activity linked to the project. This includes expectations of each agency and any required resource sharing needed. Agreements can be informal handshake agreements or more formal Memorandum of Understanding or interagency or intergovernmental agreements.

ITS deployed in the Madison Metropolitan Area will likely require agreements as specific projects are defined. Agreements should be defined during the planning phase of projects and specifically when developing a Concept of Operations for the project.

8 ITS IMPLEMENTATION PLAN

The ITS Implementation Plan is the last in the series of documents, or chapters, that comprise the Regional ITS Strategic Plan. The strategies and projects proposed in this Plan address, and are based upon, the transportation-related needs and desires expressed by regional stakeholders. However, it also takes into account the resources available for implementing ITS improvements, previous, on-going and planned ITS activity and the supporting infrastructure needed to successfully deploy ITS elements. Although a timeframe for implementing projects is suggested, it is by no means a requirement of when projects should be implemented. Rather, the timeline simply serves as a phased approach for project implementation assuming a favorable environment. Such an environment would ensure that project funding and staff are available to implement, operate and maintain systems and that there is a suitable level of institutional and technical readiness.

The Implementation Plan recommends and phases ITS projects and operational improvements over the short- (0-2 years), mid- (2-5 years), and long-term (5-10 years). By phasing projects, ITS implementation can occur in a controlled, cost effective, and efficient manner, allowing benefits to be realized in the short-term while providing the foundation needed to implement larger, more complex projects with additional benefits in the long-term. Phasing projects also serves as a way to sequence projects so that they build off each other taking into consideration need, project and technology dependencies, available funding, and institution agreement and cooperation. For instance, a large project like a regional traffic management center (RTMC) will yield nominal benefit if implemented in the short-term if the communications, detection, and surveillance systems were not in place first to allow RTMC operators the ability to monitor roads and communicate conditions with other agencies. The Plan's phased approach will allow project benefits to be obtained as quickly as possible while providing the needed infrastructure to support the completion of larger projects like the RTMC and/or the completion of an integrated ITS network.

Because technologies evolve and needs change, the Implementation Plan focuses on defining projects at a high-level so that their scope can evolve based on changes to technology and user needs. However, and with that said, projects are defined with enough detail to be further developed into detailed projects as they are programmed in the future.

8.1 Purpose

The purpose of the ITS Implementation Plan is to guide local transportation officials and system implementers in the effective deployment and integration of ITS technologies and operational improvements within the Madison region over the next ten years. An Implementation Plan is needed because ITS elements are often implemented in an isolated or "stove-pipe" fashion resulting in these resources not being used to their maximum potential or benefit. If implemented efficiently, regional agencies and users of the transportation system will share the benefits of regional ITS investment.

The Implementation Plan provides project selection methodology, funding opportunities, considerations for successful implementation and project recommendations. Integration, as it pertains to implementing ITS, refers to deploying ITS elements into a system where it will support multiple user needs. There are varying levels of integration, ranging from data exchange between stakeholders to the inter-agency control of a particular stakeholder's infrastructure.

8.2 Incorporating ITS into the Transportation Planning Process

An ITS project is defined as any project which applies electronics, communications, or information processing used solely or in combination to improve the safety, management, or operations of the surface transportation system. In other words, a project that, in whole or part, significantly contributes to the provision of one or more ITS user services as defined by the National ITS Architecture (See Chapter 6: ITS Operational Concept). Examples include interconnecting traffic signals, transit signal priority systems, dynamic message signs, closed circuit television cameras, automatic vehicle locations systems, and traffic management software.

Federal ITS requirements included in the final FHWA Rule and FTA Policy were developed to foster integration of regional ITS elements through use of the National ITS Architecture and applicable standards. With respect to the Federal ITS requirements, the regional ITS architecture, or framework for ITS integration, should among other things be consistent with the transportation planning process for statewide and metropolitan planning. Therefore, it will be important that the region include ITS projects, such as those defined above and later in this chapter, in the traditional transportation planning process. This will likely require that the current project nomination and scoring process used by the region be modified or tweaked as appropriate. In recognition of this, MATPB revised their project scoring criteria to better incorporate ITS projects into the existing transportation programming process in early 2015.

When applying for federal transportation funding or including a project in an agency's capital budget for local funding, project sponsors should review their project to determine if it contains an ITS element and if it should be considered an ITS project. Project sponsors should also determine how their project (if containing an ITS element) fits into the regional ITS architecture. This may require that existing project nomination sheets be updated to include a question on ITS applicability. If the project contains an ITS element, then project sponsors will be required to complete a checklist to demonstrate compliance to FHWA requirements. A Preliminary System Engineering Checklist has been developed and included in Appendix B. The checklist contains directions that project champions will need to follow to ensure that their projects remain eligible to receive federal funding (if applicable) but also to be included in the regional transportation improvement program. The Systems Engineering Checklist should be completed upon project identification but prior to project programming.

8.3 Issues and Considerations for Successful ITS Implementation

There are several issues to consider to effectively and successfully implement ITS projects. These issues, if not addressed, may ultimately act as barriers to project implementation or may simply affect the project's success. However, if considered and addressed before projects are implemented, the resolution to these issues prepares agencies so that ITS elements can be successfully implemented, operated and maintained. As a result, the agencies are better able to satisfy regional transportation goals and objectives. It is best that these issues are addressed as early as possible in the project's life cycle so results can be taken into consideration when weighing projects against each other for possible implementation and prioritization. These issues include:

- Outreach
- Funding
- Staffing
- Implementation approach
- Continuity of operations
- Standards, and
- Architecture traceability

Failure to consider and address these issues may lead to outcomes that decrease the effectiveness of the regional planning process, poor perception of public agencies and their decisions regarding public investment, and that result in ITS being viewed as an inefficient means of addressing transportation goals and objectives. Failure to address these issues and considerations will work against the Region's effort to build the ITS program.

8.3.1 Outreach

Funding ITS projects, and for that matter incorporating ITS into traditional planning processes, cannot be easily achieved without broad-based support and approval of ITS. Outreach helps to break down barriers and misconceptions of ITS, making it easier for individuals to visualize how ITS can be used alongside traditional highway improvements to deliver benefits at significantly lower costs. Outreach can also be used to resolve or mitigate agency concerns and/or privacy issues. To be effective in implementing ITS projects, the agencies involved in the traditional planning process must be comfortable with ITS, what it does, and how it can be used to satisfy regional goals and objectives, perhaps more from the institutional than technological perspective. This means providing continuing education for those individuals and

agencies that do not have a solid understanding of ITS. This includes not only individuals and agencies associated with a project but also elected officials, agency staff, and the general public.

The Madison Metropolitan Area has already been active in this area and have to a large extent achieved broad-based understanding and support for ITS in the region. This support is demonstrated by the active participation of agencies in ITS activities in the region, but more can always be done. To continue this course and to solidify support for ITS, the MATPB and its partner agencies must continue to strengthen these efforts and should continue to gather support through effective and targeted outreach.

Outreach provides a medium through which the reasons for and benefits of ITS can be expressed. It is also a valuable tool for smoothing the implementation of strategies by promoting inter-agency cooperation, while at the same time mitigating any adverse reaction. ITS outreach activities include both delivering and gathering information from at least four key stakeholder groups:

- Intra-agency stakeholders
- Inter-agency stakeholders
- The public
- Key decision makers and elected officials

Outreach activities should be on-going, whether or not anything "new" is happening in the region. Additionally, project champions should tailor their outreach efforts to the specific groups to which information is being delivered. In doing so, the benefits of ITS activities will be more easily understood and consistently communicated, breeding an environment where ITS can flourish.

It is recommended that the project oversight and advisory committees established for this project continue to meet upon project completion. This will in part serve to continue the ITS conversation and limit the loss of knowledge gathered in developing the Implementation Plan. At a minimum, these committees should meet at least semiannually but perhaps more often in the short-term until there is strong multi-agency coordination on ITS related efforts.

8.3.2 Funding

As with any type of project, agencies must secure the funds needed to support ITS projects. The funding needs for ITS differ significantly when compared with traditional highway improvement projects. With traditional highway projects, funding is needed to design, build, operate and maintain hard highway infrastructure. The capital costs are relatively high, so their design, operation, and maintenance costs are a relatively low percentage of total project cost. Operations costs often are not even identified and, if they are, are a very small percentage of capital costs. ITS projects, on the other hand, have relatively low capital costs but require a higher percentage for design, operations, and maintenance. Electronic infrastructure associated with ITS systems must be continuously operated and preventative maintenance requires trips to the field, which is not always the case for traditional highway projects. Because funding is often limited, agencies need to understand the staff and resources required of ITS investment and must plan for these additional costs.

Because budgets are becoming more and more limited, ITS projects will also encounter more and more competition with other types of both traditional and non-traditional transportation projects. Because of this competition, individuals responsible for ITS project implementation should look for any alternative funding available and be flexible in using federal, state and local revenues. Although, this Implementation Plan phases potential ITS projects within a 10 year planning horizon, the timing of project implementation is of lesser importance than the general sequencing of project implementation. Therefore, project implementation should occur as funding becomes available and follow the general phasing of project implementation.

8.3.3 Staff, Skills and Knowledge

Before ITS projects are approved for implementation, projects should be verified that they can be adequately supported given current agency staffing levels. Agency staff are needed to plan, deploy, operate, and maintain ITS projects. It is critical that an appropriate number of staff be available to ensure that ITS elements are operated effectively, maintained, and replaced accordingly. Agencies need to identify specific individuals that will be responsible for operation and maintenance of ITS. If, for some reason, these individuals are unavailable, it is recommended that current staff be trained so seamless operations will not be affected. If staff are not available to perform these functions, maintenance issues may be ignored and ITS elements may be operated in an unsafe and/or inefficient manner. This may result in costly and otherwise unneeded replacements, inefficient use of available funding and a poor public perception of ITS investment.

Staff, skills and knowledge are of particular importance for new technologies or concepts yet to be introduced within the Madison Metropolitan Area. Projects like those tied to connected vehicles will introduce large volumes of data. Specialized staff not typically considered or employed by traffic engineering departments will likely need to be hired to oversee these projects. Hiring these individuals may represent significant annual costs and should be heavily weighed prior to project programming and implementation. Sponsoring agencies should consider hiring outside contractors to supplement staffing needs, if necessary.

Staff responsible for implementing, operating, and maintaining ITS elements should be appropriately trained. Staff should have knowledge of the system engineering process, ITS standards and their applicability, ITS procurement process, communications requirements, and needs supporting ITS deployment. Agencies may find it beneficial to develop staff skill matrices to quickly identify the skills or knowledge needed when staff leaves.

8.3.4 Continuity of Operations

Maintaining operational continuity is an absolute must for ITS projects. Failure to keep systems up and running will result in public distrust. For most new ITS applications, maintaining operational continuity will not be much of an issue, since this activity is simply a process of adding on additional functionality; however, consideration should be given to operating the system correctly. Besides new projects, there will be ITS projects proposed that will replace existing systems. In this regard, halting operations for a designated period of time, while the new system is being installed, is not an effective option. Operating in this fashion opens the door to several problems, the biggest being a reduction in safety. Maintaining operational continuity before, during, and after systems are implemented is a challenge that system implementers must address to ensure that the public's perception of ITS remains positive. One particular consideration should be continued funding for operations and maintenance, through the designed life span of ITS elements. This funding is usually in addition to the capital costs associated with deploying the project. The amount of funding allocated to ongoing operations and maintenance should fluctuate with the number of ITS devices deployed.

8.3.5 Standards

Standards define how specific ITS technologies will interconnect and interact with other ITS technologies. The underlying principal behind standards is that they enable subsystems to be designed using "open" platforms. In other words, standards allow subsystems to be easily upgraded or replaced when they fail and are interoperable. Before the introduction of standards, subsystems were often developed using proprietary software that could not be replaced with a similar subsystem or product other than those made by the same manufacturer.

ITS systems proposed for implementation should be selected to be consistent with USDOT approved standards. Standards must be identified prior to implementing projects funded by the National Highway Trust Fund. The FHWA Rule and FTA Policy on Regional ITS Architectures states that, "… federally funded ITS projects use, where appropriate, USDOT adopted ITS standards". To find more information on ITS-related standards, visit: http://www.standards.its.dot.gov/

8.3.6 Architecture Traceability and Use of Federal Funding to Support Project Implementation

ITS elements associated with projects phased for implementation and discussed later in this chapter are reflected in the Madison Regional ITS Architecture. However, projects may evolve over time that are not anticipated and included in the architecture. As new concepts arise, the architecture should be revisited to include newly identified ITS elements. Therefore, before any new ITS project is funded, local officials need to determine whether or not the proposed ITS elements fit into the Madison's Regional ITS Architecture. If all ITS elements of the project are completely covered then no action is needed and the project can proceed to implementation. However, if some or all aspects are not accounted for in the architecture and they satisfy a transportation need for the region, then MATPB will need to update the Regional ITS Architecture to include the new ITS project, or the ITS elements associated with the project. It is assumed that the project champion will assist MATPB in this effort.

FHWA regulations require that ITS projects be included within the Regional ITS Architecture if Federal funding is used to support project implementation. While, this requirement is not valid for projects funded through other non-federal programs, it is still good practice to update the Regional ITS Architecture with planned ITS projects so that the architecture remains a valid, useful document for guiding ITS implementation within the Madison region.

8.4 Project Identification and Selection Methodology

ITS project recommendations and phasing were developed based on an iterative process that evolved from outlining high-level strategies early in the project process to defining specific projects at the end of it. Strategies are essentially solutions that help the region move from where it is today to where it wants to be in the future. Strategies embrace a certain level of uncertainty and therefore are high-level in their intent and description. At the time needs were identified, ITS strategies were grouped into high-level bundles aligned with National ITS Architecture Service Areas. This is done to show consistency and conformance with the National ITS Architecture framework. These bundles include:

- Archived Data Management and Communication
- Public Transportation
- Traveler Information
- Traffic Management
- Vehicle Safety
- Emergency Management
- Maintenance and Construction

As the project team worked through the project process, strategies were later refined to more accurately reflect the breadth of stakeholder needs and regional priorities. Strategies were also expanded to include not only the needs identified through this process but also regional priorities outlined and documented in other regional Plans. For example, the strategies/projects identified in this chapter also reflect and are consistent with Regional CMP Project Priorities. To this end, strategies were expanded to include operational and institutional improvements that can be cost-effectively implemented to improve operations. As a result of the aforementioned actions, the following new strategy categories were defined;

- Communications
- Traveler Information
- Traffic Management and Operations
- Transit Management and Operations
- Safety
- Maintenance
- Traffic Data Collection and Analysis
- Institutional/Policy

While these strategy categories are specific to regional needs, they still largely align with the National ITS Service bundles.

From the new list of strategy categories, specific projects were identified and classified as one of the following types of projects.

- Infrastructure – These projects deploy hardware or software to satisfy one or more stated needs.
- Operational-Based – These projects generally do not deploy new hardware or software but may rely on ITS infrastructure to improve operations. Operational-based strategies focus on improving existing agency operations and/or the use of information and data to improve operations and maximize the benefits of deployed regional assets.
- Policy/Institutional – These projects focus on improving institutional relationships and polices so as to foster and environment that can support effective multi-agency integration.

Once projects were grouped into their respective categories and classified as either an Infrastructure/Operation-Based and/or Policy/Institutional project they were screened to determine their applicability for implementation within the region in the next ten years. Project selection consisted of a three phase approach. The first phase of this approach applied a set of three screening criteria to each project to quickly assess whether or not projects aligned with the regional ITS program. The three screening criteria used were:

1. Projects must address at least one identified need(s)
2. Projects must align with at least one ITS goal
3. Project must be consistent with Regional CMP Project Priorities.

Proposed projects that did not meet all three screening criteria above were removed from further consideration. Projects that satisfied all three screening criteria continued onto the second project selection phase.

During the second phase, a qualitative application of the MATPB's STP - Urban Project Evaluation Criteria & Scoring Guidelines for ITS projects (See Appendix H) was utilized to further screen potential projects. The STP - Urban Project Evaluation Criteria & Scoring Guidelines consists of the following general criteria:

1. Importance to Regional Transportation System – Will the project be deployed or impact traffic operations on regionally significant roadways or transit routes?
2. System Preservation – Will the project help preserve the viability of existing transportation infrastructure including transit vehicles/equipment?
3. Congestion Mitigation & Transportation System Management – Will the project mitigate existing recurring and/or non-recurring traffic congestion?
4. Safety Enhancement – Will the project improve safety?
5. Enhancement of Multi-modal Options – Will the project improve accommodations for pedestrians, bicyclists, and/or transit users?
6. Supports Transportation Efficient Land Use, Livability and Economic Prosperity – Will the project benefit existing or planned mixed use or regional employment/activity centers.
7. Environment – Will the project reduce vehicle trips, resulting in environmental improvements?
8. Environmental Justice and Public Health – Will the project create a positive impact to human health, environmental, social, or economic impacts on environmental justice groups,
9. Cost-Benefit – Will the benefits of the project exceed its total costs?

If a potential project did not have a positive impact on one or more of the criteria listed above the project was removed from further consideration. Those projects that were viewed to have a positive impact on one or more of the criteria listed above moved onto the third and last project evaluation phase or project phasing.

Projects making it to the third phase of project evaluation are considered viable for the Madison Regional Area; however, due to the rapid evolution of technology some projects may not be viable for implementation within the 10 year planning horizon. Remaining projects were prioritized based on the following considerations:

- Potential to be an early winner (immediate benefits). Projects that are relatively inexpensive and provide immediate benefits were targeted for the short-term.
- Cost
- Technology maturity
- Project dependencies
- Breadth of benefits

Projects successfully making it past each of the screening criteria were then prioritized for implementation.

8.5 Considerations for Project Prioritization

Technology is evolving far too swiftly to make operational commitments to equipment that will not be deployed within the short-term. A "short-term" horizon of 3 years allows for the identification of ITS functions and strategies that can be converted to projects in a timely manner without over-committing to a technology-based application before it is necessary.

The 3-to-5 and 5-10 year horizons, or mid-term and long-term, allows for the identification of ITS concepts and supporting functions without committing to a specific strategy/project. It is sufficient to say the rate of technological evolution makes it wiser to defer the "how," of implementing an ITS project to a point in time closer to actual deployment.

As the regional ITS strategies and projects were developed and sequenced, several criteria were considered in order to place each initiative into a specific deployment timeframe (e.g., short-term, mid-term, long-term, etc.). Ultimately, the deployment of each initiative will be impacted by these factors as well as others, but will most directly be impacted by an agency taking a lead in deploying the project. Considerations for prioritizing strategies included:

- Demonstrated short-term need;
- Project Inter-relationships and dependencies;
- Ease of implementation;
- Fundability;
- Marketing of "early success"; and
- Leveraging on-going projects.

8.6 Conceptual Integration for ITS in Madison

ITS strategies are proposed for implementation in the Madison Metropolitan Area in three phases; short-term, mid-term, and long-term. These three phases and the projects that align with them are explained in greater detail below. It is anticipated that periodic revisiting of the Plan and regional priorities will result in some adjustments to projects. As previously mentioned, the specific phase in which projects fall is not as important as the general order they follow.

The summary of proposed projects described in the following sections and tables contain planning level cost estimates, which should be considered highly variable due to dependence on a number of factors that cannot be accurately gauged until preliminarily engineering, including but not limited to precise functional requirements required of systems, field conditions including access to communications and power, current build out of existing infrastructure, and the types of equipment installed. Additionally, the costs provided for each project should be assumed applicable for only the planning/design, capital, and maintenance/operations costs unless otherwise noted. Many of the recommended projects contain equipment that needs to be operated and maintained, therefore, the labor costs and equipment needed

to perform these actions need to be taken into consideration prior to project implementation to ensure that deployed technology can be operated correctly and regularly maintained to maximize benefits and to ensure public trust and support. All costs are reported are in today's dollars.

Proposed projects are shown in Table 65 and Table 66. In Table 65, projects are sorted by their applicable strategy category. In Table 66, projects are sorted by the phase that project implementation is scheduled to occur. Table 66 also highlights the annual staffing full-time equivalents associated with each project. FTEs are planning level estimates. In most cases the actual number of FTEs is dependent on a number of factors including current staffing numbers, staff knowledge, skills and abilities, and timing and duration of work.

The implementation timeframe of several projects overlap two or more phases. In these cases, projects are classified by the phase in which they slated to begin.

Table 65

Proposed Potential ITS Projects for the Madison Metropolitan Area by ITS Strategy Category

Strategy Category	Table #	Identifier	Potential Project	Type	Phase		
					S	M	L
Communications	67	COM1	Traffic Signal Communications Upgrades	Infrastructure	●	●	●
	110	COM2	Center-to-Center Communications (existing centers)	Infrastructure		●	●
	111	COM3	Center-to-Center Communications (planned centers)	Infrastructure		●	●
	94	COM4	Incident Communication System	Infrastructure		●	
Traveler Information	95	INFO1	Arterial DMS at Decision Points for Travel Times	Infrastructure		●	
	96	INFO2	Downtown Madison Parking Wayfinding System	Infrastructure		●	
	97	INFO3	UW Visitor Parking Wayfinding System	Infrastructure		●	
	89	INFO4	Connected Vehicle/Technology Pilot	Infrastructure	●	●	
Traffic Management and Operations	82	TSMO1	Regional Transportation Management Center (RTMC) ConOps	Operations	●		
	98	TSMO2	RTMC Design/Implementation	Infrastructure		●	
	118	TSMO3	RTMC Operations (ongoing) incl mode choice	Operations			●
	68	TSMO4	CCTV Camera Expansion	Infrastructure	●	●	●
	90	TSMO5	Traffic Responsive Signal Systems (Phase 1)	Infrastructure	●	●	
	112	TSMO6	Traffic Responsive Signal Systems (Phase 2)	Infrastructure		●	●
	113	TSMO7	Adaptive Traffic Signal Systems	Infrastructure		●	●
	91	TSMO8	Vehicle/Pedestrian Detection Upgrades	Infrastructure	●	●	
	99	TSMO9	Preplanned Emergency Alternate Routes & Signal Timing	Operations		●	
	69	TSMO10	Traffic Signal Optimization for Daily Ops, TIM and PSEs	Operations	●	●	●
	70	TSMO11	Traffic Signal System and Controller Upgrades for CV	Infrastructure	●	●	●
	114	TSMO12	CV Roadside Infrastructure	Infrastructure		●	●
	71	TSMO13	Floating Bike Lane Sign Expansion	Infrastructure	●	●	●
Transit Management and Operations	83	TRAN1	Transit Radio Communication System Upgrade	Infrastructure	●		
	84	TRAN2	Transit Vehicle On-Board Equipment Upgrade	Infrastructure	●		
	100	TRAN3	Transit Dynamic Message Sign (DMS) Upgrade and Expansion	Infrastructure		●	
	101	TRAN4	Transit Information Dissemination Study	Operations		●	
	102	TRAN5	Transit Signal Priority (TSP) Pilot Project	Infrastructure		●	
	115	TRAN6	Bus Rapid Transit (BRT) Signal Priority	Infrastructure		●	●
	116	TRAN7	Bus Rapid Transit (BRT) ITS Deployment	Infrastructure		●	●
	85	TRAN8	Metro Transit Garage Facility Communications Improvements	Infrastructure	●		
	120	TRAN9	Real-time Transit Vehicle CCTV Camera Image Communications Pilot	Infrastructure			●

Strategy Category	Table #	Identifier	Potential Project	Type	Phase		
					S	M	L
	103	TRAN10	Smart Card for Transit and Parking	Infrastructure		●	
	86	TRAN11	Transit Passenger Fare Card System Upgrade	Infrastructure	●		
	92	TRAN12	Nakoosa Trail Bus Satellite Facility ITS Technologies	Infrastructure	●	●	
	104	TRAN13	Transit Vehicle Technology Evaluation Study	Operations		●	●
Safety	93	SAFE1	Bicycle/Pedestrian (Arterial) Crossing Warning Systems	Infrastructure	●	●	
	117	SAFE2	Freeway Service Team Expansion	Operations		●	●
	72	SAFE3	Traffic Incident Management Responder Training	Institutional/Policy	●	●	●
	73	SAFE4	Regional Traffic Incident Management Coordination	Institutional/Policy	●	●	●
	118	SAFE5	Arterial Traffic Incident Response Teams	Operations		●	●
Maintenance	121	MAINT1	Automatic Bridge Deicing Pilot	Operations			●
	105	MAINT2	Expansion of Weather/Pavement Sensors (Streets)	Infrastructure		●	
Traffic Data Collection and Analysis	106	DATA1	Regional Data Clearinghouse (RDC) ConOps	Operations		●	
	107	DATA2	RDC Design/Implementation	Infrastructure		●	
	108	DATA3	RDC Data Sharing Standard Operating Procedures	Operations		●	
	74	DATA4	Arterial Travel Times	Infrastructure	●	●	●
	75	DATA5	Pilot/Technology Evaluations (incl. before/after data)	Institutional/Policy	●	●	●
	76	DATA6	Performance Measurement for Operations	Institutional/Policy	●	●	●
	122	DATA7	Big Data Analysis Software & Support	Institutional/Policy			●
	87	DATA8	Metro Transit AVL Update	Infrastructure	●		
	109	DATA9	Automated Motor-Vehicle and Bicycle Count System	Infrastructure		●	
	88	DATA10	Traffic Count Data Storage and Analysis Software	Infrastructure	●		
Policy	77	POLICY1	ITS Advisory Committee	Institutional/Policy	●	●	●
	78	POLICY2	Funding/Grant Research for ITS	Institutional/Policy	●	●	●
	79	POLICY3	Sponsorship Research	Institutional/Policy	●	●	●
	80	POLICY4	Interagency Operations Agreements/MOUs	Institutional/Policy	●	●	●
	81	POLICY5	ITS Architecture/Strategic Plan Maintenance	Institutional/Policy	●	●	●

Table 66

Proposed Potential ITS Projects for the Madison Metropolitan Area by Proposed Project Phase

Strategy Phasing Category	Table #	Identifier	Potential Project	Type	Phase			FTEs
					S	M	L	
On-going Projects & Projects Proposed for the Short-term	67	COM1	Traffic Signal Communications Upgrades	Infrastructure	●	●	●	0.25
	68	TSMO4	CCTV Camera Expansion	Infrastructure	●	●	●	0.50
	69	TSMO10	Traffic Signal Optimization for Daily Ops, TIM and PSEs	Operations	●	●	●	0.50
	70	TSMO11	Traffic Signal System and Controller Upgrades for CV	Infrastructure	●	●	●	0.50
	71	TSMO13	Floating Bike Lane Sign Expansion	Infrastructure	●	●	●	0.25
	72	SAFE3	Traffic Incident Management Responder Training	Institutional/Policy	●	●	●	0.25
	73	SAFE4	Regional Traffic Incident Management Coordination	Institutional/Policy	●	●	●	0.25
	74	DATA4	Arterial Travel Times	Infrastructure	●	●	●	1.00
	75	DATA5	Pilot/Technology Evaluations (incl. before/after data)	Institutional/Policy	●	●	●	0.25
	76	DATA6	Performance Measurement for Operations	Institutional/Policy	●	●	●	0.50
	77	POLICY1	ITS Advisory Committee	Institutional/Policy	●	●	●	0.00
	78	POLICY2	Funding/Grant Research for ITS	Institutional/Policy	●	●	●	0.00
	79	POLICY3	Sponsorship Research	Institutional/Policy	●	●	●	0.00
	80	POLICY4	Interagency Operations Agreements/MOUs	Institutional/Policy	●	●	●	0.00

Strategy Phasing Category	Table #	Identifier	Potential Project	Type	Phase			FTEs
					S	M	L	
	81	POLICY5	ITS Architecture/Strategic Plan Maintenance	Institutional/Policy	●	●	●	0.25
	82	TSMO1	Regional Transportation Management Center (RTMC) ConOps	Infrastructure	●			0.25
	83	TRAN1	Transit Radio Communication System Upgrade	Infrastructure	●			0.25
	84	TRAN2	Transit Vehicle On-Board Equipment Upgrade	Infrastructure	●			0.25
	85	TRAN8	Metro Transit Garage Facility Communications Improvements	Infrastructure	●			1.50
	86	TRAN11	Transit Passenger Fare Card System Upgrade	Infrastructure	●			1.00
	87	Metro tr	Metro Transit AVL Update	Infrastructure	●			0.25
	88	DATA10	Traffic Count Data Storage and Analysis Software	Infrastructure	●			0.25
	89	INFO4	Connected Vehicle/Technology Pilot	Infrastructure	●	●		0.50
	90	TSMO5	Traffic Responsive Signal Systems (Phase 1)	Infrastructure	●	●		1.00
	91	TSMO8	Vehicle/Pedestrian Detection Upgrades	Infrastructure	●	●		0.50
	92	TRAN12	Nakoosa Trail Bus Satellite Facility ITS Technologies	Infrastructure	●	●		0.50
	93	SAFE1	Bicycle/Pedestrian (Arterial) Crossing Warning Systems	Infrastructure	●	●		0.25
Projects Proposed for the Mid-term	94	COM4	Incident Communication System	Infrastructure		●		0.50
	95	INFO1	Arterial DMS at Decision Points for Travel Times	Infrastructure		●		0.50
	96	INFO2	Downtown Madison Parking Wayfinding System	Infrastructure		●		0.50
	97	INFO3	UW Visitor Parking Wayfinding System	Infrastructure		●		1.00
	98	TSMO2	RTMC Design/Implementation	Infrastructure		●		1.00
	99	TSMO9	Preplanned Emergency Alternate Routes & Signal Timing	Operations		●		0.25
	100	TRAN3	Transit Dynamic Message Sign (DMS) Upgrade and Expansion	Infrastructure		●		0.50
	101	TRAN4	Transit Information Dissemination Study	Operations		●		0.25
	102	TRAN5	Transit Signal Priority (TSP) Pilot Project	Infrastructure		●		1.00
	103	TRAN10	Smart Card for Transit and Parking	Infrastructure		●		2.00
	104	TRAN13	Transit Vehicle Technology Evaluation Study	Operations		●	●	0.25
	105	MAINT2	Expansion of Weather/Pavement Sensors (Streets)	Infrastructure		●		0.50
	106	DATA1	Regional Data Clearinghouse (RDC) ConOps	Operations		●		0.25
	107	DATA2	RDC Design/Implementation	Infrastructure		●		0.50
	108	DATA3	RDC Data Sharing Standard Operating Procedures	Operations		●		0.25
	109	DATA9	Automated Motor-Vehicle and Bicycle Count System	Infrastructure		●		1.00
	110	COM2	Center-to-Center Communications (existing centers)	Infrastructure		●	●	0.25
	111	COM3	Center-to-Center Communications (planned centers)	Infrastructure		●	●	0.50
	112	TSMO6	Traffic Responsive Signal Systems (Phase 2)	Infrastructure		●	●	1.00
	113	TSMO7	Adaptive Traffic Signal Systems	Infrastructure		●	●	2.00
	114	TSMO12	CV Roadside Infrastructure	Infrastructure		●	●	2.00
	115	TRAN6	Bus Rapid Transit (BRT) Signal Priority	Infrastructure		●	●	1.00
	116	TRAN7	Bus Rapid Transit (BRT) ITS Deployment	Infrastructure		●	●	1.00
	117	SAFE2	Freeway Service Team Expansion	Operations		●	●	2.00
	118	SAFE5	Arterial Traffic Incident Response Teams	Operations		●	●	2.00
Projects Proposed for the Long-term	119	TSMO3	RTMC Operations (ongoing) incl mode choice	Operations			●	2.00
	120	TRAN9	Real-time Transit Vehicle CCTV Camera Image Communications Pilot	Infrastructure			●	0.50
	121	MAINT1	Automatic Bridge Deicing Pilot	Operations			●	0.25
	122	DATA7	Big Data Analysis Software & Support	Institutional/Policy			●	1.00

8.6.1 On-going and Short-term Projects (0-2 year)

On-going and short-term projects are those that are either currently programmed within local, regional, or statewide transportation programs or can be initiated within two years of this Plan's acceptance and approval. These are projects that can be implemented quickly and deploy ITS equipment and technologies that fill in gaps in existing ITS coverage. In many cases, the project capital to implement these projects (if needed or if not already programmed) can be absorbed within existing agency budgets. Short-term projects tend to be more collaborative projects focused on making operational or intuitional improvements and decisions. Compared to mid-term projects, short-term projects can be implemented more quickly in terms of their institutional and technical readiness. In some cases, these projects may support mid-term and long-term projects by providing the needed ITS infrastructure to support those projects. Short-term projects are generally not yet programmed within the transitional programming streams but represent candidates for inclusion in the next round of programming.

Table 67

Traffic Signal Communications Upgrades Project Overview

COM1	Traffic Signal Communications Upgrades		
Description:	This project upgrades existing traffic signal communications from twisted pair to fiber communications on the City of Madison network. This may be accomplished by integrating with the existing City of Madison fiber Backbone network or through the use of wireless Ethernet radios.		
Lead Agency:	• City of Madison Traffic Engineering Division		
Supporting Agency(ies):	• City of Madison Information Technology • WisDOT, SW Region • Dane County • Municipalities		
Location/Limits:	City of Madison and Region (Specific locations to be determined prior to project programming). All CMP Transportation Services Areas.		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Communications		
Expected High-Level Benefits	Upgrading these signals will improve the ability of the City of Madison Traffic Engineering Division to make changes to the signal system for both planned and unplanned events as fiber communications are necessary to bring a traffic signal onto the existing ATMS Centracs system. This also is a major step in preparing the traffic signal infrastructure for vehicle to infrastructure communications. In addition these communications allow the addition of CCTV cameras as well. This project will also serve to automate and expand the City of Madison Count program for both motor vehicles and bicycles.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$75,000	$480,000	$24,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Availability of existing fiber and conduits as well as future construction projects		
Related Projects	• TSMO4 - CCTV Expansion		
ITS Architecture Elements	NA		
Other/Notes:	Assumes 5% of total project implementation cost in annual O&M.		

Table 68

CCTV Camera Expansion Project Overview

TSMO4	CCTV Camera Expansion		
Description:	This project expands the network of closed circuit cameras at various locations across the city. This may require upgrading City of Madison IT servers as well. Additional cameras would be implemented at new signalized intersections (depending on availability of fiber) or at locations where there is a gap in current coverage.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• City of Madison IT		
Location/Limits:	City-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Additional CCTV cameras will improve City of Madison Traffic Engineering Division's ability to modify signal timing for planned and unplanned events and incidents. In addition these cameras are used by Metro Transit for rerouting of buses, Streets to evaluate snow removal operations, police and fire for incident response, police investigative work, and Emergency operations situational awareness.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$60,000	$600,000	$60,000
Staffing Impact	Medium. .5 FTE (Short-term) additional .5 FTE (Mid-term)		
Project Dependencies & Considerations	Local fiber available at intersections.		
Related Projects	• COM1 - Traffic Signal Communications Upgrades • COM2 - Center-to-Center Communications (existing centers) • COM3 - Center-to-Center Communications (planned centers) • TSMO2 – RTMC Design/Implementation • TSMO8 – Preplanned Emergency Alternate Routes & Signal Timing • MAINT4 – Automatic Bridge Deicing Pilot • MAINT5 – Expansion of Weather/Pavement Sensors (Streets)		
ITS Architecture Elements	• Network Surveillance (ATMS01) • Traffic Signal Control (ATMS03) • Traffic Information Dissemination (ATMS06) • Regional Traffic Management (ATMS07) • Traffic Incident Management System (ATMS08) • Emergency Call Taking and Dispatch (EM01) • Transit Fixed Route Operations (APTS02) • Broadcast Traveler Information (ATIS01) • Transportation Operations Data Sharing (ATIS06) • Winter Maintenance (MC06) • Work Zone Management (MC08)		
Other/Notes:	60 locations		

Table 69

Traffic Signal Optimization for Daily Operations, Traffic Incident Management and Planned Special Events Project Overview

TSMO10	Traffic Signal Optimization for Daily Operations, Traffic Incident Management and Planned Special Events		
Description:	This project will optimize traffic signal timing plans and expand signal control systems along all major signalized arterials in Dane County, and interconnect signals, in some cases across jurisdictions. Unique signal timing plans will be developed or improved for daily operations, incidents at defined locations and planned special events.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• WisDOT • Municipal Traffic Engineering Departments (Various) • This project will require cooperation amongst participating agencies for the funding, design, and construction of proposed projects, including traffic signal optimizations and signal interconnects.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	• Reduced delay (i.e., fewer stops) • Reduced motorist frustration • Improved safety • Reduce environmental impacts (i.e., reduced fuel consumption and emissions) • System preservation		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$261,000
Staffing Impact	Low (.5 FTE). The staffing impacts of this project are expected to be mostly covered through existing staff. However, there will be some coordination with external agencies and some planning work that is not accounted for in existing budgets.		
Project Dependencies & Considerations	The optimization of signal timing requires regular collection of traffic condition data (e.g., traffic counts, traffic flow speed). With the continued growth of development in Dane County, data collection must be carried out frequently. Improved and increased traffic condition measurement would help in gathering a larger set of data and, in turn, allow the traffic agencies in the county to identify signal improvements to be made.		
Related Projects	• TSMO1 – Regional Transportation Management Center (RTMC) ConOps • TSMO2 – RTMC Design/Implementation		
ITS Architecture Elements	• Traffic Signal Control (ATMS03) • Regional Traffic Management (ATMS07)		
Other/Notes:	Signal optimization cost per intersection is estimated to be $3,000 per intersection. Cost estimate assumes signal optimization for 25% of the City of Madison Traffic Signals. (.25 x 348 total traffic signals = 87).		

Table 70

Traffic Signal System and Controller Upgrades for Connected Vehicles Project Overview

TSMO11	Traffic Signal System and Controller Upgrades for Connected Vehicles		
Description:	This project upgrades existing traffic signal systems and controllers so that they can communicate with connected vehicles using short range communications or other medium determined at time of implementation.		
Lead Agency:	• City of Madison Traffic Engineering Department		
Supporting Agency(ies):	• WisDOT • Municipal Traffic Engineering Departments (placeholder)		
Location/Limits:	All traffic signal controllers in the Madison Metropolitan Area.		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	• Improved signalized operations • Improved Safety		
Project Phasing	Short- to Long-term (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$200,000	$3,480,000	$34,800
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Short- to Mid-term upgrades should focus on high-priority corridors. Long-term deployment should occur as needed when controllers need to be replaced due to age or functional obsolescence.		
Related Projects	• TSMO11 – CV Roadside Infrastructure		
ITS Architecture Elements	• Regional Traffic Management (ATMS07) • Short-Range Communication Traveler Information (ATIS10)		
Other/Notes:	$10,000 per intersection for controller upgrades. 348 signals.		

Table 71

Floating Bike Lane Sign Expansion Project Overview

TSMO13	Floating Bike Lane Sign Expansion		
Description:	There is a potential for expansion of the floating bike lane currently in use on Doty Street between Hamilton Street and King Street. There is the need for at least one additional set of signs on Doty Street and potential for expansion onto West Washington Avenue. The current control system does not support expansion of the system.		
Lead Agency:	• City of Madison-Traffic Engineering • City of Madison-Parking Utility		
Supporting Agency(ies):	• City of Madison Information Technology		
Location/Limits:	Doty Street East of MLK Jr. Blvd. West Washington Avenue-Fairchild to Bedford		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction • Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Maximizes the movement of people and improves the efficiency of the arterial street network		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$15,000	$150,000	$15,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Existing fiber optic and conduit network.		
Related Projects	• INFO1 – Arterial DMS at Decision Points for Travel Times • INFO2 – Downtown Madison Parking Wayfinding System • INFO3 – UW Visitor Parking Wayfinding System • Device Connections		
ITS Architecture Elements	• Dynamic Lane Management and Shoulder Use (ATMS23)		
Other/Notes:	Project assumes 3 additional signs and supporting infrastructure (i.e., structures, conduit, controllers)		

Table 72

Traffic Incident Management Responder Training Project Overview

SAFE3	Traffic Incident Management Responder Training		
Description:	The project will conduct Traffic Incident Management Responder Training for regional first responders. Training promotes a shared understanding of the requirements for safe, quick clearance at traffic incident scenes, prompt, reliable and open communications; and motorist and responder safeguards. TIM responder training will focus on a response effort that protects motorists and responders while minimizing the impact on traffic flow. TIM efforts include detecting, verifying, and responding to incidents; clearing the incident scene; and restoring traffic flow.		
Lead Agency:	• City of Madison Police Department		
Supporting Agency(ies):	• Wisconsin State Patrol • Dane County Sheriff's Office • Municipal Police Departments (placeholder)		
Location/Limits:	Dane County		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Safety		
Expected High-Level Benefits	• Improved safety • Improved efficiency and cost effectiveness • Improve incident response and incident clearance		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$20,000
Staffing Impact	Minimal. The impact of this project is expected to be absorbed into agencies' current staffing levels.		
Project Dependencies & Considerations	NA		
Related Projects	NA		
ITS Architecture Elements	NA		
Other/Notes:	Annual O&M costs are for staff time to attend training sessions		

Table 73

Regional Traffic Incident Management Coordination Project Overview

SAFE4	Regional Traffic Incident Management Coordination		
Description:	Successful Traffic Incident Management (TIM) is dependent upon the coordination of all emergency response agencies and disciplines, including those representing law enforcement, fire, EMS, towing/recovery and State and local DOTs. This project will build on WisDOT SW Region Traffic Incident Management Enhancement (TIME) Program initiatives and focus on the Madison area. This project will include ongoing quarterly meetings with representatives from each of the aforementioned disciplines. It is expected that this group will serve as the operational/technical complement to the ITS Advisory Committee (project POLICY1).		
Lead Agency:	• Metropolitan Area Transportation Planning Board		
Supporting Agency(ies):	• WisDOT • City of Madison Traffic Engineering • Madison Police Department • Madison Fire Department • Dane County 9-1-1 • Dane County Sheriff • Dane County Emergency Management • Dane County Highway Department		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	X
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Safety		
Expected High-Level Benefits	Studies have shown that areas with closely coordinated TIM programs reduce the duration of traffic incidents thereby improving safety and system reliability.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$25,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	This project requires coordination with WisDOT SW Region TIME Program initiatives.		
Related Projects	• COM4 – Incident Communication System • TMO1-TMO3 – Regional Transportation Management Center • TMO09 – Preplanned Emergency Alternate Routes & Signal Timing • SAFE5 – Arterial Traffic Incident Response Teams		
ITS Architecture Elements	Traffic Incident Management System – ATMS08		
Other/Notes:			

Table 74

Arterial Travel Times Project Overview

DATA4	Arterial Travel Times		
Description:	This project implements vehicle detection sensors, arterial DMS and related software that can collect and analyze the data needed to calculate and disseminate travel times along key arterials within the Madison Metropolitan Area.		
Lead Agency:	• City of Madison Traffic Engineering Department		
Supporting Agency(ies):	• WisDOT STOC • Municipalities		
Location/Limits:	Region-wide. Likely locations include key arterials that connect local freeways to major trip generators (e.g., UW Campus, State Capital Area, etc.).		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	Improved mobility and reduced congestion Improved en-route decision making and network efficiency		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$200,000	$400,000	$40,000
Staffing Impact	Medium (1 FTE)		
Project Dependencies & Considerations	This project can make use of electronic signage that is distributed along arterials and support other objectives like wayfinding to parking facilities or used for lower priority uses such as dynamic lane control signs used for the City of Madison floating Bike lane. Policies would need to be drafted to indicate when these signs might be used to disseminate arterial travel time information.		
Related Projects	• INFO1 – Arterial DMS at Decision Points for Travel Times • INFO2 – Downtown Madison Parking Wayfinding System • INFO3 – UW Visitor Parking Wayfinding System		
ITS Architecture Elements	• Roadway Traffic Information Dissemination (ATMS06)		
Other/Notes:			

Table 75

Pilot/Technology Evaluations (incl. before/after data) Project Overview

DATA5	Pilot/Technology Evaluations (incl. before/after data)		
Description:	This is a placeholder project that provides a pool of funds for the evaluation of new technologies that work toward meeting one or more of the Regional ITS goals. This project will collect data prior to project implementation to assess the formal effectiveness of the project once implemented. The specific technologies that will be evaluated will be determined by the Regional ITS Advisory Committee.		
Lead Agency:	Project dependent		
Supporting Agency(ies):	Project dependent		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	TBD		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	• Promote working relationships and build momentum for ITS within the region.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$50,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	This project should be funded concurrently or immediately after the funding of the ITS Advisory Committee Project.		
Related Projects	• POLICY1 - ITS Advisory Committee		
ITS Architecture Elements	TBD		
Other/Notes:	ITS Advisory Committee will determine the direction and specific projects that will be eligible to receive funding provided by this project.		

Table 76

Performance Measurement for Operations Project Overview

DATA 6	Performance Measurement for Operations		
Description:	This project conducts periodic (i.e., semi-annually or annual) development and reporting of pre-defined performance measures that measure the region's progress toward meeting transportation system management and operations goals and objectives. The project will establish a hardcopy report and website that promotes transparency and accountability to the public. Performance will be reported in a visual, easy to understand scorecard or dashboard type view.		
Lead Agency:	• Metropolitan Area Transportation Planning Board		
Supporting Agency(ies):	TBD – Supporting agencies will likely consist of the agencies that collect data that can be used to assess the Region's performance in meeting pre-define goals and objectives.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	X
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	• Increased accountability • Improved understanding of ITS investment effectiveness • Improved use of limited resources (i.e., funding, staffing, etc.)		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	$100,000	$25,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	While this project can be implemented as soon as possible, the effectiveness of the project will increase as the deployment of ITS systems that collect needed data to assess performance matures.		
Related Projects	• COM2 – Center-to-Center Communications • DATA1 – Regional Data Clearinghouse (RDC) ConOps • DATA2 – RDC Design/Implementation • DATA3 – RDC Data Sharing Standard Operating Procedures		
ITS Architecture Elements	NA		
Other/Notes:			

Table 77

ITS Advisory Committee Project Overview

POLICY1	ITS Advisory Committee		
Description:	This project establishes and maintains a Regional ITS Advisory Committee. The Oversight Committee established for the Madison Regional ITS Strategic Plan will serve as the foundation for further development of a formal Regional ITS Advisory Committee. The Regional ITS Advisory Committee will meet at consistent, periodic intervals to discuss agency specific ITS projects and to align these projects with Regional ITS Goals, Objectives and Performance Measures. One objective of the ITS Advisory Committee Meeting is to develop and coordinate ITS project benefits and costs among participating agencies so that the costs to implement projects of regional significance, as well as their benefits can be distributed among agencies. This will improve regional agency collaboration. The ITS Advisory Committee will also be charged to conduct region-wide outreach to alert agencies of ITS activity and to promote benefits of ITS.		
Lead Agency:	• Madison Area Transportation Planning Board		
Supporting Agency(ies):	• City of Madison, Traffic Engineering Division/Parking Utility • City of Madison, Metro Transit • University of Wisconsin Traffic Operations and Safety (TOPS) Laboratory • WisDOT, State Traffic Operations Center • WisDOT, Southwest Region • Dane County Highway Department • Dane County Public Communications (911) Center • Dane County Emergency Management • Dane County Sheriff's Department • UW Transportation Services • City of Madison Police Department • City of Madison Information Technology Department		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
			X
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Institutional/Policy		
Expected High-Level Benefits	Improved regional ITS decision making and collaboration.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	NA	NA	NA
Staffing Impact	Minimal. The impact of this project is expected to be absorbed into agencies' current staffing levels.		
Project Dependencies & Considerations	This project should be implemented upon completion of the Madison Regional ITS Strategic Plan to continue momentum for enhancing the region's ITS program.		
Related Projects	• POLICY2 – Funding/Grant Research for ITS • POLICY3 – Sponsorship Research		
ITS Architecture Elements	NA		
Other/Notes:			

Table 78

Funding/Grant Research for ITS Project Overview

POLICY2	Funding/Grant Research for ITS		
Description:	This project provides a pool of funds to conduct periodic research on potential funding/grant opportunities that may support the implementation, operation and/or maintenance of ITS within the region.		
Lead Agency:	• Metropolitan Area Transportation Planning Board • TOPS Lab		
Supporting Agency(ies):	TBD. Supporting agencies will be dependent on specific projects or initiatives.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
			X
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for Alternative Transportation Modes • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Institutional/Policy		
Expected High-Level Benefits	Funding/Grant opportunities will support and enhance the regional ITS program. This project will also improve public perception of regional transportation agencies.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$5,000
Staffing Impact	Minimal. The impact of this project is expected to be absorbed into the agencies' current staffing levels.		
Project Dependencies & Considerations	This project should be conducted in parallel with project POLICY1. The ITS Advisory Committee will be charged with the responsibility of setting the direction of the Regional ITS Program. This project should seek funding/grant opportunities that support the Regional ITS Program.		
Related Projects	• POLICY1 – ITS Advisory Committee		
ITS Architecture Elements	NA		
Other/Notes:	Full implementation cost is for a 10 year period or $5,000 annually.		

Table 79

Sponsorship Research Project Overview

POLICY3	Sponsorship Research		
Description:	This project provides a pool of funds that can be used to investigate the use of sponsorships to fund or partially off-set funding for other regional ITS projects. For example, sponsorships can be used to fund existing and/or additional freeway services teams. This project would also investigate the use of public private partnerships to improve public services. For example, images and video may be shared with local media outlets in exchange for widely disseminating images and video over media outlets.		
Lead Agency:	TBD. Lead agency will be dependent on specific projects or initiatives identified by the ITS Advisory Committee		
Supporting Agency(ies):	TBD. Supporting agencies will be dependent on specific projects or initiatives.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
			X
ITS Goals Addressed	• Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Institutional/Policy		
Expected High-Level Benefits	This project will lead off-set project and operations costs or enhanced services without additional costs to regional stakeholders.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$5,000
Staffing Impact	Minimal. The impact of this project is expected to be absorbed into the agencies' current staffing levels.		
Project Dependencies & Considerations	This project is dependent on the consideration of projects that would potential benefit from the involvement of public, third parties.		
Related Projects	• POLICY1 – ITS Advisory Committee • SAFE2 - Freeway Service Team Expansion • SAFE5 - Arterial Traffic Incident Response Teams		
ITS Architecture Elements	NA		
Other/Notes:	Full implementation cost is for a 10 year period or $5,000 annually.		

Table 80

Interagency Operations Agreements/Memoranda of Understanding Project Overview

POLICY4	Interagency Operations Agreements/Memoranda of Understanding		
Description:	This project develops formal interagency operations agreements and/or memorandum of understanding agreements to formalize agencies roles and responsibilities for planning, designing, implementing operating and funding multi-agency ITS projects in the region. Formal inter-agency operations agreements and/or MOUs will clearly set forth expectations prior to investing in select ITS projects in an overall attempt to maximize the value of limited resources.		
Lead Agency:	Varies. The Metropolitan Area Transportation Planning Board will be the default agency responsible for coordinating multi-agency ITS projects. However, details specific to projects will be best left to the project sponsors and the agencies participating in the project's planning and implementation.		
Supporting Agency(ies):	TBD. Dependent on the project being implemented.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
			X
ITS Goals Addressed	• Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing		
ITS Strategy Category(ies)	Institutional/Policy		
Expected High-Level Benefits	Clear delineation of agency roles, responsibilities and expectations prior to project implementation.		
Project Phasing	On-going (0-10 years). Timing dictated as project needs warrant.		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	-
Staffing Impact	Minimal. The impact of this project is expected to be absorbed into the agencies' current staffing levels.		
Project Dependencies & Considerations	The initiation of the project will be dependent on the timing of multi-agency projects requiring operational agreement.		
Related Projects	There are a number of projects that are related to this project. Any project that involves two or more agencies or departments within a particular agency are candidates for agreements/MOUs.		
ITS Architecture Elements	NA		
Other/Notes:	The annual costs associated with this project are expected to be absorbed by current agency operations. The cost of this project will only be pertinent to those agencies involved in projects where agreements/MOUs are required to clearly dictate roles and responsibilities.		

Table 81

ITS Architecture/Strategic Plan Maintenance Project Overview

POLICY5	ITS Architecture/Strategic Plan Maintenance		
Description:	This project will maintain the Madison Regional ITS Architecture and Strategic Plan so that the plan remains an up-to-date, valid document.		
Lead Agency:	• Madison Area Transportation Planning Board		
Supporting Agency(ies):	All agencies with a stake in regional ITS planning, implementation, and operation will support this project and provide pertinent information to help keep the Regional ITS Architecture and Strategic Plan up-to-date.		
Location/Limits:	Madison Area Transportation Planning Board's Planning Boundary		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
			X
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Institutional/Policy		
Expected High-Level Benefits	Periodic maintenance of the Regional ITS Strategic Plan/Architecture will help to preserve the investment made to develop the Plan/Architecture and will ensure that they remain an up-to-date, valid planning document. Periodic maintenance will also help to promote the Regional ITS Program through additional collaboration and outreach needed to update the documents.		
Project Phasing	On-going (0-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$20,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	The Madison Regional ITS Strategic Plan will need to be updated whenever there is a change to Regional ITS needs, inventory, architecture or project implementation.		
Related Projects	All ITS projects implemented within the Madison Metropolitan area will have an impact on this project. In other words, this project needs to reflect ITS activities that are planned or conducted within the Region.		
ITS Architecture Elements	NA		
Other/Notes:			

Table 82

Regional Transportation Management Center (RTMC) Concept of Operations Project Overview

TSMO1	Regional Transportation Management Center (RTMC) Concept of Operations		
Description:	The project develops a Concept of Operations for a Regional Transportation Management Center (RTMC). The Concept of Operations will delineate the need for a RTMC, the agencies involved, and roles and responsibilities for its planning, design, and implementation.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• WisDOT, STOC • WisDOT, SW Region • Dane County 9-1-1 • Dane County Emergency Management • Law enforcement • City of Madison Information Technology • Dane County Public Works?		
Location/Limits:	NA		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability, and Reduce its Impact on the Environment • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	This project will provide greater understanding of the need for a RTMC and whether or not the RTMC should be a fixed multi-agency facility or a virtual entity that integrates multi-agency communications systems owned and operated at individual agency locations.		
Project Phasing	Short-term (0-2 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$200,000	-	-
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Project DATA1 (Regional Data Clearinghouse) is expected to provide details on how the region will effectively share information and data. Details provided by Project DATA1 will feed the development of a RTMC ConOps. This project should build off momentum of Project DATA1.		
Related Projects	• DATA1 – Regional Data Clearinghouse (RDC) ConOps • TSMO2 – RTMC Design/Implementation • TSMO3 – RTMC Operations (on-going) including mode choice		
ITS Architecture Elements	NA		
Other/Notes:	This project is slated for the immediate-term because selected agencies in the region have expressed interest and have even initiated steps to implement a traffic management center. The ConOps will provide the means to conduct more extensive planning for a RTMC.		

Table 83

Transit Radio Communication System Upgrade Project Overview

TRAN1	Transit Radio Communication System Upgrade		
Description:	This project upgrades existing transit radio communication systems from analog to digital. This includes both voice and data communications.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Traffic Engineering Radio Shop		
Location/Limits:	City of Madison Metro Transit's fixed route, paratransit, and support vehicles		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal B: Enhance Multiagency Communication, Coordination, and Data Sharing • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Upgrading the transit radio communication system enables • Larger data sharing capacity • More effective interagency radio communications		
Project Phasing	Planning/Design/Implementation – Short-term (0-2 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$50,000	$500,000	$50,000
Staffing Impact	Low (.25 FTE). This project is an upgrade to an existing communications system so impact to existing staff will be minimal. However, some staff time will be required for system planning and implementation.		
Project Dependencies & Considerations	Project needs specified funding item in city capital budget.		
Related Projects	• COM2 – Center-to-Center Communications (existing centers) • TSMO1 – Regional Transportation Management Center (RTMC) ConOps • TSMO2 – RTMC Design/Implementation • TSMO3 – RTMC Operations (ongoing) inlc. mode choice • TRAN2 - Transit Vehicle On-Board Equipment Upgrade • Metro Transit Garage Facility communication Improvements		
ITS Architecture Elements	NA		
Other/Notes:	Project is currently identified in the capital budget for 2017.		

Table 84

Transit Vehicle On-Board Equipment Upgrade Project Overview

TRAN2	Transit Vehicle On-Board Equipment Upgrade		
Description:	This project upgrades or replaces existing onboard vehicle logic units and other associated onboard equipment on Metro Transit fixed route, paratransit, and support vehicles; including fixed site equipment in the transit service area, as appropriate.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	City of Madison Information Technology;		
Location/Limits:	Metro Transit fleet/service area		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Improved on-board communications and data collection.		
Project Phasing	Planning/Design/Implementation – Short-term (0-2 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	$4,500,000	$10,000
Staffing Impact	Minimal. This project is an upgrade to existing equipment.		
Project Dependencies & Considerations	The implementation of this project will depend TRAN1 – Transit Radio Communication System Upgrade		
Related Projects	• TRAN1 – Transit Radio Communication System Upgrade • TRAN8 - Metro Transit Garage Facility Communications Improvements		
ITS Architecture Elements	• Transit Vehicle Tracking (APTS01) • Transit Fixed Route Operations (APTS02) • Demand Responsive Transit Operations (APTS03) • Transit Fare Collection Management (APTS04) • Transit Traveler Information (APTS08) • Transit Signal Priority (APTS09) • Transit Passenger Counting (APTS10)		
Other/Notes:	Currently identified in capital budget for 2017 (~$4.5M). Metro Transit's current onboard ITS equipment was installed in 2003. The scope of this replacement project should be made after an evaluation of physical condition and functionality of current hardware and software.		

Table 85

Metro Transit Garage Facility Communications Improvements Project Overview

TRAN8	Metro Transit Garage Facility Communications Improvements		
Description:	This project deploys Wi-Fi and transit vehicle radio-frequency identification (RFID) technologies to allow automatic downloading of on-board CCTV camera images and video from on-board hard disk drive storage units. Additionally, this project would implement technologies to quickly and easily locate specific buses when parked within the garage.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Department of Information Technology		
Location/Limits:	Metro Transit Garage. 1101 E. Washington Avenue, Madison, WI 53703		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Installing Wi-Fi and RFID enables Metro Transit to: Locate and track transit vehicles within the garage Enable wireless data transfer between on-board ITS equipment and facility servers		
Project Phasing	Planning/Design/Implementation – Short-term (0-2 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	Funded Per Metro Transit		
Staffing Impact	Medium (1.5 FTE)		
Project Dependencies & Considerations	None		
Related Projects	• Transit Vehicle On-Board Equipment Upgrade, • Real Time Transit Vehicle CCTV Camera Image Communications Pilot • Nakoosa Trail Bus Satellite Facility ITS Technologies		
ITS Architecture Elements	• Transit Vehicle Tracking (APTS01) • Transit Fleet Management (APTS06)		
Other/Notes:	Project is currently funded for implementation in 2015/2016.		

Table 86

Transit Passenger Fare Card System Upgrade Project Overview

TRAN11	Transit Passenger Fare Card System Upgrade		
Description:	This project would enable Metro Transit's SPX Genfare Fast FareTM fare boxes to accept smart card technology.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Information Technology		
Location/Limits:	City of Metro Transit's Fixed Route Fleet		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Enabling Metro Transit's fare boxes with smart card technology would allow • Transit users to pay fares electronically and would allow Metro Transit to collect additional data on its riders and their travel habits		
Project Phasing	Planning/Design/Implementation – Short-term (0-2 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	TBD. Dependent upon results of study		
Staffing Impact	TBD. Dependent upon results of study		
Project Dependencies & Considerations			
Related Projects	• TRAN10 - Smart Card for Transit and Parking		
ITS Architecture Elements	• Transit Fare Collection Management (APTS04)		
Other/Notes:			

Table 87

Metro Transit AVL Update Project Overview

DATA 8	Metro Transit AVL Update		
Description:	The project will update and replace Metro Transit's automatic vehicle location (AVL) system. The system which was purchased in 2003 and is rapidly approaching the end of its designed life. Besides the system's age, the need to replace the current AVL system is in part due to a requirement to replace the integrated analog voice radio equipment and to replace this equipment with new digital communications equipment.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison, Traffic Engineering • City of Madison, Streets Division		
Location/Limits:	Metro Transit's entire vehicle fleet		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	This project will improve the collection and accuracy of bus location information and will reduce the time in which this information is collected by transit agencies and then disseminated to the public.		
Project Phasing	Short-term (0-2 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	$3,250,000	-
Staffing Impact	Minimal. Project is an update to an existing system that current staff already operates and maintains. Staff will need to be trained on the implementation and operation of the upgraded AVL system.		
Project Dependencies & Considerations	This project may be best implemented with other transit on-board projects to reduce cost and impacts on operating fleet.		
Related Projects	• TRAN2 – Transit Vehicle On-Board Equipment Upgrade		
ITS Architecture Elements	• On-board Transit Trip Monitoring (APTS01)		
Other/Notes:	12K per equipped bus		

Table 88

Traffic Count Data Storage and Analysis Software Project Overview

DATA10	Traffic Count Data Storage and Analysis Software		
Description:	This project procures traffic count software capable of receiving automated motor-vehicle and bicyclist count data from the existing Centracs ATMS. The procured software will also be able to analyze that data for use in the CMP and provide the ability for the public to access count data.		
Lead Agency:	• City of Madison Traffic Engineering Department		
Supporting Agency(ies):	• WisDOT • Municipalities		
Location/Limits:	Citywide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	Ability to effectively analyze count data to help implement CMP process. Ability to share data with public.		
Project Phasing	Short-term (0-2 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$20,000	$120,000	$25,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Device Connections Traffic count data storage and analysis software		
Related Projects	• DATA9 – Automated Motor-Vehicle and Bicycle Count System		
ITS Architecture Elements	• ITS Data Mart (AD1)		
Other/Notes:	In the process of purchasing equipment in coordination with WisDOT		

Table 89

Connected Vehicle/Technology Pilot Project Overview

INFO4	Connected Vehicle/Technology Pilot		
Description:	Connected vehicles is a multimodal initiative that aims to enable safe, interoperable networked wireless communications among vehicles, the infrastructure, and passengers' personal communications devices. This project is predominantly a "place holder" to be implemented when connected vehicle technology matures to the extent that deployments are possible to demonstrate benefits. Project can also be used to support an advanced technology project, that is not directly connected to connected vehicles if deemed important by the ITS Advisory Committee.		
Lead Agency:	• City of Madison Traffic Engineering • TOPS Lab		
Supporting Agency(ies):	• WisDOT		
Location/Limits:	TBD		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	Given that this project is pending further development and detail, it is difficult to identify the Madison Metropolitan ITS Goals that will be addressed. However, given current research it is likely that a connected vehicle pilot project will at a minimum address: • Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traveler Information		
Expected High-Level Benefits	TBD. Consistent with the Madison Metropolitan ITS Goals addressed, benefits are likely to focus on enhancing safety and transportation system efficiency and reliability.		
Project Phasing	Planning/Design – Short-term (0-2 years) Construction/Deployment – Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$100,000	$300,000	$30,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Build-out of communications system		
Related Projects	• COM1 – Traffic Signal Communications Upgrades		
ITS Architecture Elements	• Short Range Communications Traveler Information (ATIS10)		
Other/Notes:			

Table 90

Traffic Responsive Signal Systems (Phase 1) Project Overview

TSMO5	Traffic Responsive Signal Systems (Phase 1)		
Description:	This project will install necessary equipment and procure necessary licenses to operate traffic responsive and/or traffic adaptive traffic signal systems along specific corridors.		
Lead Agency:	• City of Madison Traffic Engineering Department		
Supporting Agency(ies):	• City of Madison Information Technology		
Location/Limits:	• Gammon Road- Schroeder Road to Gammon Place - This corridor experiences a high level of variability due to West Towne Mall and would be an ideal corridor for adaptive and responsive traffic control systems. • Park Street Corridor-Beltline Highway to Dayton Street (12 signals) • Mineral Point Road- Junction Road to Midvale Blvd - This corridor experiences a high level of variability due to West Towne Mall and would be an ideal corridor for adaptive and responsive traffic control systems. • University/Gorham Corridor-Campus Drive to First Street, and Johnson Street Corridor-Campus Drive to First Street (40 Traffic signals in the corridor) • Williamson Street-Blair Street to Riverside, and Eastwood/Atwood Corridor-First Street to Fair Oaks Avenue (11 traffic signals in the corridor).		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Traffic signals will have the ability to automatically adjust to unanticipated traffic flows in the corridor. This system will help to reduce non- recurring congestion during non-peak hours and eliminate unnecessary fuel consumption and emissions. This will especially improve operations during non-normal staffing hours. Validation studies of similar traffic adaptive systems on Fish Hatchery Road have shown up to a 22% reduction in travel times and a decrease in the number of stops in the corridor. These modifications can greatly reduce fuel consumption and emissions from motor vehicles.		
Project Phasing	Short- to Mid-term (0-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$5,000 (1)* $20,000 (2) $20,000 (3) $15,000 (4)** $56,000 (5) $5,000 (6)*** $5,000 (7)	$100,000 (1)* $170,000 (2) $400,000 (3) $154,000 (4)** $400,000 (5) $60,000(6)*** $60,000 (7)	$135,000
Staffing Impact	High (1 FTE per phase)		
Project Dependencies & Considerations	Device connections. With Gammon Road Construction.		
Related Projects	• COM1 – Traffic Signal Communications Upgrades		
ITS Architecture Elements	• Traffic Signal Control (ATMS03) • Regional Traffic Management (ATMS07)		
Other/Notes:	*It is anticipated that controller upgrades and detection would be installed as part of the future reconstruction project **Anticipated that detection from Beltline to West Washington would be included with future construction project. ***Communications equipment at the necessary traffic signals is already in place.		

Table 91

Vehicle/Pedestrian Detection Upgrades Project Overview

TSMO8	Vehicle/Pedestrian Detection Upgrades		
Description:	This project upgrades vehicle/pedestrian detection technologies to improve signalized operations. Where needed and beneficial, project may include warning systems to alert motorists to the presence of pedestrians.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• WisDOT • Municipal Traffic Engineering Departments		
Location/Limits:	City-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Project will enhance the operation/efficiency of the traffic signal and reliability of the information collected. New technologies will reduce false calls made to traffic signal systems. Project will also allow the collection of data needed to generate travel time information.		
Project Phasing	Short-term (0-2 years) – Phase 1 Mid-term (2-5 years) – Phase 2		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$20,000	$200,000	$30,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Project to be implemented in coordination with improvements to signalized intersections, where possible and feasible.		
Related Projects	• COM1 – Traffic Signal Communications Upgrades • TSMO5 – Traffic Responsive Signal Systems • TSMO6 – Adaptive Traffic Signal Systems		
ITS Architecture Elements	• ATMS03 – Traffic Signal Control (ATMS03)		
Other/Notes:	Assumed 15% for annual O&M.		

Table 92

Nakoosa Trail Bus Satellite Facility ITS Technologies Project Overview

TRAN12	Nakoosa Trail Bus Satellite Facility ITS Technologies		
Description:	This project would integrate ITS technologies in the proposed satellite bus garage on Nakoosa Trail.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Information Technology • Other City of Madison Departments that will be located here		
Location/Limits:	Metro Transit's proposed satellite bus garage on Nakoosa Trail.		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C - Enhance Transportation System Efficiency and Reliability • Goal D - Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Implementing ITS technology at the proposed Nakoosa Trail Satellite Bus Garage enables Metro Transit to maintain similar levels of service as its main garage on E. Washington Avenue. Knowing transit vehicle locations will allow drivers to locate buses faster, increasing their chance of leaving the garage on-time.		
Project Phasing	Planning and Design – Short-term (0-2 years) Implementation – Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	TBD. Dependent upon results of study		
Staffing Impact	TBD. Dependent upon results of study		
Project Dependencies & Considerations	This project is dependent on the award of a TIGER 2015 Discretionary Grant, which the City of Madison needs in order to finance the garage construction.		
Related Projects	• Transit Vehicle On-Board Equipment Upgrade, • Real Time Transit Vehicle CCTV Camera Image Communications Pilot, • Metro Transit Garage Facility Communications Improvements		
ITS Architecture Elements	• Transit Fleet Management (APTS06)		
Other/Notes:			

Table 93

Bicycle/Pedestrian (Arterial) Crossing Warning System Project Overview

SAFE1	Bicycle/Pedestrian (Arterial) Crossing Warning System		
Description:	This project implements automated activated flasher warning systems for shared use path crossings of arterial roadways. System should activate differently based on whether a pedestrian or bicyclist is crossing the roadway.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	None		
Location/Limits:	• Midvale Blvd @ Southwest Path Crossing • West Washington Avenue @ Southwest Path Crossing • North Shore Drive @ Southwest Path Crossing		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Safety		
Expected High-Level Benefits	This project is expected to reduce traffic fatalities and injuries at locations where modes intersect.		
Project Phasing	Short- to Mid-term (0-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$25,000	$150,000	$15,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	None		
Related Projects	• Vehicle/Pedestrian Detection Upgrades		
ITS Architecture Elements	• Mixed Use Warning Systems (ATMS26)		
Other/Notes:	Project costs include pedestrian detection and signal, including conduit and controller for 3 locations.		

8.6.2 Mid-Term ITS Projects (2-5 years)

Recommended potential mid-term projects are envisioned for the Madison Metropolitan Area within the three to five year timeframe. Within the five-year horizon, ITS deployments will begin to migrate into an integrated system. This will be fostered by an increasing number of ITS deployments and by the development of enabling technologies that will provide the basis for multiple functions. The goal of this period is to continue to incrementally expand ITS deployment that currently exist today or is programmed for deployment in the short-term. For instance, it will be beneficial to expand coverage of the existing networks of cameras, ESS and in some cases DMS. These types of projects are relatively inexpensive, highly visible, and provide the infrastructure needed to enable future projects like an integrated regional traffic management center. In comparison to the long-term projects, those slated for the short-term and mid-term focus on deploying ITS elements that show the greatest potential to produce immediate benefits, or work to enable the implementation of long-term projects. Projects identified below are considered viable for the mid-term.

Table 94

Incident Communication System Project Overview

COM4	Incident Communication System		
Description:	This project implements an automated system to share traffic and other related incident alerts and information between police agencies and transportation staff including Madison Metro Transit and City Traffic Engineering. System would be similar in nature to current WisDOT system that provides information to the state STOC for incidents on state highways directly from the Dane County 911 center CAD platform via TOPS Lab		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• City of Madison Metro Transit • State, County and Municipal Law Enforcement Agencies • Dane County Emergency Management • Dane County 9-1-1		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Communications		
Expected High-Level Benefits	Ability for transportation agencies to respond to incidents immediately including rerouting of Madison Metro busses, retiming of traffic signals on effected and alternate routes to help clear incidents and prevent additional secondary incidents.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$50,000	$150,000	$15,000
Staffing Impact			
Project Dependencies & Considerations	This project would benefit from center-to-center communications (fiber) to enable fast and secure communications.		
Related Projects	• COM2 – Center-to-Center Communication (Existing centers) • COM3 – Center-to-Center Communication (Planned centers)		
ITS Architecture Elements	• Traffic Incident Management System (ATMS08)		
Other/Notes:			

Table 95

Arterial DMS at Decision Points for Travel Times Project Overview

INFO1	Arterial DMS at Decision Points for Travel Times		
Description:	This project will strategically place arterial dynamic message signs (DMS) at key decision points for entering the City of Madison and displaying travel times and other traveler information (incidents, special events, and emergency information) so that motorists may make informed decisions about which route to use.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• WisDOT • City of Madison Parking Utility • UW Transportation Services		
Location/Limits:	Five general (preliminary) locations at/near: • Mineral Point Rd. and the Beltline • Fish Hatchery Rd. and the Beltline • Midvale Blvd./Verona Rd. and the Beltline • Park St. and the Beltline • E. Washington Ave. approaching STH 30		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traveler Information		
Expected High-Level Benefits	Providing motorists with travel times and traffic incident information at key decision points to entering the City will help reduce congestion and improve system reliability.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$100,000	$300,000	$30,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Arterial DMS will require communications via the City's fiber optic backbone, additional detectors for collecting travel times and a regional transportation management center (TMC) for operations.		
Related Projects	• COM1 – Regional Traffic Signal Communications Upgrades • TSMO1- Regional Transportation Management Center (TMC) ConOps • TSMO2 – RTMC Design/Implementation • TSMO3 – RTMC Operations (On-going) including mode choice • DATA4 – Arterial Travel Times		
ITS Architecture Elements	• Traffic Information Dissemination (ATMS06) • Wide Area Alert (EM06)		
Other/Notes:	Project assumes 5 small LED full matrix signs and structure suitable for arterials.		

Table 96

Downtown Madison Parking Wayfinding System Project Overview

INFO2	Downtown Madison Parking Wayfinding System		
Description:	This project implements a parking management system that includes wayfinding signing that dynamically displays the number of current parking spaces available at each City of Madison operated parking facility. Data collected by the system may also be available for websites and third-party developed smartphone applications.		
Lead Agency:	• City of Madison Parking Utility		
Supporting Agency(ies):	• City of Madison Traffic Engineering • UW Transportation Services		
Location/Limits:	Downtown City of Madison (Central/Near West & East Isthmus): • State Street Campus Garage • Buckeye Lot • State Street Capitol Garage • Overture Center Garage • Lot 88 • Government East Garage • Brayton Lot • Capitol Square North Garage		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability, and Reduce its Impact on the Environment		
ITS Strategy Category(ies)	Traveler Information		
Expected High-Level Benefits	Implementing a parking wayfinding system in downtown Madison will enhance transportation system efficiency and reliability by minimizing patrons driving streets in search of available parking. Fewer passenger vehicles on the streets will also facilitate pedestrian and transit mobility.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$60,000	$355,000	$35,500
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Parking management systems that can determine parking availability must be installed before this project is implemented. Some parking garages within downtown Madison are able to determine parking availability but may be updated to improve accuracy of parking space occupancy. Project should be coordinated with any planned improvements to parking management systems.		
Related Projects	• INFO3 – UW Visitor Parking Wayfinding System		
ITS Architecture Elements	• Parking Facility Management (ATMS16)		
Other/Notes:	2 dynamic signs and 4 static signs on average per parking facility. Cost Breakdown: Dynamic Signs: 16 at $10,000 = $160,000 Dynamic Sign Communications: 16 at $2,000 = $32,000 Static Signs: 32 at $1,500 = $48,000 Facility Equipment: 8 at $10,000 = $80,000 Software: $35,000 Total: $355,000		

Table 97

UW Visitor Parking Wayfinding System Project Overview

INFO3	UW Visitor Parking Wayfinding System		
Description:	This project implements a parking management system that includes wayfinding signing that dynamically displays the number of current parking spaces available at each University of Wisconsin operated visitor parking facility. Data collected by the system may also be available for websites and third-party developed smartphone applications.		
Lead Agency:	• UW Transportation Services		
Supporting Agency(ies):	• City of Madison Parking Utility • City of Madison Transportation Division		
Location/Limits:	UW Visitor Parking Facilities: • University Ave. Ramp (020) • Nancy Nicholas Hall Garage (027) • Observatory Dr. Ramp (036) • HC White Garage Lower (006L) • HC White Garage Upper (006U) • Grainger Hall Garage (007) • N. Park St. Ramp (029) • Lake & Johnson Ramp (046) • Fluno Center Garage (083) • Engineering Dr. Ramp (017) • Union South Garage (080) • University Bay Drive Ramp (076)		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traveler Information		
Expected High-Level Benefits	Implementing a parking wayfinding system in the UW area will enhance transportation system efficiency and reliability by minimizing patrons and visitors driving streets in search of available parking. Fewer passenger vehicles on the streets will also facilitate pedestrian, bicycle and transit mobility.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$90,000	$530,000	$53,000
Staffing Impact	Medium (1 FTE)		
Project Dependencies & Considerations	Parking management systems that can determine parking availability must be installed before this project is implemented. Some of parking garages within downtown Madison are able to determine parking availability but may be updated to improve accuracy of parking space occupancy. Project should be coordinated with any planned improvements to parking management systems.		
Related Projects	• INFO2 – Downtown Madison Parking Wayfinding System		
ITS Architecture Elements	• Parking Facility Management (ATMS16)		
Other/Notes:	2 dynamic signs and 4 static signs on average per parking facility. Cost Breakdown: Dynamic Signs: 24 at $10,000 = $240,000 Dynamic Sign Communications: 24 at $2,000 = $48,000 Static Signs: 48 at $1,500 = $72,000 Facility Equipment: 12 at $10,000 = $120,000 Software: $50,000 Total: $530,000		

Table 98

Regional Traffic Management Center Design/Implementation Project Overview

TSMO2	Regional Traffic Management Center Design/Implementation		
Description:	This project will design and construct a Regional Traffic Management Center. A RTMC would allow regional agencies to monitor traffic and remotely operate ITS devices along local arterials in Dane County. Additionally, a RTMC would allow for improved emergency response, and maintenance and construction management. The center would integrate existing City of Madison traffic and ITS functions, consolidating control in one location. The RTMC concept would gradually expand to increase functionality and integrate new ITS systems as they are deployed. The Center would serve as a coordinating point with other transportation and emergency management, and emergency response agencies.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• WisDOT, Bureau of Traffic Operations • Dane County Emergency Management		
Location/Limits:	Dane County (non-freeway) road network		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	• More system operation information for managers and incident responders • Centralized control of traffic operations • Improved traffic operations • Improved travel information • Increased coordination		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$250,000	$500,000	-
Staffing Impact	Medium (1 FTE)		
Project Dependencies & Considerations	The benefit of a regional traffic management center will be maximized in an environment where field device deployment is mature. It is recommended that field devices that provide network surveillance and traveler information be widely deployed before a RTMC is deployed.		
Related Projects	• COM1 – Traffic Signal Communications • COM2 – Center-to-Center Communications (existing centers) • COM 3 – Center-to-Center Communications (planned centers) • INFO1 – Arterial DMS at Decision Points for Travel Times • TSMO1 – Regional Transportation Management Center (RTMC) ConOps • POLICY4 - Interagency Operations Agreements/MOUs		
ITS Architecture Elements	• Network Surveillance (ATMS01) • Traffic Signal Control (ATMS03) • Traffic Information Dissemination (ATMS06) • Regional Traffic Management (ATMS07) • Traffic Incident Management System (ATMS08) • Mixed Use Warning Systems (ATMS26) • Early Warning System (EM07) • Multi-modal Coordination (APTS07)		
Other/Notes:			

Table 99

Preplanned Emergency Alternate Routes & Signal Timing Project Overview

TSMO9	Preplanned Emergency Alternate Routes & Signal Timing		
Description:	The project develops emergency alternate route plans for freeways within Dane County. The emergency alternate routes plans resulting from this project will help minimize the disruptions that traffic incidents, emergencies, planned special events, and road maintenance and construction have on normal traffic flow. Because emergency routes will be developed before they are needed, emergency response and traffic management can be conducted in a controlled, organized manner when full or partial road closure do occur.		
Lead Agency:	• Madison Area Transportation Planning Board • City of Madison Traffic Engineering		
Supporting Agency(ies):	• City of Madison Traffic Engineering • WisDOT • Local, Regional, and State Law Enforcement agencies • Local, Regional fire departments and emergency medical service providers • Local public works departments		
Location/Limits:	Dane County Freeway Network		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Preplanned, readily available emergency alternate route plans will decrease secondary incidents, improve incident response, improve transportation system user quality of life and perception of traffic management agencies and will lead to environmental improvements through reduced fuel consumption and emissions.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$100,000	-	$20,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Where possible and feasible, preplanned emergency alternate routes should be equipped with the necessary ITS fields devices to monitor and control traffic. Arterial DMS will be beneficial for providing traveler information to motorists unfamiliar with alternate routes and can be used to guide motorist to freeway entrance locations upstream on impacted areas. Similarly, traffic responsive and adaptive traffic signal systems can better accommodate increased vehicular demand when alternate routes are activated. Policies and memorandum of understanding agreements may be needed if alternate routes transverse jurisdictional boundaries.		
Related Projects	INFO1 – Arterial DMS at Decision Points for Travel Times TSMO4 – CCTV Camera Expansion TSMO5 – Traffic Responsive Signal Systems TSMO6 – Adaptive Traffic Signal Systems SAFE4 – Regional Traffic Incident Management Coordination POLICY 4– Interagency Operations Agreement/MOUs		
ITS Architecture Elements	NA		
Other/Notes:			

Table 100

Transit Dynamic Message Sign (DMS) Upgrade and Expansion Project Overview

TRAN3	Transit Dynamic Message Sign (DMS) Upgrade and Expansion		
Description:	This project replaces existing dynamic message signs (DMS), and implements a minimal number of new signs at popular Metro Transit bus stops. Existing signs only allow operators to send messages to signs but do not allow for sign message verification or operational status. Project will replace existing signs with those that allow two-way communication between signs.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Traffic Engineering Division		
Location/Limits:	City/Region-wide. Currently, there are four DMS at the transfer points, seven at the Capitol Square, one at Madison Area Technical College, and one at Dane County Regional Airport. A study should be done to see which of the most popular bus stops are appropriate for expansion.		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Providing real-time information via DMS at transit facilities will enhance the reliability and attractiveness of transit and increase ridership. Safety and security messages may also be displayed. Increased ridership may decrease auto volumes thereby decreasing congestion and enhancing overall transportation system efficiency.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$30,000	$100,000	$15,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	No current funding allocated to this project.		
Related Projects	• TRAN4 - Transit Information Dissemination Study		
ITS Architecture Elements	• Transit Traveler Information (APTS08) • Wide-area Alert (EM06)		
Other/Notes:	Signs cost depends on quality, size, and controller capabilities. Project assumes 20 signs total at an average capital cost of $5,000 each.		

Table 101

Transit Information Dissemination Study Project Overview

TRAN4	Transit Information Dissemination Study		
Description:	This project will conduct a study that explores the most efficient means of communicating information to transit users, including sharing system data with third party entities and applications.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	None identified		
Location/Limits:	City of Madison Transit Service Area		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	This project is expected to result in recommendations that Metro Transit can explore to improve communication with its patrons. Once implemented, recommendations will improve public perception and use of public transportation ultimately leading to greater revenues and reduced single occupant vehicle use.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$100,000	-	-
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	None		
Related Projects	• TRAN3 - Transit Dynamic Message Sign Upgrade and Expansion		
ITS Architecture Elements	NA		
Other/Notes:			

Table 102

Transit Signal Priority (TSP) Pilot Project Overview

TRAN5	Transit Signal Priority (TSP) Pilot Project		
Description:	This project will test and evaluate transit signal priority (TSP) technologies and identify corridors and specific intersections that could benefit from TSP.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Traffic Engineering • Municipal Traffic Engineering Departments • Madison Area Transportation Planning Board		
Location/Limits:	Key transit routes Planned BRT corridors		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Testing TSP enables Metro Transit to: • Demonstrate benefits in advance of bus rapid transit (BRT) deployment • Identify corridors and intersections that could benefit from TSP		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$50,000	$200,000	$20,000
Staffing Impact	Medium (1 FTE). This is a new technology and is expected to be expanded in the future as a result of future BRT system, thus a dedicated staff person is likely needed through deployment.		
Project Dependencies & Considerations	Implementation of transit signal priority will be dependent on regional BRT planning efforts, and specifically the selection of routes for BRT. This project should be coordinated and implemented in concert with BRT improvements to reduce construction costs and limit impacts to the public.		
Related Projects	• TRANS6 – Bus Rapid Transit (BRT) Signal Priority		
ITS Architecture Elements	• Transit Signal Priority (APTS09)		
Other/Notes:	Project assumes deployment of on-board equipment (Pre-emption processor, emitter, transponder) on 10 vehicles and roadside equipment at 10 signals)		

Table 103

Smart Card for Transit and Parking Project Overview

TRAN10	Smart Card for Transit and Parking		
Description:	The project will procure and implement technology to support the collection of parking and transit fees using multi-use proximity cards.		
Lead Agency:	• City of Madison Metro Transit • City of Madison Parking Utility		
Supporting Agency(ies):	• City of Madison Information Technology • Dane County Parking Management • UW Transportation Services		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	The use of proximity cards for the collection of transit fares and parking fees will improve transit boarding times and vehicle entry into parking facilities. As a result, service and public perception of these agencies will be improved. This project will also enable Metro Transit to collect additional data on its riders and their travel habits. The use of contactless fare/payment cards is also expected to reduce maintenance costs.		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	TBD. Dependent upon results of study		
Staffing Impact	TBD. Dependent upon results of study		
Project Dependencies & Considerations	This project is dependent on Metro Transit enabling its fare boxes to accept smart cards as well as the Parking Utility enabling their equipment. Short- to Mid-term implementation of connected vehicle technologies may present alternatives that may work alongside or in lieu of proximity cards.		
Related Projects	• TRAN11 - Transit Passenger Fare Card System Upgrade		
ITS Architecture Elements	• Transit Fare Collection Management (APTS04) • Multi-modal Connection Protection (APTS11) • Parking Facility Management (ATMS16)		
Other/Notes:	There is a possibility the smart card could also allow B-Cycle users to pay to use a bike electronically, and potential other yet undefined functions. $10 per card 60K for training 100K for annual operations		

Table 104

Transit Vehicle Technology Evaluation Study Project Overview

TRAN13	Transit Vehicle Technology Evaluation Study		
Description:	This project evaluates existing and emerging technologies such as dedicated short range communications (DSRC) radios and engine monitoring systems.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	None		
Location/Limits:	Metro Transit Vehicle fleet		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Transit Management		
Expected High-Level Benefits	The results of this study will be used to refine bus procurement specifications.		
Project Phasing	Mid-term (2-5 years) Long-term (5-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$150,000	-	-
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	• TSMO12 - CV Roadside Infrastructure • TRAN6 - Bus Rapid Transit (BRT) Signal Priority • TRAN7 - Bus Rapid Transit (BRT) ITS Deployment		
Related Projects	• TRAN4 – Transit Information Dissemination Study		
ITS Architecture Elements	• ATMS06 – Transit Fleet Management • TSMO10 – Traffic Signal System and Controller Updates for CV • TSMO11 – CV Roadside Infrastructure		
Other/Notes:	Timing of project is dependent on the results/timing of Project TSMO12 (CV Roadside Infrastructure), Project TRAN6 (Bus Rapid Transit (BRT) Signal Priority, and Project TRAN7 (Bus Rapid Transit (BRT) ITS Deployment.		

Table 105

Expansion of Weather/Pavement Sensors (Streets) Project Overview

MAINT2	Expansion of Weather/Pavement Sensors (Streets)		
Description:	This project implements pavement sensors located along primary arterials to support winter maintenance operations. Pavement sensors will monitor and measure pavement temperate and conditions (snow, ice, frost, wet) in real-time to alert maintenance dispatchers of streets that need to be plowed or treated and to make efficient use of de-icing materials.		
Lead Agency:	• City of Madison Streets Division • Dane County Highway Department		
Supporting Agency(ies):	• City of Madison Traffic Engineering • City of Madison Information Technology		
Location/Limits:	• Webster St. between East Washington and Main Street • North Port Drive-Near Troy Drive • East Washington Avenue-Near East Towne Mall		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Maintenance		
Expected High-Level Benefits	This project will improve real-time monitoring of weather conditions occurring in the field and their impact on pavement surface state. By monitoring weather and pavement conditions in real-time, maintenance crews and plow operators can be quickly dispatched to areas being impacted or potentially impacted. Additionally, materials used to fight snow and ice can be used only at locations where conditions have deteriorated saving the cost of materials that would otherwise be used on roadways where roadways that are not impacted.		
Project Phasing	Mid-Term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$5,000	$60,000	$12,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Project requires a link to communications so that data can be transmitted to monitoring centers in real-time.		
Related Projects	None		
ITS Architecture Elements	• Road Weather Data Collection (MC03) • Weather Information Processing and Distribution (MC04)		
Other/Notes:			

Table 106

Regional Data Clearinghouse (RDC) Concept of Operations Project Overview

DATA1	Regional Data Clearinghouse (RDC) Concept of Operations		
Description:	This project will develop a Concept of Operations document for a Regional Data Clearinghouse. The Concept of Operations will analyze alternatives for a Regional Data Clearinghouse leading to the recommendation of a preferred concept to be designed in Project DATA2-RDC Design/Implementation. Besides identifying a viable concept, the RDC Concept of Operations will document the need for a data clearinghouse, and stakeholder roles and responsibilities for its design, implementation, operation and/or maintenance.		
Lead Agency:	• Madison Area Transportation Planning Board		
Supporting Agency(ies):	TBD. Supporting agencies will likely include those agencies that collect data and information which if shared can benefit the operations of other agencies. These will likely include: • City of Madison Traffic Engineering • WisDOT SE Region • TOPS Lab		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	Improved use and sharing of collected data		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$150,000	-	-
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Project will require significant multi-agency coordination.		
Related Projects	• COM2 – Center-to-Center Communications (existing centers) • POLICY1 – ITS Advisory Committee • DATA2 – RDC Design/Implementation • DATA3 – RDC Data Sharing Standard Operating Procedures		
ITS Architecture Elements	NA		
Other/Notes:			

Table 107

Regional Data Clearinghouse Design/Implementation Project Overview

DATA2	Regional Data Clearinghouse Design/Implementation		
Description:	This project will implement the Regional Data Clearinghouse described in project DATA1. Project details, including timing and system architecture will largely be dependent on the desired concept identified in the RDC Concept of Operations.		
Lead Agency:	• Madison Area Transportation Planning Board		
Supporting Agency(ies):	TBD. Supporting agencies will likely include those agencies that collect data and information which if shared can benefit the operations of other agencies.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	Improved use and sharing of collected data		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$60,000	$ 300,000	$30,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Project will require the completion of a Regional Data Clearinghouse Concept of Operations (Project DATA 1).		
Related Projects	• DATA1 – Regional Data Clearinghouse (RDC) ConOps • DATA3 – RDC Data Sharing Standard Operating Procedures		
ITS Architecture Elements	• ITS Data Warehouse (AD2)		
Other/Notes:			

Table 108

Regional Data Clearinghouse Data Sharing Standard Operating Procedures Project Overview

DATA3	Regional Data Clearinghouse Data Sharing Standard Operating Procedures		
Description:	This project develops operating procedures for exchanging data via the regional data clearinghouse. Standard operating procedures will specify among other things, access credentials and levels, what types of data will be collected and shared and agency roles and responsibilities for writing data to the achieve.		
Lead Agency:	• Madison Area Transportation Planning Board		
Supporting Agency(ies):	TBD. Supporting agencies will likely include those agencies that collect data and information which if shared can benefit the operations of other agencies.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	Standard operating procedures		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$100,000	-	-
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Standard operating procedures should be developed in concert with the development of the regional data clearinghouse. Standard operating procedures should be finalized prior to the first day of operations.		
Related Projects	• DATA1 – Regional Data Clearinghouse (RDC) ConOps • DATA2 – RDC Design/Implementation		
ITS Architecture Elements	NA		
Other/Notes:			

Table 109

Automated Motor-Vehicle and Bicycle Count System Project Overview

DATA9	Automated Motor-Vehicle and Bicycle Count System		
Description:	Currently, traffic volume counts that are used to establish yearly ADWT, are collected using outdated hose collection methods. Hoses are typically installed at many but not all count stations and collect count data for a single day. This leads to extreme variability in the count program due to factors such as weather. This project would install the necessary detection systems at traffic signals and use the signal controller to count in real time allowing multiple days of data to determine ADWT. This will help better determine volumes and inform planning and signal timing decisions related to infrastructure investments for both motor-vehicles and bicycles.		
Lead Agency:	• City of Madison Traffic Engineering Department		
Supporting Agency(ies):	• Metropolitan Area Transportation Planning Board		
Location/Limits:	City-wide. 115 Traffic signal locations		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	Improved data to assist in evaluating the CMP		
Project Phasing	Mid-term (2-5 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$70,000	$760,000	$76,000
Staffing Impact	Medium (1 FTE)		
Project Dependencies & Considerations	Device Connections Traffic count data storage and analysis software		
Related Projects	• DATA10 – Traffic Count Data Storage and Analysis Software		
ITS Architecture Elements	• Network Surveillance (ATMS01)		
Other/Notes:			

Table 110

Center-to-Center Communications Infrastructure (Existing Centers) Project Overview

COM2	Center-to-Center Communications Infrastructure (Existing Centers)		
Description:	This project enables/enhances physical communication links between existing facilities/centers to improve incident management and response such as: • Dane County 9-1-1 • City of Madison Emergency Operations Center (EOC) • WisDOT Statewide Traffic Operations Center (STOC) • WisDOT SW Region Office • Metro Dispatch Facility • Wisconsin State Patrol, DeForest Post		
Lead Agency:	• Dane County 9-1-1		
Supporting Agency(ies):	• City of Madison • WisDOT • Metro Transit • Dane County Emergency Management • Wisconsin State Patrol, DeForest Post • Regional Law Enforcement		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal B: Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing		
ITS Strategy Category(ies)	Communications		
Expected High-Level Benefits	Providing and/or enhancing communication linkages to/between existing center-to-center facilities will improve multiagency response, coordination and data sharing during traffic incidents and other emergencies.		
Project Phasing	Planning/Design - Mid-term (2-5 years) Implementation - Long-term (5-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$25,000	$250,000	$25,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	Availability of existing infrastructure (e.g. conduit, fiber, etc.) to facilitate center-to-center connections.		
Related Projects	• COM3 – Center-to-Center Communications (planned centers)		
ITS Architecture Elements	NA		
Other/Notes:			

Table 111

Center-to-Center Communications (Planned Centers) Project Overview

COM3	Center-to-Center Communications (Planned Centers)		
Description:	This project enables/enhances physical communication links between the planned City of Madison Regional Transportation Management Center (RTMC) (see projects TSMO1-TSMO3) and other existing centers such as: • Dane County 9-1-1 • City of Madison Emergency Operations Center (EOC) • WisDOT Statewide Traffic Operations Center (STOC) • Metro Dispatch		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• Dane County • WisDOT • Metro Transit		
Location/Limits:	Center location dependent		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal B: Enhance and/or Enable Multiagency Communication, Coordination and Data Sharing		
ITS Strategy Category(ies)	Communications		
Expected High-Level Benefits	Providing and/or enhancing communication linkages to/between the planned City of Madison Transportation Management Center and other existing center-to-center facilities will improve multiagency response, coordination and data sharing during routine operations, traffic incidents and other emergencies.		
Project Phasing	Planning/Design - Mid-term (2-5 years) Implementation – Long-term (5-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$50,000	$200,000	$10,000
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	Build-out of City of Madison RTMC and availability of existing infrastructure (e.g. conduit, fiber, etc.) to facilitate center-to-center connections.		
Related Projects	• COM2 – Center-to-Center Communications (existing centers) • TSMO1 – Regional Transportation Management Center (RTMC) ConOps • TSMO2 – RTMC Design/Implementation • TSMO3 – RTMC Operations (ongoing) incl. Mode choice		
ITS Architecture Elements	NA		
Other/Notes:			

Table 112

Traffic Responsive Signal Systems (Phase2)

TSMO6	Traffic Responsive Signal Systems (Phase 2)		
Description:	This project builds from Project TSMO5 – Traffic Responsive Signal Systems (Phase1) by installing the necessary equipment and procuring the necessary licenses to operate traffic responsive and/or traffic adaptive traffic signal systems that we not deployed in the Phase 1.		
Lead Agency:	• City of Madison Traffic Engineering Department		
Supporting Agency(ies):	• City of Madison Information Technology		
Location/Limits:	• Gammon Road- Schroeder Road to Gammon Place - This corridor experiences a high level of variability due to West Towne Mall and would be an ideal corridor for adaptive and responsive traffic control systems. • Park Street Corridor-Beltline Highway to Dayton Street (12 signals) • Mineral Point Road- Junction Road to Midvale Blvd - This corridor experiences a high level of variability due to West Towne Mall and would be an ideal corridor for adaptive and responsive traffic control systems. • University/Gorham Corridor-Campus Drive to First Street, and Johnson Street Corridor-Campus Drive to First Street (40 Traffic signals in the corridor) • Williamson Street-Blair Street to Riverside, and Eastwood/Atwood Corridor-First Street to Fair Oaks Avenue (11 traffic signals in the corridor).		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Traffic signals will have the ability to automatically adjust to unanticipated traffic flows in the corridor. This system will help to reduce non- recurring congestion during non-peak hours and eliminate unnecessary fuel consumption and emissions. This will especially improve operations during non-normal staffing hours. Validation studies of similar traffic adaptive systems on Fish Hatchery Road have shown up to a 22% reduction in travel times and a decrease in the number of stops in the corridor. These modifications can greatly reduce fuel consumption and emissions from motor vehicles.		
Project Phasing	Mid- to Long-term (2-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$5,000 (1)* $20,000 (2) $20,000 (3) $15,000 (4)** $56,000 (5) $5,000 (6)*** $5,000 (7)	$100,000 (1)* $170,000 (2) $400,000 (3) $154,000 (4)** $400,000 (5) $60,000(6)*** $60,000 (7)	$135,000
Staffing Impact	High (1 FTE per phase)		
Project Dependencies & Considerations	Device connections. With Gammon Road Construction.		
Related Projects	• COM1 – Traffic Signal Communications Upgrades		
ITS Architecture Elements	• Traffic Signal Control (ATMS03) • Regional Traffic Management (ATMS07)		
Other/Notes:	The timing of specific projects to be made closer to the date of project initiation, and is subject to available funding. *It is anticipated that controller upgrades and detection would be installed as part of the future reconstruction project **Anticipated that detection from Beltline to West Washington would be included with future construction project. ***Communications equipment at the necessary traffic signals is already in place.		

Table 113

Adaptive Traffic Signal Systems Project Overview

TSMO7	Adaptive Traffic Signal Systems		
Description:	This project procures and installs the necessary licenses and equipment needed to operate traffic signals via adaptive traffic signal system technology.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• City of Madison Information Technology		
Location/Limits:	East Washington Avenue (Park Street Corridor – Beltline Highway to Dayton Street, 20 signals).		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Traffic signals will have the ability to automatically adjust to unanticipated traffic flows in the corridor. This system will help to reduce non- reoccurring congestion during non-peak hours and eliminate unnecessary fuel consumption and emissions. This will especially improve operations during non-normal staffing hours. Validation studies of similar traffic adaptive systems on Fish Hatchery Road have shown up to a 22% reduction in travel times and a decrease in the number of stops in the corridor. These modifications can greatly reduce fuel consumption and emissions from motor vehicles.		
Project Phasing	Mid- to Long-term (2-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$65,000	$630,000	$63,000
Staffing Impact	High (2 FTEs)		
Project Dependencies & Considerations	Device connections		
Related Projects	• COM1 – Traffic Signal Communications Upgrades		
ITS Architecture Elements	• Traffic Signal Control (ATMS03) • Regional Traffic Management (ATMS07)		
Other/Notes:			

Table 114

Connected Vehicle Roadside Infrastructure Project Overview

TSMO12	Connected Vehicle Roadside Infrastructure		
Description:	The project procures and implements roadside equipment (RSE) needed to provide vehicle-to-infrastructure communications. The RSE communicates with vehicle on-board equipment and sends and receives information about infrastructure based conditions, such as signal phase and timing (SPaT) and geographic-based data for safety applications. The RSE communicates to vehicles using dedicated short range communications (DSRC).		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• WisDOT		
Location/Limits:	TBD		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	This project will establish the necessary field equipment needed to accommodate future connected vehicles. Vehicle-to-Infrastructure communication will provide a myriad of benefits ranging from improved alerting and safety to enhance driver experience.		
Project Phasing	Mid- to Long-term (2-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$500,000	$5,000,000	$500,000
Staffing Impact	High (2+ FTEs)		
Project Dependencies & Considerations	The modernization of existing signal controllers is a proactive measure to prepare the City of Madison Traffic Engineering Department for a full-scale Connected Vehicle deployment.		
Related Projects	• INFO4 – Connected Vehicle Pilot • TSMO10 – Traffic Signal System and Controller Updates for CV		
ITS Architecture Elements	• Short Range Communications Traveler Information (ATIS10)		
Other/Notes:			

Table 115

Bus Rapid Transit (BRT) Signal Priority Project Overview

TRAN6	Bus Rapid Transit (BRT) Signal Priority		
Description:	This project implements transit signal priority (TSP) technologies during bus rapid transit (BRT) deployment. This project would likely build from the initial deployment of transit signal priority in the transit signal priority pilot project.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Traffic Engineering Department • Madison Area Transportation Planning Board		
Location/Limits:	• Planned BRT corridors (Short-term) • Key transit routes (Mid- to Long-term)		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C – Enhance Transportation System Efficiency and Reliability • Goal D – Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	Implementing TSP technologies enables Metro Transit to: • qualify for Federal funds • gain transit travel speeds so as to decrease travel times		
Project Phasing	Mid- to Long-term (2-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$100,000	$800,000	$80,000
Staffing Impact	Medium (1 FTE)		
Project Dependencies & Considerations	City of Madison will be conducting a study to identify environmental and logistical issues in creating a BRT system. This project is dependent on the study's findings. Madison does not face significant hurdles to building BRT. No current funding allocated to this project.		
Related Projects	• Transit Signal Priority Pilot • BRT ITS Deployment		
ITS Architecture Elements	• Transit Signal Priority (APTS09)		
Other/Notes:	Assumes deployment on 30 additional transit vehicles and 50 additional signalized intersections.		

Table 116

Bus Rapid Transit (BRT) ITS Deployment Project Overview

TRAN7	Bus Rapid Transit (BRT) ITS Deployment		
Description:	This project ensures that ITS elements, such as smart card fare validators and ticket vending machines, are incorporated into the City of Madison's bus rapid transit (BRT) deployment.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• Madison Area Transportation Planning Board		
Location/Limits:	City of Madison Metro Transit Service Area		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal C: Enhance Transportation System Efficiency and Reliability • Goal D: Enhance Attractiveness of, and Operational Support for, Alternative Transportation Modes		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	This project will allow for off-vehicle payment which will reduce delays associated with collecting fares on the vehicle leading to improved transit vehicle running times.		
Project Phasing	Mid- to Long-term (2-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$40,000	$400,000	$40,000
Staffing Impact	Medium (1 FTE)		
Project Dependencies & Considerations	City of Madison will be conducting a study to identify environmental and logistical issues in creating a BRT system. This project is dependent on the study finding Madison does not face significant hurdles to building BRT.		
Related Projects	• TRAN6 - BRT Signal Priority		
ITS Architecture Elements	• Transit Fare Collection Management – APTS04 • Transit Security – APTS05		
Other/Notes:			

Table 117

Freeway Service Team Expansion Project Overview

SAFE2	Freeway Service Team Expansion		
Description:	This project will purchase, operate and maintain 2 additional freeway service vehicles in Dane County. The additional freeway service team vehicles will supplement current vehicles to provide more reliable and timely service to motorists whose vehicles have become disabled or have been in an accident.		
Lead Agency:	• WisDOT		
Supporting Agency(ies):	• Wisconsin State Patrol		
Location/Limits:	Madison Regional Freeways		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Safety		
Expected High-Level Benefits	• Improved safety • Reduced traffic delay		
Project Phasing	Mid-to Long-term (2-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$150,000	$1,000,000	$400,000
Staffing Impact	High (2+FTEs)		
Project Dependencies & Considerations	None		
Related Projects	• SAFE5 – Arterial Traffic Incident Response Teams • POLICY3 – Sponsorship Research		
ITS Architecture Elements	• Roadway Service Patrols (EM04)		
Other/Notes:	Annual O&M per vehicle is assumed to be $100,000 per year.		

Table 118

Arterial Traffic Incident Response Teams Project Overview

SAFE5	Arterial Traffic Incident Response Teams		
Description:	As initially recommended in the Madison Metropolitan Area Congestion Management Process (CMP), this project will develop a team specifically to focus on responding to traffic incidents on capacity constrained arterial segments. This project also includes establishment of an arterial TIM subcommittee (see project SAFE4-Regional TIM Coordination) that will oversee Arterial Traffic Incident Response Team development and further definition.		
Lead Agency:	• City of Madison Traffic Engineering		
Supporting Agency(ies):	• WisDOT • Madison Police Department • Madison Fire Department • Dane County Sheriff • Emergency Management • Highway Department • Metropolitan Area Transportation Planning Board		
Location/Limits:	Capacity constrained arterials TBD		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Safety		
Expected High-Level Benefits	Establishment of a team that focuses on safe, quick clearance of arterial incidents will improve safety for responders and motorists and improve travel time reliability on the arterial network.		
Project Phasing	Mid- to Long-Term (2-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	$100,000	$50,000
Staffing Impact	High (2+ FTE)		
Project Dependencies & Considerations	None		
Related Projects	• SAFE2 – Freeway Service Team Expansion • POLICY3 – Sponsorship Research		
ITS Architecture Elements	• Roadway Service Patrols (EM04)		
Other/Notes:			

8.6.3 Long-Term ITS Projects (5-10 years)

Recommended potential long-term projects are envisioned for Madison Metropolitan Area within the five to ten year timeframe. Within the ten-year horizon, ITS deployments will begin to be fully integrated to create an integrated system-of-systems. The ITS deployment that will occur in the short- and mid-term will lay down the foundation for this integration. These deployments will be integrated in the long-term to begin to maximize the benefits of ITS deployment. The goal of this period is to build off the foundation of ITS deployment developed in the short- and mid-term and to fully maximize the benefits these systems offer. Long-term projects are outlined in greater detail below.

Table 119

RTMC Operations (Ongoing) Including Mode Choice Project Overview

TSMO3	RTMC Operations (Ongoing) Including Mode Choice		
Description:	Dependent on the result of the RTMC Concept of Operations, this project enables on-going operations at the proposed RTMC.		
Lead Agency:	• City of Madison Traffic Engineering Department		
Supporting Agency(ies):	TBD. Concept of Operations Dependent.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traffic Management and Operations		
Expected High-Level Benefits	Sustained continuity in operations		
Project Phasing	Long-term (5-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$200,000
Staffing Impact	High (2+ FTEs)		
Project Dependencies & Considerations	Project is dependent on the outcome of the RTMC Concept of Operations Project.		
Related Projects	• TSMO1 – Regional Transportation Management Center (RTMC) ConOps • TSMO2 – RTMC Design/Implementation		
ITS Architecture Elements	NA		
Other/Notes:			

Table 120

Real-time Transit Vehicle CCTV Camera Image Communications Pilot Project Overview

TRAN9	Real-time Transit Vehicle CCTV Camera Image Communications Pilot		
Description:	This project will demonstrate the safety and security benefits of real time communication of transit vehicle CCTV camera images to law enforcement and Metro Transit Dispatch.		
Lead Agency:	• City of Madison Metro Transit		
Supporting Agency(ies):	• City of Madison Police and Fire Departments • City of Madison Traffic Engineering • Dane County 9-1-1		
Location/Limits:	City of Metro Transit's fixed route and paratransit fleet		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X		
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators, and Public Safety and Construction/Maintenance Personnel • Goal B: Enhance Multiagency Communication, Coordination, and Data Sharing		
ITS Strategy Category(ies)	Transit Management and Operations		
Expected High-Level Benefits	This pilot project will enable Metro Transit to identify the safety and security benefits of real time communication of CCTV camera images to law enforcement and Metro Dispatch		
Project Phasing	Long-term (5-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$30,000	$100,000	-
Staffing Impact	Low (.5 FTE)		
Project Dependencies & Considerations	This project depends on Metro Transit adding WiFi to its garage at 1101 E. Washington Avenue. This project should, in part, build upon the results of the Transit Information Dissemination Study to investigate the applicability of technologies that will improve transit travel information.		
Related Projects	• TRAN8 - Metro Transit Garage Facility Communications Improvements		
ITS Architecture Elements	• Transit Security (APTS05)		
Other/Notes:	Project will equip 1 Metro Transit Bus with real-time monitoring cameras to allow a remote operator to monitor and control an on-board camera. Camera design is anticipated to allow monitoring through the front windshield and within the transit vehicle itself.		

Table 121

Automatic Bridge Deicing Pilot Project Overview

MAINT1	Automatic Bridge Deicing Pilot		
Description:	This project deploys automatic bridge deicing equipment at freeway locations known to be adversely impacted by winter weather events.		
Lead Agency:	• Dane County Highway Department		
Supporting Agency(ies):	• City of Madison Traffic Engineering • City of Madison Streets Department • Municipalities • WisDOT		
Location/Limits:	Region-wide. Assumes deployment on 3 bridges.		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
	X	X	
ITS Goals Addressed	• Goal A: Improve Safety and Security for All Transportation System Users, Operators and Public Safety and Construction/Maintenance Personnel • Goal C: Enhance Transportation System Efficiency and Reliability • Goal E: Preserve the Transportation System		
ITS Strategy Category(ies)	Maintenance		
Expected High-Level Benefits	This project will improve travel safety on selected regional bridges known to be impacted by winter weather conditions. The project will automatically disperse deicing chemicals at the onset of ice formation so that safety is not compromised. This will reduce time and effort maintenance crews must spend to ensure bridges are not impacted by ice. This may be especially true for heavily traveled bridges located in remote parts of Dane county.		
Project Phasing	Long-term (5-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	$15,000	$150,000	$30,000
Staffing Impact	Low (.25 FTE)		
Project Dependencies & Considerations	None		
Related Projects	• MAINT2 – Expansion of Weather/Pavement Sensors (Streets)		
ITS Architecture Elements	• Roadway Automated Treatment (MC05)		
Other/Notes:	Project funds equipment for 3 large span bridges. Typical automatic anti-icing system consists of a control system, chemical storage tank, distribution lines, pump, and nozzles. Pump and control hardware are typically replaced every five years at cost of $3.5K. O&M costs include system maintenance, utilities, materials, and labor.		

Table 122

Big Data Analysis Software & Support Project Overview

DATA7	Big Data Analysis Software & Support		
Description:	This project procures specialized data analysis software that can analyze data from the Regional Data Achieve to support improve operational decision making, both on a historical and real-time basis. This project is a companion project to the Connected Vehicle Projects, where large volumes of data is expected to be collected.		
Lead Agency:	• Metropolitan Area Transportation Planning Board		
Supporting Agency(ies):	TBD.		
Location/Limits:	Region-wide		
Project Type:	**Infrastructure**	**Operations**	**Institutional/Policy**
		X	
ITS Goals Addressed	• Goal B: Enhance or Enable Multiagency Communication, Coordination and Data Sharing • Goal C: Enhance Transportation System Efficiency and Reliability		
ITS Strategy Category(ies)	Traffic Data Collection and Analysis		
Expected High-Level Benefits	This project will use historical data to improve operational decision making and work toward developing more predictive decisions.		
Project Phasing	Long-term (5-10 years)		
Planning-Level Cost Estimate	**Planning & Design**	**Implementation**	**O&M (annual)**
	-	-	$100,000
Staffing Impact	Medium (1 FTE)		
Project Dependencies & Considerations	Implement should occur in parallel or immediately prior to the deployment of connected vehicle projects within the region.		
Related Projects	• COM2 – Center-to-Center Communications (existing centers) • COM3 – Center-to-Center Communications (planned centers) • INFO4 – Connected Vehicle Pilot • TSMO11 – Connected Vehicle Roadside Infrastructure		
ITS Architecture Elements	• ITS Data Warehouse (AD2)		
Other/Notes:	It is recommended that one FTE equivalent with the knowledge, skills and abilities to analyze large volumes of data be hired to support this project. This labor cost has not been incorporated into the O&M cost of this project.		

8.7 Funding Needs

Funding is key for ITS implementation and integration. Funding is needed for the following activities:

- Planning and design of new ITS elements
- Purchasing ITS infrastructure (i.e., field elements, communications, and computer hardware and software).
- On-going operations and maintenance of ITS elements

8.7.1 Planning and Design

As with most capital projects, ITS projects require planning and design work to determine what will be built, how it will be built, and to determine benefits and costs of proposed improvements. Special attention needs to be paid to ensure that enough funds are allocated for planning and design. This is crucial for adequately defining the project so that cost estimates are reasonably accurate to budget for the construction, operations, and maintenance phases.

8.7.2 Implementation/Capital Costs

Capital expenditures for ITS will include, but are not limited to:

- Infrastructure, including roadside devices, communications media (e.g., fiber-optic cable), and the infrastructure required for the Integrated Transportation Operations and Communications Center.
- Software
- Other materials directly tied to the project implementation (e.g., marketing, training materials, etc.). These are generally one-time charges.

8.7.3 Operations and Maintenance

Adequate operations and maintenance funding is needed for effective and safe system operations. The level of sophisticated technical and software systems inherent in most ITS projects is substantial. The Madison Metropolitan Area needs to account for routine maintenance to ensure a full design lifecycle for each system. These investments need to be protected to avoid premature system(s) replacement.

One positive attribute of ITS standards adoption will be the development of more interoperable equipment and common system platforms, which will encourage more choices among vendors, thus helping to reduce replacement costs.

8.7.4 Training

As the agencies within the region continue to deploy ITS, it will be increasingly important to ensure that the staff responsible for operating and maintaining these devices receive adequate training. Training will be required for all new employees who will be responsible for operating and maintaining ITS. Training will also be needed for existing employees having to operate or maintain new ITS systems. Allocating funds to ensure that staff receive proper and adequate training will help ensure that maximum benefits are derived and that system life is maximized. Training will be of particular importance for technologies that have yet to be used within the region, including but not limited to, connected vehicle applications, proximity cards, arterial DMS as well as others.

8.8 Funding Opportunities

Funding is needed to plan, develop, implement, operate, and maintain equipment deployed as part of a project. Implementing agencies, as well as the MATPB, should be aware of the various types of funding opportunities that can be used to deploy ITS and how the characteristics of each apply to potential ITS projects. In addition, project champions need to investigate how coordination among other agencies and departments can be drawn upon to help distribute funding responsibilities. This may include identifying how resources such as staff, equipment, and actual funding can be shared across different programs in an effort to reduce costs and maximize benefits when planning and implementing an ITS project. This may be achieved in part with a RTMC. However, in the short-term projects will need to be financed and cost saving strategies identified so that scarce resources are applied to projects where costs cannot be offset by operational efficiencies.

Funding is needed to support the ITS project throughout its entire life cycle. Without adequate funding, it will be difficult to complete ITS projects on time and to the desired functionality. An important consideration in determining how much funding is needed, and when it is needed, is the project schedule. Longer more complex projects will often require more funding to complete versus projects smaller in scope and duration. Additionally, since costs are often difficult to estimate, contingency funding may need to be garnered to account for underestimates. Opportunities to fund ITS projects are identified below.

8.8.1 National Highway Performance

NHS funds can be used for improvements to rural and urban highways that are part of the NHS, including the Interstate System and designated connections to major intermodal terminals. Also included are highways that provide motor vehicle access between the NHS and major intermodal transportation facilities, the defense strategic highway network, and strategic highway network connectors. These funds may also be used to fund transit improvements in NHS corridors but certain restrictions apply.

Figure 38 shows the existing and proposed changes to the designated NHS system in the Madison Metropolitan Area.

Additional information on the National Highway System Program can be obtained at: http://www.fhwa.dot.gov/safetealu/factsheets/nhs.htm

8.8.2 Surface Transportation Program (STP)

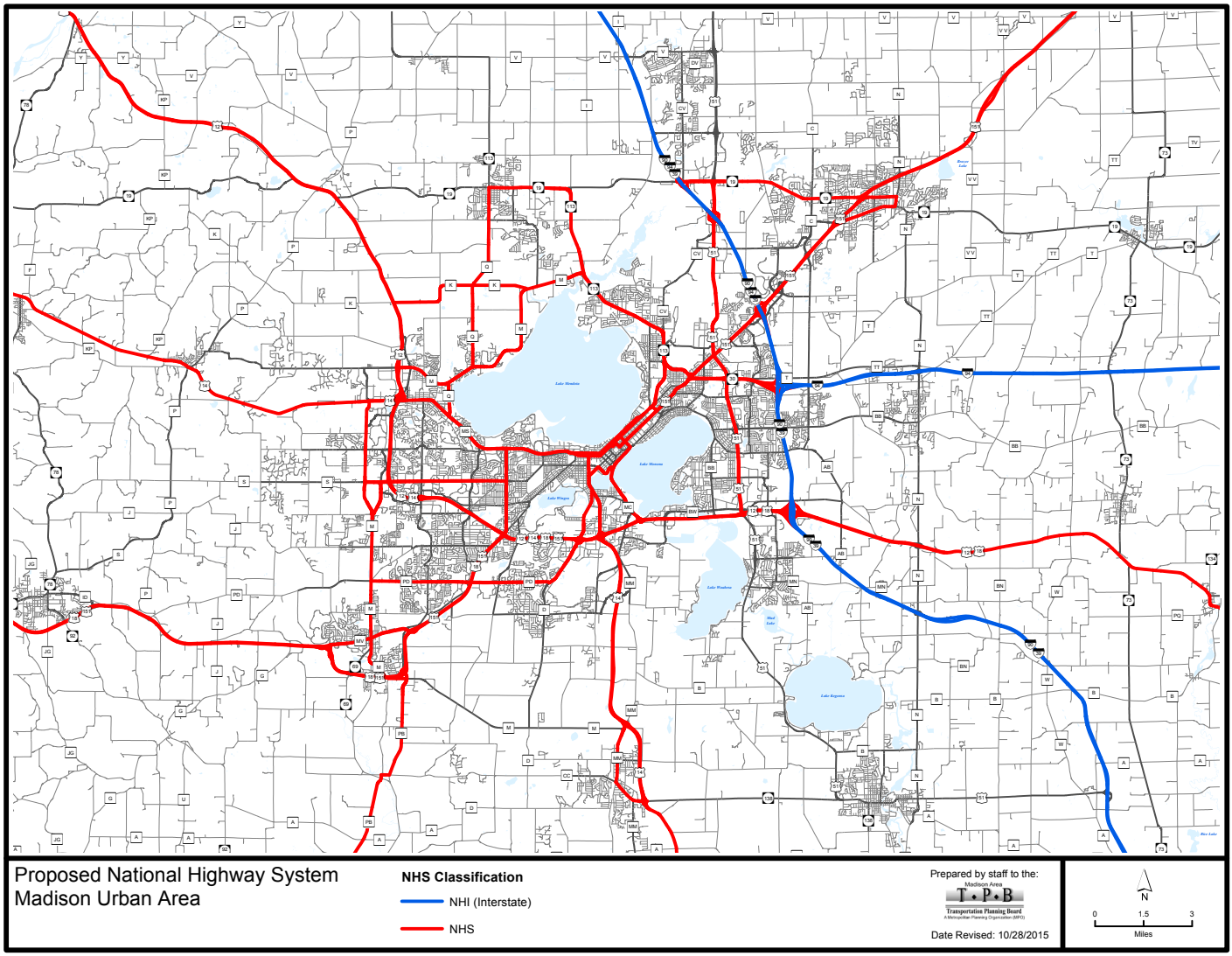
The Surface Transportation Program (STP) provides flexible funding that may be used by states and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals.

Capital costs for transit projects eligible for assistance under Chapter 53 of title 49, including vehicles and facilities used to provide intercity passenger bus service.

- Carpool projects, fringe and corridor parking facilities and programs, including electric and natural gas vehicle charging infrastructure, bicycle transportation and pedestrian walkways, and ADA sidewalk modification
- Highway and transit research, development, technology transfer.
- Capital and operating costs for traffic monitoring, management and control facilities and programs, including advanced truck stop electrification.
- Transportation control measures.
- Development and establishment of management systems.
- Infrastructure-based ITS capital improvements.
- Congestion pricing projects and strategies, including electric toll collection and travel demand management strategies and programs.

In general, STP projects may not be on local or rural minor collectors. However, there are a number of exceptions to this requirement. A State may use up to 15% of its rural sub allocation on minor collectors. Other exceptions include: ADHS local access roads, bridge and tunnel replacement and rehabilitation (not new construction), bridge and tunnel inspection, carpool projects, fringe/corridor parking facilities, bike/pedestrian walkways, safety infrastructure, Transportation Alternatives, recreational trails, port terminal modifications, minor collectors in NHS corridors, and the two new bridge eligibilities brought over from the HBP.

Figure 38: Proposed National Highway System in the Madison Metropolitan Area



As a large MPO, the Madison Area Transportation Planning Board (MATPB) receives a sub-allocation of STP funding, which is referred to as the STP – Urban program. The MATPB's current allocation averages about $6.9 million per year. As part of the recently completed 2016-2020 project application cycle, the MPO awarded funding for a City of Madison sponsored project to implement an adaptive traffic signal system in the University Avenue corridor.

8.8.3 Highway Safety Improvement Program (HSIP)

MAP-21 also provides the Highway Safety Improvement Program (HSIP) to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance.

A highway safety improvement project is any strategy, activity or project on a public road that is consistent with the data-driven State Strategic Highway Safety Plan (SHSP) and corrects or improves a hazardous road location or feature or addresses a highway safety problem. The 2014-2016 Wisconsin State SHSP is available at: http://wisconsindot.gov/Documents/doing-bus/local-gov/astnce-pgms/highway/hwy-safety.pdf. The Wisconsin State SHSP identifies the following high priority issues areas that may be most applicable to identified needs and corresponding projects for the Madison Metropolitan Area:

- Provide Safe Pedestrian and Bicycle Travel. Of particular note are projects that improve data/information collection and decision support.
- Improve Incident Management/Safe Travel in Bad Weather. Projects that broaden education for Traffic Incident Management and improve travel in bad weather may be candidates for HSIP funds.
- Reduce Speed-Related Crashes/Curb Aggressive Driving.

8.8.4 Congestion Mitigation & Air Quality Improvement (CMAQ)

The CMAQ program provides a flexible funding source to State and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards for ozone, carbon monoxide, or particulate matter (nonattainment areas) and for former nonattainment areas that are now in compliance (maintenance areas). This funding is not currently available in the Madison Metropolitan Area.

Funds may be used for transportation projects likely to contribute to the attainment or maintenance of a national ambient air quality standard, with a high level of effectiveness in reducing air pollution, and be included in the Metropolitan Planning Organization's (MPO's) current transportation plan and transportation improvement program (TIP) or the current state transportation improvement program (STIP) in areas without an MPO.

Eligible activities that can be funded through the CMAQ program include:

- Establishment or operation of a traffic monitoring, management, and control facility, including advanced truck stop electrification systems, if it contributes to attainment of an air quality standard.
- Projects that improve traffic flow, including projects to improve signalization, construct HOV lanes, improve intersections, add turning lanes, improve transportation systems management and operations that mitigate congestion and improve air quality, and implement ITS and other CMAQ-eligible projects, including projects to improve incident and emergency response or improve mobility, such as real-time traffic, transit, and multimodal traveler information.
- Purchase of integrated, interoperable emergency communications equipment.
- Projects that shift traffic demand to nonpeak hours or other transportation modes, increase vehicle occupancy rates, or otherwise reduce demand.
- Purchase of diesel retrofits or conduct of related outreach activities.
- Facilities serving electric or natural gas-fueled vehicles (except where this conflicts with prohibition on rest area commercialization) are explicitly eligible.
- Some expanded authority to use funds for transit operations.

CMAQ funds may not be used to add capacity except HOV facilities that are available to SOV only at off-peak times.

8.8.5 National Highway Performance Program (NHPP)

The NHPP provides support for the condition and performance of the National Highway System (NHS), for the construction of new facilities on the NHS, and to ensure that investments of Federal-aid funds in highway construction are directed to support progress toward the achievement of performance targets established in a State's asset management plan for the NHS.

NHPP projects must be on an eligible facility and support progress toward achievement of national performance goals for improving infrastructure condition, safety, mobility, or freight movement on the NHS, and be consistent with Metropolitan and Statewide planning requirements. Eligible activities include:

- Highway safety improvements on the NHS.
- Capital and operating costs for traffic and traveler information, monitoring, management, and control facilities and programs.
- Development and implementation of a State Asset Management Plan for the NHS including data collection, maintenance and integration, software costs, and equipment costs.
- Infrastructure-based ITS capital improvements.

8.8.6 Transportation Infrastructure Finance and Innovation Act (TIFIA)

The Transportation Infrastructure Finance and Innovation Act (TIFIA) Program provides Federal credit assistance to eligible surface transportation projects, including highway, transit, intercity passenger rail, some types of freight rail, and intermodal freight transfer facilities. Projects eligible to receive TIFIA assistance include:

- Projects eligible for assistance under title 23 or chapter 53 of title 49. These include:
  - Provide funding to supporting public transportation
  - Improve the development and delivery of capital projects;
  - Establish standards for the state of good repair of public transportation infrastructure and vehicles;
  - Promote continuing, cooperative, and comprehensive planning that improves the performance of the transportation network;
  - Establish a technical assistance program to assist recipients to more effectively and efficiently provide public transportation service;
  - Continue federal support for public transportation providers to deliver high quality service to all users , including individuals with disabilities, seniors, and individuals who depend on public transportation
  - Support research, development, demonstration, and deployment projects dedicated to assisting in the delivery of efficient and effective public transportation services; and
  - Promote the development of the public transportation workforce.
- International bridges and tunnels.
- Intercity passenger bus or rail facilities and vehicles, including those owned by Amtrak.
- Public freight rail projects.
- Private freight rail projects that provide public benefit for highway users by way of direct highway-rail freight interchange (a refinement of the SAFETEA-LU eligibility criterion).
- Intermodal freight transfer facilities.
- Projects providing access to, or improving the service of, the freight rail projects and transfer facilities described above.
- Surface transportation infrastructure modifications necessary to facilitate direct intermodal interchange, transfer and access into and out of a port

However, to receive TIFIA assistance, an eligible ITS project must have costs that exceed $15 million. TIFIA assistance must be repaid through dedicated revenue sources that secure project obligations, such as tolls, other user fees, or payments received under a public-private partnership agreement. Repayment of a TIFIA loan must begin by five years after the substantial completion of the project, and the loan must be fully repaid within 35 years after the project's substantial completion or by the end of the useful life of the asset being financed, if that life is less than 35 years.

While it is unlikely that the Madison Metropolitan Area will have many, if any, projects that exceed the $15 million requirement, potential projects that may have costs that approach this threshold may include the RTMC, and BRT projects. Additional projects that fall under these projects such as bus shelter signage may also be funded.

8.8.7 Highway Trust Fund and Taxes

These taxes consist of gallonage taxes on highway motor fuel and truck related taxes, including an annual tax on heavy vehicle use, a load rating-based tax on heavy truck tires and a retail sales tax on truck and trailer sales. The heavy vehicle use tax is extended through September 30, 2017. The taxes on highway motor fuel will continue past September 30, 2016, but at a reduced rate of 4.3 cents per gallon.

8.8.8 Public-Private Partnerships

A Public-Private Partnership (PPP) is a business relationship between the public and private sectors. To a specific degree, both entities share responsibilities and the costs, risks, and benefits associated with delivering goods and/or services. From a transportation standpoint, a public-private partnership is a form of service delivery with a collaborative approach based on reallocating traditional responsibilities, costs, risks, and benefits between the public agency and private entities. While PPPs do not provide funding to procure ITS, these relationships can be valuable for enhancing services for both the public and private entity without having to increase expenditures. PPPs are only valid where both the public and private agency have mutual interest in the other agencies services/hardware.

8.8.9 Private Enterprise

This is a privately-funded source to implement an ITS sub¬system of value to the owner and the general public. Naturally, such investments must comply with normal business regulations, ordinance, and covenants, but otherwise are within the purview of the investor. A private enterprise funding source may include sponsorships fees that private agencies contribute to increase exposure of their company/agency.

8.9 Potential Supporting Multi-Agency Agreements and Policies

Integrating ITS across jurisdictional boundaries requires agencies to share a common set of goals and perspectives on the purpose of implementing integrated ITS. This has been in part achieved through the development of this plan and the ITS goals and objectives documented earlier. However, there are several areas where specific agreement and policies are needed to foster integration and effective operation of regional ITS assets. It is recommended that an ITS Advisory Committee be formed to work out the details of multi-agency agreements and policies.

8.9.1 Policy on Data Archival and Sharing

Agencies need to collectively develop a cost-effective approach to a future regional data archive. Today, agencies that have developed data archives used them primarily to support their internal operating needs. There is an immediate need to develop agreements/polices the stipulate how individual data archives should be configured so they can be merged at some future date into a useful regional data archive.

Key activities that are suggested in support of this policy include:

- Identify common data standards and protocols that, while deployed individually at each agency, will allow data to be merged into a regional archive. In addition, common data standards and protocols will allow for easy data sharing across agencies - which may mean that a physical regional data archive is not required.
- For the long-term, partner agencies need to jointly develop a set of requirements each agency should follow when using the regional data archive (whether it is a physical or virtual archive). This shall include rules that dictate how agencies access, submit, and disseminate data.
- Besides reaching an agreement on the requirements for data archive establishment and use, partner agencies also need to identify an approach to define the cost and management responsibilities (i.e., which agency is going to be responsible for implementing, operating, and maintaining the regional data archive). It is recommended that an agency with the staff resources and vested interest in regional transportation operations such as the MATPB, City of Madison or WisDOT assume these responsibilities. There will be a need to maintain a regional data archive, whether it is a physical or virtual archive.

- Partner agencies need to be able to identify which of their data will be made available on a regional basis. Some agencies archive sensitive information. They will be allowed to determine if this data will be made available to others, and how they might be formatted to avoid release of sensitive data.

8.9.2 Policy on Regional Coordinated Transportation Operations during Incidents and Emergencies

This policy furthers the regional, multi-agency, coordinated approach to managing the regional surface transportation network during incidents and emergencies, with the support of ITS. Specifically, this policy addresses the development of alternate route plans to mitigate incidents that occur on freeways or critical arterials. In addition, the plans need to include guidelines on dynamic message sign (DMS) messaging, public information, and signal timing plans to support the alternative routes. Multi-agency agreements are needed to outline agency roles and responsibilities for operating regional ITS assets, especially for agencies the will operate devices that are owned by other agencies. Agreements should spell out what resources are available, what agencies can use these resources, circumstances in which these resources may be used, and tier structured by which agencies are allowed access and control with respect to other authorized users.

8.9.3 Policy on Efficient Operations

The Policy on Efficient Operations focuses on getting the most out of Region's investment in ITS. It supports agencies in their efforts to maximize the transportation network's output using ITS. It additionally suggests that the regional surface transportation network be viewed as a single asset and operational approaches be implemented that maximize the complete network's efficiency. In other words, one agency's system should not be operated at the expense of another's. The focus of this policy is on normal, day-to-day operations.

8.9.4 Policy on Video Sharing

The Policy on Video Sharing promotes the sharing of camera images and/or video among agencies for their mutual benefit. Camera images and video may be useful to each other's operations. For example, city streets may be experiencing congestion. The video from the adjacent freeway could be panned over to allow viewing of the situation on the surface streets. This means that staff need not be sent into the field as often to determine if there is a signal malfunction, unusual traffic, accident, or other anomalies - as they can assess the situation from their offices.

In addition, video images are very useful to emergency responders. Without images or video, an emergency responder must arrive at a scene to visually assess the situation. Often, the visual assessment results in the dispatch of additional equipment and resources. With images and video, the visual assessment can occur at the dispatch center as soon as an emergency call is received, thus speeding the appropriate response.

Agreements need to be developed to outline the protocols for operating cameras, desensitizing the images or video and disseminating it to the external agencies, including the media. Agreements should cover the procedures agencies should follow when taking control of and relinquishing control of a camera.