Michigan Department of Transportation
Regional ITS Architectures and Deployment Plans

Statewide

Statewide ITS Architecture and Deployment Plan

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February 2010
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REVISION HISTORY

STATEWIDE ITS ARCHITECTURE REPORT

DATE	AUTHOR	QC	COMMENT
09/25/08	KHM	HNTB	
10/28/09	KHM	HNTB	Final Version
01/21/10	KHM	HNTB	Final Version v2
02/02/10	KHM	HNTB	Final Version v3

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List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
AHS	Automated Highway System
AMBER	America's Missing: Broadcast Emergency Response
ANSI	American National Standards Institute
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
AWOS	Automated Weather Observing System
CCTV	Closed Circuit Television
CJIC	Criminal Justice Information Center
CVISN	Commercial Vehicle Information Systems and Networks
CRC	County Road Commission
DCM	Data Collection and Monitoring
DEM	Department of Emergency Management
DMS	Dynamic Message Sign
DNR	Department of Natural Resources
DPW	Department of Public Works
DSRC	Dedicated Short Range Communication
EOC	Emergency Operations Center
ESS	Environmental Sensor Stations
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FTA	Federal Transit Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HRI	Highway Rail Intersection
ICM	Integrated Corridor Management
IDAS	ITS Deployment Analysis Software
IEEE	Institute of Electrical and Electronics Engineers
IMMS	Incident Management Message Sets
ISO	International Standards Organization
ISP	Information Service Provider
ITS	Intelligent Transportation System

LIST OF ACRONYMS

LRTP	Long Range Transportation Plan
MAC	Medium Access Control
MDOT	Michigan Department of Transportation
MDT	Mobile Data Terminal
MIOC	Michigan Intelligence Operations Center
MITSC	Michigan Intelligent Transportation Systems Center
MOU	Memorandum of Understanding
MSP	Michigan State Police
NEMA	National Emergency Management Association
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
NWS	National Weather Service
PCMS	Portable Changeable Message Signs
RWIS	Roadway Weather Information System
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible and Efficient Transportation Equity Act – A Legacy for Users
SDO	Standards Development Organization
SEMCOG	Southeast Michigan Council of Governments
STIP	Statewide Transportation Improvement Program
STMF	Simple Transportation Management Framework
TCP/IP	Transmission Control Protocol/Internet Protocol
TEA-21	Transportation Equity Act for the 21st Century
TIP	Transportation Improvement Program
TMC	Transportation Management Center
TOC	Traffic Operations Center
TSC	Transportation Service Centers
UDP/IP	User Datagram Protocol/Internet Protocol
USACE	United States Army Corp of Engineers
USDOT	United States Department of Transportation
VIVDS	Vehicle Imaging Video Detection Systems
XML	Extensible Markup Language

1. INTRODUCTION

1.1 Project Overview

Development of an intelligent transportation system (ITS) architecture is one of the most important steps in planning for and implementing ITS in a region or state. ITS architectures provide a framework for implementing ITS projects, encourage interoperability and resource sharing among agencies, identify applicable standards to apply to projects, and allow for cohesive long-range planning among regional stakeholders. The ITS architecture allows stakeholders to plan for what they want their system to look like in the long term, and then divide the system into modular pieces that can be implemented over time as funding permits.

ITS architectures satisfy the conformity requirements first established in the Transportation Equity Act for the 21st Century (TEA-21) highway bill and continued in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) bill passed in 2005. In response to Section 5206(e) of TEA-21, the Federal Highway Administration (FHWA) issued a final rule and the Federal Transit Administration (FTA) issued a final policy that required regions implementing any ITS projects using federal funds to have an ITS architecture in place by April 2005. After this date, all ITS projects must show conformance with their applicable regional or statewide ITS architecture in order to be eligible for funding from FHWA or FTA. Regions that had not yet deployed ITS were given four years to develop an ITS architecture after their first ITS project proceeded to final design.

In late 2006, the Michigan Department of Transportation (MDOT) began development of several Regional ITS Architectures throughout the state. Those regions include the MDOT Superior, North, Bay, Grand, and Southwest, and the geographic boundary of the Southeast Michigan Council of Governments (SEMCOG). A separate Regional ITS Architecture was not completed for the University Region. Instead, the University Region was split and portions were included in the Southwest and SEMCOG Regional ITS Architectures. Each of the Regional ITS Architectures as well as the Statewide ITS Architecture focuses on a 10-15 year vision of ITS. In addition, a separate ITS Deployment Plan was developed as a companion to each of the architectures to identify and prioritize specific ITS projects recommended in order to implement the ITS architecture.

The Michigan Statewide ITS Architecture and ITS Deployment Plan consider statewide ITS needs and services as well as identify inter-regional needs. The Statewide ITS Architecture and ITS Deployment Plan reflect a snapshot of existing ITS deployments and future ITS plans for the State of Michigan. Needs and priorities for the State will change over time and, in order to remain effective, this plan should be reviewed and updated periodically.

1.2 Document Overview

The Statewide ITS Architecture report is organized into five key sections:

Section 1 – Introduction

This section provides an overview of the National ITS Architecture requirements, the Statewide ITS Architecture, overview of existing regional ITS architectures, and the key features and stakeholders involved in the development.

Section 2 – Regional ITS Architecture Development Process

An overview of the key steps involved in developing the Statewide ITS Architecture is provided in this section. It includes a discussion of stakeholder involvement and the architecture development process.

Section 3 – Customization of the National ITS Architecture for the State of Michigan

This section contains a summary of needs and details the customization of the National ITS Architecture to meet the ITS vision for the State. The market packages that were selected are included in this section and interconnects are presented, including the "sausage diagram" showing the relationships of the key subsystems and elements.

Section 4 – Application of the Statewide ITS Architecture

Applicable functional requirements and standards, as indicated by the Statewide ITS Architecture, are presented in Section 4. Operational concepts identifying stakeholder roles and responsibilities have been prepared and potential agreements to support the sharing of data and resources are identified.

Section 5 – Maintaining the Statewide ITS Architecture

A use and maintenance plan has been developed for the Statewide ITS Architecture and included in this section. The plan outlines the procedure for updating the ITS architecture over time.

The Statewide ITS Architecture also contains five appendices:

- Appendix A – National ITS Architecture Market Package Definitions;
- Appendix B – Customized Market Packages;
- Appendix C – Element Functional Requirements;
- Appendix D – Stakeholder Database; and
- Appendix E – Architecture Maintenance Documentation Form.

1.3 Assessment

The Statewide ITS Architecture and Deployment Plan has been assessed based on 12 items derived from both the April 8, 2001 USDOT ITS Architecture and Standards Conformity Rule/Policy and from the architecture development process described in the *Regional ITS Architecture Guidance Document*. A listing of these items is shown in **Table 1**.

Table 1 – Summary of Architecture Assessment Categories

Content Criteria	Architecture Implementation Criteria
1. Architecture Scope	8. Implementation Plan (use)
2. Stakeholder Identification	9. Maintenance Plan
3. System Inventory	10. Agreements
4. Needs and Services	11. Standards Identification
5. Operational Concept	12. Project Sequencing
6. Functional Requirements	
7. Interfaces/Flows	

1.4 Statewide

1.4.1 Geographic Overview

The geographic boundary for the Michigan Statewide ITS Architecture is the same as that of the State of Michigan. As shown in **Figure 1**, the state is comprised of 83 counties and divided into seven MDOT regions. Michigan is bordered by Ohio to the south, Lake Erie and Lake Huron to the east, Lake Michigan to the west, and Lake Superior to the north.

The largest cities within the State are Detroit, Grand Rapids, Flint, and Lansing. Significant cities that are located just beyond Michigan's boundaries include Toledo, Ohio to the south, Windsor, Ontario, Canada to the east, Sault Ste. Marie, Ontario, Canada to the north, and Chicago, Illinois and Green Bay, Wisconsin to the west. This geographic location not only requires coordination within Michigan, but partnerships across state lines and the US-Canada border.

When developing the architecture, a 10-15-year vision for ITS in the State was documented. In the ITS Deployment Plan, the 10-15-year timeframe was broken down into smaller time periods to prioritize and sequence the projects. The naming convention used for elements in the Statewide ITS Architecture is consistent with the naming convention that is used in the Superior, Bay, Grand, North, Southwest, and SEMCOG Regional ITS Architectures. This consistency provides seamless connections to those other architectures without requiring that they be specifically called out. Statewide initiatives, such as statewide commercial vehicle operations and 511 traveler information service, were referenced in each of the Regional ITS Architectures and will be addressed in further detail in the Statewide ITS Architecture.

1.4.2 Transportation Infrastructure

As illustrated in **Figure 1,** the primary interstate and US highway facilities in the State include I-69, I-75, I-94, I-96, US 2, US 12, US 23, US 24, US 31, US 41, US 127, and US 131. Additional primary State routes include M-10, M-14, M-28, M-46, and M-55.

I-75 is a major north-south roadway that begins in Ft. Lauderdale, Florida and continues on to the Canadian border in Sault Ste. Marie, Michigan where it terminates at Trans-Canada 17. I-94 runs from I-90 in Billings, Montana to Port Huron, Michigan where it ends at the U.S. side of the Blue Water Bridge. I-96 is located entirely within the state of Michigan and runs from Norton Shores on the western coast of the Lower Peninsula to I-75 near the Ambassador Bridge in Detroit. The Wayne County portion of I-96 is often referred to as "The Jeffries" because of its original name, the Jeffries Freeway. I-69 begins in Indianapolis, Indiana, and runs northeast to the Canadian border in Port Huron, Michigan. The complete corridor eventually will connect from the Canadian border in Port Huron with the Mexico border in Texas.

US 23 extend from Jacksonville, Florida to Mackinaw City, Michigan. It serves as a significant north-south connector from Toledo, Ohio through Ann Arbor to Flint. US 24 serves as both a north-south and east-west route across the United States; linking I-75 in Clarkston, Michigan to I-70 in Minturn, Colorado. US 12 begin at the intersection of Michigan Avenue and Cass Street in downtown Detroit and extend 2,500 miles to US 101 in Aberdeen, Washington. Certain segments of this corridor run concurrently with I-94 and I-90. US 131 is located almost entirely within the state of Michigan. It runs north-south from Middlebury, Indiana to Petoskey, Michigan where it terminates at US 31. US 31 extend from Spanish Fort, Alabama to Mackinaw City, Michigan. US 2 is the northernmost east-west US Route and runs from State Route 529 in Everett, Washington to I-95 in Houlton, Maine.

M-55 and M-46 are two of three state trunklines in Michigan that extend east to west across the lower portion of the state. M-28 is one of two major east-west state trunkline highways in the Upper Peninsula and runs from Sault Ste. Marie to Wakefield. It is Michigan's longest state trunkline numbered with the "M" prefix. M-10 is one of several major highways from downtown Detroit to Oakland County. It was named after John C. Lodge, mayor of Detroit in the 1920's, and is typically referred to as "the Lodge" rather than the route number. M-14 originally was designated as a north-south route in the 1920's and was later re-designated east-west. It connects Ann Arbor with Detroit.

Along with a focus on the roadway facilities, it is important to note the impact of border crossings on transportation in Michigan. The International Bridge in Sault St. Marie, the Blue Water Bridge in Port Huron, and the Ambassador Bridge and Detroit Windsor Tunnel in Detroit all have a direct impact on the operations of the roadway network and require close coordination with other transportation agencies. These border crossings also introduce security procedures that vary depending on the crossing and the volume of traffic. For example, the volume of vehicles crossing the Mackinac Bridge to the Upper Peninsula is significantly lower than the volume of vehicles handled by the three border crossings in the MDOT Metro Region.

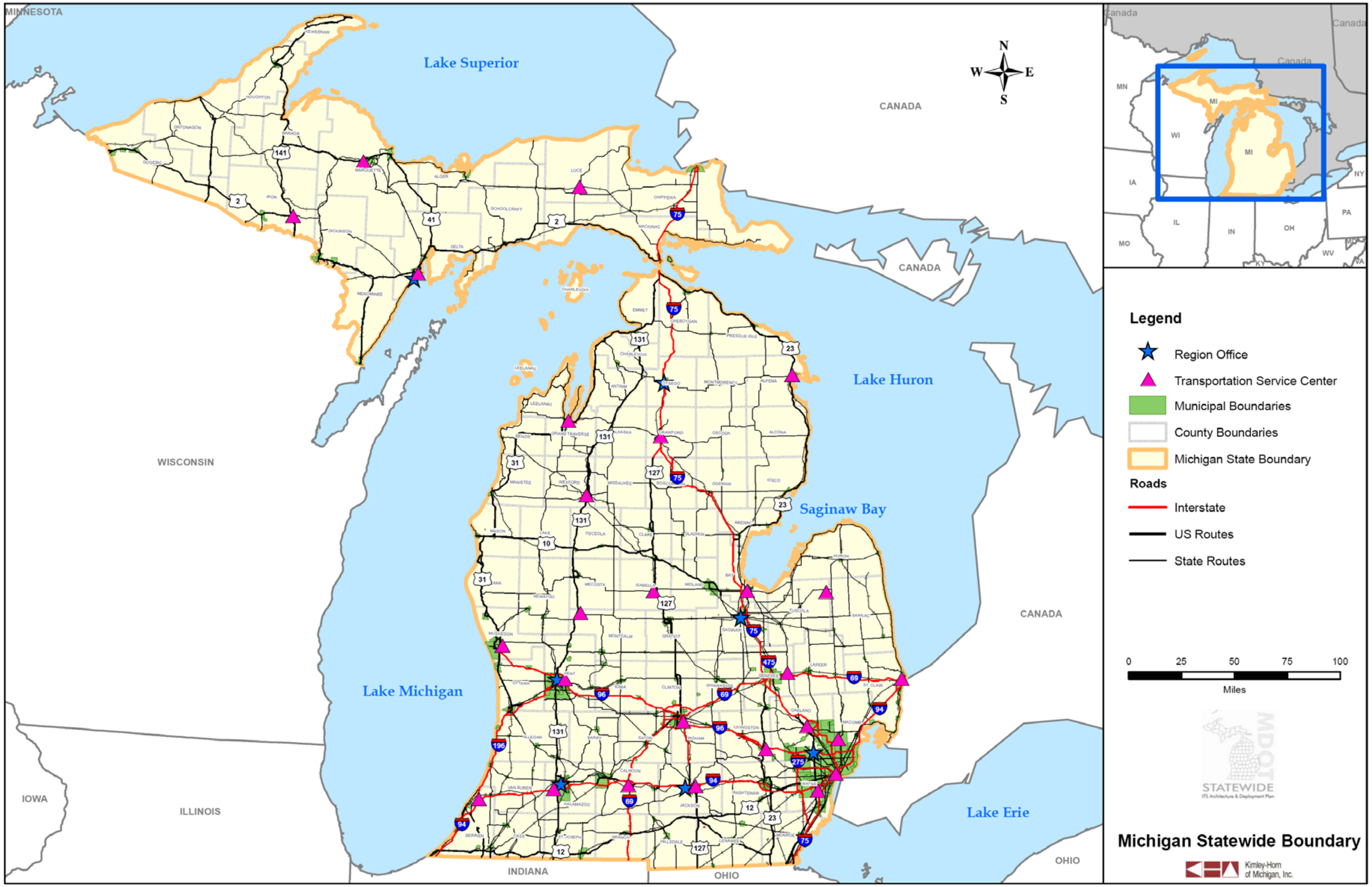

Figure 1 – Michigan Boundaries

1.4.3 Michigan Regional ITS Plans

MDOT began the development of a statewide ITS architecture in 2007 after contracting with a consultant in 2006 to develop several regional ITS architectures and deployment plans across the State of Michigan. Version 6.0 of the National Architecture and Version 4.0 of Turbo Architecture were used in the architecture development. Before the Architecture was finalized Version 4.1 of Turbo Architecture was released and the database was converted to Version 4.1.

The State of Michigan has deployed several ITS components within its seven regions. Examples of implementations in the regions include closed circuit television (CCTV) cameras for surveillance, dynamic message signs (DMS), and interconnected signal systems. From a Statewide perspective, MDOT currently is developing advanced traffic management (ATMS) software that will allow multiple MDOT and local agency facilities to access and control field devices through a simple connection to the Internet. As the State pursues funding opportunities for additional projects, it will be necessary to show that a project fits within the ITS architecture.

1.4.4 Overview of Statewide Plans and Regional ITS Architectures

1.4.4.1 Overview of the Regional ITS Architectures

Regional ITS Architectures already have been developed or are underway for several regions within the state of Michigan. Each of the regional architectures outlines the information shared between the stakeholders and reflects the unique issues and needs of the region. The regional architectures focus on local ITS implementation. The Statewide ITS Architecture addresses how ITS implementation will proceed in areas not already covered within one of the regional architectures or statewide projects.

- The North Region ITS Architecture was completed January 10, 2008 and includes the geographic boundaries of the MDOT North Region. Operational scenarios in the plan cover day-to-day traffic operations, incident management, maintenance and construction, and the integration of roadway weather information system (RWIS).
- The Superior Region ITS Architecture was completed January 17, 2008 and includes the geographic boundaries of the MDOT Superior Region. It documents aspects of traffic management and incident management. The implementation of environmental sensor stations (ESS) and the Superior Region Traffic Management Center (TMC) will continue to serve as a backbone for the region's ITS needs.
- The Grand Region ITS Architecture was completed January 24, 2008 and includes the geographic boundaries of the MDOT Grand Region, except for the Grand Rapids metropolitan area, which completed a Regional ITS Architecture and Strategic Deployment Plan in February 2006. The implementation of RWIS and an expansion of the freeway management system operated out of the West Michigan TMC are a focus of the Grand Region plan.
- The Southwest Region ITS Architecture was completed January 24, 2008 and includes the geographic boundaries of the MDOT Southwest Region as well as Jackson and Shiawassee Counties from the MDOT University Region. The

Southwest Region ITS Architecture emphasizes aspects such as RWIS, incident management, and maintenance and construction.

- The Regional ITS Architecture for the Bay Region was completed January 31, 2008 and includes the geographic boundaries of the MDOT Bay Region. Development of the Regional Architecture included an update to the Genesee County Regional ITS Architecture. Implementation of traffic management tools and integration with the Metro and North Region were a focus.

- The SEMCOG Regional ITS Architecture development was completed in November 2008. The SEMCOG Regional ITS Architecture includes the geographic boundaries of SEMCOG, which includes the MDOT Metro Region and sections of the MDOT University Region. The architecture focused on traffic and incident management to manage congestion in the Detroit metropolitan area as well as the implementation of RWIS.

- The Michigan ITS Pre-Deployment Study – Lansing Sector ITS Architecture was completed in December 2001. The plan included projects that improved the existing freeway and arterial management systems, developed road weather information systems, and even introduced some parking management technology for the region.

- Grand Rapids Metro Area ITS Strategic Deployment Plan Architecture was completed in February 2006. It was originally completed in 1996 and the current version is an update and expansion of the plan complete 10 years earlier. The update expanded the original focus from only freeways to arterial management and required the addition of several new stakeholders and elements. The plan focuses on an integrated transportation system that looks at all roads and all modes and includes an advanced traveler information component to get the information to the public.

1.4.4.2 Long Range Transportation Plan

The MI Transportation Plan is Michigan's 25-year Long Range Transportation Plan (LRTP). It is a comprehensive effort to address Michigan's multi-modal transportation needs. For the purpose of the ITS Architecture, the ITS elements are the most significant for referencing. The LRTP has identified key investment areas or goals where MDOT resources are foreseen to be focused for the next 25 years:

- Economic Impact
- Stewardship
- Safety and Security
- System Improvement/Integrated Transportation System
- Efficient and Effective Operations

1.4.4.3 Commercial Vehicle Information Systems and Networks

Michigan has developed a Commercial Vehicle Information Systems and Networks (CVISN) Program Plan that has been approved by the Federal Motor Carrier Safety Administration (FMCSA). The FMCSA is leading a nationwide effort to help support better data exchange, communications networks, and implement standards to support improved safety and efficiency of commercial vehicle operations. Michigan's CVISN program covers three main areas: safety information exchange, electronic credentials, and electronic screening. Key elements of the plan include:

- Improved electronic exchange of safety information between the Michigan State Police, MDOT, and County Road Commissions, as well as FHWA, FMCSA, and the National Highway Traffic Safety Administration.
- Capability to allow motor carriers to apply for, pay for, and receive credentials electronically.
- Capability to automatically screen vehicles as they approach weigh stations and allow those that are safe and legal to bypass without slowing or stopping.

1.4.5 Stakeholders

Due to the fact that ITS often transcends traditional transportation infrastructure, it is important to involve nontraditional stakeholders in the architecture development, and visioning process. Input from these stakeholders, both public and private, is a critical part of defining the interfaces, integration needs, and overall vision for ITS in a region.

Table 2 contains a listing of stakeholders in the State who have provided input to the study team about the needs and issues that should be considered as part of the Statewide ITS Architecture. Stakeholders were provided workshop minutes and copies of reports from the Regional ITS Architectures to encourage their participation. Appendix D contains a copy of all stakeholders identified to have an interest in statewide ITS projects.

Table 2 – Stakeholder Agencies and Contacts

Stakeholder Agency	Address	Contact
Centra/Ambassador Bridge Corporation	P.O. Box 32666 Detroit, MI 48232	Skip McMahon
Detroit Windsor Tunnel LLC	100 East Jefferson Detroit, MI 48226	Robert Howell
FHWA-Michigan Division	315 West Allegan, Suite 201 Lansing, MI 48933	Morrie Hoevel
International Bridge Authority	934 I-75 Bridge Plaza Sault Ste. Marie, MI 49783	Phil Becker
Mackinac Bridge Authority	Mackinac Bridge Plaza, N415 I-75 St. Ignace, MI 49781	Jim Laakko
MDOT – Bay Region	55 East Morley Drive Saginaw, MI 48601	Jay Reithel
MDOT – Blue Water Bridge	1410 Elmwood Port Huron, MI 48060	Michael Szuch
MDOT – Grand Region	1420 Front Avenue, N.W. Grand Rapids, MI 49504	Suzette Peplinski
MDOT-ITS Program Office	8885 Ricks Rd, Mail Code E020 Lansing, MI 48917	Greg Krueger
MDOT-ITS Program Office	8885 Ricks Rd, Mail Code E020 Lansing, MI 48917	Collin Castle
MDOT – Metro Region	18101 West Nine Mile Road Southfield, MI 48933	Matt Smith
MDOT – North Region	1680 Hartwick Pine Road Grayling, MI 49738	Matt Radulski
MDOT – Southwest Region	1501 Kilgore Road Kalamazoo, MI 49001	David VanStensel
MDOT – Superior Region	1818 3rd Avenue North Escanaba, MI 49829	Dawn Gustafson
MDOT-University Region	4701 West Michigan Avenue Jackson, MI 49201	Stephanie Palmer
MIOC	425 West Ottawa Street, Mail Code B165 Lansing, MI 48933	Eileen Phifer
MSP Negaunee Regional Dispatch	180 US 41 East Negaunee, MI 49866	Brian McEachern
MSP Gaylord Regional Dispatch	563 S. Otsego Gaylord, MI 49735	Ann Vogel
MSP Rockford Regional Dispatch	345 Northland Drive NE Rockford, MI 49341	Vacant
MSP Second District Regional Dispatch	1050 Sixth Street Detroit, MI 48226	Michael Morenko
MSP Headquarters – East Lansing	714 S. Harrison Road East Lansing, MI 48823	Pam Matelski
National Weather Service	4899 South Complex Drive, SE Grand Rapids, MI 49512-4034	John Kowaleski
SEMCOG	535 Griswold Street, Suite 300 Detroit, MI 48226	Tom Bruff

2. ITS ARCHITECTURE DEVELOPMENT PROCESS

Development of the ITS Architecture and Deployment Plan for the State of Michigan relied heavily on input from the various MDOT Regions to ensure that the architecture reflected the needs of the entire state. During the development of the individual regional ITS architectures the focus was on maximizing local stakeholder involvement to ensure that the specific local needs were incorporated. **Figure 2** illustrates the process followed by each individual region during the development of their Regional ITS Architectures and Deployment Plans.

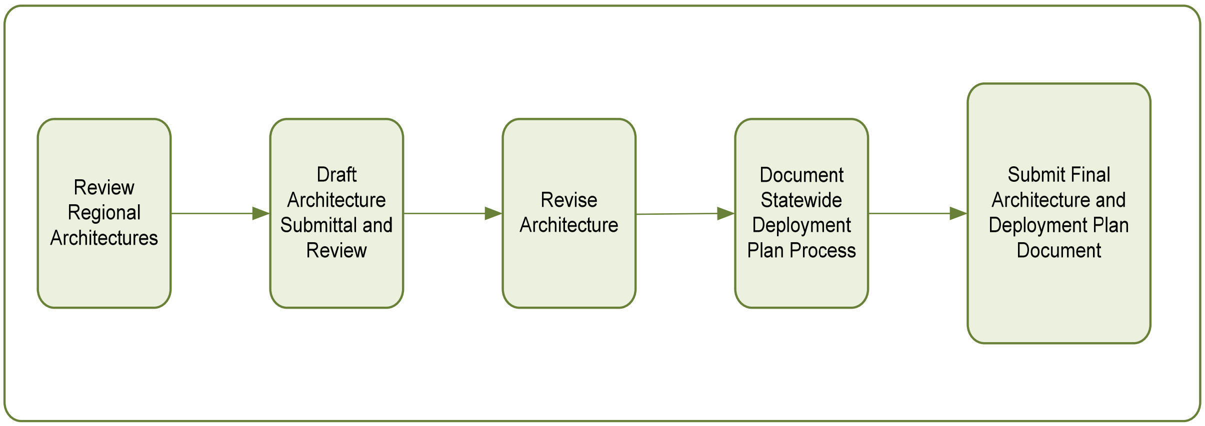

Figure 2 – Regional ITS Architecture and Deployment Plan Development Process

A total of four workshops with stakeholders typically spread over a period of 11 months were used to develop the Regional ITS Architecture and Deployment Plans. These workshops included:

- Kick-Off Workshop;
- Regional ITS Architecture Development Workshop;
- ITS Deployment Plan Workshop; and
- Comment Resolution Workshop.

The Statewide ITS Architecture and Deployment Plan was developed using a simplified stakeholder involvement process since so much of the specific local documentation occurred during the development of the individual Regional ITS Architectures. Key steps in the process for the development of the Statewide Regional ITS Architecture and Deployment Plan are:

Step 1 – Review of Regional Architectures: Review of all existing Regional ITS Architectures for applicable statewide elements as well as key planning documents for input (including the MI Transportation Plan, Statewide Transportation Improvement Program (STIP), and MDOT's 5-Year Plan).

Step 2 – Draft Architecture Submittal and Review: Customization of the National ITS Architecture to address transportation, safety, maintenance, and other needs. Customized market packages were developed to reflect Michigan-specific needs and functions at the statewide level. Interface and interconnect diagrams were developed using Version 6.0 of the National ITS Architecture and the Turbo Architecture Version 4.0 (Before the Architecture was finalized Version 4.1 of Turbo Architecture was released and the database was converted to Version 4.1). The Regional ITS Architecture also includes functional requirements for statewide applications and relevant ITS standards.

Step 3 – Revise Architectures: Comments were incorporated into the final Statewide ITS Architecture Plan.

Step 4 – Document Statewide Deployment Plan Process: A project listing for the State of Michigan was developed at the annual MDOT Statewide ITS Planning Meeting. Various stakeholders were asked to provide input on recommended projects, associated costs, and deployment timeframe. Following the meeting, a draft project listing was sent to stakeholders for comments and review. The final project listing was then finalized.

Step 5 – Submit Final Architecture and Deployment Plan Document

3. CUSTOMIZATION OF THE NATIONAL ITS ARCHITECTURE FOR THE STATE OF MICHIGAN

3.1 Systems Inventory

An important initial step in the architecture development process is to establish an inventory of existing ITS elements. After careful review of the existing regional architectures and key planning documents, the team gathered information about existing and planned systems that would play a role in the Statewide ITS Architecture.

The National ITS Architecture includes eight groups of ITS service areas. Existing, planned, and future systems were identified in the following service areas:

- ***Traffic Management*** – includes the future Statewide TMC that will be located in Lansing, as well as other existing and future TMCs and traffic operations centers (TOCs), detection systems, CCTV cameras, fixed DMS and portable changeable message signs (PCMS), and other related technologies.
- ***Emergency Management*** – includes emergency operations/management centers, improved information sharing among traffic and emergency services, automated vehicle location (AVL) on emergency vehicles, traffic signal preemption for emergency vehicles, and wide-area alerts.
- ***Maintenance and Construction Management*** – includes work zone management, roadway maintenance and construction information, and road weather information systems.
- ***Public Transportation Management*** – includes transit and paratransit AVL, transit travel information systems, electronic fare collection, and transit security.
- ***Commercial Vehicle Operations*** – includes coordination with CVISN efforts, and hazardous material (HAZMAT) management.
- ***Traveler Information*** – includes broadcast traveler information such as 511, traveler information kiosks, and highway advisory radio (HAR).
- ***Archived Data Management*** – includes electronic data management and archiving systems.
- ***Vehicle Safety*** – includes collision avoidance and automated highway systems.

3.2 Statewide Needs

The needs for the State were identified from each of the existing Regional ITS Architectures within Michigan. The needs identified provided guidance for determining which market packages should be included in the architecture. The identified ITS needs for the State include:

- Traffic Management;
- Emergency Management;
- Maintenance and Construction Management;
- Commercial Vehicle Operations;
- Traveler Information; and
- Archived Data Management.

Section 3.4.3 contains additional information about the specific needs identified and relates those needs to the market packages that document the corresponding ITS service.

3.3 Element Customization

The inventory and needs documented from each of the Regional ITS Architectures are the starting point for customizing the National ITS Architecture to develop the Michigan Statewide ITS Architecture.

When developing customized elements, the stakeholder group agreed not to create individual traffic, maintenance, and emergency management elements for individual cities within the State. Those smaller communities not already covered in any of the Regional Architectures are documented in the Statewide ITS Architecture as part of the local agency elements. This documentation allows the communities to be included in the Statewide ITS Architecture, and therefore be eligible to use federal monies on potential future ITS deployments.

3.3.1 Subsystems and Terminators

Each identified system or component in the Statewide ITS inventory was mapped to a subsystem or terminator in the National ITS Architecture. Subsystems and terminators are the entities that represent systems in ITS.

Subsystems are the highest level building blocks of the physical architecture, and the National ITS Architecture groups them into four major classes: Centers, Field, Vehicles, and Travelers. Each of these major classes includes various components that represent a set of transportation functions (or processes). Each set of functions is grouped under one agency, jurisdiction, or location, and corresponds to physical elements such as: a TOC, traffic signals, or vehicles. **Figure 3** shows the National ITS Architecture subsystems. This figure, also known as the “sausage diagram,” is a standard interconnect diagram, showing the relationships of the various subsystems within the architecture..

Communication functions between the subsystems are represented in the ovals. Fixed-point to fixed-point communications include not only twisted pair and fiber optic technologies, but also wireless technologies such as microwave and spread spectrum.

Terminators are the people, systems, other facilities, and environmental conditions outside of ITS that need to communicate or interface with ITS subsystems. Terminators help define the boundaries of the National ITS Architecture as well as a regional or statewide system. Examples of terminators include: drivers, weather information providers, and information service providers.

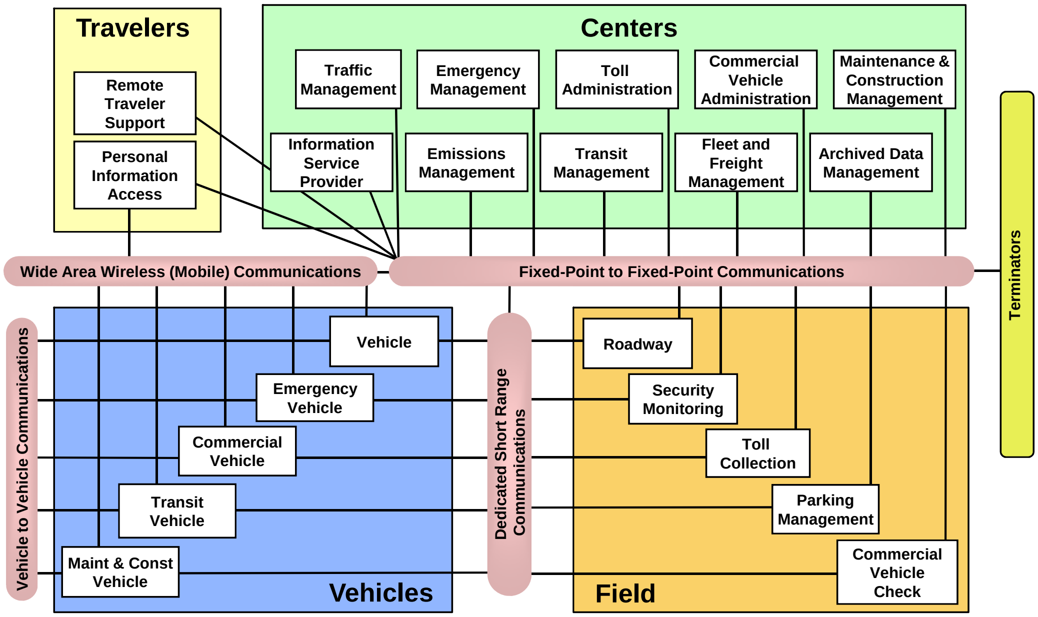

Figure 3 – National ITS Architecture Physical Subsystem Interconnect Diagram

3.3.2 ITS Inventory by Stakeholder

Each stakeholder is associated with one or more systems or elements (subsystems and terminators) that make up the transportation system in the State. A review of the existing regional architectures was completed to help with the creation of the statewide list of stakeholders. **Table 3** shows the list of stakeholders, as identified in the architecture, along with a description of the stakeholder. For example, rather than individually documenting each of the smaller local agencies in the State, a single stakeholder was created for local agencies to represent the counties, cities, and towns not specifically called out in the Statewide ITS Architecture.

Table 4 sorts the inventory by stakeholder so that each stakeholder can easily identify and review all of the architecture elements associated with their agency. The table includes the status of the element. In many cases, an element classified as existing might still need to be enhanced to attain the service level desired.

Table 3 – Stakeholder Descriptions

Stakeholder	Stakeholder Description
Centra Ambassador Bridge Corporation	The Central Cartage/Ambassador Bridge Company is responsible for the maintenance and operations of the Ambassador Bridge with the help of its Canadian subsidiary, the Canadian Transit Company.
Detroit and Canada Tunnel Corporation	Detroit and Canada Tunnel Corporation is responsible for the maintenance and operations of the Detroit Windsor Tunnel. It is helped by their subsidiary in Windsor, Canada.
DNR	Department of Natural Resources is responsible for Michigan's natural resources and for the provision of outdoor recreational opportunities.
International Bridge Authority	Oversees the movement of people and goods as well as collection of tolls on the International Bridge. The International Bridge connects Sault Ste. Marie, Michigan to Sault Ste. Marie, Ontario, Canada.
Local Agency	Local government for all cities and municipalities that are not specifically called out. Covers all city departments including those that deal with traffic and public safety. Local agency includes: RCOC, RCMC, City of Detroit, City of Grand Rapids, etc.
Mackinac Bridge Authority	Oversees the movement of people and goods across the Mackinac Bridge, the third largest suspension bridge in the world, which connects the Upper Peninsula with the Lower Peninsula.
MDIT	Michigan Department of Information Technology responsible for the oversight and management of all communications, networks, network equipment, etc between State of Michigan Government facilities.
MDOT	The Michigan Department of Transportation is responsible for the planning, design, construction, maintenance, and operation of all aspects of a comprehensive integrated transportation system in the State of Michigan.
Media	Local media outlets including television stations, newspapers, radio stations, and their associated websites.
MSP	The Michigan State Police are the statewide law enforcement agency that enforces traffic safety laws as well as commercial vehicle regulations.
NOAA	The National Oceanic and Atmospheric Administration gathers weather information and issues severe weather warnings.
Other Agencies	This stakeholder represents a wide variety of agencies. The associated elements are groups of agencies or providers that do not have a primary stakeholder agency.
Other Elements	Other elements include potential obstacles, roadway environment, and other vehicles.
Other States and Countries	Emergency or traffic management agencies in other states or countries adjacent to Michigan. This would include Minnesota, Ohio, Wisconsin, Indiana, and Canada.
Private Information Service Provider	Private sector business responsible for the gathering and distribution of traveler information. This service is typically provided on a subscription basis.
Private Operators	Private Operators manage privately owned resources that interconnect with public sector elements and sub-systems of the Regional Architecture.
Province of Ontario Ministry of Transportation (MTO)	Agency in charge of transportation concerns, issues, and development in Ontario, Canada.
System Users	All users of the transportation system.
US Army Corp of Engineers (USACE)	Full-spectrum engineer force delivering solutions for national security, environmental sustainability, economic vitality, water-resource management and emergency assistance throughout the Great Lakes Region.

Table 4 – Inventory of ITS Elements

Stakeholder Name	Element Name	Element Description	Status
Centra Ambassador Bridge Corporation	Ambassador Bridge Operations Center	Operations Center responsible for bridge system operations at the Ambassador Bridge.	Existing
Detroit and Canada Tunnel Corporation	Detroit Windsor Tunnel TOC	Traffic Operations Center responsible for tunnel system operations at the Detroit Windsor Tunnel.	Existing
DNR	DNR Weather Stations	Department of Natural Resources field equipment that collects weather data such as temperature and visibility.	Planned
International Bridge Authority	International Bridge Authority TOC	Traffic Operations Center responsible for bridge system operations on the International Bridge.	Existing
Local Agency	County Road Commission (CRC)	Contract agency managed by a county that oversees road maintenance and snow removal on local and MDOT facilities.	Existing
	Local Agency 911 Dispatch	Answers all 911 calls made from within the local area and then forwards the call to the appropriate dispatcher. It is inclusive of all local dispatches throughout the State.	Planned
	Local Agency CCTV Cameras	Closed circuit television cameras operated by the Local Agency TOC for traffic condition monitoring and management of incidents.	Existing
	Local Agency DPW	Department of Public Works run by individual local agencies.	Existing
	Local Agency Emergency Operations Center (EOC)	Central command and control facility responsible for carrying out the principles of emergency preparedness and emergency management; or disaster management functions at a strategic level in an emergency situation.	Planned
	Local Agency Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, RTMS or traditional loops.	Existing
	Local Agency TOC	Local Traffic Operations Center responsible for municipal signal system operations and CCTV video images.	Existing
	Local Agency Website	Transportation information website for each local agency. In the future will include real-time construction, work zone, special event, incident, and traffic information.	Existing
	Local Transit Agency Dispatch	Provides local public transportation and associated facilities. It is inclusive of all local transit dispatches throughout the State.	Existing
Mackinac Bridge Authority	Mackinac Bridge Authority TOC	Traffic Operations Center responsible for bridge system operation at the Mackinac Bridge.	Existing
MDOT	ATMS Database	Database platform for real-time and archived traffic event data, and the sharing of traffic information between MDOT Operation Centers, external agencies, and the media	Planned
	ATMS Gateway Server	A server to make available ATMS event, traffic and weather data, to external agencies in real-time.	Planned
	MDOT Bay Region TMC	Transportation management center for Bay Region that will include the freeway management system in the Bay Region as well as rural ITS deployments.	Planned
	MDOT Bay Region TSCs	MDOT Transportation Service Centers are field offices that oversee road construction and maintenance on MDOT facilities. Most maintenance and snow removal in this region is achieved through contract agencies.	Existing

Table 4 – Inventory of ITS Elements

Stakeholder Name	Element Name	Element Description	Status
MDOT (continued)	MDOT Blue Water Bridge TOC	Traffic Operations Center responsible for bridge system operations at the Blue Water Bridge.	Planned
	MDOT CCTV Cameras	Roadside equipment located on local roadways used for traffic condition monitoring and management of incidents.	Planned
	MDOT Commercial Vehicle Permitting System	System to direct the electronic application, processing, fee collection, issuance, and distribution of commercial vehicle operation credentials and tax filings.	Planned
	MDOT DMS	Roadside equipment on MDOT routes used to share traveler information with motorists through dynamic messaging.	Existing
	MDOT DUAP	Sensing equipment onboard MDOT vehicles that collect roadway information. The information is downloaded nightly at a designated MDOT facility.	Planned
	MDOT Field Sensors	Roadway equipment located on MDOT roadways used to detect vehicle volumes and/or speeds. This information is used in the operation of the traffic signal system and collected by the TOC. MDOT field sensors include VIVDS and any other vehicle detection.	Existing
	MDOT Grand Region TSCs	MDOT Transportation Service Centers are field offices that oversee road construction and maintenance on MDOT facilities. Most maintenance and snow removal in this region is achieved through contract agencies.	Existing
	MDOT HAR	Highway advisory radio allows roadway conditions, incidents, etc. to be broadcast to travelers.	Existing
	MDOT Metro Region TSCs	MDOT Transportation Service Centers are field offices that oversee road construction and maintenance on MDOT facilities. Most maintenance and snow removal in this region is achieved through contract agencies.	Existing
	MDOT MI Drive Website	MDOT website for dissemination of traveler information.	Existing
	MDOT MITSC	Transportation management center that operates the freeway management system and ITS deployments for the Detroit/SE Michigan area.	Existing
	MDOT North Region TMC	MDOT traffic management center located in the North Region.	Planned
	MDOT North Region TSCs	MDOT Transportation Service Centers are field offices that oversee road construction and maintenance on MDOT facilities. Most maintenance and snow removal in this region is achieved through contract agencies.	Existing
	MDOT Office of Communication	Michigan Department of Transportation office responsible for the dissemination of traffic information to the media and public.	Existing
	MDOT Planning Division Data Warehouse	Archive that contains historical traffic data such as volume and speed information.	Existing
	MDOT Roadside Equipment for AHS	Equipment located along MDOT routes that allows communication between roadside devices and vehicles.	Planned
	MDOT Roadside Signing Equipment	Equipment located along MDOT routes that provide data through dynamic messaging or in-vehicle messaging.	Planned
	MDOT Southwest Region TMC	MDOT traffic management center located in the Southwest Region.	Planned

Table 4 – Inventory of ITS Elements

Stakeholder Name	Element Name	Element Description	Status
MDOT (continued)	MDOT Southwest Region TSCs	MDOT Transportation Service Centers are field offices that oversee road construction and maintenance on MDOT facilities. Most maintenance and snow removal in this region is achieved through contract agencies.	Existing
	MDOT Statewide TMC - Lansing	MDOT traffic management center located in Lansing.	Planned
	MDOT Superior Region TMC	MDOT traffic management center located in the Superior Region.	Planned
	MDOT Superior Region TSCs	MDOT Transportation Service Centers are field offices that oversee road construction and maintenance on MDOT facilities. Most maintenance and snow removal in this region is achieved through contract agencies.	Existing
	MDOT Traffic Signals	Multiple traffic signals interconnected and operated by MDOT.	Existing
	MDOT Traveler Information Database	MDOT maintained database for collecting and disseminating road condition data about construction and maintenance activities, incidents, and special events.	Planned
	MDOT Traveler Information Kiosks	Interactive kiosks that provide users the ability to request and receive transportation information.	Planned
	MDOT University Region TSCs	MDOT Transportation Service Centers are field offices that oversee road construction and maintenance on MDOT facilities. Most maintenance and snow removal in this region is achieved through contract agencies.	Existing
	MDOT Vehicles	Vehicles operated by the Michigan Department of Transportation (MDOT).	Existing
	MDOT Weigh-in-Motion	Michigan Department of Transportation's device to capture and record truck axle weights and gross vehicle weights as the driver drives over a sensor.	Existing
	MDOT West Michigan TMC	MDOT traffic management center located in the Grand Region.	Existing
	Michigan 511 System	511 Traveler information system central server.	Planned
	Michigan 511 Voice Response System	Michigan 511 Interactive Voice Response system. This is the customer interface component of the 511 system.	Planned
Media	Local Print and Broadcast Media	Local media that provide traffic or incident information to the public.	Existing
MSP	CJIC Database	Database for the archiving of crash data and crime reporting information that can be accessed by multiple agencies.	Existing
	MIOC	The Michigan Intelligence Operations Center. Provides 24-hours a day statewide information sharing among local, state and federal public safety agencies and private sector organizations in order to facilitate the collection, analysis and dissemination of intelligence relevant to terrorism and public safety.	Existing
	MSP Gaylord Regional Dispatch	Answers all 911 calls made from within the county and then forwards the call to the appropriate dispatcher.	Existing
	MSP Headquarters - East Lansing	Michigan State Police headquarters that oversees operations of MSP.	Existing
	MSP Motor Carrier Division	Responsible for monitoring commercial vehicle regulations on MDOT routes.	Existing
	MSP Motor Carrier Division Enforcement	Responsible for enforcing commercial vehicle regulations on MDOT routes.	Existing

Table 4 – Inventory of ITS Elements

Stakeholder Name	Element Name	Element Description	Status
MSP (continued)	MSP Negaunee Regional Dispatch	Answers all 911 calls made from within the county and then forwards the call to the appropriate dispatcher.	Existing
	MSP Office of Highway Safety Planning	Create programs to increase safety along Michigan's roadways and facilitate partnerships with public and private organizations.	Existing
	MSP Rockford Regional Dispatch	Answers all 911 calls made from within the county and then forwards the call to the appropriate dispatcher.	Existing
	MSP Second District Regional Dispatch	Answers all 911 calls made from within the county and then forwards the call to the appropriate dispatcher.	Existing
	MSP Vehicles	Public Safety vehicles owned and operated by the Michigan State Police. Includes the ITS equipment installed on the cruisers (AVL, MDTs, etc.).	Existing
	MSP Winter Travel Advisory Website	Traveler Information website operated by Michigan State Police for dissemination of winter weather advisories.	Existing
	MSP Winter Travel Toll Free Number	Winter weather information operated from November through March to share winter weather conditions as received.	Existing
NOAA	National Weather Service	Provides official US weather, marine, fire and aviation forecasts, warnings, meteorological products, climate forecasts, and information about meteorology.	Existing
Other Agencies	US Coast Guard	Military unit responsible for maritime and coastal patrol.	Existing
Other Elements	Location Data Source	Electronic devices that provide accurate positioning information (GPS, driver input, etc.).	Existing
	Potential Obstacles	Obstacles that could interfere with the safe operation of vehicles.	Existing
	Roadway Environment	All objects and conditions in the vicinity of the traveler that can affect the operations of the traveler.	Existing
Other States and Countries	Illinois DOT	The Illinois Department of Transportation is responsible for the construction, maintenance, and operation of roadways in the State of Illinois.	Existing
	Indiana DOT	The Indiana Department of Transportation is responsible for the construction, maintenance, and operation of roadways in the State of Indiana.	Existing
	Minnesota DOT	The Minnesota Department of Transportation is responsible for the construction, maintenance, and operation of roadways in the State of Minnesota.	Existing
	Ohio DOT	The Ohio Department of Transportation is responsible for the construction, maintenance, and operation of roadways in the State of Minnesota.	Existing
	Wisconsin DOT	The Wisconsin Department of Transportation is responsible for the construction, maintenance, and operation of roadways in the State of Wisconsin.	Existing
Private Operators	Private Fleet Operations	Private companies that proactively manage and operate their fleet routing. Includes reactions to incidents and possible delays.	Existing
	Third Party RWIS Provider	Contract provider of road weather information statewide.	Existing
Private Information Service Provider	Private Sector ISP	Private entities that collect and disseminate traffic information.	Planned
	Private Sector Traveler Information Services	Website sponsored by a private entity. Often this information is provided through a subscription.	Existing
Province of Ontario Ministry of Transportation (MTO)	MTO	Agency in charge of transportation concerns, issues, and development in Ontario, Canada.	Existing

Table 4 – Inventory of ITS Elements

Stakeholder Name	Element Name	Element Description	Status
System Users	Archived Data Users	Those who request information from the data archive systems.	Existing
	Basic Commercial Vehicle	Vehicles without transponders.	Existing
	Basic Vehicle	Vehicles in the control of a driver.	Existing
	Commercial Vehicle	Privately owned commercial vehicles that travel throughout the Region. Included in the architecture to cover HAZMAT incident reporting.	Existing
	Driver	Individual operating a vehicle on roadways within the region.	Planned
	Other Vehicle	Vehicles outside of the control of the driver.	Existing
	Other Private Vehicle	Vehicles operated by the public	Planned
	Private Travelers Personal Computing Devices	Computing devices that travelers use to access public information.	Planned
	Private Vehicles	Vehicles operated by the public.	Planned
US Army Corp of Engineers (USACE)	USACE Detroit District Headquarters	US Army Corp of Engineers District Headquarters office responsible for investigating, planning, designing, constructing, operating, and maintaining authorized water resource projects related to navigation, flood control, beach erosion, and other activities.	Existing

3.3.3 Top Level Regional System Interconnect Diagram

A system interconnect diagram, or “sausage diagram” (shown previously in **Figure 3**), shows the systems and primary interconnects in a region. The National ITS Architecture interconnect diagram has been customized for the Statewide Architecture based on the system inventory and information gathered from the Regional Architecture and Statewide stakeholders.

Figure 4 and **Figure 5** summarize the existing and planned ITS elements for the Statewide ITS Architecture in the context of physical interconnects. Subsystems and elements specific to the State of Michigan are called out in the boxes surrounding the main interconnect diagram; these are color-coded to the subsystem with which they are associated.

Legend

Subsystem — Statewide Architecture Elements Map To National ITS Architecture

Subsystem ····· No Statewide Architecture Elements Map To National ITS Architecture

Remote Traveler Support
- MDOT Traveler Information Kiosks

Personal Information Access
- Private Travelers Personal Computing Devices

Basic Vehicle
- Private Vehicles

Emergency Vehicle Subsystem
- MSP Vehicles

Commercial Vehicle Subsystem
- Commercial Vehicles

Other Vehicle
- Private Vehicle
- Other Private Vehicle
- MDOT Vehicle

Traffic Management
- Ambassador Bridge Operations Center
- ATMS Database
- ATMS Gateway Server
- Detroit Windsor Tunnel TOC
- International Bridge Authority TOC
- Local Agency TOC
- Mackinac Bridge Authority TOC
- MDOT Bay Region TMC
- MDOT Blue Water Bridge TOC
- MDOT MITSC
- MDOT North Region TMC
- MDOT Southwest Region TMC
- MDOT Statewide TMC – Lansing

Traffic Management Cont.
- MDOT Superior Region TMC
- MDOT West Michigan TMC
- MSP Gaylord Regional Dispatch
- MSP Headquarters - East Lansing
- MSP Negaunee Regional Dispatch
- MSP Rockford Regional Dispatch
- MSP Second District Regional Dispatch

Fleet and Freight Management
- Private Fleet Operations

Emergency Management
- ATMS Database
- Local Agency 911 Dispatch
- Local Agency EOC
- MIOC
- MSP Gaylord Regional Dispatch
- MSP Headquarters - East Lansing
- MSP Negaunee Regional Dispatch
- MSP Office of Highway Safety Planning
- MSP Rockford Regional Dispatch
- MSP Second District Regional Dispatch
- US Coast Guard

Information Service Provider
- ATMS Database
- ATMS Gateway Server
- Local Agency Website
- MDOT MI Drive Website
- MDOT Office of Communications
- Michigan 511 System
- MSP Winter Travel Advisory Website
- MSP Winter Travel Toll Free Number
- Private Sector ISP
- Private Sector Traveler Information Services

Transit Management
- Local Transit Agency Dispatch

Commercial Vehicle Administration
- MDOT Commercial Vehicle Permitting System
- MSP Motor Carrier Division

Maintenance & Construction Management
- ATMS Database
- County Road Commission (CRC)
- Local Agency DPW
- MDOT Bay Region TMC
- MDOT Bay Region TSCs
- MDOT Grand Region TSCs
- MDOT Metro Region TSCs
- MDOT MITSC
- MDOT North Region TMC
- MDOT North Region TSCs
- MDOT Southwest Region TMC
- MDOT Southwest Region TSCs
- MDOT Statewide TMC – Lansing
- MDOT Superior Region TMC
- MDOT Superior Region TSCs
- MDOT West Michigan TMC
- MDOT University Region TSCs
- Third Party RWIS Provider

Archived Data Management Subsystem
- CJIC Database
- MDOT Planning Division Data Warehouse

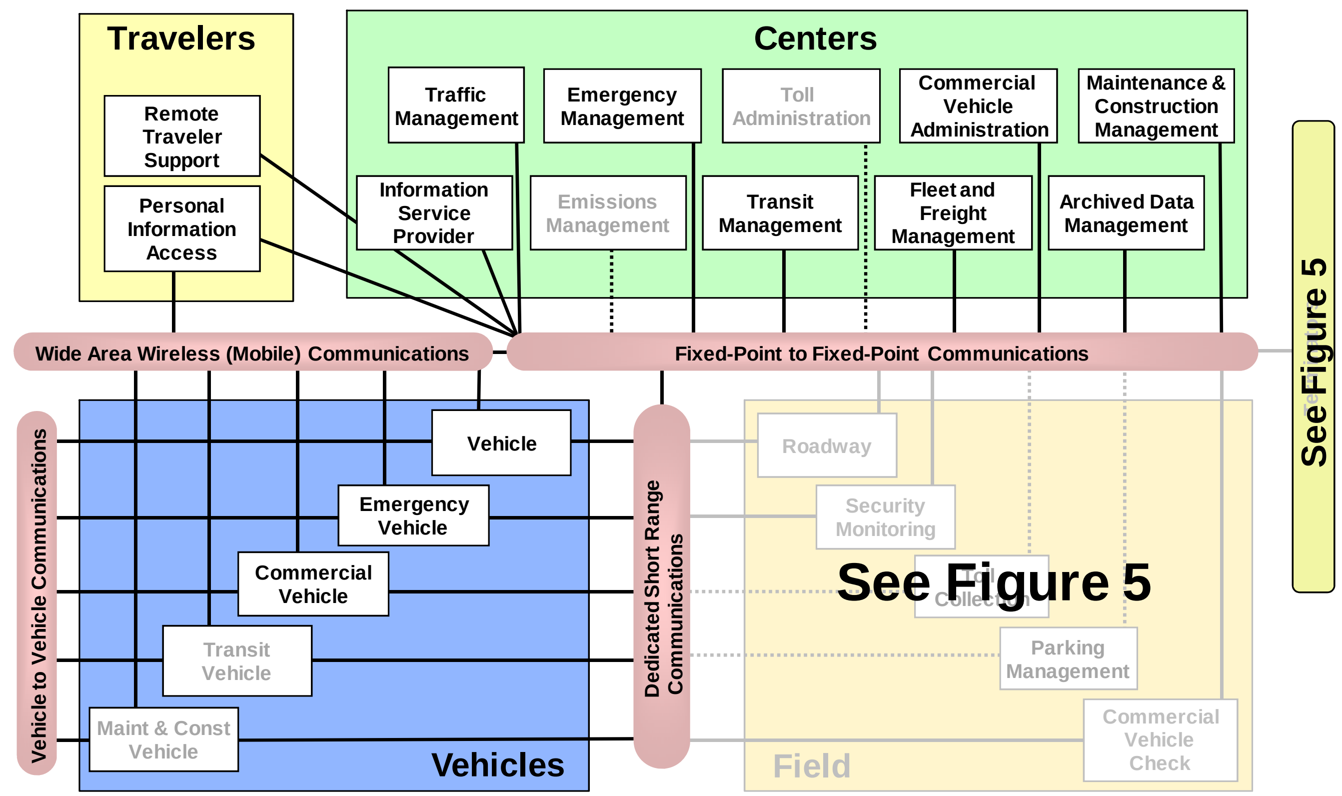

Figure 4 – Statewide System Interconnect Diagram

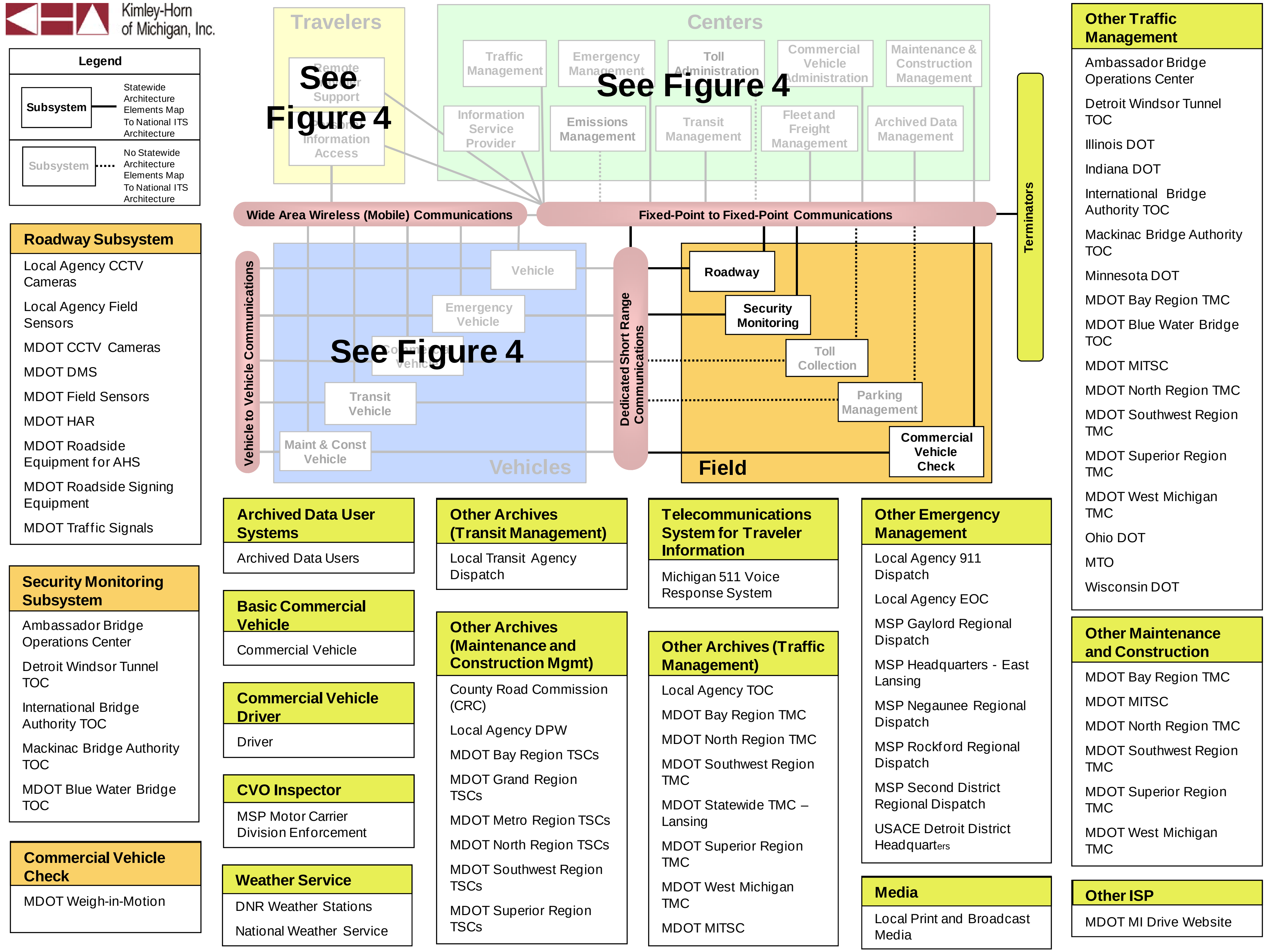

Figure 5 – Statewide System Interconnect Diagram

3.4 Market Packages

Upon completion of the system inventory, the next step in the development of the architecture was to identify the transportation services that are important to the State of Michigan. In the National ITS Architecture, services are referred to as market packages. Market packages can include several stakeholders and elements that work together to provide a service in a region or state. Examples of market packages from the National ITS Architecture include Network Surveillance, Traffic Information Dissemination, and Transit Vehicle Tracking. There are currently a total of 91 market packages identified in the National ITS Architecture Version 6.0. **Appendix A** provides definitions for each of the National ITS Architecture market packages.

The market packages are grouped together into eight ITS service areas: Traffic Management, Emergency Management, Maintenance and Construction Management, Public Transportation Management, Commercial Vehicle Operations, Traveler Information, Archived Data Management, and Vehicle Safety.

3.4.1 Selection and Prioritization of Regional Market Packages

The National ITS Architecture market packages were reviewed and selected based on the relevance of the service that the market package could provide to the State of Michigan. Twenty-eight market packages were selected for implementation in the State. They are identified in **Table 5**. The selected market packages were then prioritized based on need. The prioritization does not necessarily represent the timeframe for funding of these deployments. The table organizes the market packages into service areas and priority groupings. These priorities also can be affected by several other factors such as existing infrastructure, dependency on other systems, and the maturity of the technology associated with the market package.

After selecting the market packages that were applicable, each market package and its elements were customized for the State. This customization is discussed further in the following section.

Table 5 – Market Package Prioritization by Functional Area

High Priority Market Packages	Medium Priority Market Packages	Low Priority Market Packages
Travel and Traffic Management		
ATMS01 Network Surveillance ATMS02 Probe Surveillance ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management ATMS08 Traffic Incident Management System	ATMS03 Surface Street Control	
Emergency Management		
EM01 Emergency Call Taking and Dispatch EM06 Wide-Area Alert	EM07 Early Warning System EM08 Disaster Response and Recovery	EM09 Evacuation and Reentry Management EM10 Disaster Traveler Information
Maintenance and Construction Management		
MC04 Weather Information Processing and Distribution		
Commercial Vehicle Operations		
CVO06 Weigh-in-Motion	CVO03 Electronic Clearance CVO04 Administrative Processes CVO10 HAZMAT Management	CVO01 Fleet Administration CVO02 Freight Administration
Traveler Information		
ATIS01 Broadcast Traveler Information	ATIS02 Interactive Traveler Information ATIS04 Dynamic Route Guidance ATIS09 In Vehicle Signing	ATIS05 ISP Based Route Guidance
Archived Data Management		
	AD01 ITS Data Mart AD03 ITS Virtual Data Warehouse	
Advanced Vehicle Safety System		
	AVSS11 Automated Vehicle Operations AVSS12 Cooperative Vehicle Safety Systems	

3.4.2 Customized Market Packages

The market packages in the National ITS Architecture were customized to reflect the unique systems, subsystems, and terminators throughout the state of Michigan. Each market package is shown graphically with the market package name, the local agencies involved, and the desired data flows included. Market packages represent a service that will be deployed as an integrated capability.

Figure 6 is an example of an Emergency Management (EM) market package for Wide-Area Alert that has been customized for the State. This market package shows the three subsystems Traffic Management, Roadway, and Emergency Management, and the associated entities (MDOT TMCs, MDOT HAR and DMS, as well as MSP) for wide area alert within the State. Data flows between the subsystems indicate what information is being shared. All of the remaining customized market packages for the Statewide Architecture are shown in **Appendix B**.

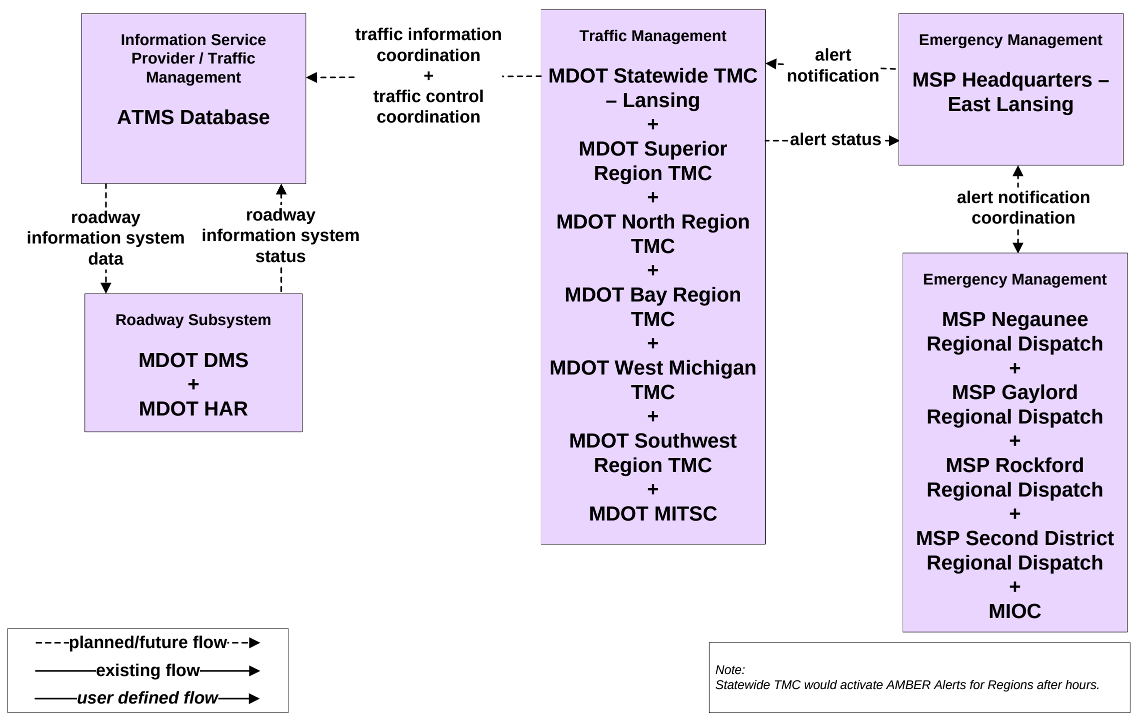

Figure 6 – Example Market Package Diagram: EM06 – Wide-Area Alert

3.4.3 Regional ITS Needs and Customized Market Packages

Input from the other Regional Architectures within the State provided valuable input for the market package customization process. **Table 6** presents several of the needs identified in the recently developed Regional Architectures that have a statewide impact. The table identifies which market package addresses the particular ITS need and which regions presented each of the needs.

Table 6 – Statewide ITS Needs and Corresponding Market Packages

ITS Need	Market Package	North	Grand	Bay	Superior	SW	SEMCOG
Travel and Traffic Management Needs							
Need comprehensive communications network Need assistance building communications between agencies	ATMS01 ATIS01 ATMS06 ATIS02 ATMS07		X			X	X
Need to identify Integrated Corridor Management (ICM) corridors	ATMS01 ATMS08 ATMS02 ATIS01 ATMS06 MC04 ATMS07						X
Need improved data collection capabilities	ATMS01 ATMS02						X
Need improved communication with MSP about incidents	ATMS08			X			
Need better information sharing through media	ATMS06			X			
Need information directed towards tourist traffic and incident management	ATMS06 ATIS01 ATMS08 ATIS02			X			
Need remote access to closed loop systems so MDOT can adjust timing plans	ATMS03		X				
Need to integrate TMC with EMS CAD	ATMS06 ATMS08		X				
Need coordination of travel conditions in other Regions	ATMS07	X					
Traveler Information							
Need to share traffic information throughout the State	ATMS06 ATMS07	X			X		
Emergency Management							
Need a plan for an Emergency Alert System	EM06				X		
Need assistance in case of emergency at area nuclear plants	EM06 EM09 EM07 EM10 EM08					X	
Maintenance and Construction Management							
Need method to distribute weather information	MC04	X	X		X		
Need system to communicate construction and maintenance activities to the public	ATMS06 ATIS01 MC08 ATIS02 MC10			X			
Commercial Vehicle Operations							
Need permanent Weigh-In-Motion (WIM) stations	CVO06		X				
Need improved access to remote WIM sites	CVO06		X				
Archive Data							
Need ability to archive speed and weather data	AD1 AD3		X		X		X
Need method for sharing historical data	AD1 AD3		X				

3.5 Architecture Interfaces

While it is important to identify the various systems and stakeholders that are part of a statewide ITS, a primary purpose of the architecture is to identify the connectivity between transportation systems for the entire State. The system interconnect diagram shown previously in **Figure 6** showed the high-level relationships of the subsystems and terminators in the State and the associated elements and systems. The customized market packages represent services that can be deployed as an integrated capability and the market package diagrams show the information flows between the subsystems and terminators that are most important to the operation of the market packages. How these systems interface with each other is an integral part of the overall ITS architecture.

3.5.1 Element Connections

There are a variety of different elements identified as part of the Statewide ITS Architecture. These elements include TMCs, dispatch centers, emergency management agencies, media outlets, and others—essentially, all of the existing and planned physical components that contribute to the ITS. Interfaces have been identified for each element in the Statewide ITS Architecture and each element has been mapped to those other elements with which it must interface. The Turbo Architecture software can generate interconnect diagrams for each element that show which elements are connected to one another. **Figure 7** is an example of a context style interconnect diagram from the Turbo database output. This particular interconnect diagram is for the MDOT MI Drive Website and is called a context diagram because it shows every element in the architecture that connects with the website.

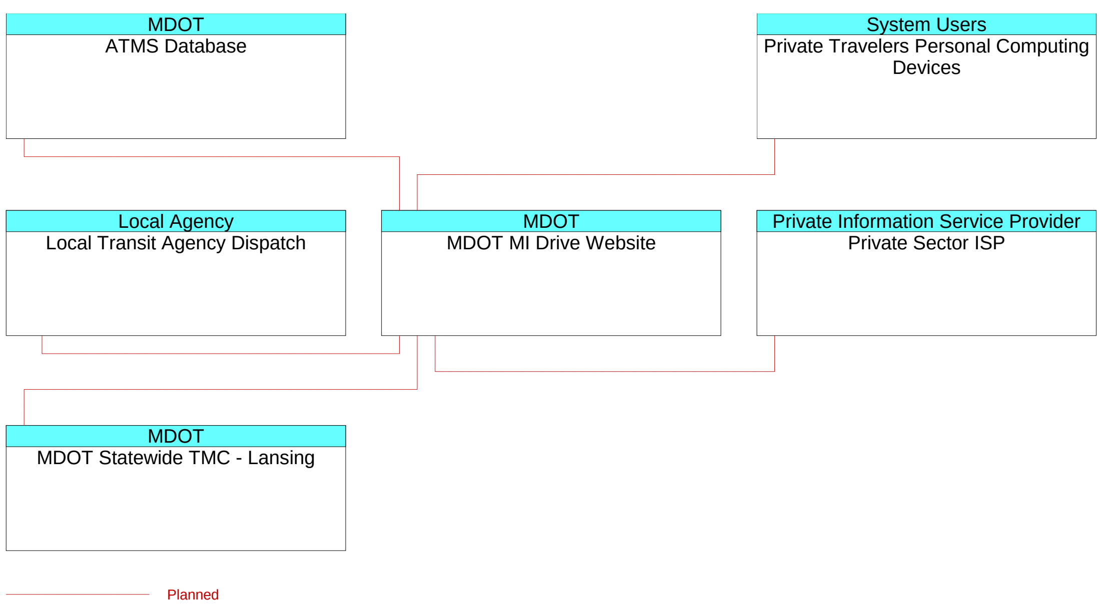

Figure 7 – Example Interconnect Diagram: MDOT MI Drive

3.5.2 Data Flows Between Elements

In the market package diagrams, flows between the subsystems and terminators define the specific information (data) that is exchanged between the elements and the direction of the exchange. The data flows could be requests for information, alerts and messages, status requests, broadcast advisories, event messages, confirmations, electronic credentials, and other key information requirements. Turbo Architecture can be used to output flow diagrams and can be filtered by market package for ease of interpretation; however, it is important to remember that custom data flows will not show up in diagrams that are filtered by market package. An example of a flow diagram for MDOT that has been filtered for Probe Surveillance is shown in **Figure 8**.

The flow diagrams can vary greatly in complexity and, in turn, legibility. **Figure 9** shows a more complex flow diagram for ATMS06 – Traffic Information Dissemination – MDOT.

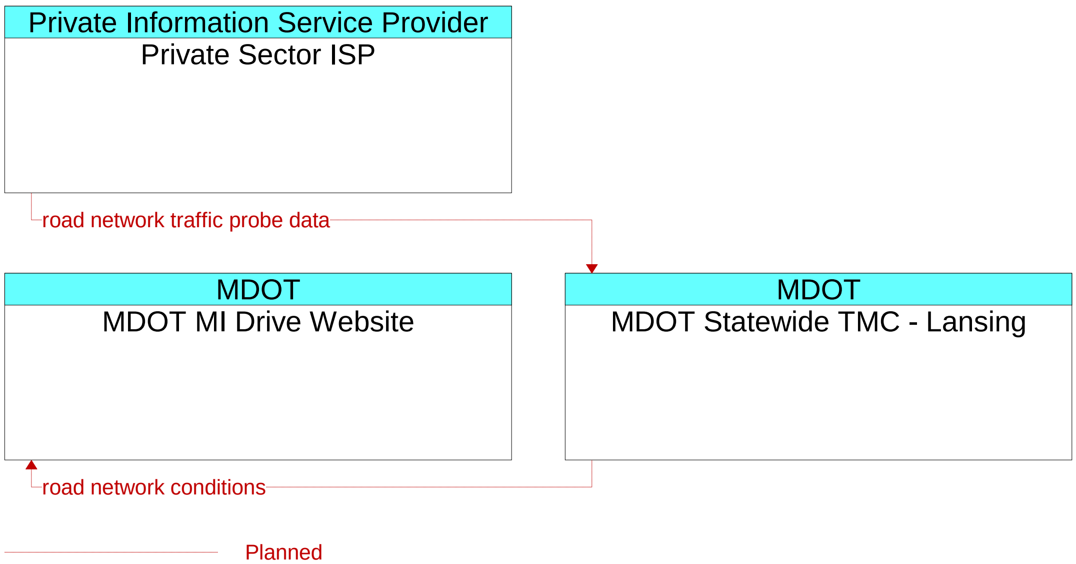

Figure 8 – Example Flow Diagram: ATMS02 – MDOT

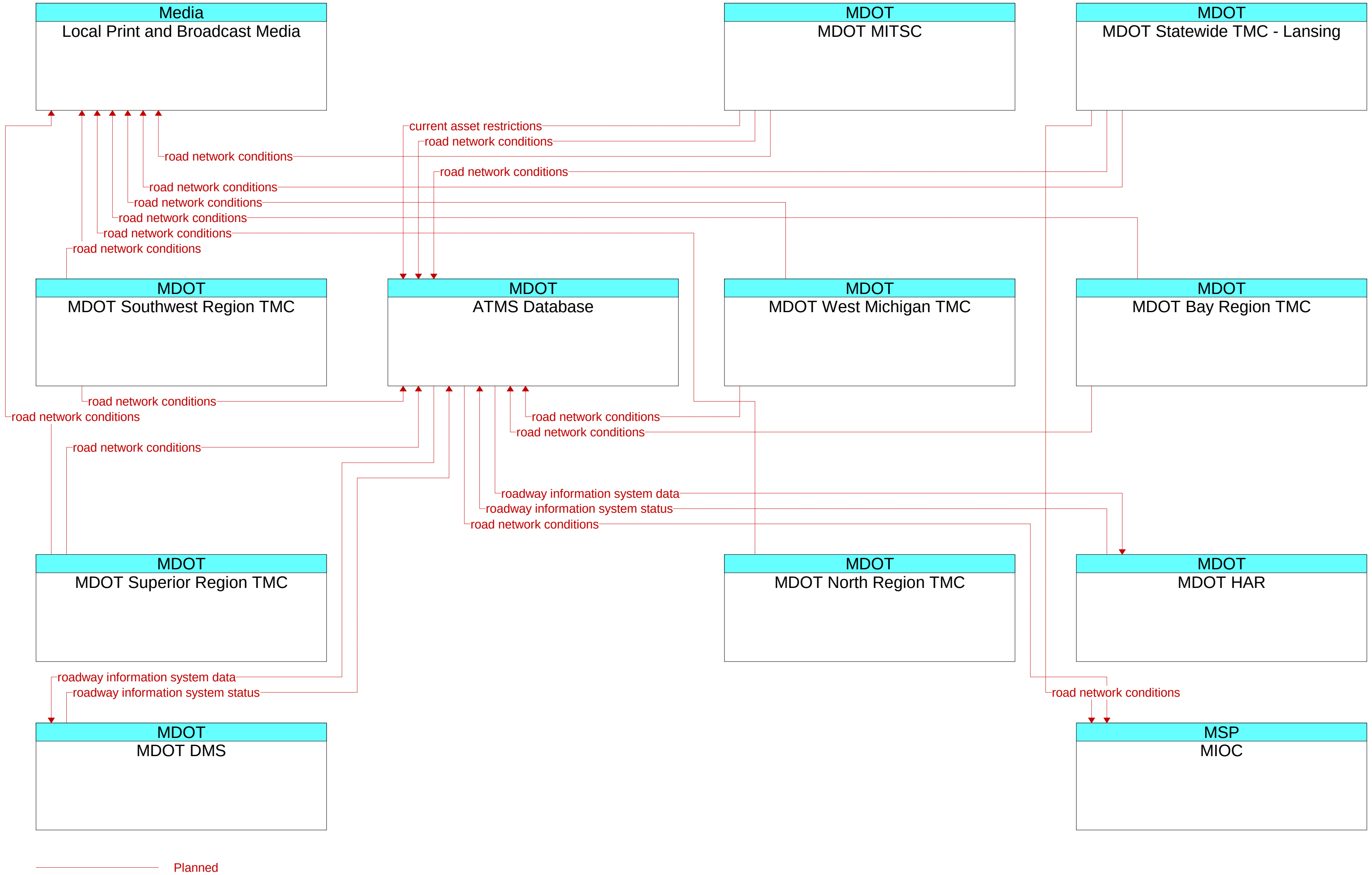

Figure 9 – Example Flow Diagram: ATMS06 – Traffic Information Dissemination, MDOT

In addition to market package style flow diagrams, Turbo Architecture has the ability to create flow diagrams that show only the connections between two or three specific elements or context diagrams that show all of the flows that involve an element. Filtering the diagrams to generate specific scenarios can be very useful during the project implementation process. For example, **Figure 10** shows the flows between the Michigan 511 System and the Michigan 511 Voice Response System. While this is a portion of the planned interactions for the Michigan 511 System, it also could be useful to use a context diagram for the element, as shown in **Figure 11** to view all of the other interactions so that the project can be designed with the future in mind. Context style flow diagrams can get very large and complicated for elements with lots of connections such as a TMC.

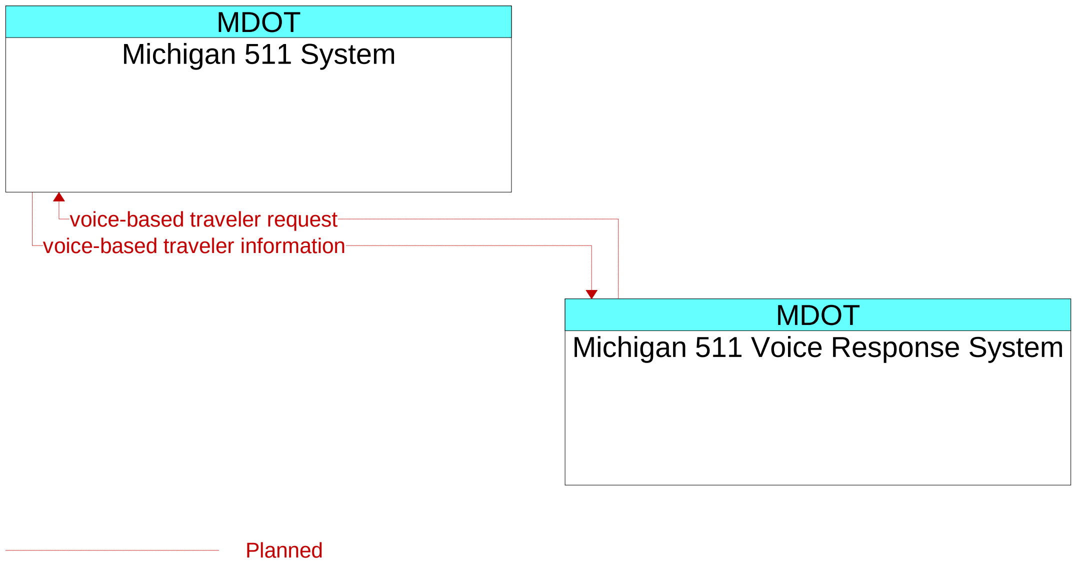

Figure 10 – Example Two Element Flow Diagram

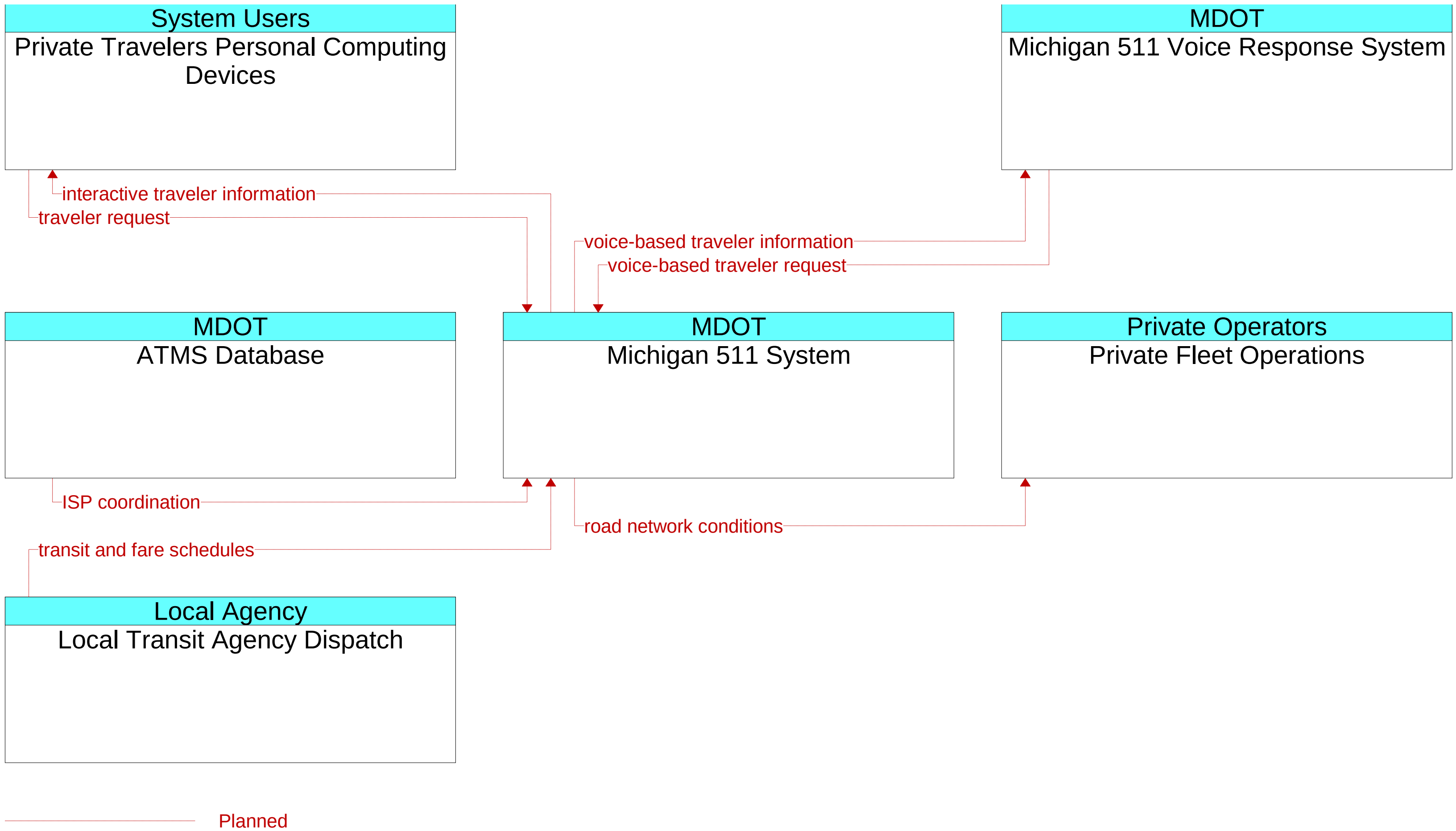

Figure 11 – Example Context Flow Diagram: Michigan 511 System

4. APPLICATION OF THE STATEWIDE ITS ARCHITECTURE

Once the desired components of ITS have been identified and stakeholders have established which agencies and systems need to be connected, the structure of the National ITS Architecture assists with planning and implementation. This section addresses the application of the Statewide ITS Architecture. The National ITS Architecture provides recommendations for standards and functional requirements that should be considered when implementing ITS elements. In addition, an operational concept has been developed to document the roles and responsibilities of stakeholders in the operation of statewide deployments. The implementation of statewide systems likely will require interagency agreements. Potential agreements will be identified based on the desired data flows identified. The ITS Architecture and ITS Deployment Plan developed as part of this process will be incorporated into the existing planning process for the State to ensure that the maximum benefit is realized from the development effort.

4.1 Functional Requirements

Functions are a description of what the system has to do. In the National ITS Architecture, functions are defined at several different levels, ranging from general subsystem descriptions through somewhat more specific equipment package descriptions to process specifications that include substantial detail. Guidance from the USDOT on developing a Regional ITS Architecture recommends that each region determine the level of detail of the functional requirements for their region. It is recommended that the development of detailed functional requirements such as the "shall" statements included in process specifications for a system be developed at the project level. These detailed "shall" statements identify all functions that a project or system needs to perform.

For the Statewide ITS Architecture, functional requirements have been identified at two levels. The customized market packages, discussed previously in Section 3.4.2, describe the services that ITS needs to provide and the architecture flows between the elements. These market packages and data flows describe what systems in the State have to do and the data that needs to be shared among elements. At a more detailed level, functional requirements are described in terms of functions that each element in the architecture performs or will perform in the future. **Appendix C** contains a table that summarizes the functions by element.

4.2 Standards

Standards are an important tool that will allow efficient implementation of the elements in the Statewide ITS Architecture over time. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances, vendors change, and as new approaches evolve. The USDOT's ITS Joint Program Office is supporting Standards Development Organizations (SDOs) with an extensive, multi-year program of accelerated, consensus-based standards development to facilitate successful ITS deployment in the United States. **Table 7** identifies each of the ITS standards that could apply to the Regional ITS Architecture. These standards are based on the physical subsystem architecture flows previously identified in Section 3.5.2.

The MDOT ITS Program Office oversees the development and maintenance of standard project special provisions for use in the design and construction of ITS projects. For details contact the MDOT ITS Program Office (www.michigan.gov/its).

Table 7 – Applicable ITS Standards

SDO	Document ID	Title
AASHTO/ITE	ITE TMDD	Traffic Management Data Dictionary and Message Sets for External TMC Communication (TMDD and MS/ETMCC)
AASHTO/ITE/NEMA	NTCIP 1102	Octet Encoding Rules Base Protocol
	NTCIP 1103	Transportation Management Protocols
	NTCIP 1104	Center-to-Center Naming Convention Specification
	NTCIP 1201	Global Object Definitions
	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller Units
	NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)
	NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control
	NTCIP 1208	Object Definition for CCTV Camera Switching
	NTCIP 1209	Data Element Definitions for Transportation Sensor Systems
	NTCIP 1210	Field Management Stations – Part 1: Object Definitions for Signal System Masters
	NTCIP 1211	Object Definitions for Signal Control and Prioritization
	NTCIP 2101	Point to Multi-Point Protocol Using RS-232 Subnetwork Profile
	NTCIP 2102	Point to Multi-Point Protocol Using Frequency Shift Keying Modem Subnetwork Profile
	NTCIP 2103	Point-to-Point Protocol Over RS-232 Subnetwork Profile
	NTCIP 2104	Ethernet Subnetwork Profile
	NTCIP 2201	Transportation Transport Profile
	NTCIP 2202	Internet Transmission Control Protocol/Internet Protocol and Universal Datagram Protocol/Internet Protocol Transport Profile
	NTCIP 2301	Simple Transportation Management Framework Application Profile
	NTCIP 2302	Trivial File Transfer Protocol Application Profile
	NTCIP 2303	File Transfer Protocol Application Profile
	NTCIP 2304	Application Profile for DATEX-ASN (AP-DATEX)
	NTCIP 2306	Application Profile for Extensible Markup Language (XML) Message Encoding and Transport in ITS Center-to-Center Communications
ASTM	ASTM E2213-03	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems – 5 GHz Band DSRC Medium Access Control and Physical Layer Specifications
	ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems
IEEE	IEEE 1455-1999	Standard for Message Sets for Vehicle/Roadside Communications
	IEEE 1512-2006	Standard for Common Incident Management Message Sets for use by Emergency Management Centers
	IEEE 1512.1-2006	Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers
	IEEE 1512.2-2004	Standard for Public Safety Traffic Management Message Sets for use by Emergency Management Centers

IEEE (cont)	IEEE 1512.3-2006	Standard for Hazardous Material Incident Management Sets for Use by Emergency Management Centers
	IEEE P1512.4	Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers
	IEEE 1609.1 – 2006	Standard for Wireless Access in Vehicular Environments (WAVE) – Resource Manager
	IEEE 1609.2 – 2006	Standard for WAVE – Security Services for Applications and Management Messages
	IEEE 1609.3	Standard for WAVE – Networking Services
	IEEE 1609.4 – 2006	Standard for WAVE – Multi-Channel Operation
	IEEE P1609.0	Standard for WAVE – Architecture
	IEEE P802.11p	Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part II: Wireless LAN Medium Access Control and Physical Layer Specifications
SAE	SAE J2266	Location Referencing Message Specification
	SAE J2313	On-Board Land Vehicle Mayday Reporting Interface
	SAE J2354	Message Set for Advanced Traveler Information System (ATIS)
	SAE J2369	Standard for ATIS Message Sets Delivered Over Reduced Bandwidth Media
	SAE J2395	ITS In-Vehicle Message Priority
	SAE J2396	Definitions and Experimental Measures Related to the Specification of Driver Visual Behavior Using Video Based Techniques
	SAE J2399	Adaptive Cruise Control Operating Characteristics and User Interface
	SAE J2400	Human Factors in Forward Collision Warning Systems: Operating Characteristics and User Interface Requirements
	SAE J2540	Messages for Handling Strings and Look-Up Tables in ATIS Standards
	SAE J2540/1	Radio Data System Phrase Lists
	SAE J2540/2	International Traveler Information Systems Phrase Lists
	SAE J2540/3	National Names Phrase List
	SAE J2735	Dedicated Short Range Communications (DSRC) Message Set Dictionary

4.3 Operational Concepts

An operational concept documents each stakeholder's current and future roles and responsibilities across a range of transportation services, as grouped in the Operational Concepts section of Turbo Architecture, in the operation of the statewide ITS. The services covered are:

- ***Arterial Management*** – The development of signal systems that react to changing traffic conditions and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions.
- ***Highway Management*** – The development of systems to monitor freeway (or tollway) traffic flow and roadway conditions, and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. Includes systems to provide information to travelers on the roadway.
- ***Incident Management*** – The development of systems to provide rapid and effective response to incidents. Includes systems to detect and verify incidents, along with coordinated agency response to the incidents.
- ***Emergency Management*** – The development of systems to provide emergency call taking, public safety dispatch, and emergency operations center operations.
- ***Maintenance and Construction Management*** – The development of systems to manage the maintenance of roadways in the Region, including winter snow and ice clearance. Includes the managing of construction operations.
- ***Transit Management*** – The development of systems to more efficiently manage fleets of transit vehicles or transit rail. Includes systems to provide transit traveler information both pre-trip and during the trip.
- ***Electronic Payment*** – The development of electronic fare payment systems for use by transit and other agencies (e.g., parking).
- ***Commercial Vehicle Operations*** – The development of systems to facilitate the management of commercial vehicles (e.g., electronic clearance).
- ***Traveler Information*** – The development of systems to provide static and real time transportation information to travelers.
- ***Archived Data Management*** – The development of systems to collect transportation data for use in non-operational purposes (e.g., planning and research).
- ***Vehicle Safety*** – The development of systems to support private sector vehicle safety initiatives (e.g., intersection collision avoidance).

Table 8 identifies the roles and responsibilities of key stakeholders for a range of transportation services.

Table 8 – Stakeholder Roles and Responsibilities

Transportation Service	Stakeholder	Roles/Responsibilities
Arterial Management	MDOT	Operate network surveillance equipment including CCTV cameras and field sensors on MDOT routes not managed by local agencies to facilitate traffic signal operations.
		Provide traffic information to regional agencies including transit, emergency management, maintenance and construction, and the media.
		Coordinate traffic information and control with local agency TOCs and other MDOT TMCs.
Highway Management	Centra Ambassador Bridge Corporation	Coordinate traffic information and traffic control with other MDOT TMCs.
	Detroit and Canada Tunnel Corporation	Coordinate traffic information and traffic control with other MDOT TMCs.
	Mackinac Bridge Authority	Coordinate traffic information and traffic control with other MDOT TMCs.
	International Bridge Authority	Coordinate traffic information and traffic control with other MDOT TMCs.
	MDOT Blue Water Bridge Authority	Coordinate traffic information and traffic control with other MDOT TMCs.
	MDOT	Coordinate traffic information and traffic control with other MDOT TMCs
	Province of Ontario Ministry of Transportation	Coordinate traffic information and traffic control with other MDOT TMCs.
Incident Management (Traffic)	MDOT	Perform network surveillance for detection and verification of incidents on MDOT routes.
		Provide incident information to travelers via traffic information devices on highways (e.g. MDOT DMS).
		Responsible for coordination with other traffic operations centers and emergency management agencies for coordinated incident management.
		Coordinate maintenance resources for incident response with MDOT TSC Construction and Maintenance Operations.
		Responsible for the development, coordination, and execution of special traffic management strategies during an evacuation.
	Local Agency	Provide incident information to regional emergency responders, including the MSP and MDOT.
Incident Management (Emergency)	MSP	Receive emergency calls for incidents on all routes.
		Coordinate incident response with other public safety agencies (local police, fire, EMS, sheriff) as well as MDOT.
		Coordinate public safety resources for incident response on local routes.
		Perform incident detection and verification for the highways within the region and provide this information to traffic and other public safety agencies.
	Local Agency	Receive emergency calls for incidents on local routes.
		Coordinate public safety resources for incident response on local routes.
		Coordinate incident response with other public safety agencies (fire, EMS, ambulance, etc.).
		Perform incident detection and verification on local routes and provide this information to the Local Agency TOC.

Table 8 – Stakeholder Roles and Responsibilities

Transportation Service	Stakeholder	Roles/Responsibilities
Emergency Management	MSP	Receive AMBER Alert and other Wide Area Alert information from MSP Headquarters.
		Receive early warning information and threat information from the NWS and Local Agencies.
		Coordinate with regional emergency management providers, maintenance and construction providers, and regional traffic management providers for emergency plans and evacuation and reentry plans.
		Disseminate disaster information to other agencies and the traveling public.
		Provide security monitoring of critical infrastructure for MDOT.
	MIOC	Participate in the incident response, coordination, and reporting.
	Local Agency	Participate in the incident response, coordination, and reporting.
		Receive AMBER Alert and other wide area alert information from MSP.
Maintenance and Construction Management	Local Agency	Receive a request for maintenance resources for incident response from regional emergency management agencies.
	MDOT	Receive requests for maintenance resources for incident response from regional emergency management agencies.
		Supports coordinated response to incidents.
		Collect road weather information with MDOT equipment and distribute it to regional traffic, maintenance, and transit agencies.
		Provide maintenance of state highways within the regions, including pavement maintenance, winter maintenance, and construction activities.
		Coordinate maintenance and construction activities with other regional maintenance and construction agencies.
Commercial Vehicle Operations	MSP	Provide enforcement of permits for overheight/overweight or HAZMAT commercial vehicles.
		Provide first response to commercial vehicle incidents and coordinate for HAZMAT conditions/clean-up.
	MDOT	Provide route restriction information to private fleet systems.
		Provide automated weigh-in-motion inspections for private fleet operations.
		Provide permit information to regional emergency management providers and regional enforcement agencies.
Traveler Information	MDOT	Collection, processing, storage, and broadcast dissemination of traffic, transit, maintenance and construction, and weather information to travelers via the 511 Traveler Information System and MI Drive website.
		Provide traveler information to private travelers through in vehicle, personal computing devices or kiosks upon request.
		Provide traveler information to the media.
	MSP	Collect traffic information (road network conditions), work zone information, travel times, and weather information.
	Local Agency	Collect traffic information (road network conditions), work zone information, travel times, and weather information.

Table 8 – Stakeholder Roles and Responsibilities

Transportation Service	Stakeholder	Roles/Responsibilities
Archived Data Management	MDOT	Collect and archive asset status information from all MDOT maintenance offices and MDOT asset management systems.
		Collect and archive traffic information from regional traffic management providers and centers, emergency information from MSP and Local Agency Police, and transit information from regional transit agencies for planning purposes.
		Coordinate with MDOT Transportation Planning Division.
	MSP	Collect and archive asset status information from all MDOT maintenance offices and MDOT asset management systems.

4.4 Potential Agreements

The Statewide ITS Architecture has identified many agency interfaces, information exchanges, and integration strategies that would be needed to provide the ITS services and systems identified in the State. Interfaces and data flows among public and private entities will require agreements among agencies that establish parameters for sharing agency information to support traffic management, incident management, provide traveler information, and perform other functions identified in the Statewide ITS Architecture.

With the implementation of ITS technologies, integrating systems from one or more agencies, and the anticipated level of information exchange identified in the architecture, it is likely that formal agreements between agencies will be needed in the future. These agreements, while perhaps not requiring a financial commitment from agencies in the region, should outline specific roles, responsibilities, data exchanges, levels of authority, and other facets of regional operations. Some agreements also will outline specific funding responsibilities where appropriate and applicable.

Agreements should avoid being specific with regards to technology when possible. Technology is likely to change rapidly and changes to technology could require an update of the agreement if the agreement is not technology neutral. The focus of the agreement should be on the responsibilities of the agencies and the high level information that needs to be exchanged. Depending on the type of agreement being used, agencies should be prepared for the process to complete an agreement to take several months to years. Agencies must first reach consensus on what should be in an agreement and then proceed through the approval process. The approval process for formal agreements varies by agency and often can be quite lengthy, so it is recommended that agencies plan ahead to ensure that the agreement does not delay the project.

When implementing an agreement for ITS, it is recommended that as a first step any existing agreements are reviewed to determine whether they can be amended or modified to include the additional requirements that will come with deploying a system. If there are no existing agreements that can be modified or used for ITS implementation, then a new agreement will need to be developed. The formality and type of agreement used is a key consideration. If the arrangement will be in effect for an extended duration or involve any sort of long term maintenance, then written agreements should be used. Often during long term operations, staff may change and a verbal agreement between agency representatives may be forgotten by new staff.

Common agreement types and potential applications include:

- **Handshake Agreement:** Handshake agreements often are used in the early stage of a project. This type of informal agreement depends on relationships between agencies and may not be appropriate for long term operations where staff is likely to change.
- **Memorandum of Understanding (MOU):** A MOU demonstrates general consensus or willingness to participate as part of a particular project but is not typically very detailed.
- **Interagency and Intergovernmental Agreements:** These agreements between public agencies can be used for operation, maintenance, or funding of projects and systems. They can include documentation on the responsibility of each agency, functions they will provide, and liability.
- **Funding Agreements:** Funding agreements document the funding arrangements for ITS projects. At a minimum, funding agreements include a detailed scope, services to be performed, and a detailed project budget.

- **Master Agreements:** Master agreements include standard contract language for an agency and serve as the main agreement between two entities which guides all business transactions. Use of a master agreement can allow an agency to do business with another agency or private entity without having to go through the often lengthy development of a formal agreement each time.

Table 9 provides a list of existing and potential agreements based on the interfaces identified in the Statewide ITS Architecture. It is important to note that as ITS services and systems are implemented, part of the planning and review process for those projects should include a review of potential agreements that would be needed for implementation or operations.

Table 9 – Potential Agreements

Status	Agreement and Agencies	Agreement Description
Future	**Joint Operations/Shared Control Agreements (Public-Public or Public-Private)**	These agreements would allow joint operations or control of certain systems and equipment. The agreement should define such items as hours of operation and time of day/day of week when shared control would take effect, circumstances, or incidents when shared control would take effect, notification procedures between the agencies agreeing to shared control arrangements, overriding capabilities of owning agency, etc. Private agencies, such as information service providers that provide traffic reports, also could be part of this agreement.
Future	**Data Sharing and Usage (Public-Public)**	These agreements would define the parameters, guidelines, and policies for inter- and intra-agency ITS data sharing. This data sharing would support regional activities related to traffic management, incident management, traveler information, and other functions. The terms of this agreement generally should address such items as types of data and information to be shared, how the information will be used (traffic incident information to be shared, displayed on website for travel information, distributed to private media, etc.), and parameters for data format, quality, and security.
Future	**Data Sharing and Usage (Public-Private)**	These agreements would define the parameters, guidelines, and policies for private sector (such as the media or other information service providers) use of ITS data. This type of agreement is recommended to define terms of use for broadcasting public agency information regarding traffic conditions, closures, restrictions, as well as video images. Agreements also can include requirements for the media to "source" the information (e.g., using the providing agency's logo on all video images broadcast).
Future	**Mutual Aid Agreements (Public-Public)**	Mutual aid agreements often exist as either formal or informal arrangements. They are a routine practice among many public safety and emergency services agencies. Formal mutual aid agreements will become more important as agencies integrate systems and capabilities, particularly automated dispatch and notification. Formalized agreements should be considered as ITS or other electronic data sharing systems are implemented in the region.

4.5 Phases of Implementation

The Statewide ITS Architecture will be implemented over time through a series of projects led by both public sector and private sector agencies. Key foundation systems will need to be implemented in order to support other systems that have been identified in the Statewide ITS Architecture. The deployment of all of the systems required to achieve the final Statewide ITS Architecture build out will occur over many years.

A sequence of projects and their respective time frames have been identified in the Statewide ITS Deployment Plan. These projects will be sequenced over a 15-year period, with projects identified for deployment in 0 to 3 year, 4 to 8 year, and 8 to 15 year timeframes.

Some of the key market packages that will provide the functions for the foundation systems for the State of Michigan are listed below. Projects associated with these and other market packages identified for the State will be included in the Statewide ITS Deployment Plan.

- Network Surveillance;
- Weather Information Processing and Distribution;
- Traffic Information Dissemination; and
- Interagency Coordination.

4.6 Incorporation into the Regional Planning Process

Stakeholders invested a considerable amount of effort in the development of the Statewide Architecture and the Regional ITS Architecture and Regional ITS Deployment Plans in Michigan. The plans need to be incorporated into local and statewide planning process so that the ITS vision for the State of Michigan is considered when implementing ITS projects and to ensure that Michigan remains eligible for federal funding for implementation of the projects.

As projects are added to the Transportation Improvement Program (TIP), each project should be evaluated to determine if the project includes any ITS elements. If the project contains an ITS element, then the Statewide and corresponding Regional ITS Architecture needs to be reviewed to ensure that the project is in conformance. The MDOT ITS Program Office will perform this examination as part of the planning process using the procedure outlined in Section 6.

5. STATEWIDE DEPLOYMENT PLAN DEVELOPMENT

The MDOT Statewide ITS Deployment Plan is based on a summary of the regional deployment plans amended with any statewide projects that may require ITS funds. To date, ITS deployments have been concentrated almost exclusively in the two largest metropolitan areas, Detroit and Grand Rapids. Both systems include a Transportation Management Center (TMC) that utilizes closed circuit television (CCTV) cameras, detection equipment and dynamic message signs (DMS) to manage traffic on regional freeways. Both systems focus on incident management activities and traveler information with the goal of improving the safety and mobility of the traveling public.

In recent years, initial deployments have been implemented in the North, Superior, and Bay regions. Along with the growing deployment, has come the need to look at ITS from a statewide perspective. Not only is this important from a funding standpoint, but also from a systems engineering approach. It is important for the regions to learn from each other and grow the Department's collective knowledge of ITS. For example, the Superior Region has become the lead for RWIS deployments and other regions, including the North Region, will follow their lead based on certain lessons learned. Also several TMCs are planned across the state, and it is important to look at these facilities from a statewide perspective to ensure consistency and interoperability.

While recognizing the potential of ITS applications, MDOT also recognizes that implementing ITS technologies in an ad-hoc manner across the State would not provide the system wide integration desired, nor achieve statewide performance requirements, and would not be cost-effective. Coordination of services and communication between regions on program and project investments is a critical requirement for long-term success. Operations, maintenance and ultimately replacement costs would be increased without this integrated approach.

Statewide initiatives currently under development include the implementation of statewide Advanced Traffic Management System (ATMS) software. The ATMS project will provide a common platform for all ITS deployments across the State and allow any facility to access and control field devices regardless of the facility of device location. This will enhance coordination between regions and enable centers to back each other up during off-hours or times of emergency.

The development of a Statewide ITS Deployment Plan should be seen as a living document that is revisited annually and updated based on the available budget for ITS projects. During the winter of each year, usually in February, the MDOT ITS Program Office conducts a meeting with the regional ITS representatives from each of the 7 regions and the ITS Program Office. The intent of the meeting is to discuss project needs, desires, and the proposed budget for funding future ITS projects. Most of the regions revised or completed their regional architectures and deployment plans in 2008, with the exception of 2 that will be revised in 2010. Once completed, all of the regions will have deployment plans based on consistently evaluated projects. Because the regional deployment plans were implemented based on a standardized analysis, the prioritization of projects from a statewide perspective is more easily achieved.

At the annual regional ITS representatives meeting, the ITS Program Office facilitates a discussion to prioritize the regions' projects from a statewide perspective. Currently, the projects are grouped on a yearly basis for a range of 4 to 7 years. Each year is fiscally constrained based on the anticipated budget for that year. Through collaboration, the stakeholders resolve to a revised statewide list of prioritized projects. A graphical representation of this process is shown in **Figure 12.**

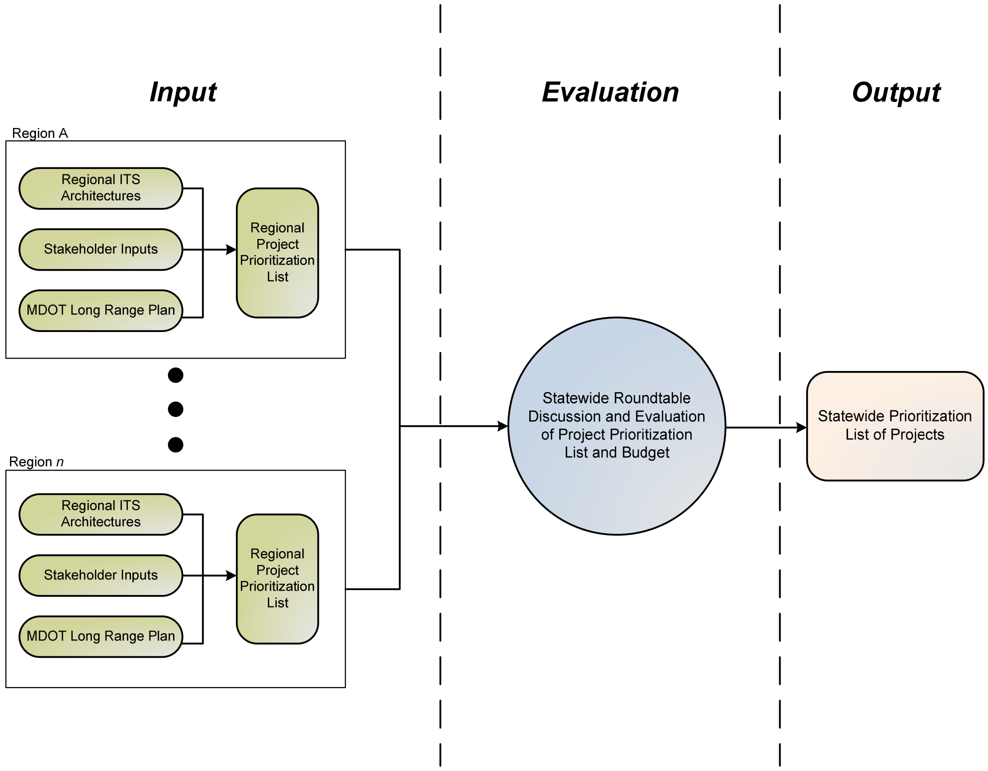

Figure 12 - Process to Determine Statewide Project Prioritization List

The initial list of statewide projects was developed in 2008. In 2009, and in future years, the statewide list of prioritized projects is evaluated and expanded based on anticipated changes in the ITS budget. Once the existing years of projects are addressed, consideration is given to projects not currently included and the list is expanded based on the number of years that is deemed appropriate with the current budget standings. If the ITS budget has been substantially cut, it may be appropriate to show more years than usual so regions can see how long their project may be delayed. Each year the list of projects is evaluated based on the existing funding environment and feedback from the regional ITS representatives.

6. USE AND MAINTENANCE PLAN FOR THE STATEWIDE ITS ARCHITECTURE

The Statewide ITS Architecture and Deployment Plan developed addresses the state's vision for ITS implementation at the time the plan was developed. Stakeholders invested a considerable amount of effort in the development of the Statewide ITS Architecture and Statewide ITS Deployment Plan. As time goes on, needs will change, priorities will shift as areas of the State grow and develop, and, as technology progresses, new ITS opportunities will arise. Shifts in focus as well as changes in the National ITS Architecture will necessitate that the Statewide ITS Architecture be updated to remain a useful resource for the State of Michigan. The following section outlines how MDOT can work with partner agencies to ensure projects are in conformity and also provide updates as ITS evolves in the State.

6.1 Process for Determining Architecture Conformity

The Statewide ITS Architecture and Statewide ITS Deployment Plan documents the customized market packages that were developed as part of the ITS architecture process. To satisfy federal requirements and retain eligibility to use federal funds, a project must be documented accurately. To document the conformity of an ITS project with the regional architecture, MDOT's ITS Program Office will oversee the development of a regional architecture conformance form to guide project managers through the process. The project managers will be able to coordinate with the ITS Program Office and regional contact for additional assistance and guidance. The steps of the process are as follows:

- Identify the ITS components in the project;
- Identify the corresponding market packages(s) from the ITS Architecture;
- Locate the component within the market package;
- Compare the connections to other agencies or elements documented in the ITS Architecture as well as the information flows between them to the connections that will be part of the project;
- Assess the use of relevant standards; and
- Document any changes necessary to the ITS Architecture or the project to ensure there is conformance.

<u>Identifying the ITS Components</u>

ITS components can be fairly apparent in an ITS-focused project such as CCTV or DMS deployments, but also could be included in other types of projects. For example, an arterial widening project could include the installation of signal system interconnect, signal upgrades, and the incorporation of the signals in the project limits into the MDOT's signal system. These are all ITS deployments and should be part of the ITS architecture.

<u>Identifying the Corresponding Market Packages</u>

If a project was included in the Deployment Plan, then the applicable market package(s) for that project are identified in a column. ITS projects are not required to be included in the ITS Deployment Plan in order to be eligible for federal funding; therefore, market packages might need to be identified without the assistance of an ITS Deployment Plan. In that case, the market packages selected and customized for Statewide are identified in **Table 5** of this document, detailed market package definitions are located in **Appendix A**, and customized market packages for Statewide are included in **Appendix B**.

Identifying the Component within the Market Package

The customized market packages for Statewide are located in **Appendix B**. Once the element is located on the market package, the evaluator may determine that the element name should be modified. For example, an element called the Statewide TMC - Lansing was included in the architecture, but at the time of deployment, MDOT may decide to call the center by a new name once the location is finalized. This name change should be documented using the process outlined in Section 1.3.

Evaluating the Connections and Flows

The connections and architecture flows documented in the market package diagrams were selected based on the information available at the time the plan was developed. As the projects are designed, decisions will be made on the system layout that might differ from what is shown in the market package. These changes in the project should be documented in the ITS market packages using the process outlined in Section 1.3.

Relevant Standards

ITS Standards are documented guidelines or rules specifying the interconnections among elements and the characteristics of technologies and products to be used in ITS installations. Standards describe in detail what types of interfaces should exist between ITS components and how the components will exchange information and work together to deliver certain user services. The Statewide ITS Architecture highlights the relevant standards based on the region's needs. These standards should be reviewed as part of this conformity exercise. Where standards can be utilized, they should be noted. Where standards are not or could not be utilized, an explanation of why also should be noted.

Documenting Required Changes

If any changes are needed to accommodate the project under review, Section 1.3 describes how those changes should be documented. Any changes will be incorporated during the next architecture update. Conformance will be accomplished by documenting how the market package(s) should be modified so that the connections and data flows are consistent with the project.

6.2 Maintenance Process

MDOT's ITS Program Office will be responsible for leading the maintenance of the Statewide ITS Architecture and ITS Deployment Plan in coordination with the statewide contact. Maintenance includes modifications to the plan as well as complete updates. **Table 10** summarizes the maintenance process agreed upon by stakeholders.

Table 10 – Regional ITS Architecture and Deployment Plan Maintenance Summary

Maintenance Details	Regional ITS Architecture		Regional ITS Deployment Plan	
	Modification	Complete Update	Modification	Complete Update
Timeframe for Updates	As needed	Every 5-7 years	As needed	Every 5-7 years
Scope of Update	Update market packages to satisfy architecture conformance requirements of projects or to document other changes that impact the ITS Architecture	Entire ITS Architecture	Update project status and add or remove projects as needed	Entire ITS Deployment Plan
Lead Agency	MDOT ITS Program Office*		MDOT ITS Program Office*	
Participants	Stakeholders impacted by market package modifications	Entire stakeholder group	Entire stakeholder group	
Results	Market package or other change(s) documented for next complete update	Updated North Regional ITS Architecture document, Appendices, and Turbo Architecture database	Updated project tables	Updated North Regional ITS Deployment Plan document

** Transit related projects will be supported by MDOT's Bureau of Passenger Transportation*

Modifications to the Statewide ITS Architecture and ITS Deployment Plan often will be necessitated by ITS projects that are receiving federal funding but do not conform to the Statewide ITS Architecture. MDOT's ITS Program Office will take the lead in working with agencies that receive federal funding for ITS projects and will keep a record of any changes that are needed to the Statewide ITS Architecture. Complete updates to the Statewide ITS Architecture will occur approximately every five to seven years and will be led by the MDOT's ITS Program Office. The entire stakeholder group that was engaged to develop this first Statewide ITS Architecture will be reconvened for the complete updates.

6.3 Procedure for Submitting ITS Architecture Changes Between Scheduled Updates

Updates to the Statewide ITS Architecture will occur on a regular basis as described in Section 1.2 to maintain the architecture as a useful planning tool. Between complete plan updates, smaller modifications will likely be required to accommodate ITS projects within the State. Section 1.1 contains step by step guidance for determining whether or not a project requires architecture modifications.

For situations where a change is required, an ITS Architecture Maintenance Documentation Form was developed and is included in **Appendix E**. This form should be completed and submitted to the MDOT ITS Program Office whenever a change to the Statewide ITS Architecture or ITS Deployment Plan is proposed. Please note that MDOT's Bureau of Passenger Transportation also should be copied if the project has a transit related component.

The Maintenance Documentation form identifies three levels of modifications. They include:

- Level 1 – Basic changes that do not affect the structure of the architecture.
  Examples include: Changes to stakeholder or element name, element status, or data flow status.
- Level 2 – Structural changes that impact only one agency.
  Examples include: Addition of a new market package or modifications to an existing market package that affects only one agency.
- Level 3 – Structural changes that have the potential to impact multiple agencies.
  Examples include: Addition of a new market package or modifications to an existing market package that involves multiple agencies or incorporation of a new stakeholder into the architecture.

While documenting the proposed change, the project manager completing the change form should coordinate with any of the other agencies that may be impacted by the modification. This communication between agencies will simplify the process of performing a complete plan update. MDOT's ITS Program Office will review and accept the proposed changes. When a complete update is performed by MDOT's ITS Program Office, all of the documented changes will be incorporated into the ITS architecture. Error! Reference source not found. graphically illustrates this process.

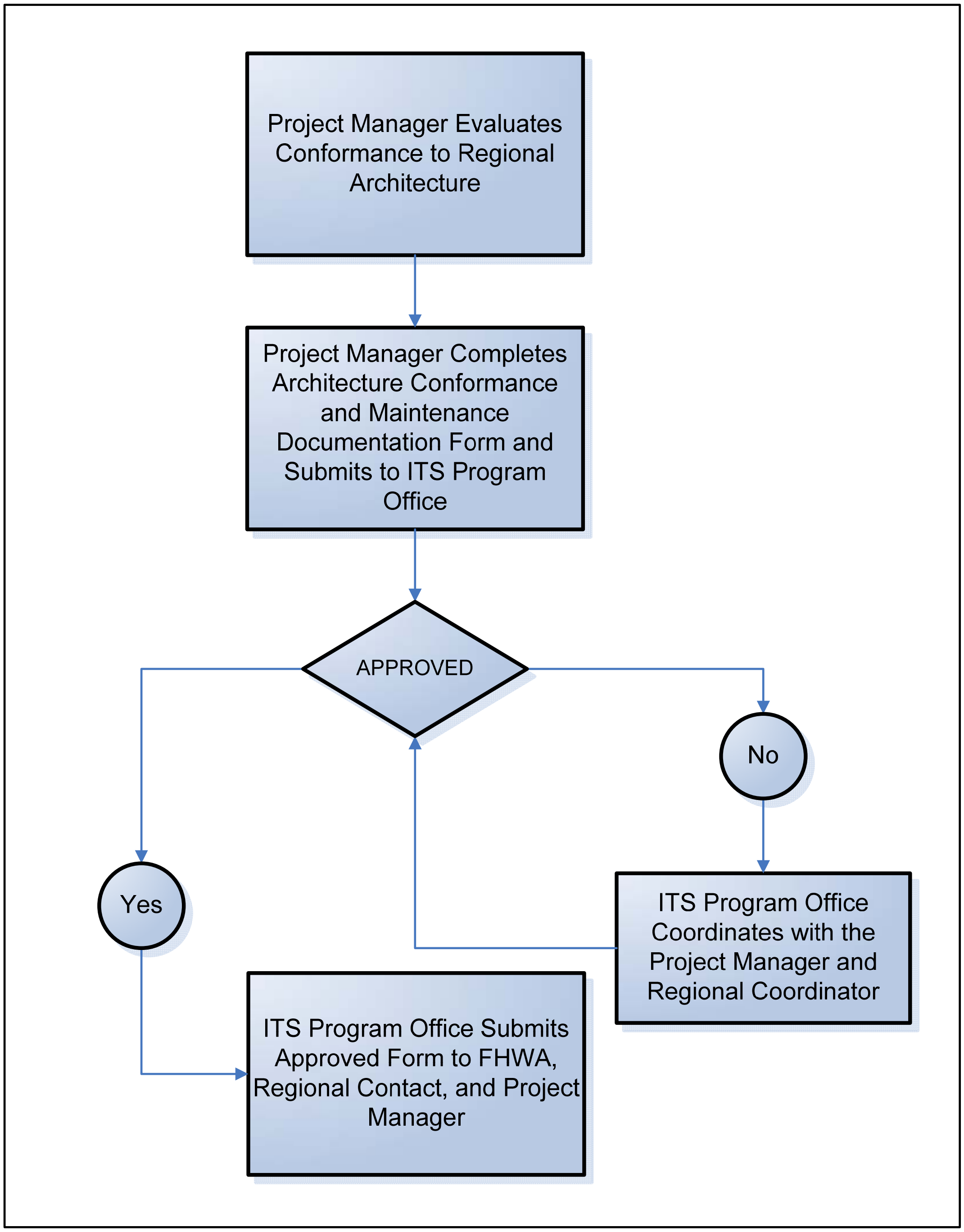

Figure 13. Process for Documenting Architecture Performance