



Nashville Area

Regional ITS Architecture



Regional ITS Deployment Plan

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TABLE OF CONTENTS

REGIONAL ITS DEPLOYMENT PLAN

1. INTRODUCTION.....	1
1.1 Project Overview.....	1
1.2 Deployment Plan Project Development Process.....	3
1.3 Document Overview.....	5
2. ITS PROJECT IDENTIFICATION AND SELECTION	6
2.1 Project Development Inputs	6
2.1.1 <i>Regional ITS Needs</i>	<i>6</i>
2.1.2 <i>ITS Market Package Prioritization.....</i>	<i>7</i>
2.1.3 <i>Existing and Planned ITS Projects.....</i>	<i>9</i>
2.1.4 <i>Stakeholder Input</i>	<i>9</i>
2.2 Project Types for Consideration.....	11
2.2.1 <i>Traffic Management and Traveler Information Project Types</i>	<i>11</i>
2.2.2 <i>Emergency Management Project Types.....</i>	<i>13</i>
2.2.3 <i>Maintenance and Construction Management Project Types</i>	<i>14</i>
2.2.4 <i>Transit Management Project Types.....</i>	<i>14</i>
2.2.5 <i>Archived Data Management Project Types</i>	<i>15</i>
3. ITS MARKET PACKAGE IMPLEMENTATION.....	17
3.1 Traffic Management Service Area	18
3.2 Emergency Management Service Area	22
3.3 Maintenance and Construction Management Service Area	25
3.4 Public Transportation Management Service Area.....	26
3.5 Traveler Information Service Area	29
3.6 Commercial Vehicle Operations.....	30
3.7 Archived Data Management Service Area	30
4. ITS PROJECT RECOMMENDATIONS	32
4.1 Nashville Area 2035 Regional Transportation Plan ITS Projects	32
4.1.1 <i>Municipal and County 2035 Regional Transportation Plan ITS Projects.....</i>	<i>34</i>
4.1.2 <i>Transit 2035 Regional Transportation Plan ITS Projects</i>	<i>37</i>
4.2 Nashville Area Recommended ITS Projects	39
4.2.1 <i>TDOT Recommended ITS Projects.....</i>	<i>40</i>
4.2.2 <i>Municipal and County Recommended ITS Projects</i>	<i>43</i>
4.2.3 <i>Transit Recommended ITS Projects.....</i>	<i>46</i>
4.2.4 <i>Nashville Area MPO Recommended ITS Projects.....</i>	<i>48</i>
5. USE AND MAINTENANCE OF THE REGIONAL ITS DEPLOYMENT PLAN.....	49
5.1 Systems Engineering Analysis	49
5.2 Process for Determining ITS Architecture Conformity.....	51
5.3 Process for Maintaining the Regional ITS Architecture and Deployment Plan	52
5.4 Procedure for Submitting ITS Architecture Changes Between Major Updates.....	53

TABLE OF CONTENTS

REGIONAL ITS DEPLOYMENT PLAN

LIST OF FIGURES

Figure 1 – Nashville Area MPO Boundaries.....	2
Figure 2 – Nashville Area Regional ITS Deployment Plan Development Process	4
Figure 3 – TDOT Region 3 SmartWay ITS System	10
Figure 4 – Systems Engineering Vee Diagram.....	50

LIST OF TABLES

Table 1 – Nashville Area ITS Market Package Prioritization by Functional Area.....	8
Table 2 – Traffic Management Market Packages and Projects	18
Table 3 – Emergency Management Market Packages and Projects.....	22
Table 4 – Maintenance and Construction Management Market Packages and Projects	25
Table 5 – Public Transportation Management Market Packages and Projects.....	26
Table 6 – Traveler Information Market Packages and Projects.....	29
Table 7 – Commercial Vehicle Operations Market Packages and Projects	30
Table 8 – Archived Data Management Market Packages and Projects	31
Table 9 – Municipal and County ITS Projects Submitted for the 2035 Regional Transportation Plan ...	34
Table 10 – Transit ITS Projects Submitted for the 2035 Regional Transportation Plan.....	37
Table 11 – TDOT Recommended ITS Projects.....	40
Table 12 – Municipal and County Recommended ITS Projects.....	43
Table 13 – Transit Recommended ITS Projects	46
Table 14 – Nashville Area MPO Recommended ITS Projects.....	48
Table 15 – Nashville Area Regional ITS Architecture and Deployment Plan Maintenance Summary ...	53

LIST OF ACRONYMS

AD	Archived Data
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
ICM	Integrated Corridor Management
ITS	Intelligent Transportation System
LRTP	Long Range Transportation Plan
MC	Maintenance and Construction
MCHRA	Mid-Cumberland Human Resource Agency
MDT	Mobile Data Terminal
MPO	Metropolitan Planning Organization
MTA	Metropolitan Transit Authority
RTA	Regional Transportation Authority
RDS	Radar Detection System
RWIS	Road Weather Information System
TBI	Tennessee Bureau of Investigation
TDOT	Tennessee Department of Transportation

LIST OF ACRONYMS

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 Nashville Area Regional Intelligent Transportation System (ITS) Architecture was updated under the direction of the Nashville 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 Nashville 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 Nashville 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 Nashville Area Regional ITS Deployment Plan was developed as a companion document to the Nashville Area 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 Nashville 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 Nashville Area Regional ITS Architecture using the boundaries of the Nashville Area MPO plus the remainder of Robertson County. The MPO boundaries include all of Davidson, Robertson, Rutherford, Sumner, Williamson, and Wilson Counties as well as part of Maury County. Robertson County is not completely included within the MPO boundaries at the current time but the stakeholder group involved in the development of the Nashville Regional ITS Architecture decided to include all of Robertson County as part of the geographic boundaries for the ITS architecture. A map of the Nashville Area MPO has been provided in **Figure 1**. Other than Robertson County, the boundaries shown in **Figure 1** are identical to the geographic boundaries of the Regional ITS Architecture.

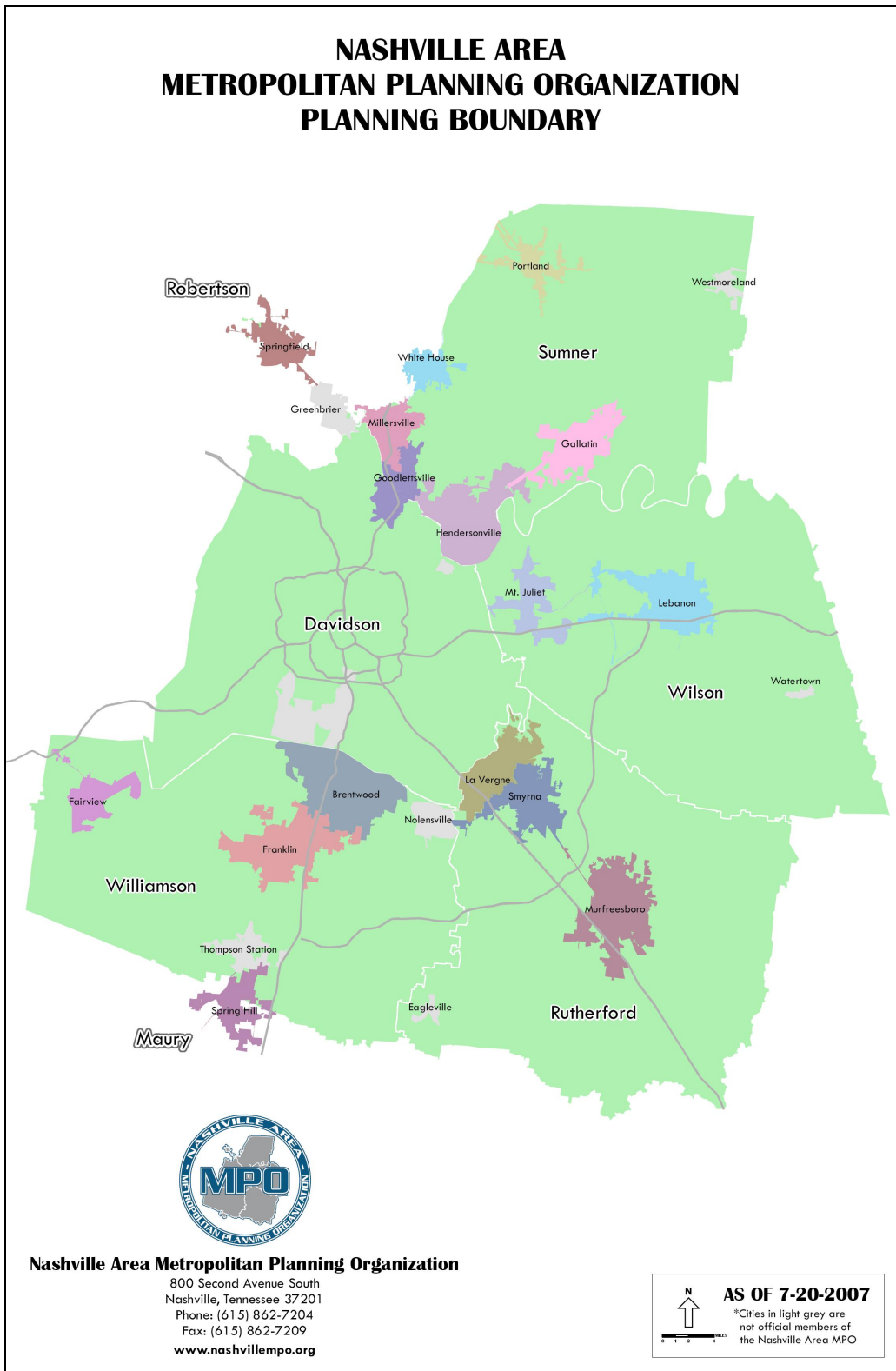


Figure 1 – Nashville Area MPO Boundaries

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 and FHWA Tennessee Division Office. A list of the participating stakeholder agencies is provided below. A complete list of individuals representing the agencies has been provided in the Nashville Area Regional ITS Architecture document.

- City of Franklin;
- City of Gallatin;
- City of Lebanon;
- City of Mt. Juliet;
- City of Murfreesboro;
- City of Nashville;
- Metro Nashville;
- Federal Highway Administration – Tennessee Division;
- Franklin Transit Authority;
- Mid-Cumberland Human Resource Agency Public Transit;
- Nashville Area MPO;
- Nashville Metropolitan Transit Authority;
- TDOT Community Relations Division;
- TDOT Long Range Planning Division;
- TDOT Project Planning Division;
- TDOT Region 3;
- Town of Smyrna;
- Williamson County; and
- Wilson County.

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 Nashville Area ITS Deployment Plan will provide stakeholders with a list of regionally significant ITS projects that are consistent with 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, projects submitted as part of the call for projects for the 2035 Regional Transportation Plan, 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 December 2009, stakeholders discussed and selected ITS market packages for the Nashville Area. ITS market packages represent the services that ITS can provide, such as Network Surveillance and Traffic Information Dissemination. In the Nashville Area stakeholders identified 40 market packages for consideration in the Region and later ranked those market packages as high, medium, or low priority. The Nashville Area MPO was in the

process of developing the Nashville Area 2035 Regional Transportation Plan and many of the stakeholders had submitted ITS project recommendations as part of a call for projects for the plan. The projects that were submitted by stakeholders for the 2035 Regional Transportation Plan have been included in this report. 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 Nashville Area MPO with a list of many of the priority ITS projects for the Nashville Area. Each of the projects recommended in the Regional ITS Deployment Plan has been checked against the Nashville Area Regional ITS Architecture to ensure they are in conformance. 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 assist with the long range planning process in the future and provide agencies with a list of priority ITS projects for consideration during future calls for projects from the Nashville Area MPO.

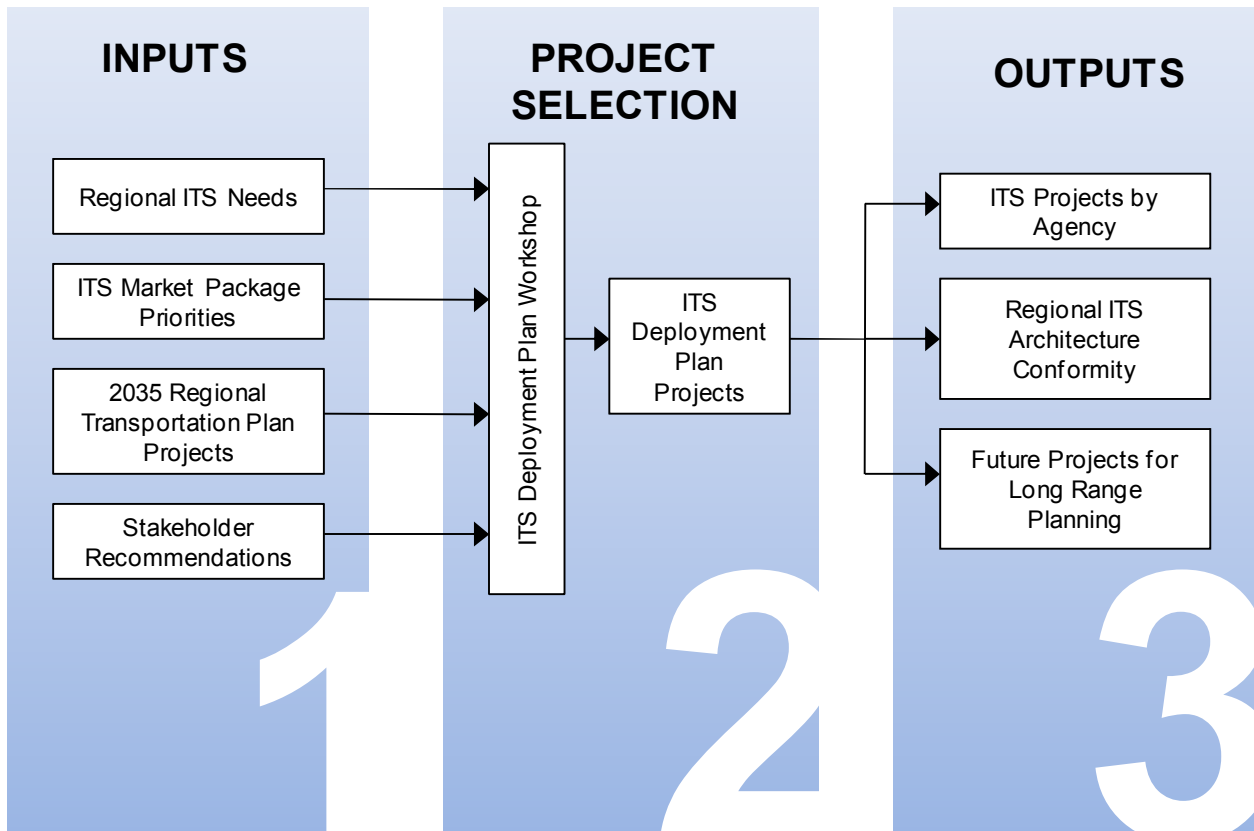


Figure 2 – Nashville Area Regional ITS Deployment Plan Development Process

1.3 Document Overview

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

Section 1 – Introduction

This section provides an overview of the Nashville 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 Nashville 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. Projects are divided between those submitted by agencies as part of the Nashville Area 2035 Regional Transportation Plan update and those recommended based on regional needs and stakeholder workshops. Each project includes a description of the project, agency responsible for deployment, an opinion of probable cost, deployment time-frame, 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 Nashville 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, stakeholder inputs, and projects submitted to the Nashville Area MPO for the development of the 2035 Regional Transportation Plan. Based on the inputs received, a series of ITS project types were developed for consideration in the Nashville 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 Nashville 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 need to deploy arterial dynamic message signs (DMS), 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 Nashville 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.

- Reduce congestion through the application of traffic management techniques that increase transportation system capacity and minimize disruptions to normal operation, such as traffic surveillance and control systems, motorist information systems, computerized and coordinated signal system, incident management, and reversible lanes (Nashville Area 2030 Long Range Transportation Plan goal);
- Implement measures to improve operating efficiency and reduce idling time such as incident management, motorist information systems, and coordinated traffic signal operation (Nashville Area 2030 Long Range Transportation Plan goal);
- Improve information sharing between the TDOT Region 3 SmartWay Traffic Management Center (TMC) and the municipal Traffic Operation Centers (TOCs) in the Region;
- Deploy arterial DMS or other roadside traveler information system;
- Develop alternate signal timing plans that can be implemented during incidents, detours, or special events;
- Develop a centralized regional information resource for traffic information;

- Expand the TDOT SmartWay 511 traveler information system by adding incident and closure information for arterial roadways;
- Improve coordination with the Tennessee Highway Patrol (THP) to share more real-time information between the TDOT Region 3 SmartWay TMC and THP;
- Improve emergency management coordination, especially along jurisdictional boundaries to speed incident response;
- Provide real-time maintenance and construction management information from traffic management to public safety and emergency management agencies to support quick dispatch of first responders; and
- Provide emergency management with access to CCTV camera feeds on mobile data terminals (MDTs).

2.1.2 ITS Market Package Prioritization

Of the 91 ITS market packages available in Version 6.1 of the National ITS Architecture, 40 were selected by stakeholders and customized for deployment in the Nashville 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 Nashville 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 – Nashville 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 ATMS15 Railroad Operations Coordination ATMS18 Reversible Lane Management ATMS19 Speed Monitoring	ATMS02 Traffic Probe Surveillance ATMS05 HOV Lane Management ATMS10 Electronic Toll Collection
Emergency Management		
EM01 Emergency Call-Taking and Dispatch EM02 Emergency Routing EM04 Roadway Service Patrols	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	MC01 Maintenance and Construction Vehicle and Equipment Tracking MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution	
Public Transportation Management		
APTS01 Transit Vehicle Tracking APTS02 Transit Fixed Route Operations APTS03 Demand Response Transit Operations APTS05 Transit Security APTS06 Transit Fleet Management APTS08 Transit Traveler Information APTS09 Transit Signal Priority	APTS04 Transit Fare Collection Management APTS07 Multi-Modal Coordination APTS10 Transit Passenger Counting	
Traveler Information		
ATIS01 Broadcast Traveler Information ATIS02 Interactive Traveler Information		
Commercial Vehicle Operations		
	CVO06 Weigh-in-Motion	
Archived Data Management		
	AD1 ITS Data Mart AD3 ITS Virtual Data Warehouse	

2.1.3 Existing and Planned ITS Projects

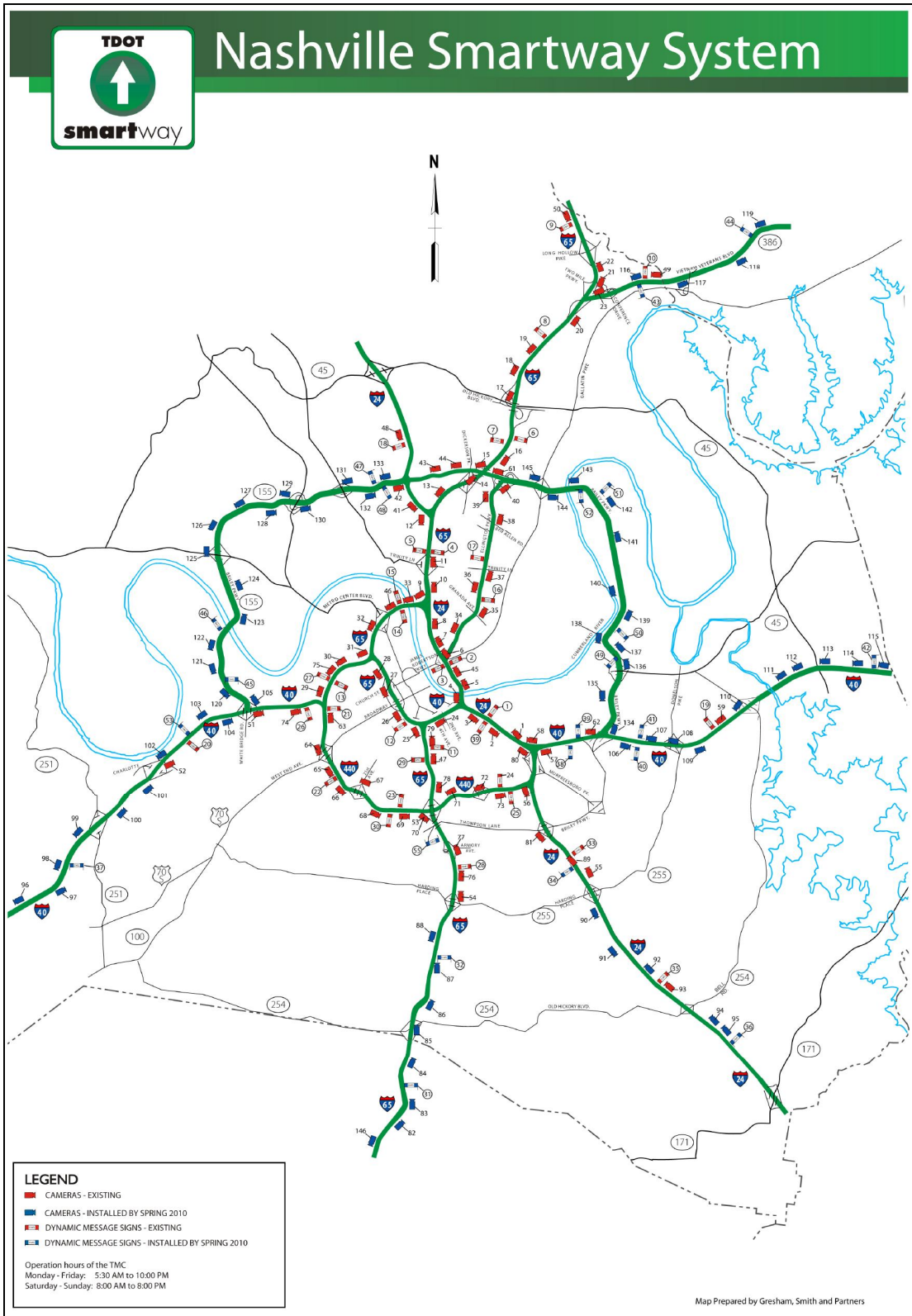
The Nashville Area has several major ITS deployments including the TDOT SmartWay ITS System, TDOT HELP service patrols, 511 traveler information, municipal TOCs and traffic signal systems, and major ITS deployments underway for transit. In **Figure 3** the largest ITS deployment in the Nashville Area, TDOT's SmartWay ITS System, is shown. These existing deployments served as a basis for developing new projects to expand the geographic coverage of existing systems and add new ITS capabilities in the Nashville Area.

There are a number of ITS projects that agencies are also planning for in the future. The Nashville Area MPO, as part of the development of the 2035 Regional Transportation Plan, issued a call for projects to member agencies to assemble all of the potential transportation projects for the Region. The projects that were submitted by member agencies included a number of projects for implementation by municipalities, counties, and transit organizations. These projects have been documented in Section 4.1 of this report.

2.1.4 Stakeholder Input

The primary source of stakeholder input came from discussions at the four stakeholder workshops conducted in the Nashville Area as part of the update of the Nashville 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. Stakeholders were also provided with a form prior to the Workshop for providing input to the project team on any ITS projects that were planned or desired by their agency.

The ITS Deployment Plan is not fiscally constrained so even though many of the ITS projects identified for the ITS Deployment Plan at the Workshop do not have any funding associated with them, they do represent projects that are important in the Region.



Source: TDOT Region 3

Figure 3 – TDOT Region 3 SmartWay ITS System

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

TDOT SmartWay ITS Extension

TDOT would like to expand the SmartWay coverage of the freeway system including areas outside of Davidson County. The SmartWay ITS extension projects will include a combination of deployments that may include CCTV cameras, DMS, radar detection systems (RDS), highway advisory radio (HAR), and the necessary communications systems to support the extensions.

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

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 often staffed beyond normal business hours. A traffic operations center (TOC) is typically thought of as a single agency facility and 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 TOC.

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.

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

Traffic Management Signal System Implementation or Upgrades

Traffic management signal systems include the communication system, field hardware, and traffic signal control software to allow real-time monitoring and control the traffic signal system.

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

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

Ramp Metering

Ramp meters can be implemented to decrease mainline congestion and incidents. Ramp meters are typically activated during peak travel periods when freeways are not at free flow conditions.

Associated Market Packages: ATMS04–Freeway Control

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

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

TDOT SmartWay Information System Modification for Municipal Traffic Information Input

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 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 Nashville Area and Metro Nashville has a program for use on arterial streets in Davidson County. As the SmartWay system coverage is extended, the HELP service patrol coverage area will also likely be expanded. Other municipalities in the Nashville Area Region are also considering the addition of service patrol programs for arterial streets in their jurisdiction.

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 vehicles 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

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

Transit Signal Priority

Transit priority allows transit buses to request priority at traffic signals to extend or accelerate the call for green. The system can be GPS based or use a transmitter activated by the driver to request priority when buses are running behind schedule.

Associated Market Packages: APTS09–Transit Signal Priority

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

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 the ITS Deployment Plan Workshop 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 4.2.

Project timeframes and costs 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 like to fund if money was available. The costs presented for the projects in Section 4.2 are planning level costs as no preliminary engineering or design was performed as part of the project development process.

3. ITS MARKET PACKAGE IMPLEMENTATION

In order to implement the ITS market package services in the Nashville 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 CCTV Cameras project will support operations of the Municipal/County Traffic Management Signal System Implementation project 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	
<ul style="list-style-type: none"> ▪ City of Franklin ITS Implementation ▪ City of Franklin TOC Phase 3 ▪ Davidson County Signal System Upgrades ▪ Metro Nashville ITS Integrated Corridor Management ▪ Municipal CCTV Cameras ▪ Municipal/County TOC ▪ TDOT Region 3 SmartWay Freeway Management System Extension 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ Metro Nashville ITS Communications Program ▪ 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
<p>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.</p>	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ City of Franklin ITS Implementation ▪ City of Franklin Murfreesboro Rd (SR 96E) Widening ▪ City of Franklin TOC Phase 3 ▪ City of Hendersonville Signal System Upgrade ▪ City of Lebanon Closed Loop Signal System ▪ County Sherriff Vehicles Traffic Signal Preemption ▪ Davidson County Signal System Optimization ▪ Davidson County Signal System Upgrades ▪ Transit Traffic Signal Priority System ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ Metro Nashville Multi-Modal Enhancements ▪ Metro Nashville Wayfinding and Traffic Guidance System Phase 2 ▪ Metro Nashville Intersection Improvements to address Multi-Modal, Safety and System Preservation Phases 1-3 ▪ Metro Nashville ITS Integrated Corridor Management ▪ MTA New Bus Rapid Transit or Light Rail Service to Vanderbilt/Hillsboro/West End Area ▪ MTA Operational Funding (for ITS Improvements) ▪ Municipal Fire and EMS Vehicles Traffic Signal Preemption ▪ Municipal/County TOC ▪ Municipal/County Traffic Management Signal System Implementation ▪ RTA Operational Funding (for ITS Improvements) ▪ Town of Smyrna Signal System 	
<p>Additional Supporting Projects</p> <ul style="list-style-type: none"> ▪ Metro Nashville ITS Communications Program ▪ Municipal CCTV Cameras 	

Freeway Control (ATMS04)	Medium Priority
<p>Provides the communications and roadside equipment to support ramp control, lane controls and interchange control for freeways. This market package is consistent with typical urban traffic freeway control systems. Also includes the capability to utilize surveillance information for detection of incidents.</p>	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ TDOT Ramp Metering 	

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

HOV Lane Management (ATMS05)	Low Priority
Manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals.	
Recommended Projects	
No projects have been identified at this time. The HOV Lane Management market package was customized and included in the ITS Architecture to reflect the possibility for HOV lanes 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	
<ul style="list-style-type: none"> ▪ City of Franklin TOC Phase 3 ▪ Metro Nashville ITS Integrated Corridor Management ▪ Municipal Arterial DMS ▪ Municipal/County TOC ▪ TDOT Region 3 SmartWay Freeway Management System Extension 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ Metro Nashville ITS Communications Program ▪ Municipal Railroad Grade Crossing Advance Notification System ▪ Municipal/County Portable DMS 	

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	
<ul style="list-style-type: none"> ▪ TDOT Region 3 SmartWay TMC Coordination with Municipal TOCs 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ Municipal/County TOC 	

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

Traffic Incident Management System (ATMS08)	High Priority
<p>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.</p>	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ City of Franklin TOC Phase 3 ▪ Metro Nashville ITS Integrated Corridor Management ▪ Municipal/County TOC ▪ TDOT Region 3 SmartWay TMC Coordination with Municipal TOCs ▪ TDOT Region 3 SmartWay TMC Coordination with THP ▪ TDOT SmartWay Information System Modification for Municipal Traffic Information Input 	
<p>Additional Supporting Projects</p> <ul style="list-style-type: none"> ▪ Metro Nashville Works ITS Communications Program ▪ Municipal Arterial DMS ▪ Municipal CCTV Cameras ▪ Municipal/County Portable DMS ▪ Municipal Service Patrol Implementation ▪ TDOT HELP Service Patrol Expansion ▪ TDOT Region 3 SmartWay Freeway Management System Extension 	

Electronic Toll Collection (ATMS10)	Low Priority
<p>Provides toll operators with the ability to collect tolls electronically and detect and process violations.</p>	
<p>Recommended Projects</p> <p>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.</p>	

Standard Railroad Grade Crossing (ATMS13)	Medium Priority
<p>Manages highway traffic at highway-rail intersections where rail operational speeds are less than 80 mph.</p>	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ Municipal Railroad Grade Crossing Advance Notification System 	

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

Railroad Operations Coordination (ATMS15)	Medium Priority
Provides an additional level of strategic coordination between freight rail operations and traffic management centers. Could include train schedules, maintenance schedules or any other anticipated HRI closures.	
Recommended Projects	
No projects have been identified at this time. The Railroad Operations Coordination market package was customized and included in the ITS Architecture to reflect the desire for future coordination with railroad operations.	

Reversible Lane Management (ATMS18)	Medium Priority
Provides for the management of reversible lane facilities and includes the field equipment, physical lane access controls, and associated control electronics.	
Recommended Projects	
There are several existing reversible lane systems in place on arterials in the Region, but no plans for additional deployments at this time.	

Speed Monitoring (ATMS19)	Medium Priority
Monitors the speeds of vehicles traveling through a roadway system.	
Recommended Projects	
<ul style="list-style-type: none"> ▪ Municipal Speed Monitoring System 	

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	
<ul style="list-style-type: none"> ▪ TDOT Region 3 SmartWay TMC Coordination with THP 	

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

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	
<ul style="list-style-type: none"> ▪ County Sherriff Vehicles Traffic Signal Preemption ▪ Municipal Fire and EMS Vehicles Traffic Signal Preemption 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ 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	
<ul style="list-style-type: none"> ▪ Municipal Service Patrol Implementation ▪ TDOT HELP Service Patrol Expansion 	

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	
<ul style="list-style-type: none"> ▪ TDOT Region 3 SmartWay TMC Coordination with the Tennessee Fusion Center 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ Municipal Arterial DMS ▪ TDOT Region 3 SmartWay Freeway Management System Extension 	

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	
<ul style="list-style-type: none"> ▪ TDOT Region 3 SmartWay TMC Coordination with County EMAs ▪ TDOT Region 3 SmartWay TMC Coordination with the Tennessee Statewide EOC 	

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

Evacuation and Reentry Management (EM09)	Medium Priority
<p>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.</p>	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ TDOT Region 3 SmartWay TMC Coordination with County EMAs ▪ TDOT Region 3 SmartWay TMC Coordination with the Tennessee Statewide EOC 	
<p>Additional Supporting Projects</p> <ul style="list-style-type: none"> ▪ Municipal Arterial DMS ▪ Municipal CCTV Cameras ▪ Municipal Service Patrol Implementation ▪ Municipal/County Portable DMS ▪ TDOT HELP Service Patrol Expansion ▪ TDOT Region 3 SmartWay Freeway Management System Extension 	

Disaster Traveler Information (EM10)	Medium Priority
<p>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.</p>	
<p>Recommended Projects</p> <p>No projects were identified specifically for disaster traveler information. However, several traveler information projects will provide useful dissemination tool in the event of a disaster.</p>	
<p>Additional Supporting Projects</p> <ul style="list-style-type: none"> ▪ Municipal Arterial DMS ▪ Municipal Real-Time Traveler Information Website ▪ Municipal/County Portable DMS ▪ TDOT Region 3 SmartWay Freeway Management System Extension ▪ 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	
<ul style="list-style-type: none"> ▪ Municipal/County RWIS Detection 	

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.	

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	
<ul style="list-style-type: none"> ▪ Municipal/County Portable DMS 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ Municipal Arterial DMS ▪ Municipal CCTV Cameras ▪ Municipal Service Patrol Implementation ▪ Municipal/County Portable DMS ▪ TDOT HELP Service Patrol Expansion ▪ TDOT Region 3 SmartWay Freeway Management System Extension 	

Table 4 – Maintenance and Construction Management Market Packages and Projects (continued)

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	
No projects have been identified at this time.	

3.4 Public Transportation Management Service Area

The following ITS market packages implement public transportation management ITS functions. Many of these market packages were ranked as high priority and projects are currently in the process of being implemented by the transit agencies in the Nashville Area Region to implement them.

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	
<ul style="list-style-type: none"> ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ MTA Operational Funding (for ITS Improvements) ▪ Murfreesboro Urban Transit Service Expansion ▪ RTA Operational Funding (for ITS Improvements) ▪ 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	
<ul style="list-style-type: none"> ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ MTA Operational Funding (for ITS Improvements) ▪ RTA Operational Funding (for ITS Improvements) ▪ Transit Dispatch Coordination with Municipal TOC 	

**Table 5 – Public Transportation Management Market Packages and Projects
(continued)**

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	
<ul style="list-style-type: none"> ▪ Transit 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)	High Priority
Provides for the physical security of transit passengers and transit vehicle operators. Includes on-board security cameras and panic buttons.	
Recommended Projects	
<ul style="list-style-type: none"> ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ MTA Operational Funding (for ITS Improvements) ▪ Murfreesboro Urban Transit Service Expansion ▪ RTA Operational Funding (for ITS Improvements) ▪ Transit Vehicle Alarm System ▪ Transit Vehicle On-Board Security Cameras 	

Transit Fleet Management (APTS06)	High 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.	

**Table 5 – Public Transportation Management Market Packages and Projects
(continued)**

Transit Traveler Information (APTS08)	High Priority
<p>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.</p>	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ Interactive Voice Response System for Reservations ▪ MTA Operational Funding (for ITS Improvements) ▪ RTA Operational Funding (for ITS Improvements) ▪ Next-bus Arrival Dynamic Message Sign ▪ Real-time Traveler Information Website 	
<p>Additional Supporting Projects</p> <ul style="list-style-type: none"> ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ MTA Operational Funding (for ITS Improvements) ▪ Murfreesboro Urban Transit Service Expansion ▪ RTA Operational Funding (for ITS Improvements) ▪ Transit Vehicle Tracking 	

Transit Signal Priority (APTS09)	High Priority
<p>Determines the need for transit priority on routes and at certain intersections and requests transit vehicle priority at these locations to improve on-time performance of the transit system.</p>	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ City of Franklin Murfreesboro Rd (SR 96E) Widening ▪ Metro Nashville Multi-Modal Enhancements ▪ Metro Nashville Intersection Improvements to address Multi-Modal, Safety and System Preservation Phases 1-3 ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ MTA Operational Funding (for ITS Improvements) ▪ RTA Operational Funding (for ITS Improvements) ▪ MTA New Bus Rapid Transit or Light Rail Service to Vanderbilt/Hillsboro/West End Area ▪ Transit Traffic Signal Priority System 	

**Table 5 – Public Transportation Management Market Packages and Projects
(continued)**

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	
<ul style="list-style-type: none"> ▪ Franklin Transit Authority Capital and Preventative Maintenance ▪ MTA Operational Funding (for ITS Improvements) ▪ RTA Operational Funding (for ITS Improvements) ▪ 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	
<ul style="list-style-type: none"> ▪ Metro Nashville Wayfinding and Traffic Guidance System Phase 2 ▪ Metro Nashville ITS Integrated Corridor Management ▪ TDOT SmartWay Information System Modification for Municipal Traffic Information Input ▪ Municipal Real-Time Traveler Information Website 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ Metro Nashville ITS Communications Program 	

Table 6 – Traveler Information Market Packages and Projects (continued)

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	
<ul style="list-style-type: none"> ▪ Metro Nashville Wayfinding and Traffic Guidance System Phase 2 ▪ Metro Nashville ITS Integrated Corridor Management 	
Additional Supporting Projects	
<ul style="list-style-type: none"> ▪ Metro Nashville ITS Communications Program 	

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

Weigh-in-Motion (CVO06)	Medium Priority
Provides for high speed weigh-in-motion with or without automated vehicle identification capabilities.	
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.	
<p>Recommended Projects</p> <p>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 to archive that data.</p>	
ITS Virtual Data Warehouse (AD3)	Medium 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.	
<p>Recommended Projects</p> <ul style="list-style-type: none"> ▪ Nashville 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 Nashville 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.

Projects identified in this Section came from two separate efforts. The first was a list of ITS related projects that member agencies have submitted to the Nashville Area MPO as part of the development of the 2035 Regional Transportation Plan. These projects are shown in Section 4.1. The second effort was based on a set of ITS projects reviewed and modified by stakeholders at the March 2010 ITS Deployment Plan Workshop. The projects that resulted from the workshop are shown in Section 4.2

4.1 Nashville Area 2035 Regional Transportation Plan ITS Projects

Concurrent with the updated of the Nashville Area Regional ITS Architecture, the Nashville Area MPO was also in the process of developing the 2035 Regional Transportation Plan. The 2035 Regional Transportation Plan will provide a 25 year vision for transportation in the greater Nashville Area. As part of the plan development, the Nashville Area MPO issued a call for projects from member agencies. These projects represented the project needs for agencies throughout the Nashville Area and included many ITS projects related to surface transportation and transit. As part of the Nashville Area Regional ITS Deployment Plan effort, the ITS related projects from the 2035 Regional Transportation Plan were assembled and reviewed to determine their conformance with the Regional ITS Architecture market packages. The 2035 Regional Transportation Plan projects and the ITS market packages they are associated with have been included in this Section.

The 2035 Regional Transportation Plan projects identified in **Table 9 and 10** include:

- **Table 9** – Municipal and County ITS Projects Submitted for the 2035 Regional Transportation Plan; and
- **Table 10** – Transit ITS Projects Submitted for the 2035 Regional Transportation Plan.

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 based on what was submitted in response to the call for projects for the 2035 Regional Transportation Plan.
- **Responsible Agency** – Identifies the primary agency or agencies responsible for the implementation and operation of the deployment project.
- **Opinion of Probable Cost and Deployment Timeframe** – Provides the cost estimate and timeframe of the funding cycle based on what was submitted in response to the call for projects for the 2035 Regional Transportation Plan.
- **Applicable Market Packages** – Identifies the ITS market packages from the Regional ITS Architecture that each project will assist in implementing. These market packages also demonstrate where in the Regional ITS Architecture the project conforms and are an important part of any ITS architecture conformance review.

One critical part of deploying ITS that is not fully addressed in the ITS Deployment Plan is the on-going cost to agencies for the maintenance and operations of ITS. Agencies must plan for continued maintenance and eventual replacement of any ITS technologies that are deployed. Lifespan of ITS infrastructure may be anywhere from five to twenty years, but once elements are out of warranty agencies should be prepared to replace infrastructure as needed. Costs for operations include the cost for staff and training as well as utility costs for power and communications. When planning for ITS deployments agencies should take into account the availability and technical proficiency of existing staff and monthly costs for leased lines, cellular, or other types of communication services that are purchased. If adequate staff and funding cannot be dedicated to the maintenance and operations of ITS, then agencies may need to consider scaling back or postponing ITS deployments until adequate staff and funding is available.

4.1.1 Municipal and County 2035 Regional Transportation Plan ITS Projects

Table 9 – Municipal and County ITS Projects Submitted for the 2035 Regional Transportation Plan

Project	Description	Responsible Agency	Cost Estimate and Deployment Timeframe	Applicable Market Packages
City of Franklin ITS Implementation	Install communications infrastructure, video monitoring systems and traffic signal coordination plans.	City of Franklin	Cost: \$6,000,000 Timeframe: 2015 Funding Cycle	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
City of Franklin Murfreesboro Rd (SR 96E) Widening	Widening of Murfreesboro Road to include the addition of sidewalks, crosswalks, bike lanes, and transit signal priority.	City of Franklin	Cost: \$30,000,000 Timeframe: 2025 Funding Cycle	ATMS03 – Surface Street Control APTS09 – Transit Signal Priority
City of Franklin TOC Phase 3	Upgrade ITS software and associated TOC infrastructure.	City of Franklin	Cost: \$2,600,000 Timeframe: 2015 Funding Cycle	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
City of Hendersonville Signal System Upgrade	Upgrade and synchronize traffic signals on Main Street, New Shackle Island Road, and several other corridors.	City of Hendersonville	Cost: \$1,520,000 Timeframe: 2015 Funding Cycle	ATMS03 – Surface Street Control
City of Lebanon Closed Loop Signal System	Perform a study of traffic signals on several corridors and implement subsequent recommendations to improve traffic flow.	City of Lebanon	Cost: \$250,000 Timeframe: 2015 Funding Cycle	ATMS03 – Surface Street Control
Davidson County Signal System Optimization	Ongoing efforts to optimize traffic signal timing countywide improve the efficiency of the traffic signal system.	Metro Nashville	Cost: \$6,000,000 Timeframe: 2015 Funding Cycle	ATMS03 – Surface Street Control
			Cost: \$6,000,000 Timeframe: 2025 Funding Cycle	
			Cost: \$6,000,000 Timeframe: 2035 Funding Cycle	

Table 9 – Municipal and County ITS Projects Submitted for the 2035 Regional Transportation Plan (continued)

Project	Description	Responsible Agency	Cost Estimate and Deployment Timeframe	Applicable Market Packages
Davidson County Signal System Upgrades	Implement advanced system detection to support real-time management of the selected corridors. Real-time management will utilize timing plan adjustments as well traffic responsive operations in some areas.	Metro Nashville	Cost: \$4,000,000 Timeframe: 2025 Funding Cycle	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Metro Nashville Multi-Modal Enhancements	Intersection improvements to increase pedestrian access and operational efficiency on transit routes. Depending on the intersection these enhancements could include sidewalks, crosswalk improvements, bicycle lanes, or bus queue jump lanes and associated signal priority features.	Metro Nashville	Cost: \$3,000,000 Timeframe: 2015 Funding Cycle	ATMS03 – Surface Street Control APTS09 – Transit Signal Priority
			Cost: \$3,000,000 Timeframe: 2025 Funding Cycle	
			Cost: \$3,000,000 Timeframe: 2035 Funding Cycle	
Metro Nashville Wayfinding and Traffic Guidance System Phase 2	In coordination with TDOT, Metro Nashville has been working to deploy a comprehensive urban wayfinding system. As part of this phase, mapping capabilities will be expanded and may include interactive, web-based maps and DMS will be deployed.	Metro Nashville	Cost: \$4,000,000 Timeframe: 2025 Funding Cycle	ATMS06 – Traffic Information Dissemination ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information
Metro Nashville Intersection Improvements to address Multi-Modal, Safety and System Preservation Phases 1-3	This series of projects will address safety, multi-modal and capacity deficiencies at intersections throughout Davidson County. Depending on the intersection these improvements could include sidewalks, crosswalk improvements, turn lane additions, traffic signal upgrades including transit signal priority, or other low cost (under \$500,000 per intersection) improvements.	Metro Nashville	Cost: \$4,000,000 Timeframe: 2015 Funding Cycle	ATMS03 – Surface Street Control APTS09 – Transit Signal Priority
			Cost: \$8,000,000 Timeframe: 2025 Funding Cycle	
			Cost: \$8,000,000 Timeframe: 2035 Funding Cycle	

Table 9 – Municipal and County ITS Projects Submitted for the 2035 Regional Transportation Plan (continued)

Project	Description	Responsible Agency	Cost Estimate and Deployment Timeframe	Applicable Market Packages		
Metro Nashville ITS Communications Program	Improve and integrate signal system communications to improve Metro's ability to actively manage the transportation network. The traffic signal system is a critical component of the system. In addition to improved operations and monitoring of the network, the communications program will return traffic information to roadway users. This will be accomplished through the use of DMS, traffic information websites, support for in-vehicle systems, social media, or other devices prevalent at the time of deployment.	Metro Nashville	Cost: \$2,000,000 Timeframe: 2035 Funding Cycle	Though this project is not specifically represented in any market packages, the communications program will support many ITS functions in other market packages.		
Metro Nashville ITS Integrated Corridor Management	Implement Integrated Corridor Management (ICM) applications within Davidson County. ICM focuses on operating all aspects of a corridor (traffic and transit) in coordination. ICM deployments will include traffic signal improvements and transit signal priority, arterial detection, and support improved traveler information using DMS or other dissemination methods.	Metro Nashville	<table border="1"> <tr> <td data-bbox="1239 672 1526 862">Cost: \$6,000,000 Timeframe: 2025 Funding Cycle</td> <td data-bbox="1526 672 1953 1070" rowspan="2"> ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System APTS09 – Transit Signal Priority ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information </td> </tr> <tr> <td data-bbox="1239 862 1526 1070">Cost: \$6,000,000 Timeframe: 2035 Funding Cycle</td> </tr> </table>	Cost: \$6,000,000 Timeframe: 2025 Funding Cycle	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System APTS09 – Transit Signal Priority ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information	Cost: \$6,000,000 Timeframe: 2035 Funding Cycle
Cost: \$6,000,000 Timeframe: 2025 Funding Cycle	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System APTS09 – Transit Signal Priority ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information					
Cost: \$6,000,000 Timeframe: 2035 Funding Cycle						
Town of Smyrna Signal System	Signal timing coordination study and system implementation.	Town of Smyrna	Cost: \$1,000,000 Timeframe: 2015 Funding Cycle	ATMS03 – Surface Street Control		

4.1.2 Transit 2035 Regional Transportation Plan ITS Projects

Table 10 – Transit ITS Projects Submitted for the 2035 Regional Transportation Plan

Project	Description	Responsible Agency	Cost Estimate and Deployment Timeframe	Applicable Market Packages
Franklin Transit Authority Capital and Preventative Maintenance	Capital and preventative maintenance program funds to support transit service, preventative maintenance, procurement of new or replacement vehicles, bus stop or station improvements, existing facility operations, and ITS improvements to include AVL, automatic passenger counters, and transit signal priority implementation.	Franklin Transit Authority	Cost: \$6,200,000 Timeframe: 2025 Funding Cycle	ATMS03 – Surface Street Control APTS01 – Transit Vehicle Tracking APTS02 – Transit Fixed Route Operations APTS05 – Transit Security
			Cost: \$6,500,000 Timeframe: 2035 Funding Cycle	APTS08 – Transit Traveler Information APTS09 – Transit Signal Priority APTS10 – Transit Passenger Counting
MTA New Bus Rapid Transit or Light Rail Service to Vanderbilt/Hillsboro/West End Area	Develop BRT/LRT service from Music City Central out the Broadway/West End corridor to the Vanderbilt/Hillsboro/West End Area.	MTA	Cost: unknown Timeframe: 2015 and 2025 Funding Cycles	ATMS03 – Surface Street Control APTS09 – Transit Signal Priority
MTA Operational Funding (for ITS Improvements)	Operational budget funding to support existing and expanded transit service, preventative maintenance, procurement of new or replacement vehicles, bus stop or station improvements (rail, BRT, express routes), existing facility operations, and ITS improvements to include AVL, automatic passenger counters, and transit signal priority implementation. (This project has been included in the Regional ITS Deployment Plan due to the ITS improvements included in the description.)	MTA	Cost: \$46,000,000 (ITS funding would only be used to fund the portion of this project for ITS improvements) Timeframe: 2015, 2025 and 2035 Funding Cycles	ATMS03 – Surface Street Control APTS01 – Transit Vehicle Tracking APTS02 – Transit Fixed Route Operations APTS05 – Transit Security APTS08 – Transit Traveler Information APTS09 – Transit Signal Priority APTS10 – Transit Passenger Counting

Table 10 – Transit ITS Projects Submitted for the 2035 Regional Transportation Plan (continued)

Project	Description	Responsible Agency	Cost Estimate and Deployment Timeframe	Applicable Market Packages
Murfreesboro Urban Transit Service Expansion	Expansion of routes and services including the procurement of new vehicles and facility and ITS improvements.	City of Murfreesboro	Cost: Unknown Timeframe: Unknown	APTS01 – Transit Vehicle Tracking APTS05 – Transit Security
RTA Operational Funding (for ITS Improvements)	Operational budget funding to support transit service, preventative maintenance, procurement of new or replacement vehicles, bus stop or station improvements (rail or BRT), existing facility operations, and ITS improvements to include AVL, automatic passenger counters, and transit signal priority implementation. (This project has been included in the Regional ITS Deployment Plan due to the ITS improvements included in the description.)	RTA	Cost: \$6,000,000 (ITS funding would only be used to fund the portion of this project for ITS improvements) Timeframe: 2015, 2025 and 2035 Funding Cycles	ATMS03 – Surface Street Control APTS01 – Transit Vehicle Tracking APTS02 – Transit Fixed Route Operations APTS05 – Transit Security APTS08 – Transit Traveler Information APTS09 – Transit Signal Priority APTS10 – Transit Passenger Counting

4.2 Nashville Area Recommended ITS Projects

To achieve input from stakeholders, an ITS Deployment Plan Workshop was held with stakeholders in the Nashville Area on March 3, 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 11** through **Table 14**. The tables are divided by primary responsible agency as follows:

- **Table 11** – Tennessee Department of Transportation recommended ITS projects;
- **Table 12** – Municipal and County recommended ITS projects;
- **Table 13** – Transit recommended ITS projects; and
- **Table 14** – Nashville Area MPO recommended ITS projects.

The projects identified in the tables represent 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.

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, timeframe for deployment, and cost.
- **Responsible Agency** – Identifies the primary agency or agencies responsible for the implementation and operation of the deployment project.
- **Opinion of Probable Cost and Deployment Timeframe** – Provides an opinion of probable cost of each project and a timeframe for deployment. 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. Deployment 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.
- **Applicable Market Packages** – Identifies the ITS market packages from the Regional ITS Architecture that each project will assist in implementing. These market packages also demonstrate where in the Regional ITS Architecture the project conforms and is an important part of an ITS architecture conformance review.

As mentioned earlier in Section 4.1, the ITS Deployment Plan does not fully address the on-going cost to agencies for the maintenance and operations of ITS. Prior to the deployment of any of the recommended projects, agencies must consider if adequate staff and funding can be dedicated to the maintenance and operations of ITS. If funding is not available then agencies may need to consider scaling back or postponing an ITS project until adequate staff and funding is available.

4.2.1 TDOT Recommended ITS Projects

Table 11 – TDOT Recommended ITS Projects

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
TDOT Region 3 SmartWay Freeway Management System Extension	Extend the coverage of the SmartWay freeway management system including the deployment CCTV cameras, DMS, RDS, and HAR and supporting communications system. A majority of the extension will occur outside of Davidson County including Rutherford, Wilson, and Robertson Counties in the Nashville Area Region. The timeframe for the extension is dependent on funding and deployments will likely occur in the short, mid, and long-term timeframes.	TDOT	Cost: \$400,000/Mile Timeframe: Short to Long-Term	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination
TDOT Ramp Metering	Implement ramp metering on urban freeway on-ramps to improve mainline traffic flow should TDOT decide to move forward with a ramp metering project. The use of ramp metering is under review by TDOT and a decision has not yet been made on deployment.	TDOT	Cost: \$20,000/Site Timeframe: Undecided	ATMS04 – Freeway Control
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 as funding allows.	TDOT	Cost: Dependant on coverage area and service schedule Timeframe: Short to Long-Term	EM04 – Roadway Service Patrols
TDOT Region 3 SmartWay TMC Coordination with Municipal TOCs	Establish communications connections between the TDOT Region 3 SmartWay TMC and Municipal TOCs for the coordination of traffic information. TOCs identified for future connections included Metro Nashville, Brentwood, Franklin, Hendersonville, and Murfreesboro. The communications connections will allow the sharing of video feeds, traffic conditions, and incident locations between the TDOT Region 3 SmartWay TMC and Municipal TOCs. The timeframe for the communications connections will be dependent on completion of TOCs and identification of funding.	TDOT and Municipalities	Cost: To Be Determined Timeframe: Short to Long-Term	ATMS07 – Regional Traffic Management ATMS08 – Traffic Incident Management System

Table 11 – TDOT Recommended ITS Projects (continued)

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
TDOT Region 3 SmartWay TMC Coordination with County EMAs	Establish communications connections between the TDOT Region 3 SmartWay TMC and County EMAs. The communications connections will provide the EMAs with access to TDOT video feeds and roadway condition information and facilitate coordination between TDOT and the EMAs during major incidents. The timeframe for the communications connections will be dependent on identification of funding.	TDOT and County EMAs	Cost: To Be Determined Timeframe: Short to Long-Term	EM08 – Disaster Response and Recovery EM09 – Evacuation and Reentry Management
TDOT Region 3 SmartWay TMC Coordination with THP	Establish a communications connection between the TDOT Region 3 SmartWay TMC and THP. This communications connection will provide THP with access to TDOT video feeds and allow coordination of incident locations between TDOT and THP. As an alternative to this project, THP could place someone in the TDOT Region 3 SmartWay TMC for coordination.	TDOT and THP	Cost: To Be Determined Timeframe: Dependant on funding for the connection	ATMS08 – Traffic Incident Management System
TDOT Region 3 SmartWay TMC Coordination with the Tennessee Statewide EOC	Establish communications connections between the TDOT Region 3 SmartWay TMC and the Tennessee Statewide EOC. The communications connections will provide the EOC with access to TDOT video feeds and roadway condition information and facilitate coordination between TDOT and the EOCs when the EOC is activated. The timeframe for the communications connections will be dependent on identification of funding.	TDOT and Statewide EOC	Cost: To Be Determined Timeframe: Dependant on funding for the connection	EM08 – Disaster Response and Recovery EM09 – Evacuation and Reentry Management
TDOT Region 3 SmartWay TMC Coordination with the Tennessee Fusion Center	Establish communications connections between the TDOT Region 3 SmartWay TMC and the Tennessee Bureau of Investigation (TBI). The communications connections will provide the Tennessee Fusion Center with access to TDOT video feeds and roadway condition information and facilitate coordination between TDOT and the Tennessee Fusion Center during major incidents. The timeframe for the communications connections will be dependent on identification of funding.	TDOT and TBI	Cost: To Be Determined Timeframe: Dependant on funding for the connection	EM06 –Wide Area Alert

Table 11 – TDOT Recommended ITS Projects (continued)

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
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.	TDOT and Municipalities	Cost: \$0 Timeframe: Short-term	ATMS08 – Traffic Incident Management System ATIS01 – Broadcast Traveler Information

¹The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

²Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

4.2.2 Municipal and County Recommended ITS Projects

Table 12 – Municipal and County Recommended ITS Projects

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe 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. Municipalities currently in the process of deploying or planning for TOCs include Metro Nashville, Hendersonville, and Lebanon.	Municipalities and Counties	Cost: \$100,000 - \$300,000 Timeframe: Short to Long-Term	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
Municipal/County Traffic Management Signal System Implementation	Implement traffic management signal systems in Municipalities and Counties in the Nashville Area Region. Signal systems could 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 Counties.	Municipalities and Counties	Cost: \$20,000 - \$40,000/Intersection Timeframe: Short to Long-Term	ATMS03 – Surface Street Control
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 3 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.	Municipalities	Cost: \$30,000/Site Timeframe: Short to Long-Term	ATMS01 – Network Surveillance

Table 12 – Municipal and County Recommended ITS Projects (continued)

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
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.	Municipalities	Cost: \$75,000/Site Timeframe: Short to Long-Term	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.	Municipalities	Cost: \$10,000 - \$20,000/ Site Timeframe: Short to Long-Term	ATMS13 – Standard Railroad Grade Crossing
Municipal/County Road Weather Information System Detection	Implement weather detection systems for snow, ice, flooding, and other severe weather conditions at various locations. Potential deployments were identified for Metro Nashville, City of Franklin and Hendersonville, and Williamson County.	Municipalities and Counties	\$10,000 - \$40,000/Site Timeframe: Short to Long-Term	MC03 – Road Weather Data Collection
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. Many of the stakeholder agencies in the Nashville Area Region currently have portable DMS and did not have a need at the present time for additional deployments. Metro Nashville did identify a possible future need for corridor management.	Metro Nashville	Cost: \$10,000 - \$15,000 Timeframe: Mid-Term	MC08 – Work Zone Management
Municipal Speed Monitoring System	Implement vehicle detection locations to monitor roadway speeds and determine locations for targeted enforcement. In select locations, such as school zones, the detection will also include driver feedback signs to inform the driver of their speed. Potential deployments were identified for Metro Nashville and the City of Franklin.	Municipalities	Cost: \$5,000 - \$20,000/ Site	ATMS19 – Speed Monitoring

Table 12 – Municipal and County Recommended ITS Projects (continued)

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
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. Municipal service patrols currently exist in Metro Nashville and were identified as a potential deployment for the City of Franklin.	City of Franklin	Cost: Dependant on Coverage Area and Service Schedule Timeframe: Short to Mid-Term	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.	Municipalities	Cost: \$50,000 - \$100,000 Timeframe: Short to Long-Term	ATIS01 – Broadcast Traveler Information
Municipal Fire and EMS Vehicles Traffic Signal Preemption	Implement or expand existing emergency vehicle signal preemption for fire and emergency medical services (EMS) vehicles to improve incident response times and emergency responder safety. Cost was estimated at \$6,000 per intersection and \$1,500 per vehicle. The cost per intersection is a one-time cost per intersection regardless of the number of vehicles with preemption installed.	Municipalities	Cost: \$6,000/Intersection \$1,500/Vehicle Timeframe: On-Going Project as Needed	ATMS03 – Surface Street Control EM02 – Emergency Routing
County Sherriff Vehicles Traffic Signal Preemption	Implement vehicle signal preemption for County Sherriff vehicles to improve incident response times and emergency responder safety. Cost was estimated at \$6,000 per intersection and \$1,500 per vehicle. The cost per intersection is a one-time cost per intersection regardless of the number of vehicles with preemption installed.	Counties	Cost: \$6,000/Intersection \$1,500/Vehicle Timeframe: On-Going Project as Needed	ATMS03 – Surface Street Control EM02 – Emergency Routing

¹The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

²Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

4.2.3 Transit Recommended ITS Projects

Table 13 – Transit Recommended ITS Projects

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
Transit Vehicle Tracking	Implement AVL on buses to allow real-time transit vehicle tracking. AVL was identified in projects submitted to the Nashville Area 2035 Regional Transportation Plan by the MTA, RTA, and Franklin Transit. MTA and Franklin Transit are currently in the process of deploying AVL.	MTA RTA Franklin Transit	Cost: Included as part of a combined ITS deployment Timeframe: Short-Term: MTA Short to Long-Term: RTA and Franklin Transit	APTS01 – Transit Vehicle Tracking
Transit Vehicle On-Board Security Cameras	Implement cameras on buses for on-board video recording with live feeds provided to operators monitoring buses. MTA and Franklin Transit are currently in the process of deploying AVL.	MTA Franklin Transit	Cost: Included as part of a combined ITS deployment Timeframe: Short-Term	APTS05 – Transit Security
Transit Vehicle Alarm System	Implement covert alarms on buses to enable drivers to send an alarm to transit dispatchers. MTA and Franklin Transit are currently in the process of deploying AVL.	MTA Franklin Transit	Cost: Included as part of a combined ITS deployment Timeframe: Short-Term	APTS05 – Transit Security
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. Passenger counters were identified in projects submitted to the Nashville Area 2035 Regional Transportation Plan by the MTA, RTA, and Franklin Transit. MTA is currently in the process of deploying passenger counters.	MTA RTA Franklin Transit	Cost: Included as part of a combined ITS deployment Timeframe: Short-Term: MTA Mid to Long-Term: RTA and Franklin Transit	APTS10 – Transit Passenger Counting
Next-bus Arrival Dynamic Message Sign	Implement next-bus arrival dynamic message signs at transit transfer stations and bus stops within the transit service area. MTA and Franklin Transit are currently in the process of deploying next-bus arrival signs.	MTA Franklin Transit	Cost: Included as part of a combined ITS deployment Timeframe: Short-Term	APTS08 – Transit Traveler Information

Table 13 – Transit Recommended ITS Projects (continued)

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
Interactive Voice Response System for Reservations	Implement interactive voice response (IVR) capability to the existing phone reservation system for the Mid-Cumberland Human Resource Agency (MCHRA).	MCHRA	Cost: To Be Determined Timeframe: Mid-Term	APTS08 – Transit Traveler Information
Real-time Traveler Information Website	Add real-time traveler information, including bus location and next bus arrival information, to existing transit website. MTA is currently in the process of deploying a real-time traveler information website.	MTA Franklin Transit	Cost: Included as part of a combined ITS deployment Timeframe: Short-Term: MTA Mid to Long-Term: Franklin Transit	APTS08 – Transit Traveler Information
Transit Signal Priority System	Implement transit signal priority on fixed route transit routes to provide buses that are behind schedule with automated signal priority at traffic signals. This project will be done in coordination with the Municipality where the transit signal priority is being implemented. Transit signal priority currently exists with limited deployment on MTA buses in Nashville but was identified for expansion. Other transit agencies identified a need for transit signal priority including RTA and Franklin Transit.	MTA RTA Franklin Transit	Cost: \$6,000/Intersection \$1,500/Vehicle Funding Identified: No	ATMS03 – Surface Street Control APTS09 – Transit Signal Priority
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.	Transit Agencies and Municipalities	Cost: To Be Determined Timeframe: Mid to Long-Term	APTS02 – Transit Fixed Route Operations APTS03 – Demand Response Transit Operations

¹The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

²Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

4.2.4 Nashville Area MPO Recommended ITS Projects

Table 14 – Nashville Area MPO Recommended ITS Projects

Project	Description	Responsible Agency	Opinion of Probable Cost ¹ and Deployment Timeframe ²	Applicable Market Packages
Nashville Area MPO Archive Data Warehouse	Establish a data warehouse to archive data from municipalities and transit agencies within the 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 MPO.	Nashville Area MPO	Cost: \$200,000 - \$400,000 Timeframe: Long-Term	AD3 – ITS Virtual Data Warehouse

¹The design has not been undertaken and thus this is only an opinion of probable cost for implementation to be used for planning purposes.

²Deployment timeframes include short-term (0-5 years), mid-term (5-10 years), and long-term (10+ years).

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 Nashville 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 Nashville 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 Nashville Area Regional ITS Architecture and Deployment Plan be updated to remain a useful resource for the Region. In the Nashville 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 Nashville 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 Nashville Area Regional ITS Deployment Plan document);
- Participating agencies roles and responsibilities (identified in the Nashville Area Regional ITS Architecture document);
- Definition of system requirements (identified in the Nashville Area Regional ITS Architecture Turbo Architecture database equipment packages); and
- Applicable ITS standards (identified using the ITS market package data flows from the Nashville 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, the systems engineering management plan framework, concept of operations, and systems requirements.

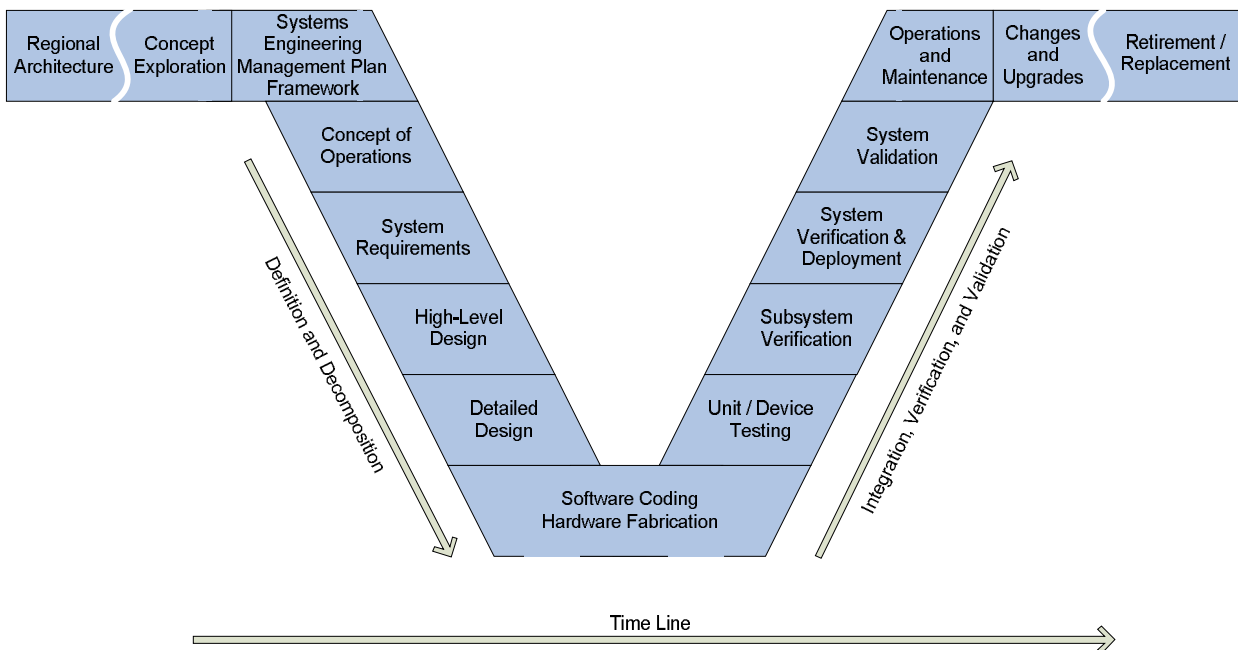


Figure 4 – Systems Engineering Vee Diagram

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 Nashville 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 Nashville 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 Nashville Area should be reviewed to determine if they adequately cover the project. Customized market package diagrams for the Nashville Area can be found in the Nashville 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 Franklin Incident Response Vehicles was included in the Nashville Area Regional ITS Architecture for a future roadway service patrol to be operated by the City of Franklin. Detailed planning for this system has not begun and it is

possible that the City of Franklin may 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 Nashville Area MPO will be responsible for leading the process to update the Nashville Area Regional ITS Architecture and Deployment Plan in coordination with the TDOT Long Range Planning Division. **Table 15** summarizes the maintenance process agreed upon by stakeholders in the Region.

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 preceding 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. In 2010 the Nashville Area MPO was in the process of developing the 2035 Regional Transportation Plan. This document will serve as the LRTP for the Nashville Area and will likely be updated in four years.

The Nashville Area MPO, in coordination with the TDOT Long Range Planning Division, will be responsible for completing the full updates of the Nashville Area Regional ITS Architecture and Deployment Plan. 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.

Table 15 – Nashville 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	As needed	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	Nashville Area MPO		Nashville 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 recommended that the Nashville Area MPO lead a 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 on an as needed basis. Minor changes to the Regional ITS Deployment Plan should be noted by the Nashville 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 Nashville 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 ITS Architecture Maintenance Documentation Form was developed and is included in the Nashville 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 ITS 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 Nashville 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.