Memphis Urban Area
Regional ITS Architecture

Regional ITS Deployment Plan

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REGIONAL ITS DEPLOYMENT PLAN

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AD	Archived Data
AHTD	Arkansas State Highway and Transportation Department
APTS	Advanced Public Transportation System
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
BRT	Bus Rapid Transit
CCTV	Closed Circuit Television
CVISN	Commercial Vehicle Information Systems and Networks
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Sign
EM	Emergency Management
EMA	Emergency Management Agency
EMS	Emergency Medical Services
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
ICS	Incident Command System
ITS	Intelligent Transportation System
MATA	Memphis Area Transit Authority
MC	Maintenance and Construction
MDOT	Mississippi Department of Transportation
MPO	Metropolitan Planning Organization
RPO	Regional Planning Organization
RWIS	Road Weather Information System
TDOT	Tennessee Department of Transportation
THP	Tennessee Highway Patrol
TMC	Traffic Management Center
TOC	Traffic Operations Center
TSIS	TDOT SmartWay Information System

1. INTRODUCTION

1.1 Project Overview

In 2010 the Memphis Urban Area Regional Intelligent Transportation System (ITS) Architecture was updated under the direction of the Memphis Urban Area Metropolitan Planning Organization (MPO) with support from the Tennessee Department of Transportation (TDOT). The Regional ITS Architecture provides a framework for implementing ITS projects, encourages interoperability and resource sharing among agencies, identifies applicable standards to apply to projects, and allows for cohesive long-range planning among regional stakeholders. The Memphis Urban Area Regional ITS Architecture focuses on the functionality that ITS provides in the Region as well as how those functions are operated by agencies in and around the Memphis Region. The Regional ITS Architecture also satisfies an important requirement from the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) regarding transportation funding. An FHWA Final Rule and an FTA Final Policy issued in 2001 require that regions have an updated regional ITS architecture and show how ITS projects conform to that regional ITS architecture in order to receive federal funding.

The 2010 Memphis Urban Area Regional ITS Deployment Plan was developed as a companion document to the Memphis Regional ITS Architecture. Although it is not required by FHWA and FTA, the Regional ITS Deployment Plan is a useful tool for regions to identify specific projects that should be deployed in order to achieve the desired functionality identified in their Regional ITS Architecture. The Regional ITS Deployment Plan builds on the Regional ITS Architecture by outlining specific ITS project recommendations and strategies for the Region and identifying deployment timeframes so that the recommended projects and strategies can be implemented over time.

The Regional ITS Deployment Plan also shows the correlation between each project and the Regional ITS Architecture by identifying the market packages that correspond with each project. If projects are identified that do not correspond to a market package, the Regional ITS Architecture can be revised while in draft format; therefore, the resulting ITS deployment projects from this effort should be clearly supported by the Regional ITS Architecture.

The Memphis Urban Area Regional ITS Architecture and Deployment Plan were both developed with significant input from local, state, and federal officials. A series of four workshops was held to solicit input from stakeholders and ensure that the plan reflected the unique needs of stakeholders in the Region. Electronic copies of the draft reports were made available to all stakeholders for their review and comment during the development of the plans, and comments were addressed with the entire stakeholder group during the workshops.

The geographic boundaries were defined for the Memphis Urban Area Regional ITS Architecture using the boundaries of the Memphis Urban Area MPO. The MPO includes all of Shelby County and the western portion of Fayette County in Tennessee, and the northern portion of De Soto County in Mississippi. In addition, the TDOT SmartWay ITS deployments on I-40 and I-55 in Arkansas are also considered part of the Memphis Urban Area Regional ITS Architecture boundaries. These deployments were implemented and are currently operated by the TDOT Region 4 SmartWay Traffic Management Center (TMC) in Memphis. A map of the Memphis Urban Area MPO, which defined the geographic boundaries of the Regional ITS Architecture, has been provided in **Figure 1**.
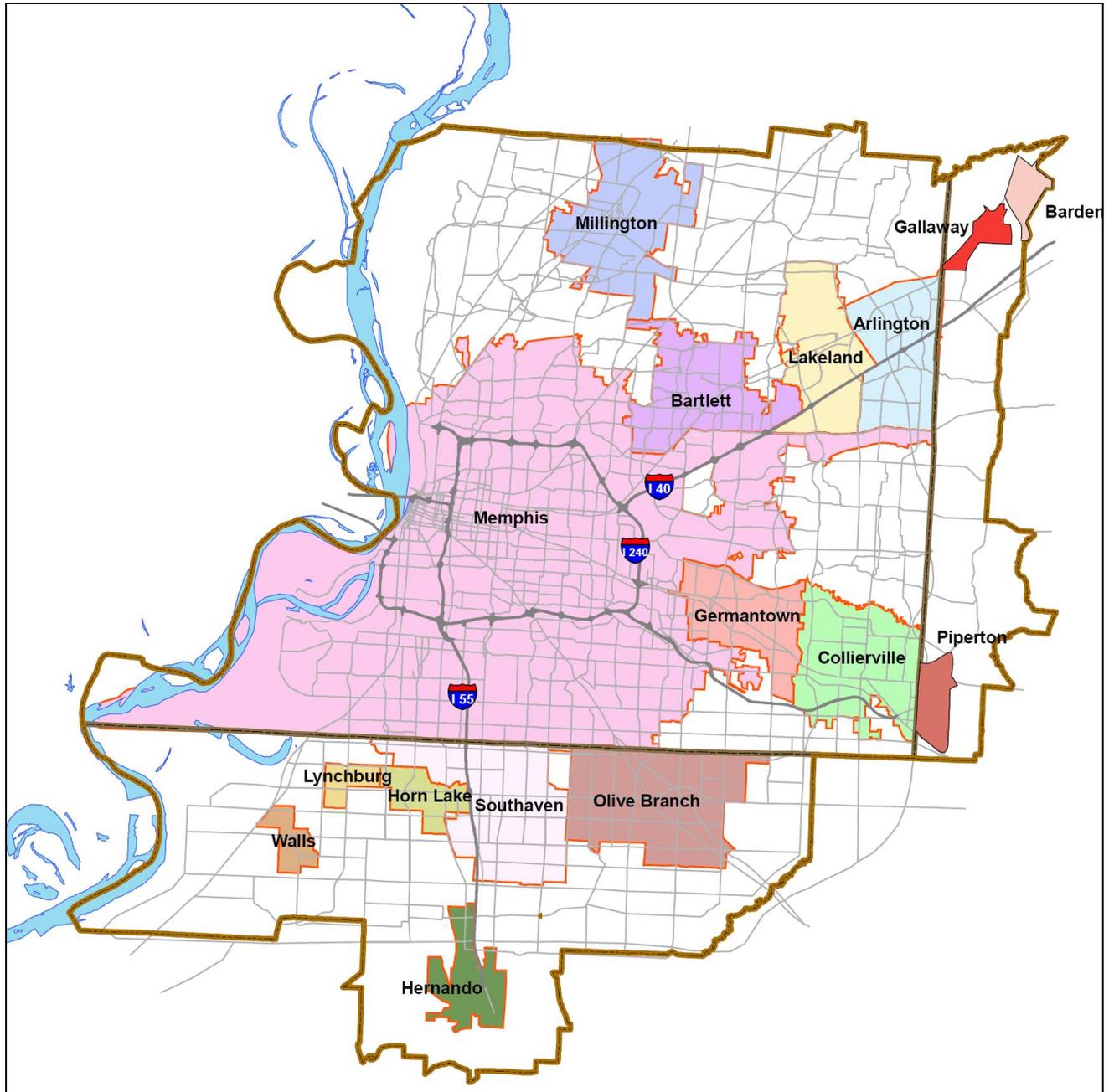
Figure 1 – Memphis Urban Area MPO Boundaries

Stakeholders that participated in the update of the Regional ITS Architecture and Deployment Plan process included representatives from city, county, regional, state, and federal agencies. Groups such as traffic, transit, and emergency management were represented. Stakeholders included both representatives from local agencies as well as representatives from the TDOT Long Range Planning Division in Nashville, Arkansas State Highway and Transportation Department (AHTD) in Little Rock, Mississippi Department of Transportation (MDOT) in Jackson, and FHWA Tennessee and Arkansas Division Offices. A list of the participating stakeholder agencies is provided below. A complete list of individuals representing the agencies has been provided in the Memphis Urban Area Regional ITS Architecture document.

- Arkansas Highway Patrol;
- Arkansas State Highway and Transportation Department;
- City of Bartlett;
- City of Germantown;
- City of Horn Lake;
- City of Memphis;
- City of Millington;
- Federal Highway Administration – Arkansas Division;
- Federal Highway Administration – Tennessee Division;
- Memphis Area Regional Planning Organization;
- Memphis Area Transit Authority;
- Memphis Urban Area MPO;
- Mississippi Department of Transportation;
- Shelby County Office of Preparedness;
- TDOT Long Range Planning Division;
- TDOT Region 4;
- Tennessee Highway Patrol;
- Town of Collierville; and
- West Memphis MPO.

1.2 Deployment Plan Project Development Process

An overview of the process used to develop the Regional ITS Deployment Plan is provided in **Figure 2**. This figure demonstrates that a variety of inputs were used to gather information and develop a set of ITS projects for selection by stakeholders. Through an ITS Deployment Plan Workshop with regional stakeholders in March 2010, and subsequent review of the plan by the stakeholders, the projects for inclusion in the ITS Deployment Plan were selected and defined. The resulting Memphis Urban Area ITS Deployment Plan will provide stakeholders with a list of regionally significant ITS projects that are consistent with to the Regional ITS Architecture and assist with addressing transportation needs in the Region.

The inputs identified in Step 1 of **Figure 2** include regional ITS needs, ITS market package priorities, regional and local plans, and stakeholder recommendations. Each of these is expanded on in Section 2 of this report. The ITS needs were gathered through the Regional ITS Architecture Kickoff Workshop which was held in October 2009 with all stakeholders. In the second Regional ITS Architecture Workshop, which was held in January 2010, stakeholders discussed and selected ITS market packages for the Memphis Urban Area. ITS market packages represent the services that ITS can provide, such as Network Surveillance and Traffic Information Dissemination. In the Memphis Urban Area stakeholders identified 44 market packages for

consideration in the Region and later ranked those market packages as high, medium, or low priority. Planning documents, such as the Memphis Urban Area 2030 Long-Range Transportation Plan and the 2002 Memphis Area Regional ITS Architecture report, were reviewed by the project team to identify other needs and priorities not specifically discussed in the workshops. Finally, stakeholders were asked directly for their project ideas to include in the Regional ITS Deployment Plan.

The inputs in Step 1 led to the project selection in Step 2. Project selection was completed through a combination of the ITS Deployment Plan Workshop held with stakeholders in March 2010 as well as stakeholder review of the Draft Regional ITS Deployment Plan. Through this two part review the final projects were selected and further defined for the plan.

The outputs of the plan, shown in Step 3, will provide stakeholders and the Memphis Urban Area MPO with a list of many of the priority ITS projects for the Memphis Urban Area. Each of the projects recommended in the Regional ITS Deployment Plan has been checked against the Memphis Urban Area Regional ITS Architecture to ensure they are consistent with the Regional ITS Architecture. This should assist agencies deploying these projects in the future with meeting FHWA and FTA requirements for ITS architecture conformity. Finally, the Regional ITS Deployment Plan is something that could feed into the long-range planning process and provide agencies with a list of priority ITS projects for consideration during future calls for projects from the Memphis Urban Area MPO.
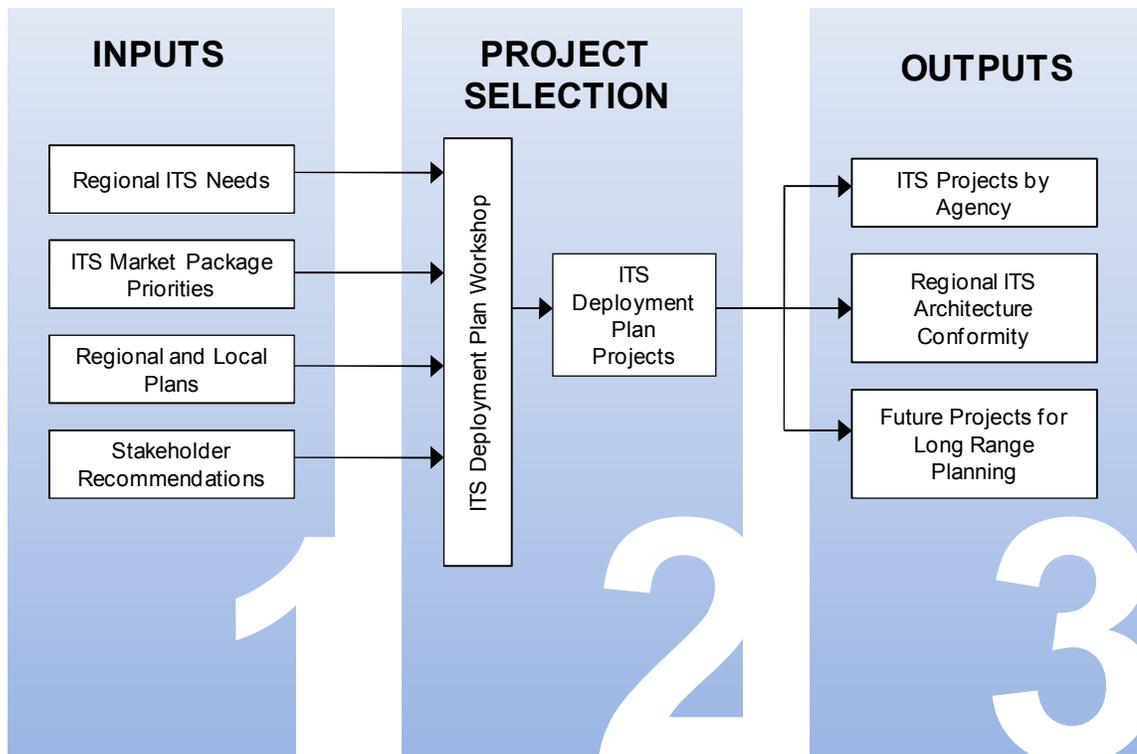
Figure 2 – Memphis Urban Area Regional ITS Deployment Plan Development Process

1.3 Document Overview

The Memphis Urban Area Regional ITS Deployment Plan is organized into five sections:

Section 1 – Introduction

This section provides an overview of the Memphis Urban Area Regional ITS Deployment Plan development process and an overview of the geographic boundaries and stakeholders in the Region.

Section 2 – ITS Project Identification and Selection

This sections identifies the inputs that were gathered to develop the ITS project recommendations and discusses the types of ITS projects that were considered for implementation in the Memphis Urban Area Region.

Section 3 – ITS Market Package Implementation

A summary of the ITS market packages that were selected and prioritized for the Region is provided in this section. Each ITS market package includes a definition and a listing of projects that support implementation of the market package services.

Section 4 – ITS Project Recommendations

This section contains project recommendations to address stakeholder needs and goals for ITS implementation in the Region. Each project includes a description of the project, deployment time-frame, agency responsible for deployment, an opinion of probable cost, status of funding, and a listing of ITS market packages associated with the project.

Section 5 – Use and Maintenance of the Regional ITS Deployment Plan

This section contains an overview of the systems engineering analysis process and a discussion on determining ITS architecture conformity for future ITS projects. Use and maintenance of the Regional ITS Architecture and Deployment Plan is also discussed.

2. ITS PROJECT IDENTIFICATION AND SELECTION

In Section 2 the process used to identify and select ITS projects for the Memphis Urban Area is presented. This consisted of two primary phases. The first was the gathering of inputs to develop projects. Inputs included a review of regional ITS needs, ITS market packages, existing and planned infrastructure, and stakeholder inputs. Based on the inputs received a series of ITS project types were developed for consideration in the Memphis Urban Area. These ITS project types were presented to stakeholders and used as the basis for developing more specific project recommendation for deployment by the stakeholder agencies in Region.

2.1 Project Development Inputs

Section 2.1.1 through 2.1.4 provides an overview of the four primary types of project inputs gathered to develop the Memphis Urban Area Regional ITS Deployment Plan. While each input was important, the primary driver of the Regional ITS Deployment Plan was the direct input from the stakeholder agencies. Each of the recommended ITS projects in the Regional ITS Deployment Plan was discussed with the stakeholder at the March 2010 ITS Deployment Plan Workshop and the projects presented in this plan are intended to directly reflect the decisions made by the stakeholders.

2.1.1 Regional ITS Needs

Regional needs were documented throughout the Regional ITS Architecture and Deployment Plan development process. Though some needs were very specific, such as the desire for an arterial service patrol, others were more general in nature and are supported by a variety of projects. Still others are important needs for the area, but are dependent on many other factors and are therefore such long-term needs that projects were not specifically identified.

Some of the primary regional ITS needs that were identified for the Memphis Urban Area are included below. These represent many of the needs that were first identified at the ITS Architecture Kick-off Workshop held in October 2009 and continued to be discussed throughout the project.

- Expand the TDOT SmartWay ITS system to provide full coverage of freeways in the Memphis Urban Area;
- Provide travel time information on dynamic message signs (DMS);
- Improve traffic signal coordination and active signal system management;
- Improve traffic signal coordination between cities at jurisdictional boundaries;
- Increase the safety and security of the transportation system;
- Improve incident management across jurisdictional boundaries, especially as it relates to traffic management;
- Establish a traffic incident management group that plans for incidents and reviews the response after a large scale incident;
- Develop and implement advanced plans for the traffic management response to roadway closures including detour routing and arterial management;
- Establish an arterial version of the HELP service patrol program; and
- Improve coordination between the Memphis Area Transit Authority (MATA) and the Arkansas State Highway and Transportation Department.

2.1.2   ITS Market Package Prioritization

Of the 91 ITS market packages available in Version 6.1 of the National ITS Architecture, 44 were selected by stakeholders and customized for deployment in the Memphis Urban Area as part of the Regional ITS Architecture development process. The market packages outline the services that ITS can provide in the Region and include the agencies that will be involved, elements that need to be deployed, and the interfaces that need to be established to integrate functionality and share data.   The selected market packages were prioritized as high, medium, or low by stakeholders at the ITS Deployment Plan Workshop in March 2010.

Many of the recommended ITS projects in the Memphis Urban Area ITS Deployment Plan have been based on the high priority ITS market packages, especially those related to Traffic Management and Public Transportation Management.   The prioritized market packages that were selected by stakeholders are shown in **Table 1**.

Table 1 – Memphis Urban Area ITS Market Package Prioritization by Functional Area

High Priority Market Packages	Medium Priority Market Packages	Low Priority Market Packages
Traffic Management		
ATMS01 Network Surveillance ATMS03 Surface Street Control ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management ATMS08 Traffic Incident Management System	ATMS04 Freeway Control ATMS13 Standard Railroad Grade Crossing ATMS17 Regional Parking Management	ATMS02 Traffic Probe Surveillance ATMS10 Electronic Toll Collection ATMS11 Emissions Monitoring and Management ATMS19 Speed Monitoring
Emergency Management		
EM01 Emergency Call-Taking and Dispatch EM02 Emergency Routing EM04 Roadway Service Patrols EM05 Transportation Infrastructure Protection	EM06 Wide-Area Alert EM08 Disaster Response and Recovery EM09 Evacuation and Reentry Management EM10 Disaster Traveler Information	
Maintenance and Construction Management		
MC08 Work Zone Management MC10 Maintenance and Construction Activity Coordination MC12 Infrastructure Monitoring	MC01 Maintenance and Construction Vehicle and Equipment Tracking MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution	MC05 Roadway Automated Treatment MC06 Winter Maintenance
Public Transportation Management		
APTS01 Transit Vehicle Tracking APTS02 Transit Fixed Route Operations APTS03 Demand Response Transit Operations APTS08 Transit Traveler Information APTS09 Transit Signal Priority	APTS04 Transit Fare Collection Management APTS05 Transit Security APTS07 Multi-Modal Coordination APTS10 Transit Passenger Counting	APTS06 Transit Fleet Management
Traveler Information		
ATIS01 Broadcast Traveler Information ATIS02 Interactive Traveler Information		
Commercial Vehicle Operations		
	CVO10 HAZMAT Management	
Archived Data Management		
	AD1 ITS Data Mart	AD2 ITS Data Warehouse AD3 ITS Virtual Data Warehouse

2.1.3 Existing Infrastructure and Planning Efforts

The Memphis Urban Area has been actively deploying ITS for over 10 years. A majority of the ITS efforts in the Region have been led by TDOT or the municipalities and have focused primarily on traffic management and traveler information. MATA has also become a very active in ITS and is currently implementing a $10 million package of ITS components that will provide them the ability to track buses, provide real-time information to transit users, and increase security.

The largest deployment in the Memphis Urban Area has been the TDOT SmartWay Program. The program began with the early deployment of closed circuit television (CCTV) cameras, DMS, and highway advisory radio (HAR) to assist with incident management and provide information to motorists during the major seismic retrofit of the I-40 bridge over the Mississippi River. This deployment included implementation of ITS in both Tennessee and Arkansas along I-40. TDOT has continued to expand the SmartWay ITS System and currently covers approximately 70 miles of freeway in Tennessee and Arkansas. **Figure 3** provides an overview of the ITS field components currently deployed in the Memphis Urban Area. TDOT deployments also include the SmartWay TMC located in Memphis, HELP service patrols, and a statewide 511 traveler information number.

The primary deployments by the municipalities in the Memphis Urban Area have been traffic signal systems. The Cities of Memphis, Bartlett, and Germantown, and the Town of Collierville each have signal systems that allow them to adjust timing plans and monitor controller operations remotely from existing or planned traffic operations centers (TOCs). Plans are also underway for CCTV cameras in each of these jurisdictions as well as communications with adjacent cities to coordinate timing plans where systems meet and share CCTV images from these same border areas.

MATA is currently in the process of a major ITS deployment. Their system will include automate vehicle location (AVL) on buses to allow real-time transit vehicle location, next-bus arrival DMS at transit transfer stations and bus stops, and real-time transit information available on a web-site. The MATA ITS deployment will also increase security with on-board video cameras and transit vehicle alarms. Automated passenger counters are also being deployed on buses. Future plans include the deployment of a bus rapid transit system with traffic signal priority provided on selected corridors.

Memphis Regional ITS System
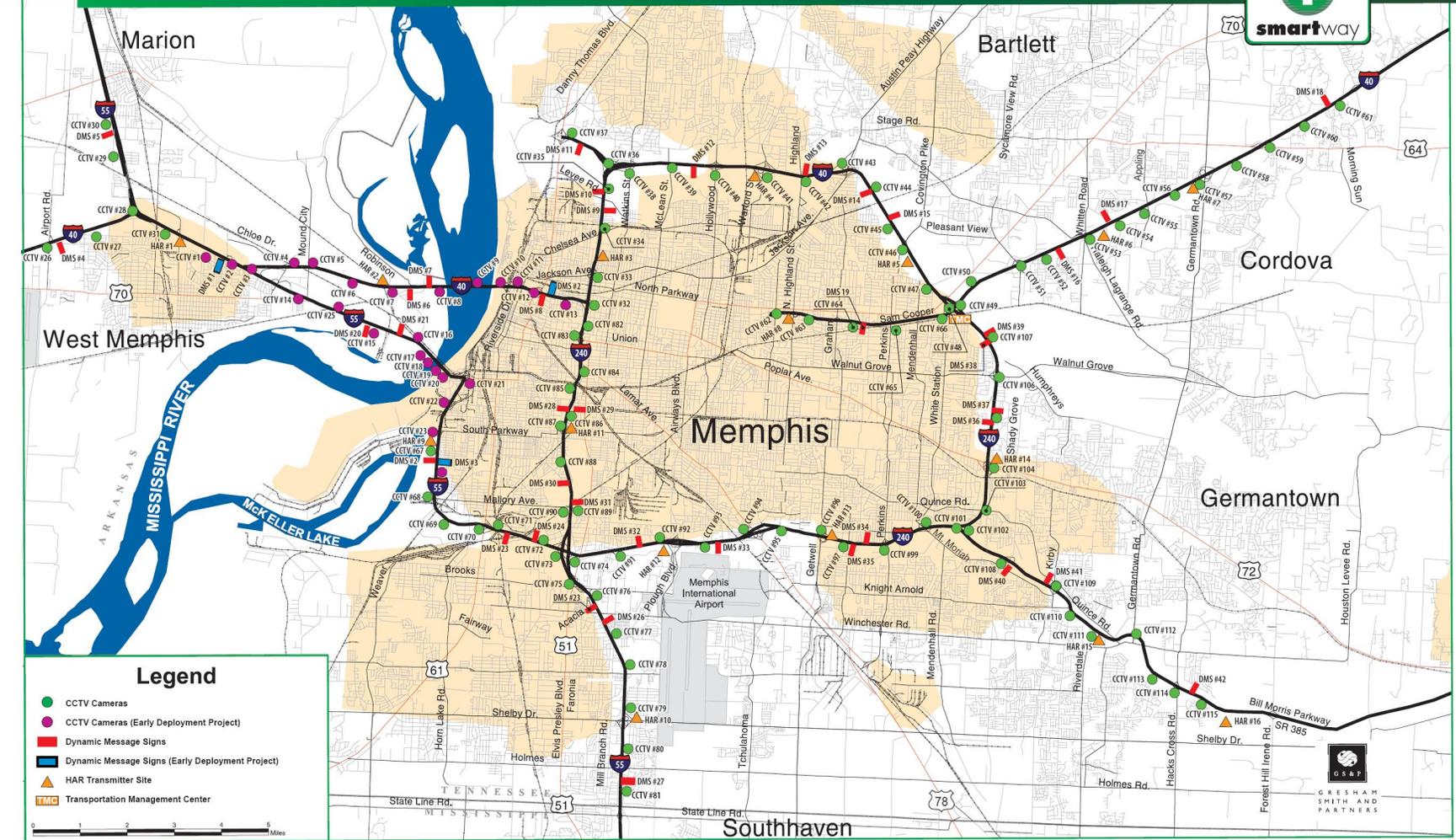
Figure 3 – TDOT Region 4 SmartWay ITS System

Source: TDOT Region 4

2.1.4 Stakeholder Input

The primary source of stakeholder input came from discussions at the four stakeholder workshops conducted in Memphis as part of the update of the Memphis Urban Area Regional ITS Architecture and Deployment Plan. In particular, the ITS Deployment Plan Workshop held in March 2010 focused almost entirely on identifying and discussing ITS projects that could be deployed in the Region to assist in implementing the services identified through the ITS market packages. At this workshop stakeholders identified specific projects and timeframes for deployment by their agencies. The ITS Deployment Plan is not fiscally constrained so even though many of the ITS projects identified do not have any funding associated with them, they do represent projects that are important in the Region.

In addition to the ITS Deployment Plan Workshop, stakeholders were also provided with a form for providing input to the project team on any ITS projects that were planned or desired by their agency.

2.2 Project Types for Consideration

To assist in the development of the ITS Deployment Plan, a number of project types were considered and presented to stakeholders as part of a straw man list of ITS projects. The list allowed stakeholders to consider many different project types and select those that they felt were most beneficial and feasible for deployment by their agency. Projects were generally assigned to one of five different categories of projects and included:

- Traffic Management and Traveler Information Projects;
- Emergency Management Projects;
- Maintenance and Construction Management Projects;
- Transit Management Projects; and
- Archived Data Management Projects.

In Section 2.2.1 through 2.2.5 the project types that were considered are provided with a description of the type of project. The ITS market packages that correspond to each project type have also been provided.

2.2.1 Traffic Management and Traveler Information Project Types

Traffic Management Center or Traffic Operations Center

The term traffic management center (TMC) is typically used to describe a large, dedicated traffic management facility that may also house other agencies, such as service patrol dispatch or a police department representative. TMCs tend to control many types of ITS equipment and are frequently staffed 24 hours a day. A traffic operations center (TOC) is typically thought of as a single agency facility, commonly incorporated into the agency's regular office space or signal maintenance facility. Traffic signal operations are generally the primary focus, although other devices may also be operated from the center.

Associated Market Packages: ATMS01–Network Surveillance, ATMS03–Surface Street Control, ATMS04–Freeway Control, ATMS06–Traffic Information Dissemination, ATMS07–Regional Traffic Management, ATMS08–Traffic Incident Management System

Interagency Traffic Information Coordination

Through either a direct communication link or web-based information exchange portal, interagency information coordination projects support regional traffic management. Information shared can include video feeds, traffic conditions, and incident locations. Data can be exchanged between states, such as the existing connection between Tennessee and Arkansas that allows sharing of I-40 camera images; between municipalities and states, such as a TDOT Region 4 SmartWay TMC and the City of Memphis TOC connection; or between municipalities.

Associated Market Packages: ATMS07–Regional Traffic Management, ATMS08–Traffic Incident Management System

Advanced Traffic Management System Signal System Implementation or Upgrades

The Advanced Traffic Management System (ATMS) Signal System includes the communication system, field hardware, and traffic signal control software to allow real-time monitoring and control the traffic signal system. Depending on the needs of the agency, the ATMS could also be implemented to allow monitor and control DMS, process data from volume and speed detection stations, and provide video switching capabilities for CCTV cameras. Frequently the ATMS will also feed data directly onto a real-time traffic conditions website. At the municipal level the ATMS is typically chosen as part of the signal system selection process and modules are added to that software as needed to support other ITS deployments.

Associated Market Packages: ATMS03–Surface Street Control

Closed Circuit Television Camera Deployment

CCTV cameras are used to monitor traffic conditions and aid incident detection and emergency response. Though most of the existing deployments in the Region are on freeways and operated by TDOT, CCTV cameras can be useful tools for arterial traffic management as well. Camera feeds are frequently shared between agencies through center-to-center communications or web based portals to facilitate incident management.

Associated Market Packages: ATMS01–Network Surveillance

Volume and Speed Detection

Volume and speed data is primarily used for real-time incident detection and the calculation of travel times, but is also useful in planning. The freeway application is probably the most common implementation of vehicle detection. The TDOT SmartWay Center ATMS uses algorithms that process the detector data to identify slowdowns that may indicate that an incident has occurred and to provide travel time data. At the municipal level, midblock arterial detection can support arterial traffic management in much the same way. Vehicle detection that is used exclusively for traffic signal operations in not included in this project type.

Associated Market Packages: ATMS01–Network Surveillance

Dynamic Message Sign Deployment

DMS can be deployed on freeways or arterials to provide traveler information such as travel times; information about incidents, road conditions, and construction closures; and to support special event management.

Associated Market Packages: ATMS06–Traffic Information Dissemination

Railroad Grade Crossing Advance Notification System

In many areas at-grade rail crossings cause significant traffic issues and can delay emergency response times. Advance notification system projects can address these concerns. Through the deployment of arterial DMS or blank out static message signs, drivers can be alerted of blocked crossings in advance so that they can detour before getting caught in a queue waiting for a crossing to clear. To facilitate efficient dispatch, emergency dispatchers can route responders around the blocked crossings or dispatch from a different station altogether if they know of blocked crossings in advance. Though separate detection can be deployed, this is typically accomplished using the traffic signal system infrastructure. When a signal is preempted by a train, the signal system can activate any advance warning signage and pass the information along to emergency dispatchers using interagency information coordination mechanisms.

Associated Market Packages: ATMS13–Standard Railroad Control

TDOT SmartWay ITS Expansion

Projects to extend the TDOT SmartWay ITS coverage area or add functionality are a combination of deployments that may include CCTV cameras, DMS, HAR, and the communications to support the expansion. This could include deployments in Arkansas or Mississippi in coordination with AHTD and MDOT.

Associated Market Packages: ATMS01–Network Surveillance, ATMS06–Traffic Information Dissemination

Real-Time Traveler Information Websites

This project type covers the creation of new traveler information websites or improvements to add functionality to existing sites. The goal of these sites is to provide real-time information about road conditions including incidents, construction closures, or weather-related issues. Sometimes users can subscribe to automated alerts through this type of website.

Associated Market Packages: ATMS01–Network Surveillance, ATIS02–Traffic Probe Surveillance

Expand Use of the TDOT SmartWay Information System

The TDOT SmartWay Information System (TSIS) is the database behind the SmartWay website and Tennessee 511 System. Currently information can only be entered into TSIS by TDOT or the Tennessee Highway Patrol (THP). As more agencies have real-time data available, TDOT would like to expand the use of TSIS to be able to include local traffic, construction and incident information.

Associated Market Packages: ATMS08 – Traffic Incident Management System, ATIS01–Broadcast Traveler Information

2.2.2   Emergency Management Project Types

Interagency Incident Management Information Coordination

Through either a direct communication link or web-based information exchange portal, interagency information coordination projects support regional incident management. Information shared between traffic and emergency management agencies can include video feeds, traffic conditions, and incident locations.

Associated Market Packages: ATMS08–Traffic Incident Management System

Motorist Assistance Patrol Establishment or Service Area Expansion

TDOT has a HELP service patrol program that operates in the Memphis Urban Area. HELP operators assist motorists and facilitate incident traffic control. As the SmartWay system coverage is extended, the HELP service area will also likely be expanded. Several municipalities in the State have established their own motorist assistance patrols to provide the same functions on local streets. Some municipalities in the Memphis Urban Area are considering establishing a similar service.

Associated Market Packages: EM04–Roadway Service Patrols

Emergency Vehicle Traffic Signal Preemption

Traffic signal preemption for emergency vehicles improves incident response times and emergency responder safety. Systems can be either GPS-based or utilize transmitters. Preemption capability has traditionally been limited to fire and emergency medical services as the quantity of police officers could lead to very frequent preemption requests that can impact the ability to maintain signal coordination.

Associated Market Packages: ATMS03–Surface Street Control, EM02–Emergency Routing

Speed Monitoring

Speed monitoring is different from speed and volume detection in the way that the data is used. Data from speed monitoring locations is provided to police to identify the need for targeted enforcement efforts. This is not automated enforcement. The same equipment used for speed and volume detection can also be used to provide this information or specific monitoring sites can be established.

Associated Market Packages: ATMS19–Speed Monitoring

2.2.3   Maintenance and Construction Management Project Types

Road Weather Information System

Road weather information system (RWIS) are road condition monitoring systems that collect pavement temperature, moisture, and wind information to support maintenance operations such as the application of anti-icing chemicals or closure of a road due to flooding.

Associated Market Packages: MC03–Road Weather Data Collection

2.2.4   Transit Management Project Types

Interagency Information Coordination for Transit Operations

Using either a direct communication link or web-based information exchange portal, interagency information coordination projects support transit operations. This connection primarily benefits the transit agency by facilitating dispatch and managing delays, but information regarding incidents involving transit vehicles can be useful for traffic or emergency management agencies as well.

Associated Market Packages: ATMS08–Traffic Incident Management System, APTS02–Transit Fixed Route Operations, APTS03–Demand Response Transit Operations, APTS05–Transit Security

Transit Vehicle Tracking

The deployment of automated vehicle location (AVL) on transit vehicles allows transit system operators to monitor vehicle locations. The data can be used to provide system users with real-time information about bus arrivals and to provide specific location information to maintenance or emergency responders in case of a breakdown or incident involving the vehicle.

Associated Market Packages: APTS01–Transit Vehicle Tracking, APTS02–Transit Fixed Route Operations, APTS03–Demand Response Transit Operations, APTS05–Transit Security

Transit On-board Security Cameras

Security cameras on transit vehicles are most frequently used for local recording only and are reviewed only if there is an issue. As communications capabilities improve, more transit agencies are deploying cameras that can be monitored real-time from a remote location.

Associated Market Packages: APTS05–Transit Security

Transit Alarm System

Silent alarms that can be activated by the driver in case of emergency send a trouble alarm to dispatchers who can then contact police for assistance.

Associated Market Packages: APTS05–Transit Security

Automated Passenger Counters

Transit passenger counting systems automate the collection of ridership data and when tied to GPS coordinates can determine the number of passengers boarding and alighting at each transit stop.

Associated Market Packages: APTS10–Transit Passenger Counting

Real-Time Next-Bus Arrival Information

Next-bus arrival information is typically provided to transit riders at a transit stop or transfer station on a DMS or kiosk. The information is calculated using the transit vehicle tracking data collected from the AVL system.

Associated Market Packages: APTS08–Transit Traveler Information

Real-Time Transit Traveler Information Website

This project type covers the creation of new transit traveler information websites or improvements to add functionality to existing sites. The goal of these sites is to provide real-time information about bus locations, next bus arrival times, or any system disruptions. Additional features can include personal trip planners and subscription based automated alerts.

Associated Market Packages: APTS08–Transit Traveler Information

Bus Rapid Transit

Bus Rapid Transit (BRT) incorporates transit vehicle signal priority into express routes to provide a level of service as close to that of a light rail or other fixed guideway system as possible. Transit priority will not force a green for a transit vehicle as emergency vehicle signal preemption does, but instead extends an existing green for a BRT vehicle that is running behind schedule. The system can be GPS based or use a transmitter activated by the driver to request priority.

Associated Market Packages: APTS09–Transit Signal Priority

2.2.5   Archived Data Management Project Types

Data Archive

Database to store operational data collected by an agency from the ITS equipment deployed. Examples include a transit ridership database or traffic speed and volume database.

Associated Market Packages: AD1–ITS Data Mart

Data Warehouse

Data collection system for information from multiple agencies; such as one established by an MPO to track operational data from multiple agencies. The data warehouse can either physically consolidate the data in a central location or link to the individual data archives using a virtual data warehouse. With the volume of data warehousing involves, more and more agencies are choosing the virtual data warehouse.

Associated Market Packages: AD2–ITS Data Warehouse, AD3–ITS Virtual Data Warehouse

2.3   Project Selection

As mentioned previously in Section 2.1.4, the majority of project selection took place at the ITS Deployment Plan Workshop held with stakeholders in March 2010. The regional needs provided the foundation for the first draft of project recommendations and deployment plan discussions gave stakeholders an opportunity to build on each other's ideas and identify opportunities to incorporate interagency coordination into the projects. With the potential project types described in Section 2.2 as a springboard, the group modified and added projects to reach the list presented in Section 4.

Project timeframes, costs, and funding status were also discussed with stakeholders and incorporated into the project recommendations. However, the project list is not fiscally constrained so the timeframes reflect the importance of the need and any necessary phasing without necessarily taking funding into account. With the ongoing funding challenges faced by agencies this provides an opportunity to express and document their most significant needs; these are the projects they would fund immediately if money was available. The costs presented are planning level costs as no preliminary engineering or design was performed as part of the project development process. Costs for any projects where funding has already been identified may be more specific.

3. ITS MARKET PACKAGE IMPLEMENTATION

In order to implement the ITS market package services in the Memphis Urban Area, each market package was reviewed to determine which projects should be deployed. Stakeholders provided a great deal of feedback on these projects through the Regional ITS Architecture Workshops. Although the timeframe of the Regional ITS Deployment Plan extended as far as twenty years, stakeholders generally focused on identifying shorter term projects that were more likely to be funded.

Not every ITS market package has an associated ITS project. Several market packages were identified as being important to the Region; however, at this time stakeholders decided there were no projects feasible enough to document in the ITS Deployment Plan. In the future, additional projects will likely be added to the ITS Deployment Plan to implement these market packages.

The ITS market packages in the following subsections are organized by service areas in the order they appear in the National ITS Architecture. Each market package includes:

- A brief definition of the ITS market package (which were modified from the National ITS Architecture definitions);
- Stakeholder priority for the ITS market package;
- Recommended projects that will address some or all of the services that are contained in the ITS market package; and
- Additional projects that support the services that are contained in the ITS market package (if applicable).

The projects listed in the Recommended Projects section of the ITS market package tables are those that can be directly tied back to a particular market package and will help support the implementation of that market package. The projects listed in the Additional Supporting Projects section lists projects that will support the market package but are not a specific part of the actual implementation of the market package. For example, the Municipal Closed Circuit Television Camera project will support operations of the Municipal/County Advanced Traffic Management System Signal System Implementation captured in the ATMS03 – Surface Street Control market package by allowing traffic operations personnel to visually monitor traffic signal operations at an intersection within range of a CCTV camera. However, the ATMS03 – Surface Street Control market package does not include any CCTV camera elements or data flows for traffic images and therefore the Municipal CCTV Camera project supports its operations but does not contribute to its implementation.

3.1 Traffic Management Service Area

The following ITS market packages and related projects implement the traffic management service area functions. These traffic management service areas represent some of the most commonly deployed projects, such as traffic signal systems, CCTV cameras, DMS, and TOCs. Many of the market packages in this service area are expected to be deployed prior to market packages in other service areas.

Table 2 – Traffic Management Market Packages and Projects

Network Surveillance (ATMS01)	High Priority
Includes traffic detectors, CCTV cameras, other surveillance equipment, supporting field equipment, and fixed-point to fixed-point communications to transmit the collected data back to a traffic management center.	
Recommended Projects	
▪ Municipal CCTV Cameras ▪ Municipal/County TOC ▪ TDOT Region 4 SmartWay ITS I-40 Extension ▪ TDOT Region 4 SmartWay ITS SR 385 Extension ▪ TDOT Region 4 SmartWay ITS SR 385/I-269 (North) Implementation ▪ TDOT Region 4 SmartWay ITS SR 385/I-269 (South) Implementation	
Additional Supporting Projects	
▪ Municipal Railroad Grade Crossing Advance Notification System	

Traffic Probe Surveillance (ATMS02)	Low Priority
Provides an alternative approach for surveillance of the roadway network. Probe vehicles are tracked, and the vehicle's position and speed information are utilized to determine road network conditions such as average speed and congestion conditions.	
Recommended Projects	
No projects have been identified at this time. The Traffic Probe Surveillance market package was customized and included in the ITS Architecture to reflect the potential that TDOT may wish to purchase private provider probe data in the future to supplement vehicle detection data.	

Table 2 – Traffic Management Market Packages and Projects (continued)

Surface Street Control (ATMS03)	High Priority
Provides the central control and monitoring equipment, communication links, and signal control equipment that support local street and/or arterial traffic management. This market package is consistent with typical urban traffic signal control systems.	

Recommended Projects

- MATA Bus Rapid Transit Traffic Signal Priority System
- Municipal/County ATMS Signal System Implementation
- Municipal/County ATMS Signal System Upgrades
- Municipal/County Fire and EMS Vehicles Traffic Signal Preemption
- Municipal/County TOC

Additional Supporting Projects

- Municipal CCTV Cameras

Freeway Control (ATMS04)	Medium Priority
Provides the communications and roadside equipment to support ramp control, lane controls and interchange control for freeways. The market package is consistent with typical urban traffic freeway control systems. Also includes the capability to utilize surveillance information for detection of incidents.	

Recommended Projects

No projects have been identified at this time. The Freeway Control market package was customized and included in the ITS Architecture to reflect the possibility for ramp metering at some point in the future.

Traffic Information Dissemination (ATMS06)	High Priority
Provides information to drivers using roadway equipment such as DMS or highway advisory radio (HAR). Information can include traffic and road conditions, closure and detour information, incident information, emergency alerts and driver advisories.	

Recommended Projects

- Municipal Arterial DMS
- Municipal/County TOC
- TDOT Region 4 SmartWay ITS I-40 Extension
- TDOT Region 4 SmartWay ITS SR 385 Extension
- TDOT Region 4 SmartWay ITS SR 385/I-269 (North) Implementation
- TDOT Region 4 SmartWay ITS SR 385/I-269 (South) Implementation

Additional Supporting Projects

- Municipal Railroad Grade Crossing Advance Notification System
- Municipal/County Portable DMS

Table 2 – Traffic Management Market Packages and Projects (continued)

Regional Traffic Management (ATMS07)	High Priority

Sharing of traffic information and control among traffic management centers to support a regional management strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions.

Recommended Projects

- Municipal TOC Coordination with TDOT Region 4 SmartWay TMC
- TDOT Region 4 SmartWay TMC Coordination with MDOT Northwest Regional TMC

Additional Supporting Projects

- Municipal/County TOC

Traffic Incident Management System (ATMS08)	High Priority

Manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. This market package includes incident detection capabilities and coordination with other agencies. It supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel.

Recommended Projects

- Municipal TOC Coordination with TDOT Region 4 SmartWay TMC
- Municipal/County TOC
- Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch
- TDOT Region 4 SmartWay TMC Coordination with MDOT Northwest Regional TMC
- TDOT SmartWay Information System Modification for Municipal Traffic Information Input

Additional Supporting Projects

- Municipal Service Patrol Implementation
- Municipal/County Portable DMS
- TDOT HELP Service Patrol Expansion
- TDOT Region 4 SmartWay ITS I-40 Extension
- TDOT Region 4 SmartWay ITS SR 385 Extension
- TDOT Region 4 SmartWay ITS SR 385/I-269 (North) Implementation
- TDOT Region 4 SmartWay ITS SR 385/I-269 (South) Implementation

Electronic Toll Collection (ATMS10)	Low Priority

Provides toll operators with the ability to collect tolls electronically and detect and process violations.

Recommended Projects

No projects have been identified at this time. The Electronic Toll Collection market package was customized and included in the ITS Architecture to reflect the potential for toll roads in the Region in the future.

Table 2 – Traffic Management Market Packages and Projects (continued)

Emissions Monitoring and Management (ATMS11)	Low Priority
Monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data.	
Recommended Projects	
No projects have been identified at this time. The Memphis and Shelby County Health Department has existing air quality sensors deployed around the County.	

Standard Railroad Grade Crossing (ATMS13)	Medium Priority
Manages highway traffic at highway-rail intersections where rail operational speeds are less than 80 mph...	
Recommended Projects	
▪ Municipal Railroad Grade Crossing Advance Notification System ▪ Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch	

Regional Parking Management (ATMS17)	Medium Priority
Supports coordination between parking facilities to enable regional parking management strategies.	
Recommended Projects	
No projects have been identified at this time. The Regional Parking Management market package was customized and included in the ITS Architecture to document the City of Memphis' interest in a parking management system.	

Speed Monitoring (ATMS19)	Low Priority
Monitors the speeds of vehicles traveling through a roadway system.	
Recommended Projects	
No projects have been identified at this time. The Speed Monitoring market package was customized and included in the ITS Architecture to reflect the potential for future installations by several of the municipalities in the Memphis Urban Area. At this time nothing is planned and the market package is included as a low priority for the Region.	

3.2   Emergency Management Service Area

The following ITS market packages and related projects implement ITS functions that support emergency management activities.   These market packages are important for incident response, coordination of the emergency management and transportation systems, traveler information during disasters, and protection of the transportation infrastructure.

Table 3 – Emergency Management Market Packages and Projects

Emergency Call-Taking and Dispatch (EM01)	High Priority
Provides basic public safety call-taking and dispatch services. Includes emergency vehicle equipment, equipment used to receive and route emergency calls, wireless communications, and coordination between emergency management agencies.	
Recommended Projects	
Though a high priority, no specific projects were identified. Most projects that focus on emergency call-taking and dispatch are considered projects internal to emergency management.	
Additional Supporting Projects	
▪ Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch	

Emergency Routing (EM02)	High Priority
Supports automated vehicle location (AVL) and dynamic routing of emergency vehicles. Traffic information, road conditions and suggested routing information are provided to enhance emergency vehicle routing. Includes signal preemption and priority applications.	
Recommended Projects	
▪ Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch	
▪ Municipal/County Fire and EMS Vehicles Traffic Signal Preemption	
Additional Supporting Projects	
▪ Municipal Railroad Grade Crossing Advance Notification System	

Roadway Service Patrols (EM04)	High Priority
Supports the roadway service patrol vehicles that aid motorists, offering rapid response to minor incidents (flat tire, crashes, out of gas) to minimize disruption to the traffic stream. This market package monitors service patrol vehicle locations and supports vehicle dispatch.	
Recommended Projects	
▪ Municipal Service Patrol Implementation	
▪ TDOT HELP Service Patrol Expansion	

Table 3 – Emergency Management Market Packages and Projects (continued)

Transportation Infrastructure Protection (EM05)	High Priority
Includes the monitoring of transportation infrastructure (e.g. bridges, tunnels and management centers) for potential threats using sensors, surveillance equipment, barriers and safeguard systems to preclude an incident, control access during and after an incident or mitigate the impact of an incident. Threats can be acts of nature, terrorist attacks or other incidents causing damage to the infrastructure.	
Recommended Projects	
Though a high priority for the Region, no projects were identified at this time to supplement the existing monitoring systems.	

Wide-Area Alert (EM06)	Medium Priority
Uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather, civil emergencies or other situations that pose a threat to life and property.	
Recommended Projects	
No projects have been identified at this time specifically for wide area alerts. Disseminating this information is a high priority for the Region and is supported by several deployments that, although primarily implemented for traffic management purposes, could also be used for the dissemination of wide area alert information.	

Disaster Response and Recovery (EM08)	Medium Priority
Enhances the ability of the surface transportation system to respond to and recover from disasters. Supports coordination of emergency response plans, provides enhanced access to the scene and better information about the transportation system in the vicinity of the disaster, and maintains situation awareness.	
Recommended Projects	
▪ TDOT Region 4 SmartWay TMC Coordination with the Memphis-Shelby County EMA	
Additional Supporting Projects	
▪ Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch	

Table 3 – Emergency Management Market Packages and Projects (continued)

Evacuation and Reentry Management (EM09)	Medium Priority

Supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. This market package supports both anticipated, well-planned, and orderly evacuations such as for a hurricane, as well as sudden evacuations with little or no time for preparation or public warning such as a terrorist act. Employs a number of strategies to maximize capacity along an evacuation route including coordination with transit.

Recommended Projects

- TDOT Region 4 SmartWay TMC Coordination with the Memphis-Shelby County EMA

Additional Supporting Projects

- Municipal Arterial DMS
- Municipal CCTV Cameras
- Municipal/County Portable DMS
- Municipal/County TOC
- Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch
- Municipal Service Patrol Implementation
- TDOT HELP Service Patrol Expansion
- TDOT Region 4 SmartWay ITS I-40 Extension
- TDOT Region 4 SmartWay ITS SR 385 Extension
- TDOT Region 4 SmartWay ITS SR 385/I-269 (North) Implementation
- TDOT Region 4 SmartWay ITS SR 385/I-269 (South) Implementation

Disaster Traveler Information (EM10)	Medium Priority

Uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster.

Recommended Projects

- TDOT Region 4 SmartWay TMC Coordination with the Memphis-Shelby County EMA

Additional Supporting Projects

- Municipal Arterial DMS
- Municipal CCTV Cameras
- Municipal Real-Time Traveler Information Website
- TDOT SmartWay Information System Modification for Municipal Traffic Information Input

3.3 Maintenance and Construction Management Service Area

The following ITS market packages and related projects implement maintenance and construction management ITS functions. The priorities identified for the Region included work zone management and maintenance and construction activity coordination.

Table 4 – Maintenance and Construction Management Market Packages and Projects

Maintenance and Construction Vehicle and Equipment Tracking (MC01)	Medium Priority
Tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities.	
Recommended Projects	
No projects have been identified at this time.	

Road Weather Data Collection (MC03)	Medium Priority
Collects current road weather conditions using data collected from environmental sensors deployed on and about the roadway.	
Recommended Projects	
No projects have been identified at this time.	

Weather Information Processing and Distribution (MC04)	Medium Priority
Processes and distributes the environmental information collected from the Road Weather Data Collection market package. This market package uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so system operators can make decisions on corrective actions to take.	
Recommended Projects	
No projects have been identified at this time.	

Roadway Automated Treatment (MC05)	Low Priority
Automatically treats a roadway section based on environmental or atmospheric conditions. Includes the sensors that detect adverse conditions, automated treatment (such as anti-icing chemicals), and driver information systems.	
Recommended Projects	
No projects have been identified at this time.	

Winter Maintenance (MC06)	Low Priority
Supports winter road maintenance. Monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities.	
Recommended Projects	
No projects have been identified at this time.	

Work Zone Management (MC08)	High Priority
Directs activity in work zones, controlling traffic through portable DMS and informing other groups of activity for better coordination management. Also provides speed and delay information to motorists prior to the work zone.	
Recommended Projects	
▪ Municipal/County Portable DMS	
Additional Supporting Projects	
▪ Municipal Arterial DMS	
▪ Municipal/County TOC	
▪ TDOT Region 4 SmartWay ITS I-40 Extension	
▪ TDOT Region 4 SmartWay ITS SR 385 Extension	
▪ TDOT Region 4 SmartWay ITS SR 385/I-269 (North) Implementation	
▪ TDOT Region 4 SmartWay ITS SR 385/I-269 (South) Implementation	

Maintenance and Construction Activity Coordination (MC10)	High Priority
Supports the dissemination of maintenance and construction activity information to centers that can utilize it as part of their operations (i.e., traffic management, transit, emergency management).	
Recommended Projects	
▪ Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch	

Infrastructure Monitoring (MC12)	High Priority
Monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure using both fixed and vehicle-based infrastructure monitoring sensors. Monitors vehicle probes used to determine current pavement conditions.	
Recommended Projects	
No projects have been identified at this time.	

3.4 Public Transportation Management Service Area

The following market packages implement public transportation management ITS functions. MATA is in the process of deploying an approximately $10 million package of ITS components into their transit system that will implement many of the transit market package functions identified below.

Table 5 – Public Transportation Management Market Packages and Projects

Transit Vehicle Tracking (APTS01)	High Priority
Monitors current transit vehicle location using an AVL system. Location data may be used to determine real time schedule adherence and update the transit system's schedule in real time.	
Recommended Projects	
▪ MATA Transit Vehicle Tracking	

Transit Fixed-Route Operations (APTS02)	High Priority
Performs vehicle routing and scheduling, as well as operator assignment and system monitoring for fixed-route and flexible-route transit services.	
Recommended Projects	
▪ MATA Dispatch Coordination with Municipal TOC	

Demand Response Transit Operations (APTS03)	High Priority
Performs vehicle routing and scheduling, as well as operator assignment and system monitoring for demand responsive transit services.	
Recommended Projects	
▪ MATA Dispatch Coordination with Municipal TOC	

Transit Fare Collection Management (APTS04)	Medium Priority
Manages transit fare collection on-board transit vehicles and at transit stops using electronic means. Allows the use of a traveler card or other electronic payment device.	
Recommended Projects	
No projects have been identified at this time.	

Transit Security (APTS05)	Medium Priority
Provides for the physical security of transit passengers and transit vehicle operators. Includes on-board security cameras and panic buttons.	
Recommended Projects	
▪ MATA Transit On-Board Security Cameras ▪ MATA Transit Vehicle Alarm System	

Transit Fleet Management (APTS06)	Low Priority
Supports automatic transit maintenance scheduling and monitoring for both routine and corrective maintenance.	
Recommended Projects	
No projects have been identified at this time.	

Multi-modal Coordination (APTS07)	Medium Priority
Establishes two way communications between multiple transit and traffic agencies to improve service coordination.	
Recommended Projects	
No projects have been identified at this time.	

Transit Traveler Information (APTS08)	High Priority
Provides transit users at transit stops and on board transit vehicles with ready access to transit information. Services include stop annunciation, imminent arrival signs, and real-time transit schedule displays. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.	
Recommended Projects	
▪ MATA Next-bus Arrival Dynamic Message Signs	
▪ MATA Real-time Traveler Information Website	
Additional Supporting Projects	
▪ MATA Transit Vehicle Tracking	

Transit Signal Priority (APTS09)	High Priority
Determines the need for transit priority on routs and at certain intersections and requests transit vehicle priority at these locations to improve on-time performance of the transit system.	
Recommended Projects	
▪ MATA Bus Rapid Transit Traffic Signal Priority System	

Transit Passenger Counting (APTS10)	Medium Priority
Counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center.	
Recommended Projects	
▪ MATA Transit Vehicle Passenger Counters	

3.5 Traveler Information Service Area

The following ITS market packages and related projects implement traveler information ITS functions. Traveler information service area projects address market packages that make traveler information available to the public over a wide area such as the 511 traveler information phone number. Traveler information provided at specific locations on the roadway, such as DMS, is addressed in the ATMS06 – Traffic Information Dissemination market package in Section 3.1.

Table 6 – Traveler Information Market Packages and Projects

Broadcast Traveler Information (ATIS01)	High Priority
Collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadly disseminates this information through existing infrastructures (radio, cell phones, etc.).	
Recommended Projects	
▪ TDOT SmartWay Information System Modification for Municipal Traffic Information Input ▪ Municipal Real-Time Traveler Information Website	

Interactive Traveler Information (ATIS02)	High Priority
Provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours, and pricing information.	
Recommended Projects	
No projects were specifically identified for local implementation. 511 traveler information phone and web-based services are being provided on a statewide level in Tennessee.	
Additional Supporting Projects	
▪ TDOT SmartWay Information System Modification for Municipal Traffic Information Input ▪ Municipal Real-Time Traveler Information Website	

3.6 Commercial Vehicle Operations

The following ITS market packages and related projects implement commercial vehicle operations ITS functions. Planning for commercial vehicle operations is being performed on a statewide level as part of the Commercial Vehicle Information Systems and Networks (CVISN) program. As part of this program projects are being developed on a statewide basis rather than a regional basis.

Table 7 – Commercial Vehicle Operations Market Packages and Projects

HAZMAT Management (CVO10)	Medium Priority
Integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents.	
Recommended Projects	
No projects have been identified at this time.	

3.7 Archived Data Management Service Area

The following ITS market packages and related projects implement archived data management ITS functions. Data collected through ITS deployments can be housed in several different formats. The market packages selected by stakeholders will allow data from a specific agency to be housed by that agency (considered an ITS data mart), or data from throughout the Region can be sent to a site to be housed together (considered an ITS virtual data warehouse). Data housed by an agency as part of an ITS data mart would likely be implemented as part of another project deployment. For example, DMS implementation might include software to archive all of the messages placed on the DMS over a period of time. The archived DMS data would be considered an ITS data mart.

Table 8 – Archived Data Management Market Packages and Projects

ITS Data Mart (AD1)	Medium Priority
Provides a focused archive that houses data collected and owned by a single agency or other organization. Focused archive typically covers a single transportation mode and one jurisdiction.	
Recommended Projects	
No projects have been identified at this time, as ITS deployments come on line and the quantity of available data increases it is likely that stakeholder agencies might develop data mart projects.	

ITS Data Warehouse (AD2)	Low Priority
Includes all the data collection and management capabilities of the ITS Data Mart. Adds the functionality to allow collection of data from multiple agencies and data sources across modal and jurisdictional boundaries.	
Recommended Projects	
▪ Memphis Urban Area MPO Archive Data Warehouse	

ITS Virtual Data Warehouse (AD3)	Low Priority
Provides the same broad access to multimodal, multidimensional data from varied sources as in the ITS Data Warehouse Market Package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed.	
Recommended Projects	
▪ Memphis Urban Area MPO Archive Data Warehouse	

4. ITS PROJECT RECOMMENDATIONS

In order to achieve the ITS deployment levels outlined in their Regional ITS Architecture, a region must deploy carefully developed projects that provide the functionality and interoperability identified in their ITS Architecture. A key step toward achieving the Memphis Urban Area Region's ITS vision as established in the Regional ITS Architecture is the development of an ITS Deployment Plan that identifies specific projects, timeframes, and responsible agencies.

Input from all stakeholders is required for stakeholders to have ownership of the ITS Deployment Plan and to ensure that the plan has realistically identified projects and timeframes for deployment. Cost is another important factor—cost can vary a great deal for many ITS elements, depending on the level of deployment, maturity of the technology, type of communications, etc. For example, freeway network surveillance could be adequately achieved for one region by the deployment of still frame CCTV cameras only at freeway interchanges. In another region, full motion cameras may be deployed at one-mile intervals to provide complete coverage of the freeway. The infrastructure and telecommunications costs for these two projects would vary a great deal, yet either one could be suitable for a particular region.

To achieve input from stakeholders, an ITS Deployment Plan Workshop was held with stakeholders in Memphis Urban Area on March 11, 2010 to discuss potential projects. Each project recommended for the Regional ITS Deployment Plan was discussed, and consensus was reached by the stakeholders on the project description and the timeframe for deployment.

Regional projects are identified in **Table 9** through **Table 12**. The tables are divided by primary responsible agency as follows:

- **Table 9** – Tennessee Department of Transportation;
- **Table 10** – Municipal/County Projects;
- **Table 11** – Transit Recommended Projects; and
- **Table 12** – Memphis Urban Area MPO.

The projects identified in the tables represent priority projects for each agency that are needed in order to implement the ITS services that were identified as part of the Regional ITS Architecture development. Many of the projects identified are not funded and identification of a funding source will likely be the most significant challenge in getting the projects implemented. Projects were only included for deployments that will occur within Tennessee even though the Region does include the northern portion of DeSoto County in Mississippi and is located adjacent to West Memphis, Arkansas. The Northwest Mississippi Region ITS Architecture and the West Memphis Regional ITS Architecture and Deployment Plan documents cover deployments in Mississippi and Arkansas and stakeholders agreed to only include Tennessee projects in the Memphis Urban Area Regional ITS Deployment Plan to avoid any overlap.

For each project, the following categories are discussed:

- **Project** – Identifies the project name including the agency responsible for implementation where applicable.
- **Description** – Provides a description of the project including notes on deployment locations, time-frame for deployment, and cost. The level of detail in the project descriptions varies depending on the implementing agency and how much detail they wanted to include regarding a project. In some cases projects had not been discussed beyond a very high conceptual level while in other cases an agency had begun detailed planning for a project implementation and more detail is provided in the description.

- **Deployment Timeframe and Responsible Agency** – Provides a recommended timeframe for deployment for each project. Timeframes have been identified as short-term (deployment recommended in 0-5 years), mid-term (deployment recommended in 5-10 years), and long-term (deployment recommended beyond 10 years). Recommendations for deployment timeframes were based on input from each agency and considered the project priority, possibility of funding, and dependency on other project deployments.

- **Opinion of Probable Cost and Funding Status** – Provides an opinion of probable cost of each project. Because design has not been undertaken for any projects, the opinion of probable cost should not be considered an estimate and should only be used for planning purposes. Costs are presented either as a total project cost when the project has been defined in more detail or as a unit cost per element when a project is at a higher conceptual level and has not been defined to the point where a total project cost opinion can be provided. In some cases an estimate of cost is not possible, particularly when the communication systems have not been designed and could have a great impact on the cost. For each project it is also noted whether funding has been identified or is still needed.

- **Applicable Market Packages** – Identifies the ITS market packages from the Regional ITS Architecture that each project will assist in implementing. Knowing which market packages each project identifies is an important part of an ITS architecture conformance review.

4.1 TDOT Recommended ITS Projects

Table 9 – TDOT Recommended ITS Projects

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
TDOT Region 4 SmartWay ITS I-40 Extension	Extend the current SmartWay ITS system eastward on I-40 from MM20 to approximately MM27. The SmartWay ITS system extension will include the installation of fiber, closed circuit television (CCTV) cameras, dynamic message signs (DMS), and highway advisory radio (HAR). This project is TDOT's first priority for SmartWay ITS implementation.	Short-Term: TDOT	Cost: $3,500,000 Funding Identified: No	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination
TDOT Region 4 SmartWay ITS SR 385 Extension	Extend the current SmartWay ITS system eastward on SR 385 from MM7 to approximately MM15 at the junction of future I-269. The SmartWay ITS system extension will include the installation of fiber, CCTV cameras, DMS, and HAR. This project is TDOT's second priority for SmartWay ITS implementation.	Short or Mid-Term: TDOT	Cost: $4,000,000 Funding Identified: No	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination
TDOT Region 4 SmartWay ITS SR 385/I-269 (South) Implementation	Implement SmartWay ITS system on SR 385/I-269 from I-40 southward to the Mississippi state line and connect it to the Mississippi ITS system. The implementation of the SmartWay ITS system will include the installation of fiber, CCTV cameras, DMS, and HAR. This project is TDOT's third priority for SmartWay ITS implementation.	Mid-Term: TDOT	Cost: $9,000,000 Funding Identified: No	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination
TDOT Region 4 SmartWay ITS SR 385/I-269 (North) Implementation	Implement SmartWay ITS system on SR 385/I-269 from I-40 northward to the future I-69 near Highway 51. The implementation of the SmartWay ITS system will include the installation of fiber, CCTV cameras, DMS, and HAR. This project is TDOT's fourth priority for SmartWay ITS extension. Deployment of this segment is dependent on completion of freeway segment construction. Accelerated completion could change the priority of this SmartWay ITS segment.	Mid-Term: TDOT	Cost: $8,000,000 Funding Identified: No	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination

Table 9 – TDOT Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
TDOT HELP Service Patrol Expansion	Expand the existing HELP Service Patrol program including additional freeway miles of coverage and hours of operation. HELP Service Patrol will be expanded in coordination with implementation of new TDOT SmartWay ITS segments on freeways.	Short to Mid-Term: TDOT (Depending on SmartWay ITS segment deployment)	Cost: Dependant on coverage area and service schedule Funding Identified: No	EM04 – Roadway Service Patrols
TDOT Region 4 SmartWay TMC Coordination with the Memphis-Shelby County EMA	Establish a communications connection between the TDOT Region 4 SmartWay TMC and the Memphis-Shelby County Emergency Management Agency (EMA). This communications connection will provide the EMA with access to TDOT video feeds and roadway condition information and facilitate coordination between TDOT and the EMA during major incidents.	Short-Term: TDOT and Memphis-Shelby County EMA	Cost: To Be Determined Funding Identified: No	EM08 – Disaster Response and Recovery EM09 – Evacuation and Reentry Management
TDOT Region 4 SmartWay TMC Coordination with MDOT Northwest Regional TMC	Establish a communications connection between the TDOT Region 4 SmartWay TMC and MDOT Northwest Regional TMC for the coordination of traffic information. This communications connection will allow the sharing of video feeds, traffic conditions, and incident locations between the TDOT Region 4 SmartWay TMC and MDOT Northwest Regional TMC.	Short-Term: TDOT and MDOT	Cost: To Be Determined Funding Identified: No	ATMS07 – Regional Traffic Management ATMS08 – Traffic Incident Management System
TDOT SmartWay Information System Modification for Municipal Traffic Information Input	Modify the existing TDOT SmartWay Information System (TSIS) to allow direct input by Municipal TOCs, including incident information, planned road closures, and real time traffic conditions. The effort to accomplish this project will primarily be through training of the municipalities on how to input data into TSIS. It is expected that this will be an internal effort and no direct costs will be associated with this project.	Short-Term: TDOT and Municipalities	Cost: $0 Funding Identified: No	ATMS08 – Traffic Incident Management System ATIS01 – Broadcast Traveler Information

[1]Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

[2]The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

4.2 Municipal/County Recommended ITS Projects

Table 10 – Municipal/County Recommended ITS Projects

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
Municipal/County TOC	Establish a Municipal or County Traffic Operations Center (TOC). The TOC will manage the traffic signal system, monitor CCTV cameras and vehicle detection, and control DMS. Cost represents equipment costs and those costs associated with modifying space in an existing facility for use as a TOC. Depending on the functionality desired cost could vary. The City of Memphis has a TOC near completion and is expected to be operational in the short-term.	Short-Term: City of Memphis Mid to Long-Term: City of Bartlett City of Germantown City of Millington Town of Collierville Other Municipalities Shelby County	Cost: $100,000 - $300,000 Funding Identified: City of Memphis – Yes Other Agencies – No	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
Municipal/County ATMS Signal System Implementation	Implement an Advanced Traffic Management System (ATMS) in Municipalities and Shelby County. System will include communications and hardware to allow signal coordination and real time monitoring of signal systems. Cost will vary significantly based on the system and communications implemented. The timeframe for this project will vary depending on the need and funding in the various municipalities and Shelby County.	Short to Long-Term: Municipalities and Shelby County	Cost: To Be Determined Funding Identified: No	ATMS03 – Surface Street Control
Municipal/County ATMS Signal System Upgrades	Upgrade and expand the existing ATMS in Memphis, Bartlett, and Germantown including improved traffic signal coordination and communications, to allow real time monitoring of traffic signals. Cost represents an average cost per intersection for upgrading and adding to the ATMS. Cost will vary based on the level of upgrades required and the communication infrastructure needed. This is an on-going project that includes Memphis, Bartlett, and Germantown which currently have an ATMS, and will include others as needed in the future as additional ATMS signal systems are deployed.	On-Going Project: City of Memphis City of Bartlett City of Germantown Others as Needed	Cost: $20,000 - $40,000/ Intersection Funding Identified: No	ATMS03 – Surface Street Control

Table 10 – Municipal/County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
Municipal TOC Coordination with TDOT Region 4 SmartWay TMC	Establish a communications connection between the TDOT Region 4 SmartWay TMC and Municipal TOCs for the coordination of traffic information. This communications connection will allow the sharing of video feeds, traffic conditions, and incident locations between the TDOT Region 4 SmartWay TMC and Municipal TOCs. The connection between the City of Memphis, which has a TMC close to completion, and TDOT will most likely occur in the short-term.	Short-Term: City of Memphis and TDOT Mid-Term: Other Municipalities and TDOT	Cost: To Be Determined Funding Identified: No	ATMS07 – Regional Traffic Management ATMS08 – Traffic Incident Management System
Municipal CCTV Cameras	Implement CCTV cameras on key sections of roadway. CCTV cameras can be used to monitor traffic conditions and to aid in incident management. Video feeds can be shared with emergency management agencies to facilitate emergency response, and with the TDOT Region 4 SmartWay TMC for monitoring traffic on arterials during freeway closures. Cost shown includes the pole and camera. The cost will be lower if the camera is installed on a signal mast arm or other existing roadside structure.	Mid-Term: City of Germantown Long-Term: City of Memphis City of Bartlett Others as Needed	Cost: $30,000/Site Funding Identified: No	ATMS01 – Network Surveillance
Municipal Arterial DMS	Deploy arterial dynamic message signs (DMS) to provide traveler information on arterials for incident management and special event management capabilities. The arterial DMS could also be used to provide information on freeway conditions prior to travelers entering freeways.	Long-Term: Municipalities as Needed	Cost: $75,000/Site Funding Identified: No	ATMS06 – Traffic Information Dissemination
Municipal Railroad Grade Crossing Advance Notification System	Implement advanced warning signs at railroad crossings to alert motorists of road blockages due to stopped trains. This project will be for locations with high volumes of traffic where rail crossings are routinely blocked for extended periods.	Mid-Term: Municipalities as Needed	Cost: $10,000 - $20,000/ Site Funding Identified: No	ATMS13 – Standard Railroad Grade Crossing

Table 10 – Municipal/County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
Municipal/County Portable DMS	Procure portable DMS with the capability to change the messages remotely for use during maintenance activities, special events, and long-term incidents. This project will be implemented as needed by the municipalities and Shelby County on an as needed basis.	Short to Long-Term: Municipalities and Shelby County as Needed	Cost: $10,000 - $15,000 Funding Identified: No	MC08 – Work Zone Management
Municipal Service Patrol Implementation	Implement a municipal service patrol program to provide assistance with incident management, including traffic control, detour routing, and roadside assistance to motorists. The City of Memphis was identified as the most likely municipality to implement this service, however funding for operation of the service has not been identified and was seen as the primary obstacle to implementation of the service.	Long-Term: City of Memphis	Cost: Dependant on Coverage Area and Service Schedule Funding Identified: No	EM04 – Roadway Service Patrols
Municipal Real-Time Traveler Information Website	Add real-time traveler information, such as incident locations, speed, and CCTV camera images to Municipal websites in the Region. The Cities of Memphis, Bartlett, and Germantown each identified a need to implement this project.	Long-Term: City of Memphis City of Bartlett City of Germantown Other Municipalities as Needed	Cost: $50,000 - $100,000 Funding Identified: No	ATIS01 – Broadcast Traveler Information
Municipal/County Fire and EMS Vehicles Traffic Signal Preemption	Implement emergency vehicle signal preemption for fire and emergency medical services (EMS) vehicles to improve incident response times and emergency responder safety. This project was considered on-going as needed by most municipalities in the Region that provide traffic signal preemption for public safety vehicles.	On-Going Project: Municipalities as Needed	Cost: $6,000/intersection $1,500/vehicle Funding Identified: No	ATMS03 – Surface Street Control EM02 – Emergency Routing

Table 10 – Municipal/County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
Municipal/County TOC Coordination with Municipal/County Public Safety Dispatch	Establish a communications connection between the TOCs and dispatch agencies for police, fire, and EMS. The purpose of the communication connection is to allow TOCs and dispatch agencies the ability to share video, road network conditions, and incident information. The City of Memphis identified this project as a short-term project as their TOC is nearly complete. Other Municipalities including the City of Germantown and Shelby County will consider this project based on the deployment timeframe of their future TOCs.	Short-Term: City of Memphis Mid to Long-Term: City of Germantown Other Municipalities Shelby County	Cost: TBD Funding Identified: No	ATMS08 – Traffic Incident Management System ATMS13 – Standard Railroad Grade Crossing EM02 – Emergency Routing MC10 – Maintenance and Construction Activity Coordination

[1]Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

[2]The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

4.3 Transit Recommended ITS Projects

Table 11 – Transit Recommended ITS Projects

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
MATA Transit Vehicle Tracking	Implement automated vehicle location on buses to allow real-time transit vehicle tracking.	Short-Term: MATA MATA is in the process of deploying all of these projects in a combined deployment package.	Cost: $10,000,000 Funding Identified: Yes MATA is funding the combined deployment package of these projects through a combination of CMAQ and ARRA funding.	APTS01 – Transit Vehicle Tracking
MATA Transit Vehicle On-Board Security Cameras	Implement cameras on buses for on-board video recording with live feeds provided to operators monitoring buses.			APTS05 – Transit Security
MATA Transit Vehicle Alarm System	Implement covert alarms on buses to enable drivers to send an alarm to transit dispatchers.			APTS05 – Transit Security
MATA Transit Vehicle Passenger Counters	Implement automated passenger counting system on buses. System could include GPS to also determine the number of passengers boarding and alighting at each transit stop.			APTS10 – Transit Passenger Counting
MATA Next-bus Arrival Dynamic Message Signs	Implement next-bus arrival dynamic message signs at transit transfer stations and bus stops within the transit service area.			APTS08 – Transit Traveler Information
MATA Real-time Traveler Information Website	Add real-time traveler information, including bus location and next bus arrival information, to existing transit website. This deployment may not be completed in the first deployment package. However, the other components that will be deployed in the first package will provide MATA with the capabilities to provide real-time information to the public regarding transit.			APTS08 – Transit Traveler Information

Table 11 – Transit Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
MATA Bus Rapid Transit Traffic Signal Priority System	Implement transit signal priority on bus rapid transit routes to provide buses that are behind schedule with automated transit signal priority. This project will be done in coordination with the Municipality where the traffic signal priority is being implemented. MATA does not currently have funding for this project but it could be implanted quickly once funding is identified.	Short to Mid-Term: MATA and Municipalities	Cost: $6,000/intersection $1,500/vehicle Funding Identified: No	ATMS03 – Surface Street Control APTS09 – Transit Signal Priority
MATA Transit Dispatch Coordination with Municipal TOC	Implement communications connection between Transit Dispatch and Municipal TOCs. Communications connection will allow the TOCs to provide Transit Dispatch with real-time traffic information including access to video, information on incidents, and information on existing and planned closures that impact routes.	Mid to Long-Term: Transit Agency Municipality	Cost: To Be Determined Funding Identified: No	APTS02 – Transit Fixed Route Operations APTS03 – Demand Response Transit Operations

[1]Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

[2]The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

4.4 Memphis Urban Area MPO Recommended ITS Projects

Table 12 – Memphis Urban Area MPO Recommended ITS Projects

Project	Description	Deployment Timeframe and Responsible Agency[1]	Opinion of Probable Cost and Funding Status[2]	Applicable Market Packages
Memphis Urban Area MPO Archive Data Warehouse	Establish a data warehouse to archive data from cities and transit agencies within the Memphis Urban Area MPO boundaries for use in regional planning. Cost for this project represents an average range for developing a data warehouse system. Cost could vary widely depending on the level of detail and functionality of the system as well as the amount of development that is done in-house by the Memphis Urban Area MPO.	Long-Term: Memphis Urban Area MPO	Cost: $200,000 - $400,000 Funding Identified: No	AD2 – ITS Data Warehouse AD3 – ITS Virtual Data Warehouse

[1]Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

[2]The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

5. USE AND MAINTENANCE OF THE REGIONAL ITS DEPLOYMENT PLAN

In 2001 the FHWA issued Final Rule 23 CFR 940, which required that ITS projects using federal funds (or ITS projects that integrate with systems that were deployed with federal funds) conform to a regional ITS architecture and also be developed using a systems engineering process. The purpose of this Section is to discuss how the Memphis Urban Area Regional ITS Architecture and ITS Deployment Plan can be used to support meeting the ITS architecture conformity and systems engineering requirements. A process for maintaining the Regional ITS Architecture and Deployment Plan is also presented. In Section 5.1 the systems engineering analysis requirements and the guidance provided by TDOT and the FHWA Tennessee Division are discussed. In Section 5.2, the process for determining ITS architecture conformity of an ITS project is presented. The conformity process documented in Section 5.2 has also been included in the Memphis Urban Area Regional ITS Architecture document.

The Regional ITS Architecture and Regional ITS Deployment Plan are both considered living documents. Shifts in regional focus and priorities, changes and new developments in technology, and changes to the National ITS Architecture will necessitate that the Memphis Urban Area Regional ITS Architecture and Deployment Plan be updated to remain a useful resource for the Region. In the Memphis Urban Area Regional ITS Architecture, a process for maintaining the Regional ITS Architecture was developed in coordination with stakeholders. The processes cover both major updates to the Regional ITS Architecture and Deployment Plan that will happen approximately every four years as well as minor changes that may be needed between major updates of the documents. These processes have been included in this document in Sections 5.3 and 5.4.

5.1 Systems Engineering Analysis

In order to assist agencies with meeting the requirements of the FHWA Final Rule 23 CFR 940, TDOT and the FHWA Tennessee Division Office developed a guidance document entitled "Standardized Procedures for Implementing ITS Regulations." The guidance document indicates that unless projects are categorically excluded, a systems engineering analysis must be performed for the project. Categorically excluded projects are those that do not utilize a centralized control, do not share data with another agency, or are expansions or enhancements to existing systems that do not add any new functionality. For example, installation of an isolated traffic signal or expansion of a freeway management system through the deployment of additional CCTV cameras would be categorically excluded and not require a systems engineering analysis.

The goal of performing a systems engineering analysis is to systematically think through the project deployment process. Thorough upfront planning has been shown to help control costs and ensure schedule adherence. The Tennessee procedures indicate that the following should be included in a systems engineering analysis:

- Identification of portions of the Regional ITS Architecture being implemented;
- Identification of participating agencies roles and responsibilities;
- Definition of system requirements;
- Analysis of alternative system configurations and technology options the meet the system requirements;
- Identification of various procurement options;
- Identification of applicable ITS standards and testing procedures; and
- Documentation of the procedures and resources necessary for operations and management of the system.

The Memphis Urban Area Regional ITS Architecture and associated Turbo Architecture database can supply information for many of the required components for a systems engineering analysis. These include:

- Portions of the Regional ITS Architecture being implemented (discussed in Section 5.2 of the Memphis Urban Area Regional ITS Deployment Plan document);
- Participating agencies roles and responsibilities (identified in the Memphis Urban Area Regional ITS Architecture document);
- Definition of system requirements (identified in the Memphis Urban Area Regional ITS Architecture Turbo Architecture database equipment packages); and
- Applicable ITS standards (identified using the ITS market package data flows from the Memphis Urban Area Regional ITS Architecture document and the National standards associated with the ITS market package data flows).

The Vee Diagram, shown as **Figure 4**, is frequently used in systems engineering discussions to demonstrate where the Regional ITS Architecture and systems engineering process fits into the life cycle of an ITS project. The Regional ITS Architecture is shown unattached from the rest of the diagram because it is not specifically project related and an undetermined amount of time can pass between the architecture development and the beginning of project implementation. Traveling along the diagram the systems engineering process addresses concept exploration, the systems engineering management plan framework, concept of operations, and systems requirements.
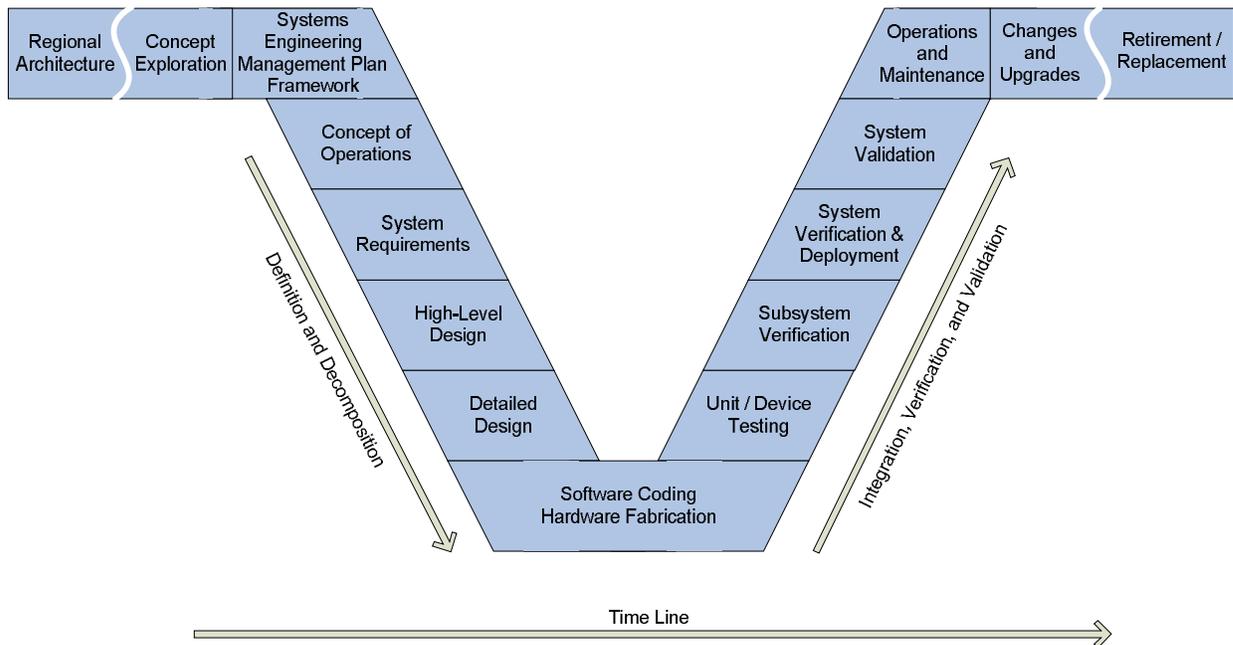

Figure 4 – Systems Engineering Vee Diagram

The Tennessee guidance document contains an example worksheet to aid in the preparation of a systems engineering analysis. During the process, if it is determined that a project is not adequately addressed in the Regional ITS Architecture, the Regional ITS Architecture maintenance process should be used to document the necessary changes.

5.2 Process for Determining ITS Architecture Conformity

The Memphis Urban Area Regional ITS Architecture documents the customized market packages that were developed as part of the ITS architecture process. To satisfy FHWA and FTA requirements and remain eligible to use Federal funds, a project must be accurately documented. The steps of the process are as follows:

- Identify the ITS components in the project;
- Identify the corresponding market packages(s) from the Regional 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; and
- Document any changes necessary to the Regional ITS Architecture or the project to ensure there is conformance.

The steps for determining ITS architecture conformity of a project are described in more detail below.

Step 1 – Identify the ITS Components

ITS components can be fairly apparent in an ITS focused project such as CCTV or DMS deployments, but could also be included in other types of projects where they are not as apparent. For example, an arterial widening project could include the installation of a signal system interconnect, signal upgrades, and the incorporation of the signals in the project limits into a city's closed loop signal system. These are all ITS functions and should be included in the ITS Architecture.

Step 2 – Identify the Corresponding Market Packages

If a project was included in the projects identified in the Memphis Urban Area Regional ITS Deployment Plan, then the applicable ITS market package(s) for that project are identified in a column of the tables. However, 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 for projects that have not been covered in the ITS Deployment Plan. In that case, the market packages selected and customized for the Memphis Urban Area should be reviewed to determine if they adequately cover the project. Customized market package diagrams for the Memphis Urban Area can be found in the Memphis Urban Area Regional ITS Architecture. The project concepts presented in Section 2.2 provide another resource to assist in determining what market packages correspond to a particular project type.

Step 3 – Identify the Component within the Market Package

Once the element is located within the appropriate ITS market package the evaluator should determine if the element name used in the market package is accurate or if a change to the name is needed. For example, a future element called the City of Memphis Arterial Emergency Response Vehicles was included in the Memphis Urban Area Regional ITS Architecture for a future roadway service patrol to be operated by the City of Memphis. Detailed planning for this system has not begun and it would not be unusual for City of Memphis to select a different name for the system once planning and implementation is underway. Such a name change should be documented using the process outlined in Section 5.4.

Step 4 – Evaluate the Connections and Flows

The connections and architecture flows documented in the ITS market package diagrams were selected based on the information available at the time the Regional ITS Architecture 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 5.4.

Step 5 – Document Required Changes

If any changes are needed to accommodate the project under review, Section 5.4 describes how those changes should be documented. Any changes will be incorporated during the next Regional ITS Architecture update. Conformance will be accomplished by documenting how the ITS market package(s) should be modified so that the connections and data flows are consistent with the project.

5.3 Process for Maintaining the Regional ITS Architecture and Deployment Plan

The Memphis Urban Area MPO will be responsible for leading the process to update the Memphis Urban Area Regional ITS Architecture and Deployment Plan in coordination with the TDOT Long Range Planning Division. **Table 13** summarizes the maintenance process agreed upon by stakeholders in the Region.

Table 13 – Memphis Urban Area Regional ITS Architecture and Deployment Plan Maintenance Summary

Maintenance Details	Regional ITS Architecture		Regional ITS Deployment Plan	
	Minor Update	**Major Update**	**Minor Update**	**Major Update**
Timeframe for Updates	As needed	Approximately every 4 years	Annually	Approximately every 4 years
Scope of Update	Review and update market packages to satisfy architecture compliance requirements of projects or to document other changes that impact the Regional ITS Architecture	Entire Regional ITS Architecture	Review and update project status and add or remove projects as needed	Entire Regional ITS Deployment Plan
Lead Agency	Memphis Urban Area MPO		Memphis Urban Area MPO	
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 Regional ITS Architecture document, Appendices, and Turbo Architecture database	Updated project tables	Updated Regional ITS Deployment Plan document

Stakeholders agreed that a full update of the Regional ITS Architecture and Deployment Plan should occur approximately every four years in the year preceding the Long-Range Transportation Plan (LRTP) update. By completing a full update in the year prior to the LRTP update, stakeholders will be able to determine the ITS needs and projects that are most important to the Region and document those needs and projects for consideration when developing the LRTP. The Memphis Urban Area MPO, in coordination with the TDOT Long Range Planning Division, will be responsible for completing the full updates. During the update process all of the stakeholder agencies that participated in the original development of the Regional ITS Architecture and Deployment Plan should be included as well as any other agencies in the Region that are deploying or may be impacted by ITS projects.

Minor changes to the Regional ITS Architecture should occur as needed between full updates of the plan. In Section 5.4 of this document the procedure for submitting a change to the Regional ITS Architecture is documented. Documentation of changes to the Regional ITS Architecture is particularly important if a project is being deployed and requires a change to the Regional ITS Architecture in order to establish conformity.

Stakeholders recommended that the Memphis Urban Area MPO lead an annual meeting to review projects in the Regional ITS Deployment Plan to update project status, remove projects that were completed, add project detail when available, and add new projects. Minor changes to the Regional ITS Deployment Plan should be noted by the Memphis Urban Area MPO. Any

corresponding changes to the Regional ITS Architecture will be documented and retained by the MPO for inclusion during the next complete update.

5.4 Procedure for Submitting ITS Architecture Changes Between Major Updates

Updates to the Memphis Urban Area Regional ITS Architecture will occur on a regular basis as described in Section 5.3 to maintain the architecture as a useful planning tool. Between major plan updates, smaller modifications will likely be required to accommodate ITS projects in the Region. Section 5.2 contains step by step guidance for determining whether or not a project requires architecture modifications to the Regional ITS Architecture.

For situations where a change is required, an Architecture Maintenance Documentation Form was developed and is included in the Memphis Urban Area Regional ITS Architecture. This form should be completed and submitted to the architecture maintenance contact person identified on the form whenever a change to the Regional ITS Architecture is proposed. There are several key questions that need to be answered when completing the Architecture Maintenance Documentation Form including those described below.

Change Information: The type of change that is being requested can include an Administrative Change, Functional Change – Single Agency, Functional Change – Multiple Agency, or a Project Change. A description of each type of change is summarized below.

- Administrative Change: Basic changes that do not affect the structure of the ITS market packages in the Regional ITS Architecture. Examples include changes to stakeholder or element names, element status, or data flow status.
- Functional Change – Single Agency: Structural changes to the ITS market packages that impact only one agency in the Regional ITS Architecture. Examples include the addition of a new ITS market package or changes to data flow connections of an existing market package. The addition or change would only impact a single agency.
- Functional Change – Multiple Agencies: Structural changes to the ITS market packages that have the potential to impact multiple agencies in the Regional ITS Architecture. Examples include the addition of a new ITS market package or changes to data flow connections of an existing ITS market package. The addition or changes would impact multiple agencies and require coordination between the agencies.
- Project Change: Addition, modification, or removal of a project in the Regional ITS Deployment Plan.

Description of the requested change: A brief description of the type of change being requested should be included.

Market packages being impacted by the change: Each of the ITS market packages that are impacted by the proposed change should be listed on the ITS Architecture Maintenance Documentation Form. If the proposed change involves creating or modifying an ITS market package then the agency completing the ITS Architecture Maintenance Documentation Form is asked to include a sketch of the new or modified market package.

Impact of proposed change on other stakeholders: If the proposed change is expected to have any impact on other stakeholders in the Region, then those stakeholders should be listed on the ITS Architecture Maintenance Documentation Form. A description of any coordination that has occurred with other stakeholders that may be impacted by the change should be also included. Ideally all stakeholders that may be impacted by the change should be contacted and consensus

should be reached on any new or modified ITS market packages that will be included as part of the Regional ITS Architecture.

The Memphis Urban Area MPO will review and accept the proposed changes and forward the form to the TDOT Long Range Planning Division for their records. When a major update is performed, all of the documented changes should be incorporated into the Regional ITS Architecture.