TDOT Go.

Tennessee Statewide ITS Architecture

ITS Architecture Final Report

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1. INTRODUCTION

1.1 Overview of Tennessee's Statewide ITS Architecture

The Tennessee Department of Transportation (TDOT) led the development of a Statewide Intelligent Transportation System (ITS) Architecture to guide ITS planning, deployment, and integration on a statewide basis for the next 15 years. This Statewide ITS Architecture is intended to address rural portions of the state, as well as those functions and services that are needed on an inter-regional basis. Regional ITS architectures have been developed for the metropolitan areas of Nashville, Memphis, Knoxville, Chattanooga, Clarksville, Johnson City, and Jackson. At this time, the Statewide Architecture covers all areas of the state not included in one of the regional architectures. It is anticipated that regional ITS architectures will be developed for the Cleveland, Kingsport, and Bristol Regions in the near future. Additional regional architectures may be required for other areas of the state as growth continues.

The Statewide Architecture satisfies requirements for TDOT to remain eligible to use federal funding for ITS projects in the rural areas of the state. The Final Rule and Policy on ITS Standards and Conformity enacted by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) established requirements and a process for what constitutes a compliant ITS architecture. The FHWA Rule and FTA Policy were established to:

- Provide a means for consistency in how states and regions are to develop their ITS architectures;
- Encourage participation of multiple agencies to develop a consensus-based architecture that meets the unique local needs and goals for ITS deployment and integration;
- Require use of the National ITS Architecture to provide further consistency and traceability between the local architecture and established terminology and national standards; and
- Identify integration and interoperability requirements as well as resource sharing opportunities, so that states and regions can establish a plan for deployment.

The Tennessee Statewide ITS Architecture considers the statewide ITS needs and services, as well as identified inter-regional needs. The result is a long-range (15-year) vision for statewide ITS projects and programs, with particular emphasis on ITS projects and integration in the next 5 to 10 years. This architecture was developed using the National ITS Architecture (version 5.1) and Turbo Architecture (version 3.1).

1.2 Architecture Organization

The Tennessee Statewide ITS Architecture consists of a Final Report and Turbo Architecture database. Turbo Architecture is a tool used to document elements and interfaces in a standard format that is consistent with the terminology and structure of the National ITS Architecture. The Final Report addresses all of the federal requirements and is organized into seven key sections:

Section 1 – Introduction

This section provides an overview of the Tennessee Statewide ITS Architecture, the Final Rule conformity, and stakeholders involved in the architecture development.

Section 2 – Statewide ITS Architecture Development Process

This section supplies the definition of what an ITS Architecture is, an overview of the National ITS Architecture, and the key features involved in the architecture development process.

Section 3 – Tennessee Statewide ITS Inventory, Needs, and Stakeholders

This section contains a summary of the geography and ITS infrastructure of the State of Tennessee. Included in this section is a summary of the existing and planned inventory, needs identified by stakeholders at the project kick-off meeting held in August 2005, and a review of existing regional ITS architectures and relevant plans.

Section 4 – Market Packages and System Interconnects

Section 4 includes the prioritized functions (market packages) for Tennessee that are envisioned for implementation in the rural areas and to address statewide needs and issues. It includes an interconnect diagram and describes the system interfaces that have been developed for Tennessee.

Section 5 – Operations Concepts and Functional Requirements

This section includes operational concepts for key functional areas, and how these functions will benefit or be impacted by ITS deployment and integration. Roles and responsibilities for various agencies are described in the context of operational concepts that look at the role of TDOT Traffic Management Centers (TMCs), ITS and how it can support incident management, public transportation in the rural areas, the role of maintenance, and a description of how the planned wireless communications backbone will support the center-to-center and center-to-field communications that are envisioned for Tennessee.

Section 6 – Project Sequencing and Implementation

Projects have been identified to implement key functions in the Statewide ITS Architecture and these projects have been categorized into short (2006-2010), mid (2011-2015), and long-term (beyond 2015) timeframes. This section also includes agreements required for operations, and identifies applicable standards that Tennessee agencies should consider as they implement and integrate ITS infrastructure.

Section 7 – ITS Architecture Use and Maintenance Plan

A plan for maintaining and updating the Tennessee Statewide ITS Architecture was developed and is included in this section. The plan outlines the procedure for updating the ITS architecture over time, recommended timeframes for review and updating, and identifies the responsible entity within TDOT that will serve as the point-of-contact for updating and maintaining the Statewide ITS Architecture.

The Tennessee Statewide ITS Architecture also contains six appendices:

- Appendix A – Stakeholder Meeting Attendance;
- Appendix B – ITS Inventory;
- Appendix C – National ITS Architecture Market Package Definitions;
- Appendix D – Customized Market Packages;
- Appendix E – Interface Diagrams; and
- Appendix F – Functional Requirements.

1.3 Final Rule Compliance

Tennessee's Statewide ITS Architecture complies with the requirements set forth in the FHWA Final Rule and FTA Policy on ITS Standards and Architecture Conformity, enacted in January 2001. The rule and policy implement section 5206(e) of TEA-21, which required that ITS projects using Highway Trust Funds conform to the National ITS Architecture and appropriate national standards. SAFETEA-LU, the transportation reauthorization legislation, signed in August 2005, continues the architecture conformity requirement set forth in the TEA-21 transportation bill.

Table 1 identifies the portion of the Tennessee Statewide ITS Architecture that satisfies each of the requirements set forth by the Final Rule and Policy on ITS standards use and ITS architecture development. A table included in Section 3 documents how the needs identified by stakeholders have been addressed in the Statewide ITS Architecture to ensure that future projects conform to the requirements and are eligible for the use of federal funds. Some sections, including Operational concepts and projects for implementation are included as part of the document only, and not within the Turbo architecture database; Turbo architecture does not support substantial amounts of narrative, and it was deemed to be more stakeholder-friendly to include certain portions (such as projects) as part of an easily accessible document.

Table 1 – Tennessee Statewide ITS Architecture Compliance with Final Rule

Final Rule/Policy Requirement	Final Report Document	Turbo Architecture Database
Description of the region	Section 3.1	Yes
Identification of agencies and other stakeholders	Section 1.4 Section 3.4	Yes
Operational concept that identifies roles and responsibilities of stakeholders	Section 5.1	Yes
Agreements required for operations	Section 6.2	Yes
System functional requirements	Section 5.2 Appendix F	Yes
Interface requirements and information exchanges with planned and existing systems and subsystems	Chapter 4 (4.1-4.5) Appendix D, Appendix E	Yes
Identification of ITS standards supporting regional and national interoperability	Section 6.3	Yes
Sequence of projects required for implementation	Section 6.1	No (does not apply to Turbo)
Procedures and responsibility for maintaining the Regional Architecture	Section 7	No (does not apply to Turbo)

1.4 Participants

The Tennessee Statewide ITS Architecture included input from a variety of perspectives, including traffic management, telecommunications, maintenance, public safety, planning, and others. Each stakeholder has an equal voice in determining the direction of the architecture for the State. Three meetings were held with the ITS stakeholders to discuss the development and gather input into the Tennessee Statewide ITS Architecture, and follow-up discussions were held with individual stakeholders on an as needed basis. Deliverables were distributed electronically to stakeholders so that they could review and comment on individual agency needs.

Table 2 lists the stakeholder agencies and contacts that participated in the nine month Statewide ITS Architecture development. **Appendix A** includes attendance lists from the three stakeholder meetings.

Table 2 – Stakeholder Agencies and Contacts

Stakeholder Agency	Division	Contact	Title	E-Mail
FHWA	Tennessee Division Office	Don Gedge	Information Technology Specialist	donald.gedge@fhwa.dot.gov
TDOT		Dennis Lowder		dennis.lowder@state.tn.us
TDOT		Jim Allen	Information Systems Manager	jim.allen@state.tn.us
TDOT		Sammy Salameh		sammy.salameh@state.tn.us
TDOT	Community Relations Division	John Hall	Motorist Information Coordinator	john.hall@state.tn.us
TDOT	Incident Management	Eddie Newcomb	Highway Response Supervisor	eddie.newcomb@state.tn.us
TDOT	Incident Management	Frank Horne	Incident Management Coordinator	frank.c.horne@state.tn.us
TDOT	Information Technology Division	Kim McDonough	GIS Manager 2	kim.mcdonough@state.tn.us
TDOT	Information Technology Division	Steve Norris		steve.norris@state.tn.us
TDOT	ITS Office	Don Dahlinger	Assistant Director Design Division	donald.dahlinger@state.tn.us
TDOT	Knoxville TMC	John Benditz	Project Manager - Knoxville SmartWay	john.benditz@state.tn.us
TDOT	Planning	Jeanne Stevens	Director of Long-Range Planning	jeanne.stevens@state.tn.us
TDOT	Planning	Steve Allen	Project Planning Director	steve.allen@state.tn.us
TDOT	Planning (RPTO)	Del Truitt	Rural Transportation Coordinator	del.truitt@state.tn.us
TDOT	Public Transportation, Waterways and Rail	Kathy Dannenhold	Statewide Transit Coordinator	kathy.dannenhold@state.tn.us
TDOT	Public Transportation, Waterways, and Rail	Diane Davidson	Director	diane.davidson@state.tn.us
TDOT	Region 1	Mark Best	ITS/Traffic Manager	mark.best@state.tn.us
TDOT	Region 1	Mickey Campbell	Incident Management Coordinator	phillip.campbell@state.tn.us

Table 2 – Stakeholder Agencies and Contacts (continued)

Stakeholder Agency	Division	Contact	Title	E-Mail
TDOT	Region 2	Alan Wolfe	Regional Traffic Manager	alan.wolfe@state.tn.us
TDOT	Region 2	Bob Van Horn		bob.vanhorn@state.tn.us
TDOT	Region 2	Janet Kelso		janet.kelso@state.tn.us
TDOT	Region 3 HELP	Robert Allen	Incident Management Coordinator	robert.e.allen@state.tn.us
TDOT	Region 4	Jason Darrell Moody		jason.d.moody@state.tn.us
TDOT	Region 4	Joe Warren	Region 4 Traffic Engineer	joe.warren@state.tn.us
TDOT	Region 4	John Thomas	Incident Management Coordinator	john.thomas@state.tn.us
TDOT	Region 4	Rick Knoll		william.knoll@state.tn.us
TDOT	Traffic Design Section, Design Division	Pete Hiett	Civil Engineering Manager 1	pete.hiett@state.tn.us
TDOT	Wireless Systems Section	Kevin Speakman	Wireless Systems Analyst	kevin.speakman@state.tn.us
TDOT	Wireless Systems Section	Mike Carroll	Wireless Systems Manager	mike.carroll@state.tn.us
TDOT	Wireless Systems Section	Mike Griffin	Assistant Wireless Systems Analyst	dennis.griffin@state.tn.us
THP/Safety	District 3 – Nashville	J.R. Perry	Captain	j.r.perry@state.tn.us
THP/Safety	District 3 – Nashville	John Savage	Lieutenant	johnny.savage@state.tn.us

2. STATEWIDE ITS ARCHITECTURE DEVELOPMENT PROCESS

2.1 ITS Architecture Definition

An ITS architecture describes how system components fit together and interact with each other to make a system work. It defines the *functions* that will be performed by the system, the physical *subsystems where those functions reside*, the *interfaces and information flows* between the subsystems, and the *communications requirements* for the information flows. An architecture is not a design. Several different system designs or implementations can fit within the same architecture. An architecture defines the framework and functionality, while a design defines the specific plans for implementation.

An ITS architecture provides the ability to accommodate inevitable technology changes, evolution, and growth of the system. It is important to start at the planning stage by determining the functions of the facility and the interfaces with other services and service providers. Rather than installing technologies and implementing systems in a piecemeal fashion, it is important to have a plan and a framework in which the various systems will be designed and integrated.

2.2 National ITS Architecture

In June of 1996, the Federal Highway Administration (FHWA) Joint Program Office (JPO) completed the development of the National Architecture for ITS. Since that time, the National ITS Architecture has expanded and evolved to meet an expanding set of priorities and integration requirements (currently version 5.1). While the early versions of the architecture focused heavily on traffic management, traveler information, public transportation and telematics, subsequent versions of the National ITS Architecture have greatly expanded these categories, as well as placed significant emphasis on emergency management and response, maintenance and construction operations, interagency coordination and information management.

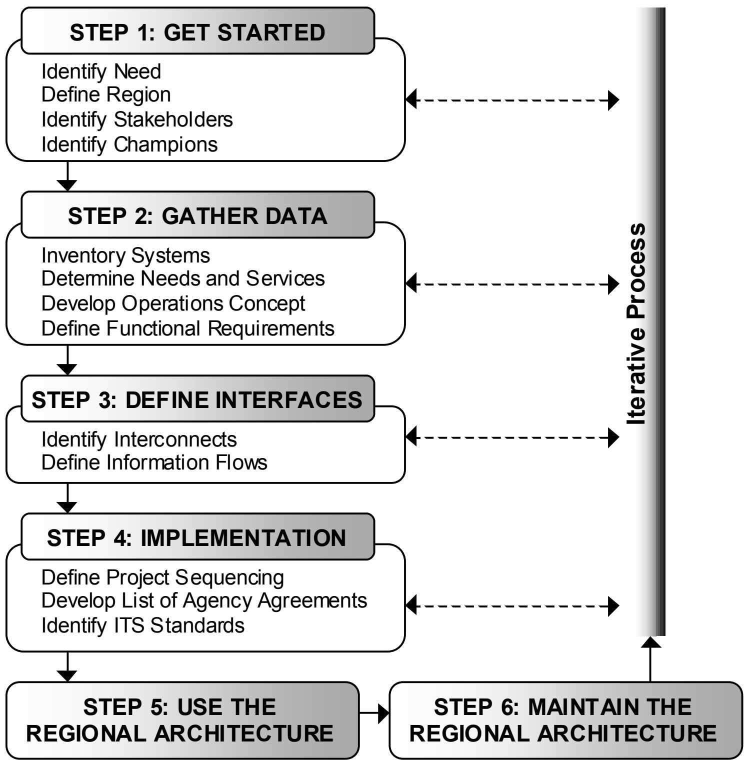
A key benefit of the National ITS Architecture is that it provides a consistent structure and framework for planning, defining, and integrating ITS. It establishes a standard vocabulary, a description of options to consider for local and regional ITS functions and activities, and a general set of tools to assist with systems integration. It is the framework around which multiple design approaches can be developed, each one specifically tailored to meet the unique needs of a state, region, or group of stakeholders, while maintaining the benefits of a common architecture. In addition, it identifies and specifies the requirements for the standards needed to support national and regional interoperability, as well as product standards needed to support economy of scale considerations in deployment.

The National Architecture (and regional or statewide architectures developed based upon it), is open, flexible, and modular which allows components to be supplied by multiple manufacturers. In other words, the architecture is based on functions rather than technologies or vendors. This openness favorably affects the potential cost of a system's components and the degree of participation by potential vendors. The flexibility of the National Architecture allows agencies to tailor their own individual architectures to meet their region's specific needs. The modular nature of the National ITS Architecture assists developers in reasonably phasing deployments in terms of function, actual projects, and various institutional aspects such as funding availability.

2.3 ITS Architecture Final Rule and Guidance

The FHWA and FTA issued a Final Rule and Policy to implement Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA-21) in January of 2001. What this Final Rule and Policy require are that ITS projects funded through the Highway Trust Fund conform to the National ITS Architecture and applicable standards. The rule went in to effect on April 8,

2005. After that date, any region with existing ITS deployments must have an ITS architecture in order to receive federal funding for ITS projects. Within this final rule and policy were guidelines and requirements for what needed to be included in an architecture. The United States Department of Transportation (USDOT) issued guidance on development of a regional ITS architecture through the document "Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region." **Figure 1** summarizes the guidance provided by the USDOT.



(Source: Regional ITS Architecture Guidance: Developing, Using, and Maintaining an ITS Architecture for Your Region, USDOT)

Figure 1 – USDOT Guidance on Regional ITS Architecture Development

The process used to develop the Tennessee Statewide ITS Architecture follows Steps 1 through 4 of the guidance. Steps 5 and 6 are designed to provide guidance upon the completion of the development of the architecture. Although this guidance primarily applies to developing regional ITS architectures, the statewide ITS architecture being developed for Tennessee will conform to these requirements.

2.4 Tennessee Statewide ITS Architecture Process

The process to develop Tennessee's Statewide ITS Architecture was designed to ensure that stakeholders could provide input and review for the development of the statewide ITS architecture at key points in the process. Turbo Architecture version 3.1 was used to develop the architecture database and information flows.

A total of three meetings with stakeholders over a period of six months were held to develop the Tennessee Statewide ITS Architecture. These meetings included:

- Stakeholder Meeting No. 1 – Kick-off and Needs Assessment Meeting;
- Stakeholder Meeting No. 2 – Regional ITS Architecture Review Workshop; and
- Stakeholder Meeting No. 3 – Project Recommendations and Strategy Meeting.

Key components of the process are described below:

Existing ITS Architectures, Establish Statewide ITS Inventory and Needs

- Reviewed existing ITS architectures for applicable statewide elements;
- Obtained input from stakeholders on existing and planned ITS inventory;
- Obtained input from stakeholders on statewide and inter-regional needs that could be addressed or supported by ITS; and
- Reviewed key planning documents for input to the statewide ITS architecture (including the SmartWay ITS Strategic Plan, Tennessee Long Range Transportation Plan and CVISN Plan).

Market Packages, Interfaces, and Interconnects

- Identified appropriate market packages from the National ITS Architecture (currently version 5.1) to address the transportation, institutional, safety, maintenance and other needs identified by stakeholders;
- Developed customized market package diagrams to reflect Tennessee-specific needs and functions, including data flows and interfaces among the appropriate systems and subsystems;
- Developed interface and interconnect diagrams using Turbo Architecture version 3.1; and
- Reviewed market packages, interfaces, and interconnects with stakeholders and revised based on feedback.

Operational Concept and Functional Requirements

- Developed scenarios to illustrate an operational concept describing how ITS systems and capabilities function and support agencies in carrying out their respective missions and responsibilities;
- Identified roles and responsibilities by functional area using the functional area categories contained in the National ITS Architecture (e.g., Traveler Information, Traffic Management, Emergency Management, etc.); and
- Developed functional requirements for statewide application, which are planning-level requirements, and provide the basis for more detailed requirement development at the project level.

Statewide ITS Project Recommendations/Phasing

- Identified ITS projects that implement the components contained in the ITS architecture over a 15 year horizon, including near-term (2006-2011), mid-term (2012-2016), and long-term (2017-2021); and
- Projects included the name, a brief description, responsible agency(ies), planning level estimate of probable cost and associated market packages.

ITS Standards and Agreements for Operations

- Identified appropriate standards that correspond to the identified functions and interfaces;
- Updated Turbo Architecture standards with current standards activities that might not be captured as part of the current National ITS Architecture (as an example, various XML standards development efforts are an important consideration for center-to-center data exchange, but not yet documented as part of the National ITS Architecture); and
- Identified any existing operations agreements that are applicable for statewide ITS implementation or operations, and developed a list of list of potential operations agreements that was needed based on the interfaces and data flows outlined in the Statewide ITS Architecture.

Use and Maintenance of the Statewide ITS Architecture

- Develop appropriate processes for how TDOT and other agencies can use the Statewide ITS Architecture to support ITS planning and project implementation in Tennessee; and
- Develop a process and plan for maintaining the Statewide ITS Architecture, including identifying which entity within TDOT will have responsibility for maintaining and updating the Statewide ITS Architecture, and time frames for reviewing the ITS architecture and project recommendations for potential updates.

The following deliverables for the Tennessee Statewide ITS Architecture were prepared and submitted to stakeholders throughout the development process:

- Technical Memorandum #1 – Statewide ITS Inventory and Needs;
- Technical Memorandum #2 – Market Packages, Interfaces and Interconnects;
- Technical Memorandum #3 – Operational Concept and Functional Requirements;
- Technical Memorandum #4 – Draft Recommended ITS Projects;
- Statewide ITS Architecture compliant with FWHA Final Rule;
- Executive Summary; and
- Turbo Architecture Database.

3. TENNESSEE STATEWIDE ITS INVENTORY, NEEDS, AND STAKEHOLDERS

3.1 State Overview – Geography and Existing Infrastructure

The State of Tennessee is bordered by Kentucky and Virginia to the north; North Carolina to the East; Georgia, Alabama, and Mississippi to the south; and Arkansas and Missouri to the west. For the Tennessee Statewide ITS Architecture, the study area focuses on the rural areas of Tennessee, and ITS needs that are envisioned on a statewide or inter-regional level rather than the metropolitan planning areas. The geographic boundaries of the state are highlighted in **Figure 2**. Regional ITS Architectures that were complete or in progress at the time of the development of the Statewide ITS Architecture are also shown.

TDOT is responsible for approximately 14,150 miles of roadway, 1,073 miles of which are Interstate highways. The most traveled roadways include Interstates 24, 40, 65, and 75.

I-40 accounts for approximately 455 miles of interstate within Tennessee. I-40 runs east-west, stretching across the entire state, connecting Tennessee with North Carolina to the east and Arkansas to the west. It is a key route between Knoxville, Nashville, Jackson, and Memphis. I-40 is also a vital national corridor that connects North Carolina on the east coast to California in the west, making it an important commercial freight route for goods movement. I-24 runs northwest-southeast, connecting Tennessee with Kentucky to the north and Georgia to the south. I-75 also runs northeast-southwest, connecting Tennessee with Kentucky to the north and Georgia to the south. I-65 runs north-south, connecting Tennessee with Kentucky to the north and Alabama to the south. Incidents, delays, closures or other blockages along these corridors can have serious implications on drive-time for commercial vehicles and motorists alike due to the lack of alternate routes, particularly along rural segments of these corridors.

Public transportation is provided by a range of operators in Tennessee. There are fixed-route systems in the larger and mid-size urban areas. Fixed route services are more limited in the rural areas, where services are provided by primarily demand-response operators. Inter-regional transportation is also a need in the rural areas to provide residents with access to services that might not be located in their immediate area. Eleven public transportation systems serve rural area residents as well as those with special needs in 95 counties within the state of Tennessee. The TDOT Office of Public Transportation has been leading efforts to coordinate ITS planning and implementation among these providers, and recently completed a needs analysis identifying key technologies and integration needs to better support demand-response operations. This effort also resulted in a standard set of requirements and procurement documents for transit operators to use to procure and implement vehicle location, demand-response dispatching and mobile data terminal technologies. The Statewide ITS Architecture includes functions and services for demand-response providers in the rural areas. Fixed-route operations are addressed as part of the completed Regional ITS Architectures.

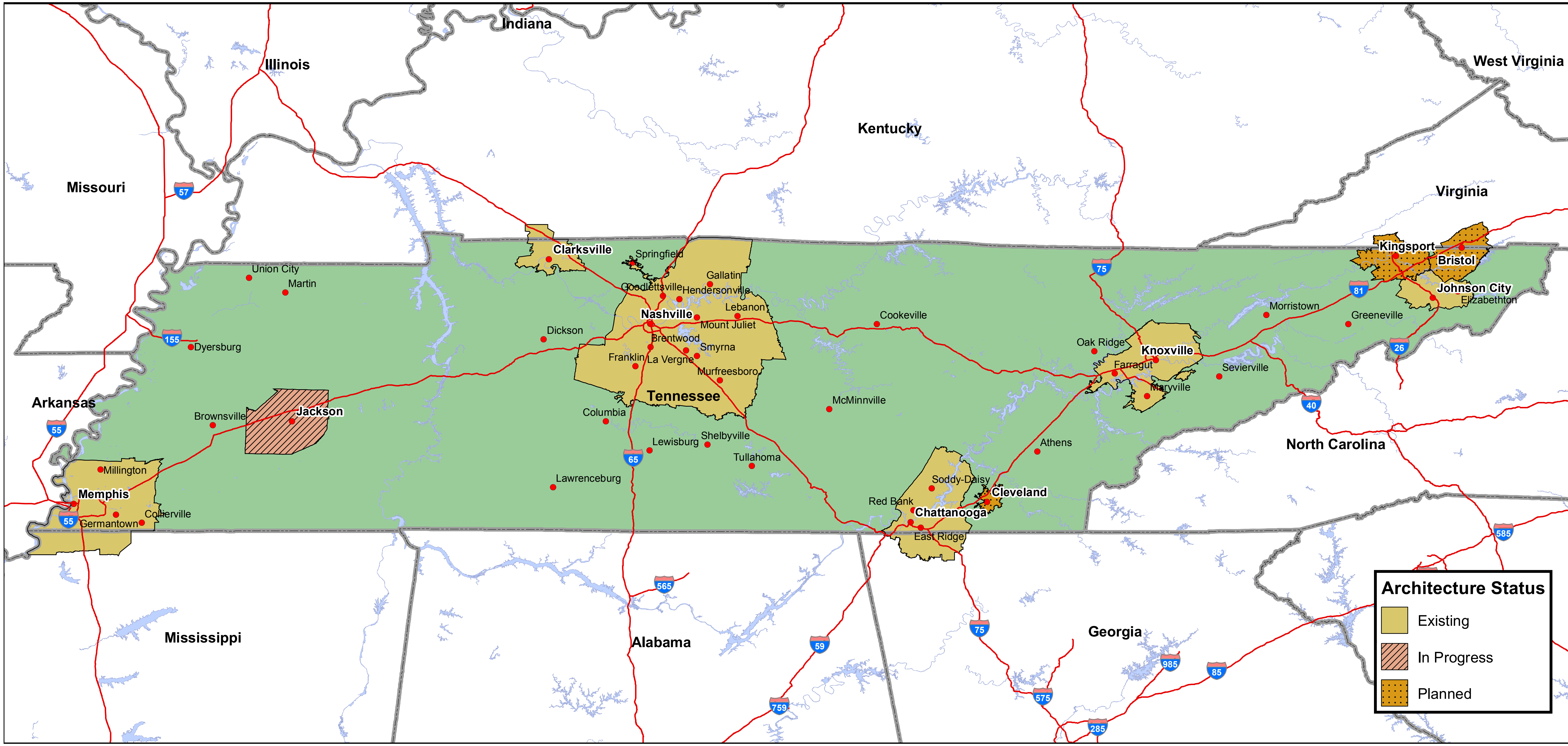


Figure 2 – State of Tennessee Metropolitan Planning Area Architectures (Existing and Underway)

3.2 Tennessee Statewide ITS Inventory

An important initial step in the architecture development process is to establish an inventory of existing and planned ITS elements. At the kick-off meeting and through subsequent discussions with agency representatives throughout the state, stakeholders provided the team with a list of existing, planned, and future systems that would play a role in the Tennessee Statewide ITS Architecture. Another important input to the inventory process is to review existing plans in Tennessee to identify additional elements or desired functions that should be incorporated in to the architecture process and overall statewide ITS vision. This section provides an overview of infrastructure inventory elements as well as other plans and documents that were reviewed and assessed for applicable elements to be included in Tennessee's Statewide ITS Architecture.

3.2.1 Inventory of Existing and Planned ITS Infrastructure

Tennessee's ITS program has been evolving rapidly over the last decade. SmartWay systems in Nashville and Knoxville are providing the foundations for robust ITS programs in those regions. Memphis and Chattanooga will see SmartWay systems in place within the next few years. This creates a series of ITS hubs throughout the state, which provides a solid backbone for Tennessee's emerging statewide ITS program. Although a majority of the state's ITS investments to date have been focused on the more populated urban areas, TDOT recognizes a need to plan for broader expansion of ITS technologies and applications to address rural portions of the state, as well as inter-regional needs among the four TDOT regions.

Table 3 documents existing and planned ITS components that have a direct impact on the Statewide ITS Architecture. Elements in this table were identified by stakeholders at the kick-off meeting and through a review of other applicable plans and documents. The Turbo Architecture databases developed for Tennessee's Statewide ITS Architecture includes a comprehensive inventory of all elements in the architecture, both existing and planned. Outputs from the Turbo Architecture inventory are included in **Appendix B**.

Table 3 – Summary of Statewide ITS Inventory

System, Technology or Capability	Status (Existing, Planned or Future Need)	Primary Operating Agency/Entity
Travel and Traffic Management		
Traffic Data Collection Stations	Existing	TDOT
Portable DMS	Existing	TDOT
Emergency Roadside Assistance – HELP Program (currently just operational in metro areas)	Existing	TDOT
HELP Program Expansion	Future Need	TDOT
24-hour Radio Center in Nashville	Existing	TDOT (wireless systems section)
Cumberland Gap Tunnel Operations Center and ITS Equipment (connects TN and KY on US25)	Existing	Currently KY Transportation Cabinet. Future joint operations with Knoxville TMC

Table 3 – Summary of Statewide ITS Inventory (continued)

System, Technology or Capability	Status (Existing, Planned or Future Need)	Primary Operating Agency/Entity
Travel and Traffic Management (continued)		
Portable HAR	Existing	North Carolina DOT
Virginia DOT DMS in Tennessee	Existing	Virginia DOT
Statewide 511	Planned	TDOT
GoSmart Welcome Center Kiosks	Existing	Department of Tourism
TDOT SmartWay web page/statewide road conditions	Existing	TDOT
Phase 1 of Statewide Wireless Communications System (Jackson to Memphis) – potential to share infrastructure with other agencies	Planned	TDOT
Public Transportation Management		
Rural Transit Dispatch/scheduling	Existing and planned	Various transit operators
Transit AVL and MDTs (standard procurement documents)	Planned	Various transit operators
Transit vehicle maintenance software	Future need	Various transit operators
Paratransit Interactive Voice Response Confirmation System	Future need	Various transit operators
Regional transit traveler information system	Future need	TDOT, various transit operators
Regional trip scheduling coordination	Future need	TDOT, various transit operators
Commercial Vehicle Operations		
Virtual Weigh-in-Motion (WIM) on I-26	Planned	TDOT
Weigh-in-motion	Existing	TDOT/THP
Emergency Management		
State Police MDTs	Existing	TN State Police
WSM Emergency Broadcast Network	Existing	WSM Radio
THP Computer Aided Dispatch (CAD) and AVL	Planned (05-06)	THP
Phase 1 Mobile Data Terminals on THP vehicles (first phase will be in Memphis and Nashville)	Planned	THP
Information Management		
Roadway Information Database (TSIS)	Existing	TDOT

Table 3 – Summary of Statewide ITS Inventory (continued)

System, Technology or Capability	Status (Existing, Planned or Future Need)	Primary Operating Agency/Entity
Maintenance and Construction Operations		
Road Weather Information Systems (RWIS) – 37 stations (27 combined with traffic detection stations)	Existing	TDOT
Flood Detection Stations	Existing	USGS
Statewide Maintenance Radio System	Existing	TDOT
Portable DMS	Existing	TDOT
Portable SmartFix Workzone Systems (3 in Knoxville area)	Existing	TDOT

3.3 Review of Statewide Plans and Regional ITS Architectures

3.3.1 Status Review of Regional ITS Architectures

Regional ITS architectures have already been developed or are underway for several metropolitan planning areas in the state of Tennessee. The architectures were developed independently and vary in format, but each one outlines the information shared between regional stakeholders and reflects the unique issues and needs of each region. These architectures focus on local ITS implementation will occur. The Statewide ITS Architecture addresses how ITS implementation will proceed in the areas outside of the metropolitan planning areas.

- The Chattanooga Regional ITS Architecture was developed in July of 2003 and includes the metropolitan Chattanooga area as well as several surrounding rural counties of Tennessee and Georgia. Operational scenarios in the plan cover day to day traffic operations, incident management, and transit operations. The Chattanooga Regional ITS Architecture includes a significant emphasis on future technologies and programs. The TDOT Chattanooga SmartWay system and TMC (scheduled for 2007) will provide a substantial foundation for the region's ITS activities.
- Including aspects of traffic management, emergency management, and transit for the Knoxville area, the Knoxville Regional ITS Architecture was developed by the Knoxville MPO and completed in March of 2005. The TDOT SmartWay program was recently launched in Knoxville with the completion of the TDOT Region 1 TMC and will continue to serve as a backbone for the region's growing ITS program.
- The Regional ITS Architecture for the Memphis Area was completed in August of 2002. The architecture covers the Memphis MPO Planning area and was extended to the west to include the Mississippi River bridge crossings. In addition to Tennessee stakeholders, the Memphis architecture also included involvement of the DOT, highway patrol, and several cities from Mississippi and Arkansas. The Regional ITS Architecture for Memphis spans a seven-year timeframe, and focuses on those ITS elements and services that are planned for deployment through 2009.
- Vanderbilt University and the Nashville MPO led the Regional ITS Architecture development for the Nashville region. Other key stakeholders in the process include TDOT, local traffic and emergency management agencies, transit, and counties. The

Nashville metropolitan area has the most established ITS program and infrastructure of any of the metropolitan regions in the state. The TDOT Region 3 SmartWay TMC provides control and monitoring of the SmartWay freeway management system. Nine planned traffic operations centers (municipal as well as airport) are also documented in the Regional ITS Architecture. There is also significant emphasis on the urban area transit system, including transit traveler information, security, vehicle tracking, and electronic payment.

- The Clarksville MPO completed their Regional ITS Architecture in the summer of 2006. This architecture includes the planning area of the Clarksville Urban Area Metropolitan Planning Organization (CUAMPO), which includes cities and portions of counties in both Tennessee and Kentucky. This regional ITS architecture was developed for a 25-year horizon. Near-term priorities included real-time corridor monitoring and traveler information along key US and State Routes in the region.
- The Johnson City Regional ITS Architecture and Deployment Plan were completed in the Fall of 2006. The Regional ITS Architecture covers the Johnson City Metropolitan Transportation Planning Organization (MTPO) service area and was developed with input from representatives from The City of Johnson City, City of Elizabethton, Johnson City Transit, Johnson City MTPO, Carter County, Washington County and TDOT. The plan documents the desired ITS services for the Region to support traffic management, emergency management and transit operations.
- At the time the Tennessee Statewide ITS Architecture was being developed, the Jackson Regional ITS Architecture and Deployment Plan were also underway, and it was anticipated would be complete by the end of 2006. TDOT plans to initiate Regional ITS Architectures for Cleveland, Bristol and Kingsport in 2007.

3.3.2 TDOT 2004 SmartWay ITS Strategic Plan (March, 2005)

The 2004 SmartWay ITS Strategic Plan serves as an annual report for TDOT's ITS activities on a statewide basis. It outlines priority user services and focus areas (ITS services and activities where TDOT will serve in a lead or support role), provides a progress report on accomplishments toward the previous years' goals, and outlines strategic priorities for the next three years (2005-2007).

Milestones and strategic priorities that are relevant to the statewide ITS architecture include:

- Highway incident management (implement strategic plan), which includes plans and estimates for equipment and training to implement TDOT's statewide incident response program;
- Explore deployment of incident management technologies in rural areas of Tennessee;
- Integrate RWIS data into TSIS. Expand and enhance TSIS to support other applications (including web and 511 – already underway);
- Develop and launch statewide 511 service (underway);
- Explore other technologies and programs for delivering traveler information to the public;
- Implement additional GoSmart kiosks at Tennessee welcome centers;
- ITS Implementation in the Rural Areas: I-81 Cumberland Gap CCTV and DMS;
- Statewide wireless communications backbone (Phase 1 – Memphis to Jackson); and
- Initiate statewide ITS architecture (underway).

3.3.3 Tennessee CVISN (Commercial Vehicle Information System Network)

The Federal Motor Carrier Safety Administration (FMCSA) is leading a nationwide effort to help support better data exchange, communications networks, and implement standards to support improved safety and efficiency of commercial vehicle operations. The Commercial Vehicle Information Systems and Networks, or CVISN, provides a framework and an architecture that allows government agencies, motor carrier operators and others to benefit from electronic operations (including permits, credentials, screening and other regulatory activities), information sharing, as well as standardized processes – this is particularly important considering motor carriers often traverse multiple states in the course of moving goods throughout the country.

Tennessee has developed a CVISN Program Plan and Top-Level Design that have been approved by the FMCSA. These documents and Tennessee's CVISN program focus on the following three core program areas: safety, electronic screening of commercial vehicles, and electronic credentialing. Key elements of the CVISN program and Tennessee's CVISN Plan include:

- Upgrades to network infrastructure to support standards, better information sharing and interoperability, and improve wireless communications. Wireless communications are a key infrastructure element to enable better communications between roadside, vehicles, and centers. Improvements are needed to facilitate communication among legacy and new CVO systems.
- Interfaces among key agencies involved, including Tennessee Highway Patrol, TDOT, Tennessee Department of Revenue, and national entities including FHWA, FMCSA and the National highway Traffic Safety Administration.
- Integrated software to support data collection and reporting for accidents, crashes, citations and inspections specific to CVO, and to support CVISN data collection/reporting requirements.

The functions and processes identified in Tennessee's CVISN plan were incorporated into the Statewide ITS Architecture.

3.3.4 TDOT 2030 Long Range Transportation Plan

The 2030 Long Range Transportation Plan (LRTP) is a comprehensive effort involving multiple modes and divisions within TDOT. For the purposes of the Statewide ITS Architecture, the ITS and Incident Management Components are the most pertinent for inclusion and reference. The Proposed LRTP Vision Plan has identified key investment areas where TDOT resources are envisioned to be focused for the next 25 years:

- Roadside Weather Information Systems;
- Traffic Management/Operations Centers;
- Urban and Rural Freeway Surveillance (note: Statewide ITS Architecture will address the rural surveillance component only);
- Urban Surface Street Control and Surveillance (to the extent that TDOT will partner with urban areas; it is envisioned that these systems will be led by the owning agency [county, city, town, etc.]);
- Incident Management;
- Wireless Communications Network;
- Transit ITS;

- General ITS (includes data archiving and management, interagency integration and interfaces to multi-agency operations center);
- Support for Transportation Demand Management; and
- Rail/Highway Interface.

3.3.5 Transit ITS Needs Assessment Draft Functional Specifications

In 2005, TDOT completed a needs assessment and developed a comprehensive functional specifications document that transit agencies throughout the state could use to procure ITS applications and equipment. The needs assessment involved 15 rural and small urban transit agencies in Tennessee, and specifically looked at ITS technologies that would be applicable and appropriate. A standard Statewide Request for Proposal also was developed so that agencies could procure:

- Paratransit scheduling and dispatching software;
- Computer aided dispatch (CAD) and Automatic Vehicle Location (AVL) systems; and
- Mobile data terminals (MDTs).

These three application areas represent the high priority needs articulated by agencies involved in the needs assessment, and were identified as short-term deployments (within the next one to two years). Among the short term priorities was communications systems, although that is not included as part of the RFP. Longer term applications and technologies included:

- Transit vehicle maintenance software;
- Technologies to support regional coordination (i.e., service coordination, trip scheduling, data sharing);
- Interactive voice response system for paratransit trip conformation; and
- Regional transit traveler information system.

By providing transit agencies with standardized procurement documentation, TDOT is helping to facilitate more functional consistency and uniformity among technology at the various operators, and providing a standard set of specifications from which multiple vendors can submit bids.

3.4 Stakeholders

Stakeholder coordination and involvement is one of the key elements to the development of the Statewide ITS Architecture. Because ITS often transcends traditional transportation infrastructure, it is important to involve non-traditional stakeholders in the architecture development and visioning process. Input from these stakeholders is a critical part of defining the interfaces, integration needs, and overall vision for ITS in the state of Tennessee.

Key stakeholder agencies who participated in the project meetings or provided input to the study team as to the needs and issues that should be considered as part of the Tennessee Statewide ITS Architecture are listed below:

- TDOT ITS Office, Headquarters;
- TDOT Community Relations Division;
- TDOT Incident Management (including Region 3 HELP);
- TDOT Public Transportation, Waterways and Rail Division;
- TDOT Information Technology Division;

- TDOT Wireless Systems Section;
- TDOT Planning;
- Federal Highway Administration, Tennessee Division Office;
- TDOT Region 1;
- TDOT Region 2;
- TDOT Region 3;
- TDOT Region 4;
- TDOT Traffic Design Section;
- TDOT Maintenance Division;
- Tennessee Highway Patrol; and
- Tennessee Emergency Management Agency (TEMA).

Stakeholders that actively participated in the development of the Statewide ITS Architecture primarily represent TDOT and other state-level organizations. The Tennessee Statewide ITS Architecture identifies roles and functions for additional stakeholders that might not have participated in the development of the architecture, but have a key function either as an information provider or an entity that would serve in a coordination or response role. Some examples of additional stakeholders that have been identified for Tennessee's Statewide ITS Architecture include weather information and service providers (United States Geological Survey, National Weather Service), future County and City Traffic Operations Centers (outside of the major metro areas), demand-response transit operators, future toll authorities, and others. **Table 4** lists all potential stakeholders that have been identified for Tennessee's Statewide ITS Architecture.

Table 4 – Potential Stakeholders

Stakeholder Name	Stakeholder Description
Airport Operator	Operators of regional airports (including commercial and general aviation) throughout the state. This does not include major commercial airports in the metropolitan areas of Memphis, Nashville, Knoxville, or Chattanooga.
Commercial Vehicle Operators	Private operators of commercial vehicles that travel on Tennessee's inter and intrastate transportation network.
County Government	Divisions and departments of county government such as traffic management and emergency management. Specific counties are not identified in the Statewide ITS Architecture; they are represented as general entities. Regional ITS Architectures in Tennessee contain specific interfaces and functions for counties within those regions.
Cumberland Gap Tunnel Authority	Responsible for traffic management and operations at the Cumberland Gap Tunnel. This tunnel carries US25E under Cumberland Gap between Tennessee and Kentucky.
Federal Motor Carrier Safety Administration	The FMCSA is a unit of the USDOT that develops and enforces regulations aimed at safer commercial truck and bus operations. It is the federal agency responsible for the SAFER (Safety and Fitness Electronic Record) system.

Table 4 – Potential Stakeholders (continued)

Stakeholder Name	Stakeholder Description
Heavy Vehicle Electronic License Plate (HELP), Inc.	HELP is a non-profit partnership between motor carriers and government agencies. HELP's mission is to develop and deploy advanced technology systems that create a cooperative operating and regulatory environment which improves the efficient and safe movement of commercial vehicles and the performance of highway systems.
International Fuel Tax Association	IFTA is an agreement among all states (except Alaska and Hawaii) and Canadian provinces (except Northwestern Territories, Nunavut, and Yukon) to simplify the reporting of fuel used by motor carriers operating in more than one jurisdiction.
International Registration Plan	Commercial Vehicle registration reciprocity agreement among states of the United States and provinces of Canada providing for payment of license fees on the basis of total distance operated in all jurisdictions.
Media	Local media outlets including broadcast television and radio. These are key partners for traveler information, and many have access to TDOT's video feeds from the SmartWay urban area systems.
Municipal Government	Divisions and departments of municipal government such as traffic management and emergency management. Specific municipalities are not identified in the Statewide ITS Architecture; they are represented as general entities. Regional ITS Architectures in Tennessee contain specific interfaces and functions for municipalities within those regions.
National Oceanic and Atmospheric Administration	National Oceanic and Atmospheric Administration (NOAA), agency that gathers weather information and issues severe weather warnings. TDOT receives weather information feeds from NOAA/National Weather Service.
Operator	System operator.
Other States	Emergency or traffic management agencies in other states. Adjacent states include: Missouri, Kentucky, Virginia, North Carolina, Georgia, Alabama, and Mississippi. TDOT's SmartWay TMC connections to neighboring states are detailed in the regional ITS architectures. Neighboring states are included in the statewide ITS architecture as a reference point for functions that include information with these neighboring state DOT traffic and emergency operations centers.
Private Contractor	Construction contractor under contract with TDOT for construction services for highway construction services, including roadway construction, ITS, maintenance and other activities.
Private Corporation	Business for profit, not affiliated with any government agency.
Railroad Operators	Companies that operate trains and/or are responsible for the maintenance and operations of railroad tracks.
Regional AMBER Alert Network Member Agencies	Agencies that participate in a regional AMBER Alert program.
Regional Toll Authority	Agency responsible for the operations and maintenance of toll facilities. This is a future entity (tolls systems are not currently implemented in TN).
System Users	Individual user of ITS elements such as data archives.

Table 4 – Potential Stakeholders (continued)

Stakeholder Name	Stakeholder Description
Tennessee Department of Safety	The Tennessee Department of Safety is responsible for issues related to safety, law enforcement on highways, issuing driver's licenses, and other aspects of driving in Tennessee. The Tennessee Highway Patrol is a division within the Department of Safety.
Tennessee Department of Transportation	The Tennessee Department of Transportation (TDOT) operates and maintains highways and other key routes throughout the state. TDOT is the lead agency for ITS planning, design, implementation, operations and management on interstate, US and state routes in Tennessee.
Tennessee Emergency Management Agency	The Tennessee Emergency Management Agency (TEMA) develops and maintains emergency response plans. It is the state agency that coordinates and responds to major disasters and emergencies.
Tennessee Highway Patrol	The Tennessee Highway Patrol (THP) is a unit within the Department of Safety. THP is responsible for law enforcement on Tennessee highways, as well as commercial vehicle weigh station monitoring.
TN Bureau of Investigation	TBI is responsible for Amber Alert notification in the state of TN.
TN Department of Health and Human Services	State department that manages funding for medical transportation services.
Transit Agency	Transit agencies responsible for operating demand response transit services in areas throughout the state. Fixed route services are documented in the regional ITS architectures. The Statewide ITS Architecture includes functions, services, and interfaces that apply to demand-response transit agencies statewide. TDOT's Public Transportation, Rail and Waterways division has spearheaded a uniform set of requirements and procurement process to help implement technologies and systems to enhance demand-response transit operations.
Traveler	Private travelers using the transportation network.
United States Geological Survey	United States Geological Survey. The USGS collects stream gauge data from rivers and other estuaries throughout the state.

3.5 Statewide ITS Needs

Needs from throughout the state were identified at the kick-off meeting held on August 2, 2005. Needs were identified for the state according to the eight user service areas defined in the National ITS Architecture. Additional needs were derived from the SmartWay Strategic Plan and Transit ITS needs assessment, as well as through subsequent meetings and discussions with stakeholders throughout the architecture development process. The needs identified are documented in **Table 5**. These needs are also mapped to applicable market packages from the National ITS Architecture.

Needs are a valuable part of the architecture development process:

- They help to identify priority areas where ITS could serve a valuable function or service;
- Needs help to identify the functional relationships between agencies that need to be further developed as part of the architecture process; and
- Needs provide a foundation for the capabilities (technical and institutional) that stakeholders see as important.

Table 5 – Summary of Statewide ITS Needs

ITS Need	Market Package
Travel and Traffic Management	
Improved communication and coordination between agencies (in state and with neighboring states)	ATMS07, ATMS08
Communications link among TDOT TMCs in Nashville, Knoxville, Memphis and Chattanooga	ATMS07
Incorporate needs of other transportation modes (transit, CVO, etc.) into 511 for improved traveler information	ATIS2
Alternate signal timing plans for detour routes	ATMS03
Additional DMS (permanent and portable)	ATMS06
Identify "trouble spots " statewide to aid in choosing locations for permanent and portable DMS	ATMS06 (3)
Agreements and communications to share video between traffic management/emergency management/maintenance and others	ATMS08 (3)
Build out statewide wireless communications network (Phase 1 planned between Jackson and Memphis)	All market packages (3)
Rural emissions sensor stations	None identified (4)
Event management plans (events/venues such as Bristol Speedway, Bonaroo, festivals, etc.)	ATMS08 (3)
CCTV on I-24 for Monteagle Mountain	ATMS01
Improved traveler information and traveler advisories for I-24 Monteagle Mountain and US 64 through Ocoee Gorge (weather and slide problems)	MC03, MC04, ATMS06, ATIS1, ATIS2
Evaluate and consider implementation of Highway Advisory Radio (HAR)	ATMS06
Additional GoSmart Kiosks (1)	ATIS1
Emerging technologies and programs for traveler information (1)	ATIS1, ATIS2, EM10 (3)
Public Transportation Management	
Ability to track transit vehicles in real time (2)	APTS1
Implement automated scheduling (2)	APTS3
Improved coordination among transit providers and other regional entities (2)	APTS7
Improve safety and security on board vehicles for drivers and passengers (2)	APTS5
Collect reliable transit operations data and provide a means for faster reporting (2)	APTS1, APTS3, APTS4
Implement systems that will eliminate manual drivers logs (2)	APTS4, AD1

Table 5 – Summary of Statewide ITS Needs (continued)

ITS Need	Market Package
Electronic Payment	
Provisions in the architecture for potential electronic toll collection in Tennessee	ATMS10
Commercial Vehicle Operations	
Security cameras at regulatory rail inspection sites	None identified [4]
Security scans at state border weigh and inspection stations	None identified [4]
Mobile truck scanning capabilities	None identified [4]
Emergency Management	
Incident management technology in rural areas [1]	None identified [4]
Explore how ITS can support TDOT's Statewide Incident Response Program [1]	ATMS08 [3]
Improved coordination for AMBER Alerts	EM06 [3]
AVL on emergency management vehicles	EM01
MDTs for State Police in rural areas	EM01, EM02
Advanced Vehicle Safety Systems	
None Identified	N/A
Information Management (Data Archiving)	
Automate and enhance the ITS data archiving functions	AD1, AD2
Maintenance and Construction Management	
Integrate RWIS with TSIS [1]	MC04
Bridge scour detection system	None identified [4]
AVL on maintenance vehicles	MC01
Additional RWIS stations	MC03
Link to USGS for flood stream gauge data	MC03

[1] SmartWay ITS Strategic Plan, March 2005

[2] Transit Needs Assessment and Draft Functional Requirements, July 2005

[3] Need is for planning agreements, or communications shown in referenced market package

[4] Though identified as a need during the architecture development process, stakeholders opted not to customize and include a market package

4. MARKET PACKAGES AND SYSTEM INTERCONNECTS

This section of the Statewide ITS Architecture identifies the candidate market packages for Tennessee that can be implemented to address statewide as well as inter-regional ITS needs. Applicable market packages from the National ITS Architecture version 5.1 were selected and customized for Tennessee-specific agencies and system elements, and priorities were established that will help guide implementation priorities in the project sequencing element of the architecture. Interfaces among these key systems and subsystems also are identified that show links and information exchanges to support the desired services and functions. Stakeholders provided valuable input to the market package identification, prioritization, and customization process at the October 2005 stakeholder meeting and through subsequent discussions with stakeholders who were not able to attend.

4.1 Definition – What is a Market Package?

An ITS architecture focuses on how different pieces of a system need to function and work together. These pieces could include field components (such as dynamic message signs or road/weather sensors), centers (such as public safety dispatch or traffic management centers), vehicles, as well as supporting communications infrastructure. Because an ITS architecture focuses primarily on functions and services and how various elements of the transportation system must work together, it is very flexible in terms of the specific technologies or delivery methods that could be used to achieve the desired functionality.

Functions provide the foundation for developing a regional or statewide ITS architecture. Within the context of an ITS architecture, these functions and services are represented as *market packages*, which provide a deployment-oriented perspective to the Tennessee Statewide ITS Architecture. Market packages group ITS technologies and services that work together to deliver a given transportation service. In other words, market packages identify the pieces of the physical system architecture that are required to implement a particular transportation service. Market packages focus on how ITS services will be delivered to the users.

The National ITS Architecture version 5.1 identifies 85 market packages. They are grouped into the following service categories:

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

4.2 Candidate Market Packages and Priorities for Tennessee

Not all market packages in the National ITS Architecture were deemed to be relevant or appropriate for Tennessee's Statewide ITS Architecture. Some are more appropriate for urban area applications, for private-sector technology or automotive manufacturers, or might represent services that are not envisioned for Tennessee. Based on input received from stakeholders about needs and issues, Tennessee's plan and vision for ITS deployment and integration, as well as existing and planned ITS infrastructure, 39 market packages were identified as candidates for implementation. These market packages represent functions or services that are either already existing in the statewide and inter-regional context of Tennessee's ITS program, or those that are needed for to address specific ITS needs and services. A full list of the market packages and abbreviated definitions from the National ITS Architecture is included as **Appendix C**.

Table 6 shows the prioritized group of candidate market packages for Tennessee's Statewide ITS Architecture. Stakeholders assigned a high, medium, or low priority to these candidate market packages, and these priorities correspond to a relative timeframe for implementation. High priority market packages could include functions or services that are already in place, or those deemed critically important for implementation. Other market packages, while they might represent highly desirable services, might be assigned a lower priority due to maturity of technology or dependence on other functions or services. In many cases, market packages classified as existing might still need to be enhanced to increase the service that the market package provides and establish all of the elements associated with it.

Table 6 – Tennessee Market Package Priorities and Timeframes

High Priority (2006-2010)	Medium Priority (2011-2015)	Low Priority (Beyond 2015)
Network Surveillance Traffic Information Dissemination Regional Traffic Control Traffic Incident Management System Speed Monitoring Roadway Closure Management Emergency Call Taking and Dispatch Emergency Routing Roadway Service Patrols Transportation Infrastructure Protection Wide Area Alert Disaster Response and Recovery Evacuation and Reentry Management Disaster Traveler Information Maintenance and Construction Vehicle and Equipment Tracking Road Weather Data Collection Weather Information Processing and Distribution Work Zone Management Work Zone Safety Monitoring Transit Vehicle Tracking Demand Response Transit Operations Transit Security Multi-modal Coordination Electronic Clearance CV Administrative Processes Weigh-in-Motion HAZMAT Management Broadcast Traveler Information Interactive Traveler Information ITS Data Mart	Surface Street Control Electronic Toll Collection Roadway Automated Treatment Maintenance and Construction Activity Coordination Transit Passenger and Fare Management Transit Traveler Information	Standard Railroad Grade Crossing Railroad Operations Coordination ITS Data Warehouse

4.3 Customized Market Packages for Tennessee

The market packages in the National ITS Architecture have been customized to reflect the unique systems, subsystems, and terminators for Tennessee, as well as the information sharing requirements among agencies and between agencies and systems. Each market package is shown graphically, with the market package name, Tennessee-specific element, and with the unique agency and system identifiers within the subsystems and terminators. Market packages represent a service that will be deployed as an integrated capability.

Figure 3 is an example of an ATMS market package for Traffic Information that has been customized for Tennessee. This market package depicts the flows of information from TDOT Regional Traffic Management Centers to field devices, including highway advisory radio and dynamic message signs. Existing information flows from TDOT Maintenance to the statewide road conditions database (TSIS) are documented, and future flows are shown for highway patrol dispatch inputs to TSIS and connections to media outlets. This market package shows an integrated capability among key Center subsystems (Traffic Management, Emergency Management, Maintenance) and the Roadway subsystem, to deliver en-route traveler information.

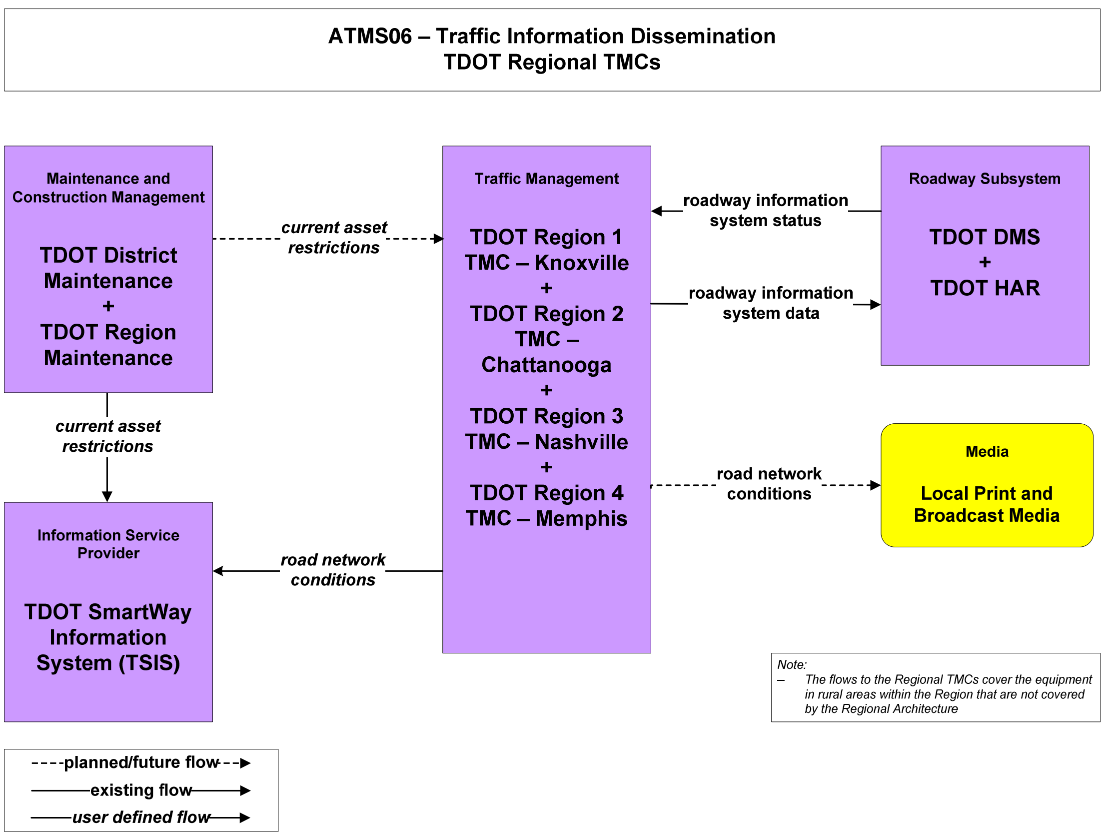


Figure 3 – Example Customized ATMS Market Package

Customized diagrams for all of Tennessee's candidate market packages are included in **Appendix D**. Market packages are also included under the "Services" tab in the Tennessee Statewide Architecture Turbo Architecture database, although Turbo Architecture does not generate the customized schematic diagrams.

4.4 Physical Architecture Interconnects (High Level)

The physical architecture focuses on the physical entities and interfaces of the system. The physical architecture covers system aspects such as where functions reside and communication interfaces among various subsystems. The candidate market packages envisioned for deployment over the 15-year horizon was used to define the subsystems and interconnects that comprise the top-level physical architecture for Tennessee.

A generalized, top-level physical architecture (interconnect diagram) is shown below in **Figure 4**. The interconnect diagram, also known as the "sausage diagram" includes all potential subsystems within the architecture. Communication functions between the subsystems are represented in the ovals.

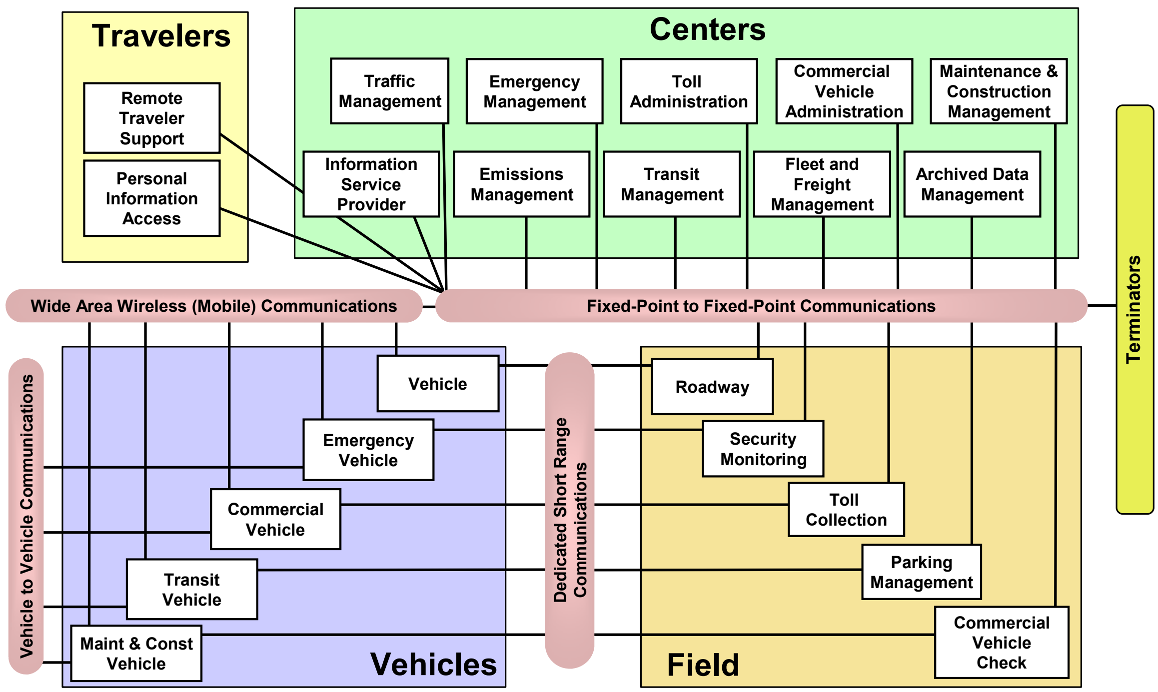


Figure 4 – Physical Architecture (Interconnect Diagram)

A customized interconnect diagram was developed for Tennessee based on the statewide elements, inventory, agencies and future interconnectivity requirements. **Figure 5** shows the detailed interconnect diagram and associated elements within each of the four major subsystems (Center, Field, Traveler and Vehicle). The Tennessee-specific elements are called out in the boxes surrounding the main interconnect diagram, and they are color-coded to correspond to the subsystem to which they are associated.

Terminators are the people, systems, other facilities, and environmental conditions outside of ITS that need to communicate or interface with ITS subsystems. They help to define the boundaries of the National ITS Architecture as well as a statewide or regional system. Examples of terminators include drivers, traffic operations personnel, information service providers, weather effects (snow, rain, ice), and government reporting systems, among others.

Legend

- Subsystem — Architecture Elements Map To National ITS Architecture
- Subsystem (grey) — No Architecture Elements Map To National ITS Architecture

Archived Data Management Subsystem
- *TDOT Data Warehouse
- *TDOT Short Range Planning and Data Office
- *TDOT SmartWay Information System (TSIS) Archive
- *Transit Agency Archive

Commercial Vehicle Administration
- *CVIEW
- *Tennessee Pre-Pass
- THP Truck Weigh and Inspection Station

Fleet and Freight Management
- Private Fleet Operations

Emergency Management
- County EMA
- County Public Safety Dispatch
- HELP Dispatch
- Municipal EMA
- Municipal Public Safety Dispatch
- Regional AMBER Alert Network
- TDOT Emergency Services Coordinator
- TDOT Region 1 TMC – Knoxville
- *TDOT Region 2 TMC – Chattanooga
- TDOT Region 3 TMC – Nashville
- TDOT Region 4 TMC – Memphis
- TEMA
- Tennessee Bureau of Investigation
- THP Dispatch

Information Service Provider
- *Private Sector Traveler Information Services
- *Regional Websites
- TDOT Public Information Office
- TDOT SmartWay Website
- Tennessee 511 System
- *Transit Website
- TDOT SmartWay Information System (TSIS)

Transit Management
- *Demand Response Transit Dispatch
- *Private Long Distance Bus Company Operations
- *Transit Agency Archive

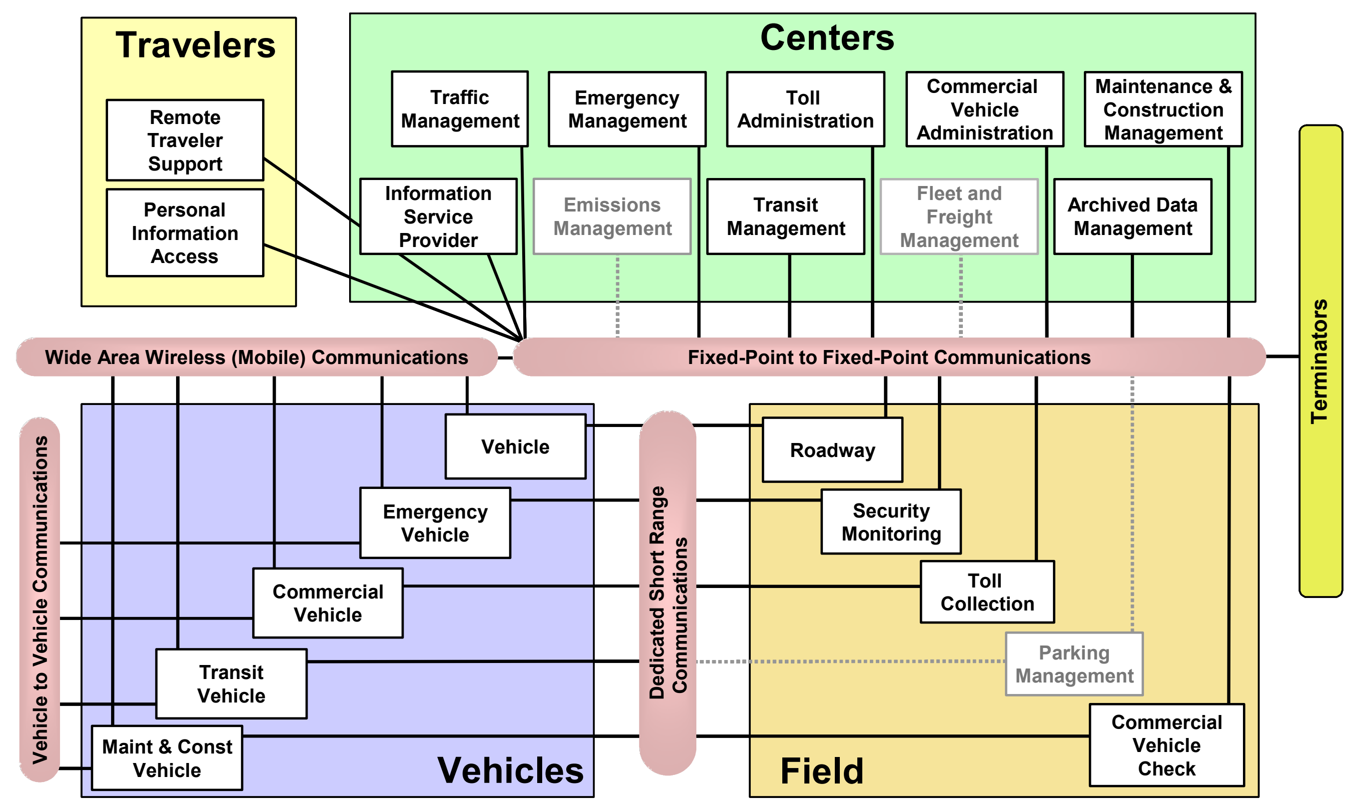
Maintenance and Construction Management
- County Maintenance
- Municipal Maintenance
- Other States Maintenance
- Other TDOT Region Construction Offices
- Other TDOT Region Maintenance
- TDOT District Maintenance
- TDOT Emergency Services Coordinator
- TDOT Maintenance Headquarters
- TDOT Region Construction Office
- TDOT Region Maintenance
- USGS Flood Monitoring System

Toll Administration
- *Regional Toll Authority

Traffic Management
- Alabama DOT
- Arkansas DOT
- *County Traffic Operations Center
- Georgia DOT
- Kentucky DOT
- Mississippi DOT
- *Municipal Traffic Operations Center
- North Carolina DOT
- TDOT Automated Closure and Warning System
- TDOT Region 1 TMC – Knoxville
- *TDOT Region 2 TMC – Chattanooga
- TDOT Region 3 TMC – Nashville
- TDOT Region 4 TMC – Memphis
- THP Dispatch
- Virginia DOT

Personal Information Access
- *Private Traveler Personal Computing Devices

Remote Traveler Support
- *Transit Kiosks
- Tennessee GoSmart Kiosks



Archived Data User System
- *Archived Data User Systems

Basic Commercial Vehicle
- Commercial Vehicle

Commercial Vehicle Check
- THP Truck Weigh and Inspection Station
- THP Weigh-in-Motion
- Violation Detection

Driver/Traveler
- Commercial Vehicle Driver
- Driver
- Traveler
- Transit Vehicle Operator

Financial Institution
- *Financial Institution
- *Service Agency

Freight Equipment
- *Freight Equipment

Maintenance and Construction Administrative Systems
- TDOT Region Engineers Office

Media
- Local Print and Broadcast Media

Multimodal Transportation Service Provider
- Airport

Other Commercial Vehicle Administrative System
- International Fuel Tax Association
- *International Registration Plan
- Single State Registration System

Rail Operations
- *Rail Operations Centers

Traveler Card
- *Electronic Fare Payment Card

Commercial Vehicle Subsystem
- Commercial Vehicle

Emergency Vehicle Subsystem
- County Public Safety Vehicles
- HELP Vehicles
- Municipal Public Safety Vehicles
- THP Vehicles

Maintenance and Construction Vehicle Subsystem
- Contractor Equipment
- TDOT Maintenance Vehicles

Transit Vehicle Subsystem
- Demand Response Transit Vehicles

Vehicle Subsystem
- Commercial Vehicle
- Private Vehicle

***Elements are *planned or future*, not *existing*.**

In some instances, field elements might be existing in urban areas, but not rural areas. For the purposes of the Statewide ITS Architecture, these elements are shown as planned/future.

Commercial Vehicle Check
- THP Weigh-in-Motion
- Violation Detection

Security Monitoring Subsystem
- *TDOT Security Monitoring Field Equipment

Toll Collection
- *Regional Toll Authority Toll Plazas

Roadway Subsystem
- *County Field Equipment
- County Traffic Signals
- *Municipal Field Equipment
- Municipal Traffic Signals
- *TDOT Anti-icing Equipment
- *TDOT CCTV
- *TDOT Closure Equipment

Roadway Subsystem (continued)
- TDOT DMS
- TDOT Field Sensors
- TDOT HAR
- TDOT RWIS Sensors
- *TDOT Speed Monitoring Equipment
- *TDOT Smart Work Zone Equipment
- USGS Field Equipment

Weather Service
- National Weather Service

Telecommunications System for Traveler Information
- Tennessee 511 IVR

Figure 5 – Tennessee Statewide System Interconnect Diagram

4.5 Tennessee ITS Interfaces

While it is important to identify the various systems and stakeholders as part of the statewide ITS architecture, a primary purpose of the architecture is to identify the *connectivity* among transportation, emergency management, maintenance and other systems in Tennessee.

The interconnect diagram shown previously in **Figure 5** showed the high-level relationships of the subsystems and terminators for the statewide context of Tennessee, and showed the corresponding existing and planned physical components that will support the statewide ITS program. The customized market packages represent services that can be deployed as an integrated capability, and the market package diagrams show the information flows between those elements that are most important to the operation of the market packages. How these systems interface with each other is an integral part of the overall ITS architecture.

Interfaces have been developed for each element in the Tennessee Statewide ITS Architecture. In developing the interfaces, elements were mapped to other components of the architecture with which they must interface. For example, the TDOT Regional TMCs show interfaces with 39 other elements, which include other operations centers (municipal, county and other states), emergency management, public safety, maintenance, transit as well as TDOT field equipment. The breadth of the operational role of the TMC within the architecture to support various functions requires a number of interfaces for information sharing, device monitoring and control, or emergency coordination. Other interfaces are much more streamlined and straightforward, such as the interface between transit vehicles and the transit dispatch center to share real-time location data.

Appendix E shows each element and its defined interfaces. An example is provided in **Figure 6**, and this graphic shows the TDOT Region Maintenance offices and each element and entity to which they interface. Data flows are shown as 'planned', because there are currently no automated interfaces among systems at the Region Maintenance offices with other entities. Future scenarios could include automated connections among Region Maintenance offices, between maintenance and regional TMCs, as well as flows between maintenance and field devices in the rural areas.

Element-to-element interfaces and associated data flows are included in the Turbo Architecture database developed for the Tennessee Statewide ITS Architecture.

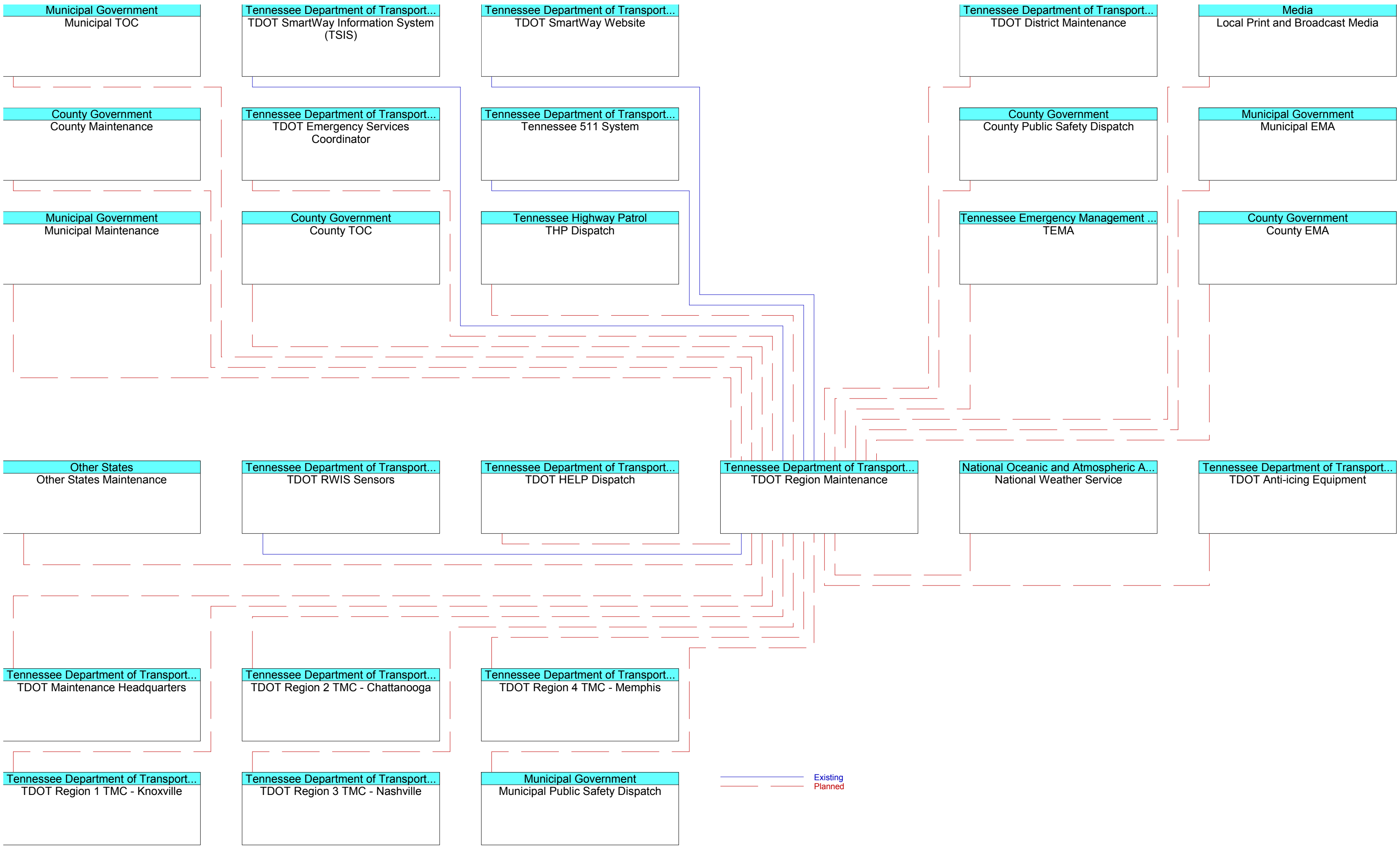


Figure 6 – TDOT Region Maintenance Interfaces

5. OPERATIONAL CONCEPTS, ROLES, AND FUNCTIONAL REQUIREMENTS

The next step in the process outlined operational concepts and defined functional requirements. With the key functions and relationships identified in the earlier tasks, the operational concepts help to better define roles and responsibilities of key stakeholders involved in the statewide ITS architecture, as well as how operational areas (such as traffic management, emergency management, transit operations, and maintenance) could operate as a result of implementing and integrating ITS systems. Functional requirements are high level descriptions about what the system, or systems, will do. They are not intended to be detailed design requirements, but provide insight into the desired functionality to use as a basis for developing more detailed requirements at the project implementation stage.

Figure 7 illustrates the systems engineering life-cycle process, also known as the "V" Diagram. The ITS Architecture is not represented in the diagram, but is a valuable input to begin the process. The foundation of the systems engineering process is to develop operational concepts and high level requirements. The remainder of the systems engineering process will occur as detailed design begins for system elements, as systems are implemented and integrated, and as systems are tested, verified, and commence with operations.

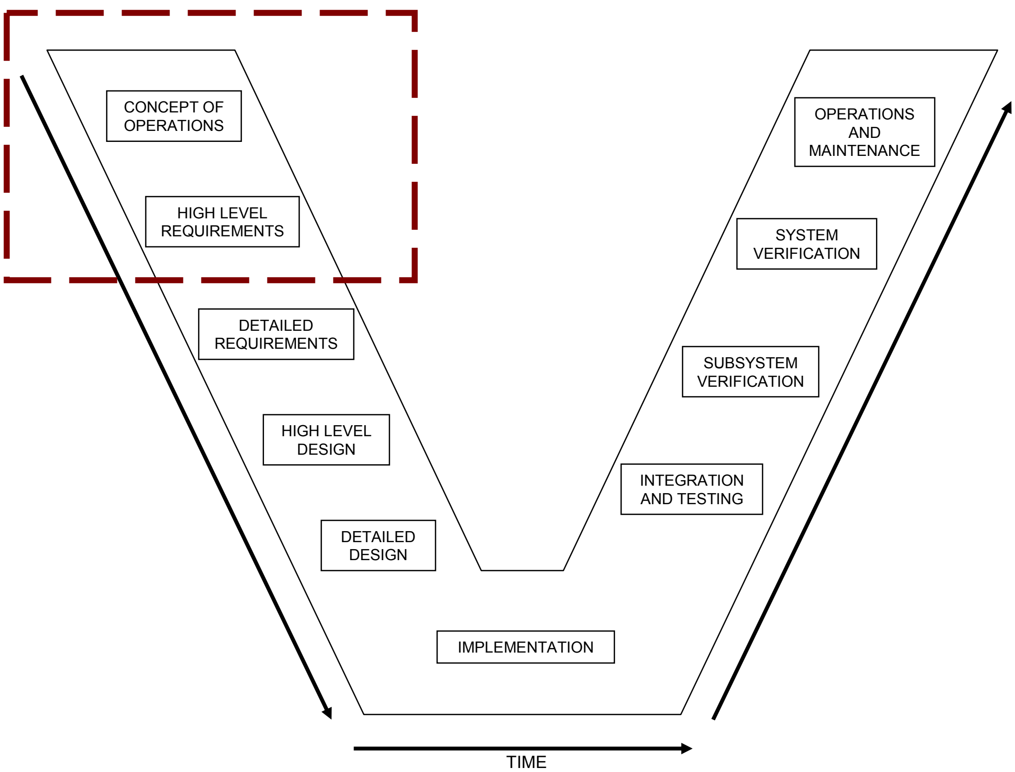


Figure 7 – Systems Engineering Process ("V" Diagram)

5.1 Operational Concepts

An Operational Concept documents stakeholders current and future roles and responsibilities in the operation of proposed ITS systems or as systems become integrated. An operational concept documents these roles and responsibilities across a range of transportation services. In essence, the market packages selected for Tennessee's Statewide ITS Architecture provide for snapshot views of various operational scenarios, including the relationships among agencies involved in a particular service or function, additional entities that might play a secondary role, or those that benefit from the outputs of a service or function. These market packages also showed what kinds of information or control strategies are desirable to execute specific functions.

Because Tennessee's Statewide ITS Architecture is looking at statewide ITS functions and services as well as inter-regional functions and services, the operational concepts for Tennessee have been developed to address key operational areas that will be impacted or enhanced as a result of ITS programs and initiatives. Stakeholder roles within various transportation services are detailed in Section 5.2.

The following sections provide a discussion on various operational areas or programs, including:

- TDOT Traffic Management Centers;
- TDOT Wireless Network;
- ITS to Support Incident and Emergency Management Coordination;
- Public Transportation in Rural Areas; and
- Role of TDOT Maintenance.

5.1.1 Operational Concepts for TDOT Traffic Management Centers

TDOT has implemented Traffic Management Centers as part of the urban area SmartWay Freeway Management System deployments. These TMCs are currently operational in Region 3 (Nashville), Region 1 (Knoxville), and an interim TMC in Region 4 (Memphis). A Region 2 TMC is planned for Chattanooga as that area's SmartWay system is implemented. The SmartWay TMCs serve as the hub for traffic management, TDOT's incident management coordination and response, freeway management and system monitoring, and localized traveler information. These facilities jointly house TDOT SmartWay operations, HELP service patrol dispatching, and TDOT Regional traffic engineering resources.

For the present and near-term, TDOT's TMCs provide for localized freeway management systems operations and monitoring. It is envisioned that the role of the TMCs will expand as TDOT's Intelligent Transportation System program expands to include ITS systems and applications beyond urban area freeways. The TDOT SmartWay TMCs are identified in several of the priority market packages that have been identified in the statewide ITS architecture, and they are envisioned to support several key functions beyond urban freeway management. The Regional ITS Architectures provide details about the specific functions and connections of the respective SmartWay TMCs. For the Statewide ITS Architecture, the TMCs are show in the context of statewide and inter-regional functions, but it is inherent that there is a substantial amount of functionality of these TMCs that happen at the regional level. Center-to-center connections among the TDOT SmartWay TMCs are also documented in the Statewide ITS Architecture.

Traffic Management and Traveler Information

- Monitoring detection and surveillance systems (including video and loop detection, CCTV, road weather information systems);
- Monitoring and control of roadside infrastructure for traveler information (DMS, HAR, and web site) and closure systems;
- Processing region-wide incident related closures outside of SmartWay coverage areas into TSIS database for inclusion in the 511 and SmartWay web applications;
- Center-to-center communications among TDOT TMCs, TMCs and local/regional traffic operations centers, interfaces with emergency management, and TMC to TMC connections with neighboring states;
- Hub for media and other information service providers, transit, and others to access to statewide traffic, road and road weather conditions information (including cameras); and
- Centralized repository for regional ITS device data (RWIS, sensors, DMS usage, etc.).

Emergency Management

- Coordination with local, regional and state emergency management, law enforcement and public safety for emergency and incident management;
- Information resource for real-time and non-real-time roadway conditions and closure information to support emergency operations;
- Monitoring the state transportation network for day-to-day and emergency operations; and
- Implementing strategies and technologies to support emergency operations or requirements.

Maintenance and Construction Management

- Regional and statewide hub for information about current and planned maintenance closures, restrictions (through TSIS);
- Process road weather condition information, as well as obtain forecasted weather information to support maintenance; and
- Monitor work zone equipment.

A future vision to have the four regional TMCs connected via center-to-center communications which will allow for more robust and automated information sharing, joint operations and back-up operations among the peer TMCs. TDOT is implementing SmartWay TMCs with compatible systems, which provides for a high level of potential interoperability among center systems. This could include:

- Shared viewing of CCTV cameras in the urban and rural areas;
- Shared control (on a permissive) of field devices; and
- Shared system monitoring.

At present, the SmartWay TMCs are not 24/7 facilities. It is envisioned that as the urban area programs expand, as well as with more operational responsibilities for rural-area systems, that some form of 24/7 monitoring and control will need to be implemented. One potential option would be to expand operating hours at each of the TMCs to 24/7. Another option could be to designate one TMC as a 24/7 facility that would have monitoring and control responsibility for devices and systems in other regions on an after-hours basis.

TDOT will explore the feasibility of these options, as well as identify key dependencies to implementation (i.e., center-to-center connectivity, phasing, timeframe, etc.).

5.1.2 Operational Concepts for the TDOT Wireless Backbone

TDOT first began exploring wireless telecommunications to support center-to-center communications when a need arose to provide the capability to transmit data from the SmartWay TMC in Memphis to the TDOT Region 4 offices in Jackson. TDOT's Wireless Group is supporting the effort to plan and implement a wireless communications backbone to support this capability. TDOT is using wireless communications in Memphis as part of the SmartWay traffic management system, and the connection between the SmartWay TMC in Memphis and the Region 4 office in Jackson will mark the first wireless center-to-center connection for TDOT's ITS program.

If TDOT moves forward with implementing point-to-point wireless communications infrastructure (including the microwave backbone as well as 'spur' connections to existing and future tower sites) to support statewide ITS connectivity and functions, there are a number of key functions where wireless could be utilized: center-to-center communications and communications between the centers and devices in the field.

Center-to-Center Communications

Wireless communications also can enable communications between centers to support enhanced traffic management, incident management and coordination, incident response, coordination with maintenance, and coordination with transit operations. The Statewide ITS Architecture for Tennessee identifies several center-to-center connections to support enhanced information sharing and coordination among agencies. These include connections between TDOT TMCs, as well as connections between TMCs and public safety, county and municipal traffic operations centers, and TDOT maintenance offices. By implementing center-to-center connections, information can be shared in real time, agencies can share data as well as video images (on a permission basis), and can even permit shared control of certain devices, such as one SmartWay TMC enabling another TMC to have permissive control over DMS in its region. It should be noted that more detailed analysis of center and system-specific conditions would be warranted to determine the optimal telecommunications strategy, and wireless telecommunications might not be feasible in all cases.

Center-to-Center communications are documented in the following market packages in Tennessee's Statewide ITS Architecture:

- ATMS07 – Regional Traffic Control;
- ATMS08 – Incident Management;
- ATMS21 – Roadway Closure Management;
- EM01 – Emergency Call Taking and Dispatch;
- EM02 – Emergency Routing;
- EM05 – Transportation Infrastructure Protection;
- EM06 – Wide Area Alert;
- EM08 – Disaster Response and Recovery;
- EM09 – Evacuation and Reentry Management;
- MC03 – Road Weather Data Collection;
- MC04 – Weather Information Processing and Distribution;

- MC05 – Roadway Automated Treatment;
- MC08 – Work Zone Management; and
- MC10 – Maintenance and Construction Activity Coordination.

Center-to-Field Communications

The wireless backbone and "spur" connections could support wireless control and monitoring of devices such as dynamic message signs, CCTV, HAR, barrier/closure systems, workzone equipment, as well as detection along key corridors. Communications between centers and vehicles would also be addressed, such as vehicle location systems for transit or maintenance vehicles, as well as on-board transit security systems. It should be noted that more detailed analysis of site and system-specific conditions would be warranted to determine the optimal telecommunications strategy. Market Packages that could potentially be included in this scenario are:

- ATMS01 – Network Surveillance;
- ATMS06 – Traffic Information Dissemination (DMS, HAR);
- ATMS10 – Electronic Toll Collection;
- ATMS19 – Speed Monitoring;
- ATMS21 – Automated Closure;
- EM01 – Emergency Call Taking and Dispatch;
- EM02 – Emergency Routing;
- EM04 – Roadway Service Patrol;
- EM10 – Disaster Traveler Information;
- EM05 – Transportation Infrastructure Protection;
- MC01 – Maintenance Vehicle Tracking;
- MC03 – Road Weather Data Collection;
- MC05 – Roadway Automated Treatment;
- MC09 – Work Zone Safety Monitoring;
- APTS1 – Transit Vehicle Tracking;
- APTS3 – Demand-Response Transit Operations;
- APTS4 – Transit Passenger and Fare Management;
- APTS5 – Transit Security;
- APTS7 – Multimodal Coordination; and
- APTS8 – Transit Traveler Information.

Supporting ITS operations is a primary purpose of the TDOT wireless network, but because TDOT's operations are not envisioned to utilize all of the available network capacity, TDOT saw a potential opportunity for other agencies to also benefit from the network infrastructure. TDOT has distributed a request for feedback and potential interest to other state agencies, including TEMA, the Department of Safety, Department of Environment & Conservations, Department of Health and the Department of Correction. Discussions about additional uses and potential applications for other state agencies are in the early stages, as are discussions about any potential cost-sharing for implementation or ongoing maintenance of the network. Any telecommunications infrastructure sharing, particularly regarding public safety communications, would require an analysis of bandwidth requirements as well as network security issues. As more devices are brought on-line, and as centers are sharing more information via wireless infrastructure, bandwidth capability and capacity would need to be evaluated.

The Statewide ITS Architecture is not intended to specify specific communications requirements between devices, between centers and devices or between centers; this communications capability could be implemented through a variety of ways, as well as with a combination of telecommunications infrastructure (depending on the location, cost, infrastructure availability, geography/terrain considerations, phasing, existing systems, etc.).

5.1.3 Operational Concepts for How ITS Can Support Incident and Emergency Management Coordination

For large scale incidents and emergencies, the Tennessee Emergency Management Agency (TEMA) is the lead in coordinating and implementing responses of other state and local agencies. In the event of a large-scale emergency or brought about by severe weather, flooding, an evacuation (or needing to manage ingress of evacuees from neighboring states), radiological or biological disaster or other natural or technological emergency, TEMA serves as the "9-1-1 of State Government". The Tennessee Governor's Executive Order 15 establishes TEMA as the lead agency for the coordination of all emergency response activities of state government.

A State Emergency Operations Center in Nashville coordinates with a network of regional TEMA offices that serve local agencies (including county emergency managers) throughout the state. The Tennessee Emergency Management Plan is required by state law, and it provides documented procedures, policies and requirements relative to TEMA's response and coordination for a range of emergency conditions.

In the event of a large-scale disaster or emergency, TEMA and the State EOC serve as the focal points for emergency response and coordination, including overseeing or directing responses from other state and local agencies. TEMA coordinates through Emergency Services Coordinators (ESC), who are designated representatives of other state, federal and private sector agencies that serve as a liaison between TEMA and their respective agency during an emergency. ESCs have authority similar to their agency's commissioner relative to summoning resources or deploying assets to support a TEMA request for response. In the case of TDOT, an ESC would be designated to TEMA and serve as TEMA's TDOT contact in the event of an emergency or needed response; TDOT's ESC would then coordinate TDOT's resources to respond to TEMA.

The Tennessee Statewide ITS Architecture identifies key functions relative to incident management, and TEMA's coordination with TDOT TMCs, transit operations, and other emergency management agencies. The ITS architecture is not intended to conflict with the State Emergency Management Plan or established procedures and protocols, rather, the capabilities, technology and ITS infrastructure that TDOT implements will be able to better support large-scale emergency management and coordination efforts.

The functions identified in TDOT's Statewide ITS Architecture will enable enhanced emergency response and coordination through several strategies. These involve:

- Traffic management and monitoring;
- Emergency broadcasts for travel or emergency information;
- Enhanced coordination and mobilization of maintenance and other critical response resources;

- Real-time information sharing among TDOT TMCs; and
- Automated information sharing connections between TDOT and other key state agencies, including TEMA, Tennessee Highway Patrol, and Tennessee Bureau of Investigation.

Some potential scenarios to illustrate this enhanced response coordination could include:

- CCTV cameras and detectors along key corridors or at key infrastructure will allow TDOT TMCs to monitor conditions in real-time and report current status of these corridors to TEMA and other response agencies.
- Connections among TDOT TMCs via the statewide wireless network would enable real-time information sharing of video, data, and field equipment status. This would allow one TMC to view and monitor the status of instrumented corridors in another TDOT Region. This would allow the EOC to view CCTV feeds, network data and other equipment status on a statewide basis.
- A connection between TDOT and TBI for AMBER Alert information could automate that information exchange process. TBI could send an alert to TDOT with AMBER Alert details and information, and this could be disseminated via DMS, 511 and TDOT's web page.
- Centralized statewide traveler information via TDOT's 511 phone and web allows floodgate and emergency messages to be included as part of the statewide traveler information resources. Dynamic message signs (both permanent and portable) could be activated with emergency information, and highway advisory radio could be utilized to provide emergency or evacuation information to travelers already on the road.
- Maintenance vehicle tracking technology would allow TDOT to identify where maintenance vehicles are, and could dispatch, mobilize and track its maintenance fleet (in real time) as these resources respond to emergency or disaster situations.

5.1.4 Operational Concepts for Public Transportation in Rural Areas

The Statewide ITS Architecture includes several market packages and functions focused on transit – those that directly support enhanced operations for rural area transit systems and providers as well as those that enable improved coordination and communication among transit and other agencies, such as TDOT, public safety, and emergency management. It is important to note that the Statewide ITS Architecture focuses primarily on demand-response transit agencies and services outside of the metropolitan planning areas of Memphis, Chattanooga, Nashville, Knoxville, Clarksville and Johnson City. Market packages and functions for transit operators in those areas, as well as transit functions that will be implemented regionally rather than on a statewide level, are documented as part of those regions' respective regional ITS architectures.

Transit dispatch centers will increase functionality as market packages and their associated projects are implemented. As shown in the Demand-Response Transit Operations market package (APTS3), transit dispatch centers will receive information about road conditions and work zone information, as well as incidents or closures that could impact routes. This will support better scheduling and implementation of route deviations in response to conditions or closures on certain corridors. It also enables communications support among transit operations centers monitor and update transit systems for demand response operations. Vehicle routing and scheduling is also performed using this market package. Transit users would be able to call for pickup using the interactive voice response confirmation system and then use electronic payment to pay for the fare using the Transit

Passenger and Fare Management market package. Passenger loading and fare payments can be monitored by the transit dispatch center to determine passenger use data. Transit Vehicle Tracking (APTS1) allows the dispatch centers to monitor and track the location of their transit vehicles using an automated vehicle location system. Currently transit schedules for rural areas are updated when road conditions change, routes change, or other major factors of the vehicle route hinder the existing schedule. Vehicle location tracking will provide the dispatch centers with real time schedule adherence information to update the transit system's schedule in real time to the dispatch center and to the various traveler information systems. For Demand Response operations, particularly in rural areas, the vehicle tracking capability will allow dispatch centers to track vehicles over a broad geographic service area.

Schedules, fares, and other transit information are updated to the various traveler information systems via the Transit Traveler Information market package (APTS8). These systems include the transit website for the dispatch center, transit kiosks, private traveler personal computing devices, and the 511 system (Note: in the near-term, transit interface to 511 is envisioned to be a call transfer directly to the transit customer service centers. As more automated transit information becomes available, that information could be included directly within Tennessee's 511 service).

Transit has been identified in several of the incident and emergency management market packages because of the role transit could serve in the event of an evacuation. There are some instances where TDOT TMCs would coordinate with transit operators, and other scenarios showing direct coordination with transit from TEMA. Key emergency management market packages and functions involving transit include:

- EM05 – Transportation Infrastructure Protection;
- EM08 – Disaster Response and Recovery; and
- EM09 – Evacuation and Reentry Management.

The Transit Security (APTS5) market package works in conjunction with the Transit Vehicle Tracking market package and provides for a video, audio, and/ or event recorder on-board surveillance system to ensure the physical security of transit passengers. In the event of an emergency, alarm notification and vehicle location is sent to the corresponding dispatch center which is then sent to county and city public safety dispatch for appropriate response. Transit Vehicle Tracking and Transit Security provide the needed safety and security of demand response transit passengers in rural areas where other means of communication may not be available.

Multi-Modal Coordination (APTS7) establishes two way communications between multiple transit and traffic agencies to improve service coordination and efficiency at transit transfer points and emergency response efforts across jurisdictional boundaries. This coordination includes agencies such as long distance bus services, airport transit services, county and municipal fixed-route systems, and county and municipal demand response systems. The coordinated use of the mentioned market packages will ensure the safety and security of transit passengers, and enhance the efficiency and application of the transit systems on a regional and statewide basis.

5.1.5 Operational Concepts for the Role of TDOT Maintenance with ITS Capabilities

Maintenance serves several functions – the role of DOT maintenance is an evolving one, in that traditional 'build and maintain' roles are expanding to serve 24/7 operations capability which includes incident response, supporting emergency operations, and supporting planned event operations. Within the Statewide ITS Architecture, several maintenance functions have been identified that include implementing technology to enhance work zone operations and safety monitoring, weather information collection and distribution, as well as coordinating maintenance activities among multiple agencies (including TDOT, counties and neighboring states for common corridors).

Many of the identified market packages in the Statewide ITS Architecture build on functions that are currently being performed by Region Maintenance and District Offices. Responding to weather conditions, particularly hazardous road weather conditions, is a key function of TDOT Maintenance. Road Weather Information Systems (RWIS) are already deployed in Tennessee to provide current road weather conditions information; this capability is envisioned to expand, and a future scenario could include RWIS data going directly to District and Region offices as well as Headquarters to allow for better localized use of the real-time weather data. Similarly, weather information feeds from other sources (such as the National Weather Service) could be directed to District offices, Headquarters and regional TMCs so that it is accessible to multiple entities within TDOT. Automated anti-icing systems also are included are a future function; these systems would be installed at locations prone to icing in the winter, and would include pavement sensors and appurtenances with anti-icing chemicals that would be activated once the pavement temperature sensor indicated ice is likely to form. TDOT District Maintenance would monitor the sensors and activation notices, and provide that information to the Regional TMCs. Dynamic message signs would warn drivers that anti-icing systems were active. Weather-related market packages included in the Statewide ITS Architecture are:

- MC03 – Road Weather Data Collection (includes RWIS capability as well as flood detection);
- MC04 – Weather Information Processing and Distribution; and
- MC05 – Roadway Automated Treatment (anti-icing systems).

The TDOT Maintenance offices will be coordinating with many agencies for maintenance and construction information and resource management. The Maintenance offices will provide road weather information, roadway maintenance status, work zone information, and road weather information to the Regional TMCs as well as the transit dispatch centers throughout the state. Maintenance to TMC connections are shown in several market packages, including MCO and ATMS. This dissemination of information is included as part of the Traffic Information Dissemination, Road Weather Data Collection, and Weather Information Processing and Distribution market packages selected for the state.

Monitoring and tracking the location of the maintenance vehicles defined by the Maintenance and Construction Vehicle and Equipment Tracking market package (MC01) will be important in allocating resources for maintenance requests. The Transportation Infrastructure Protection (EM05), Disaster Response and Recovery (EM08), and Evacuation and Reentry Management (EM09) market packages call upon TDOT Maintenance to support emergency coordination and response with TDOT Maintenance Headquarters and other TMCs. TDOT Region Maintenance and District Maintenance will participate in emergency plan coordination with TEMA, county and municipal emergency operations centers throughout the state. In the event of a natural disaster, all maintenance divisions will support TDOT and TEMA disaster coordination directives to assist in response and recovery efforts where needed. Maintenance will be able to utilize equipment such as portable DMS, portable workzone monitoring equipment and vehicle tracking to better support large-scale incident or emergency response.

5.2 Operational Roles and Responsibilities

Each stakeholder will have operational roles and responsibilities across a range of transportation services as grouped in the Operational Concepts section of Turbo Architecture. The services covered are:

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

Table 7 identifies the roles and responsibilities of key stakeholders for a range of transportation services.

Table 7 – Stakeholder Roles and Responsibilities

Transportation Service	Stakeholder	Roles/Responsibilities
Arterial Management	Municipalities and Counties	Operate and maintain traffic signal systems within the municipality or county.
		Operate network surveillance equipment including CCTV cameras and vehicle detection to facilitate traffic signal operations.
		Remotely control traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle preemptions.
		Provide traffic signal preemption for emergency vehicles.
Highway Management	TDOT	Operate dynamic message signs and highway advisory radio for the distribution of traffic information and roadway conditions to travelers on the roadway.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on state roadways.
		Operate motorist assistance patrol (HELP) to facilitate special event traffic control and incident management.
Incident Management (Traffic)	Municipalities and Counties	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Responsible for coordination with other traffic operations centers and emergency management agencies for coordinated incident management.
		Coordinate maintenance resources for incident response with local maintenance.
	TDOT	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate dynamic message signs and highway advisory radio for the distribution of incident information to travelers on the roadway.
		Responsible for coordination with other traffic operations centers and emergency management agencies for coordinated incident management.
		Responsible for the development, coordination and execution of special traffic management strategies during evacuation.

Table 7 – Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Incident Management (Emergency)	Municipal and County Public Safety Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety agencies and the TDOT SmartWay TMCs for incidents on state facilities.
	THP Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety and traffic management agencies as well as the TDOT SmartWay TMCs for incidents on state facilities.
Emergency Management	Municipal and County Public Safety Dispatch	Responsible for emergency call-taking as the 911 Public Safety Answering Point (PSAP).
		Responsible for dispatching emergency vehicles to incidents and tracking of their location and status.
		Responsible for routing emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Municipal/County EMA	Operates the Emergency Operations Center (EOC) for the County and/or City in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the County and/or City.
		Lead regional efforts for emergency planning to support large-scale incidents and disasters.
		Lead evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	TEMA	Operates the Emergency Operations Center (EOC) for the State of Tennessee in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the State.
		Lead efforts for emergency planning to support large-scale incidents and disasters.
	THP Dispatch	Responsible for dispatching patrol vehicles to incidents and tracking of their location and status.
		Responsible for routing emergency vehicles to facilitate the safest/quickest arrival at an incident.

Table 7 – Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Emergency Management (continued)	THP Dispatch (continued)	Participate in regional and statewide emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	TN Bureau of Investigation	Responsible for the initiation of AMBER alerts.
Maintenance and Construction Management	Municipalities and Counties	Responsible for tracking and dispatch of maintenance vehicles for snow removal during a winter weather event.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, highway advisory radio, and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.
	TDOT	Monitors environmental sensors and distributes information about road weather conditions.
		Responsible for the tracking and dispatch of maintenance vehicles for snow removal during a winter weather event.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, highway advisory radio, and sharing of information with other groups.
		Disseminates work activity schedules and current asset restrictions to other agencies.
		Operates work zone traffic control equipment including portable surveillance equipment, dynamic message signs, and highway advisory radio transmitters.
Transit Management	Demand Response Transit	Operates demand response transit services from a central dispatch facility responsible for tracking their location and status.
		Provide transit passenger electronic fare payment.
		Provide transit security on transit vehicles and at transit terminals through silent alarms and surveillance systems.
		Coordinate transit service with other regional transit providers.
		Provide transit traveler information to the agency website, local private sector traveler information services, and the Tennessee 511 system (511 interface to transit is a future capability).
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.

Table 7 – Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Commercial Vehicle Operations	TDOT	Establishes commercial vehicle (including HAZMAT) route restrictions.
	THP	Manages electronic filing of credentials and tax filing for commercial vehicle operators.
		Provides commercial vehicle safety criteria to roadside check facilities, collects and reviews safety data from the field and distributes safety information to other centers, carriers, and enforcement agencies.
		Operates roadside check facility equipment to communicate with commercial vehicles at mainline speeds (PrePass) – reading tag data, identification, weight and vehicle characteristics, and credential checking. Determines whether a pull-in message should be generated.
Traveler Information	TDOT	Collect, process, store and disseminate traffic, maintenance and construction, event and weather information to travelers via the 511 Traveler Information System.
		Provide transportation information to travelers via traveler information kiosks.
Archive Data Management	Demand Response Transit	Collect and format transit operations and ridership data to satisfy local, state, and federal government data reporting requirements.
	TDOT	Collect and maintain data from regional traffic and transit management agencies.

5.3 Functional Requirements

Functions are a description of what the system has to do. In the National ITS Architecture, “functions” are defined at several different levels, ranging from general subsystem descriptions through somewhat more specific equipment package descriptions to Process Specifications that include substantial detail. Guidance from the USDOT on developing a Regional ITS Architecture recommends that each Region determine the level of detail of the functional requirements for their Region.

For the Tennessee Statewide ITS Architecture, functions and functional requirements have been defined at two different levels. The first level is the customized market packages which describe the services that ITS needs to provide in Tennessee on a statewide level, as well as key inter-regional services. The customized market packages show the relationship of major subsystems and elements, as well as the data and information flows between elements.

The second, more detailed level are the Functional Requirements that include ‘shall’ statements which identify all functions that a project or system needs to perform. These ‘shall’ statements are based on equipment packages that are associated with one or more subsystems in the Tennessee Statewide ITS Architecture. An equipment package is a functional capability that could be deployed at a specific time. They are associated with market packages, and define individual functions within the market package – agencies can choose to implement certain equipment packages based on the functionality they want from a particular market package. Each equipment package can be linked in the National ITS Architecture to the Process Specifications that might be applicable.

Turbo Architecture allows the developer to identify applicable equipment packages based on the market packages that were selected, and the interfaces between key elements. The methodology to select functional requirements included:

- Reviewing potential equipment packages;
- Selecting appropriate or applicable equipment packages based on existing or planned functionality, infrastructure, and agency connections; and
- Reviewing and selecting appropriate requirements.

Functional requirements have been selected for elements in the Tennessee Statewide ITS Architecture, and are included in **Appendix F**. These requirements are organized alphabetically by element.

6. PROJECT SEQUENCING AND IMPLEMENTATION

6.1 Recommended Projects for Deployment

With priorities and functions established for the 15-year statewide ITS vision in Tennessee, this step of the process identifies projects that can be implemented to achieve that vision. Projects range from deploying and integrating infrastructure (such as telecommunications, traffic management, traveler information, weather detection and others) to establishing connections between agencies and centers to share information and coordinate responses to real-time conditions on the transportation network.

Recommended projects for deployment were developed considering several factors:

- Needs identified by stakeholders;
- Functions and connections among agencies and between agencies and field elements in the market packages;
- Market package priorities and timeframes;
- ITS components and goals identified in other plans (such as CVISN, SmartWay Strategic Plan);
- Some projects are enhancements to current programs that are envisioned to expand over the next several years, such as the TSIS database and the statewide 511 service; and
- Inter-regional and statewide needs that were not identified in the existing metropolitan area regional ITS architectures.

Table 8 presents statewide projects recommended for Tennessee. Recommended ITS projects for implementation have been identified for each of the functional areas (Traffic Management, Emergency Management, etc.). Within each functional area, deployment timeframes are categorized as:

- Short term (2006-2010);
- Mid-term (2011-2015); and
- Long-term (Beyond 2015).

Projects that are recommended for implementation are not guaranteed to be funded or implemented. In most cases, funding still needs to be identified. The candidate list shown in **Table 8** provides TDOT and other stakeholders with a list of potential projects that are a priority and should be considered for implementation as funding opportunities arise, or as opportunities arise to streamline ITS infrastructure as part of other capital improvements.

The benefit of a multi-year deployment plan is that is can be used to support mainstreaming initiatives by TDOT. The opportunity to incorporate ITS implementation or other supporting infrastructure should be explored whenever possible as part of the project development process. Some common examples include the implementation of DMS or CCTV cameras as part of a roadway reconstruction project or the installation of conduit for future communications during a widening project. The Statewide ITS Architecture and deployment plan recommendations can be used when reviewing and updating the STIP as well as to identify near-term opportunities to mainstream ITS into roadway improvement or other projects. Mainstreaming ITS as part of other capital improvement projects can reduce costs, provide traffic management support during construction depending on the phase of installation, and potentially provide alternate funding resources not typically available for traditional ITS projects.

Several projects shown in **Table 8** are shown in phases; that is, it is envisioned that projects such as the Statewide Wireless Backbone or center-to-center connectivity will likely happen through a series of phased implementations.

Note:

Costs shown in Table 8 are intended to serve as planning-level cost assumptions. Detailed cost requirements have not been developed as part of this process. There are several considerations that would factor in to detailed cost estimates, such as project scope and location, number and location of devices, telecommunications costs and O&M requirements. Where feasible and appropriate, costs are shown on a per-installation basis (such as for AVL or RWIS stations).

Table 8 – Recommended Projects

Traffic and Travel Management

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010)				
24/7 TMC Operations	Extend the hours of the Nashville, Knoxville, Memphis and Chattanooga TMCs to provide 24/7 operations. The TMCs will control ITS equipment in the rural areas within their districts.	TDOT	TBD	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS07 – Regional Traffic Control – TDOT Region 1 TMC – Knoxville ATMS07 – Regional Traffic Control – TDOT Region 2 TMC – Chattanooga ATMS07 – Regional Traffic Control – TDOT Region 3 TMC – Nashville ATMS07 – Regional Traffic Control – TDOT Region 4 TMC – Memphis ATMS08 – Traffic Incident Management System
Region 1 Rural ITS Deployment	Implement ITS elements along key corridors (including high incident locations) in the region. Technologies include DMS, HAR, CCTV, and vehicle detection. Projects will utilize existing communications infrastructure to communicate with the TMC. Planning for this Region 1 project is already underway.	TDOT	$2,000,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
Region 2 Rural ITS Deployment	Implement ITS elements along key corridors (including high incident locations) in the region. Technologies include DMS, HAR, CCTV, and vehicle detection. Projects will utilize existing communications infrastructure to communicate with the TMC; future enhancements could include migration to wireless communications following build-out of the TDOT Wireless Backbone in this region.	TDOT	$2,000,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System

Table 8 – Recommended Projects (continued)

Traffic and Travel Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010) (continued)				
Region 3 Rural ITS Deployment	Implement ITS elements along key corridors (including high incident locations) in the region. Technologies include DMS, HAR, CCTV, and vehicle detection. Projects will utilize existing communications infrastructure to communicate with the TMC; future enhancements could include migration to wireless communications following build-out of the TDOT Wireless Backbone in this region.	TDOT	$2,000,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
Region 4 Rural ITS Deployment	Implement ITS elements along key corridors (including high incident locations) in the region. Technologies include DMS, HAR, CCTV, and vehicle detection. Projects will utilize existing communications infrastructure to communicate with the TMC; future enhancements could include migration to wireless communications following build-out of the TDOT Wireless Backbone in this region.	TDOT	$2,000,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
TDOT Speed Monitoring Equipment	Procure portable speed monitoring equipment to monitor traffic speeds in work zones or other select locations. Data can be used to target areas for enforcement. Speed monitoring has also been proven to raise awareness among motorists and reduce speeding in work zones even when enforcement is not present. This equipment would likely be required for selected construction contracts.	TDOT	$7,500/per	ATMS19 – Speed Monitoring – TDOT MC08 – Work Zone Management – TDOT District Maintenance MC08 – Work Zone Management – TDOT Region Construction Office
Rural Fog Detection Systems	Implement fog detection and motorist advisory systems at select locations around the state. The systems could also include automated road closure gates.	TDOT	$5,000,000	ATMS01 – Network Surveillance ATMS21 – Roadway Closure Management

Table 8 – Recommended Projects (continued)

Traffic and Travel Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010) (continued)				
TDOT Statewide Communications Plan	Develop a statewide telecommunications master plan to identify communications needs, priorities, options, and phasing. This plan will look at wireless as well as other telecommunications options and needs to support TDOT's ITS build-out including center-to-center communications, center-to-field communications, and other connectivity needs. Connections will be provided between TDOT and other agencies, including emergency management, local governments, and neighboring states.	TDOT	$100,000	All market packages*
TDOT Statewide Wireless Network Phase 1	Implement the first phase of wireless communications to support center-to-center connectivity of TDOT TMCs, Region Offices, District Offices, and other state agencies. This first phase will connect Memphis to Jackson and is currently under construction.	TDOT	TBD	All market packages*
TDOT Statewide Wireless Network Phase 2	Implement the second phase of wireless communications to support center-to-center connectivity of TDOT TMCs, Region Offices, District Offices, and other state agencies.	TDOT	TBD	All market packages*

Table 8 – Recommended Projects (continued)

Traffic and Travel Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010) (continued)				
TDOT TMC to Local TOC Connections Phase 1	Establish a link between TDOT Regional TMCs and municipal/county traffic operations centers. This connection will allow TDOT and local agencies to share data and will provide local agencies with images from TDOT CCTV. The Cumberland Gap TOC will be connected to the TDOT TMC as part of this project. (Note: these connections apply to cities and counties in rural areas not covered in existing regional architectures)	TDOT, Cities, Counties	TBD (will vary)	ATMS07 – Regional Traffic Control – TDOT Region 1 TMC – Knoxville ATMS07 – Regional Traffic Control – TDOT Region 2 TMC – Chattanooga ATMS07 – Regional Traffic Control – TDOT Region 3 TMC – Nashville ATMS07 – Regional Traffic Control – TDOT Region 4 TMC – Memphis ATMS08 – Traffic Incident Management System EM08 – Disaster Response and Recovery – TEMA
TSIS Enhancements	Enhance the statewide TSIS database and servers to support roadway closure and restriction information management, 511, and web traveler information tools. Enhancements will also support the sharing of data to facilitate emergency response planning.	TDOT	$50,000	ATMS06 – Traffic Information Dissemination ATIS1 – Broadcast Traveler Information – Tennessee 511 and TSIS ATIS2 – Interactive Traveler Information – Tennessee 511
SmartWay Expansion and Integration	Continue to expand the SmartWay systems in the urban areas, including infrastructure deployment and TMC enhancements.	TDOT	TBD	ATMS01 – Network Surveillance ATMS06 – Traffic Information ATMS07 – Regional Traffic Control ATMS08 – Traffic Incident Management
HRI Crossing Warning System	Implement technologies to improve detection, warning, motorist advisories and coordination with local traffic control systems at railroad grade crossings.	Cities, Counties, and TDOT	$200,000	ATMS13 – Standard Railroad Grade Crossing

Table 8 – Recommended Projects (continued)

Traffic and Travel Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Mid-Term (2011-2015)				
TDOT TMC Center-to-Center Communications	Provide reliable communications between TDOT SmartWay TMCs in Regions 1, 2, 3 and 4 to share data and video as well as provide shared control of devices. (Note: This project relies heavily on the planned Statewide Wireless Backbone.)	TDOT	TBD	ATMS01 – Network Surveillance ATMS07 – Regional Traffic Control – TDOT Region 1 TMC – Knoxville ATMS07 – Regional Traffic Control – TDOT Region 2 TMC – Chattanooga ATMS07 – Regional Traffic Control – TDOT Region 3 TMC – Nashville ATMS07 – Regional Traffic Control – TDOT Region 4 TMC – Memphis ATMS08 – Traffic Incident Management System EM08 – Disaster Response and Recovery – TEMA
TDOT TMC to Local TOC Connections Phase 2	Establish a link between TDOT Regional TMCs and municipal/county traffic operations centers. This connection will allow TDOT and local agencies to share data and will provide local agencies with TDOT CCTV images. (Note: these connections apply to cities and counties in rural areas not covered in existing regional architectures)	TDOT, Cities, Counties	TBD	ATMS07 – Regional Traffic Control – TDOT Region 1 TMC – Knoxville ATMS07 – Regional Traffic Control – TDOT Region 2 TMC – Chattanooga ATMS07 – Regional Traffic Control – TDOT Region 3 TMC – Nashville ATMS07 – Regional Traffic Control – TDOT Region 4 TMC – Memphis ATMS08 – Traffic Incident Management System EM08 – Disaster Response and Recovery – TEMA
Electronic Toll Collection	Implement electronic toll collection technologies. Toll facilities could include bridges or HOT lanes. Specific applications have not been determined.	TDOT	TBD	ATMS10 – Electronic Toll Collection

Table 8 – Recommended Projects (continued)

Traffic and Travel Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Mid-Term (2011-2015) (continued)				
TDOT Statewide Wireless Network Phase 3	Implement the third phase of wireless communications to support center-to-center connectivity of TDOT TMCs, Region Offices, District Offices, and other state agencies.	TDOT	TBD	All market packages*
TSIS Enhancements Phase 2	Continue enhancements to the TSIS databases and servers to support new data sources and information, as well as increased functionality for internal users. These enhancements will also directly support 511 phone and web-based traveler information tools that rely heavily on TSIS as their primary data source.	TDOT	$100,000	ATMS06 – Traffic Information Dissemination ATIS1 -Broadcast Traveler Information – Tennessee 511 and TSIS ATIS2 – Interactive Traveler Information – Tennessee 511
SmartWay Expansion and Integration	Continue to expand the SmartWay systems in the urban areas, including infrastructure deployment and TMC enhancements.	TDOT	TBD	ATMS01 – Network Surveillance ATMS06 – Traffic Information ATMS07 – Regional Traffic Control ATMS08 – Traffic Incident Management

Table 8 – Recommended Projects (continued)

Traffic and Travel Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Long-Term (Beyond 2015)				
TDOT TMC to Local TOC Connections Phase 3	Establish a link between TDOT Regional TMCs and municipal/county traffic operations centers as they are implemented. This connection will allow TDOT and local agencies to share data and will provide local agencies with TDOT CCTV images. (Note: these connections apply to cities and counties in rural areas not covered in existing regional architectures)	TDOT, Cities, Counties	TBD	ATMS07 – Regional Traffic Control – TDOT Region 1 TMC – Knoxville ATMS07 – Regional Traffic Control – TDOT Region 2 TMC – Chattanooga ATMS07 – Regional Traffic Control – TDOT Region 3 TMC – Nashville ATMS07 – Regional Traffic Control – TDOT Region 4 TMC – Memphis ATMS08 – Traffic Incident Management System EM08 – Disaster Response and Recovery – TEMA
TSIS Enhancements Phase 3	Continue enhancements to the TSIS databases and servers to support new data sources and information, as well as increased functionality for internal users. These enhancements will also directly support 511 phone and web-based traveler information tools that rely heavily on TSIS as their primary data source.	TDOT	$100,000	ATMS06 – Traffic Information Dissemination ATIS1 – Broadcast Traveler Information – Tennessee 511and TSIS ATIS2 – Interactive Traveler Information – Tennessee 511
SmartWay Expansion and Integration	Continue to expand the SmartWay systems in the urban areas, including infrastructure deployment and TMC enhancements.	TDOT	TBD	ATMS01 – Network Surveillance ATMS06 – Traffic Information ATMS07 – Regional Traffic Control ATMS08 – Traffic Incident Management

* Supports all market packages, but is not specifically represented in any market package.

Table 8 – Recommended Projects (continued)

Emergency Management and Incident Coordination

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010)				
TMC Connection to TBI for AMBER Alerts	Establish connection between TDOT TMCs and TBI to automate AMBER Alert notifications and information exchanges. Develop procedures and implement processes for AMBER Alert confirmations and subsequent TDOT distribution via DMS, web and 511.	TDOT, TBI	TBD	EM06 – Wide Area Alert – Tennessee AMBER Alert
TMC Connection to County Public Safety Dispatch (911)	Implement connection between TDOT Regional TMCs and County 911 Dispatch Centers to share real-time information on incidents, closures, restrictions and emergency routing information (Note: these connections would apply to Public Safety agencies in rural areas not already covered by the existing regional ITS architectures)	TDOT, County 911 Dispatch Centers	TBD	ATMS08 – Traffic Incident Management System
TDOT ITS Incident/Emergency Management Plan	Develop incident and emergency management procedures and policies that integrate ITS into TDOT's incident and emergency response strategies. This plan should document how ITS can supplement current department response procedures. It is recommended that this plan involve TEMA and other appropriate emergency management entities so as not to conflict with other statewide emergency response procedures or requirements.	TDOT	$250,000	ATMS08 – Traffic Incident Management System EM08 – Disaster Response and Recovery – TEMA EM09 – Evacuation and Reentry Management – TEMA EM09 – Evacuation and Reentry Management – Local EMA EM10 – Disaster Traveler Information – Tennessee 511 EM10 – Disaster Traveler Information – TDOT

Table 8 – Recommended Projects (continued)

Emergency Management and Incident Coordination (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010) (continued)				
TDOT HELP Program Expansion Phase 1	Expand the coverage area for HELP vehicles to include rural highways outside of the metro areas. HELP is currently deployed in the Nashville, Knoxville, Memphis and Chattanooga metro areas, and this initial phase would expand geographic coverage of the service patrols.	TDOT	$5,000,000 ($1M/year above current operations costs)	ATMS08 – Incident Management EM04 – Roadway Service Patrols
TDOT HELP Program 24/7 Operations	Extend the hours of operation for the HELP program to provide 24 hour operations. HELP patrols currently operate approximately 18 hrs/day during the work week, and 12 hrs/day on weekends.	TDOT	$2,000,000	ATMS08 – Incident Management EM04 – Roadway Service Patrols
TDOT HELP Program AVL and MDTs	Implement automated vehicle location (AVL) and mobile data terminals (MDT) to enhance communication and coordination between the HELP Dispatch at the TMCs and the field personnel. AVL will allow HELP dispatchers to use a map display to locate vehicles in the field. This will be a particular benefit for an expanded HELP coverage area so that dispatchers can have an accurate and current 'snapshot' of the locations of their fleets, and will allow for better coordination among TDOT regions to share HELP resources to respond to incidents and motorists along rural corridors.	TDOT	$5,000/vehicle (leveraged to assume mapping software and on-board equipment cost)	ATMS08 – Incident Management EM04 – Roadway Service Patrols

Table 8 – Recommended Projects (continued)

Emergency Management and Incident Coordination (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Mid-Term (2011-2015)				
TDOT Maintenance Connections to Emergency Management Agencies	Implement connections between TDOT Regional and District Maintenance offices and local, county and state emergency management agencies, including public safety dispatch centers. This connection will facilitate requests for DOT maintenance resources to support incident or emergency responses.	TDOT, THP, TEMA, County EOCs, County and Municipal Public Safety Dispatch	$2,000,000	ATMS08 – Incident Management EM08 – Disaster Response and Recovery – Local EMA EM09 – Evacuation and Reentry Management – Local EMA
TDOT HELP Program Expansion Phase 2	Continue to expand the coverage area for HELP vehicles to include additional rural highways outside of the metro areas.	TDOT	$5,000,000 ($1M/year above current operations costs)	ATMS08 – Incident Management EM04 – Roadway Service Patrols
Long-Term (Beyond 2015)				
TDOT HELP Program Expansion Phase 3	Continue to expand the coverage area for HELP vehicles to include additional rural highways outside of the metro areas.	TDOT	$5,000,000 ($1M/year above current operations costs)	ATMS08 – Incident Management EM04 – Roadway Service Patrols

Table 8 – Recommended Projects (continued)

Maintenance and Construction Management

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010)				
RWIS Expansion Phase 1	Implement additional RWIS at key locations around the state to provide TDOT Maintenance with real-time weather and pavement condition data. Identify locations for CCTV to supplement RWIS.	TDOT	$25,000/each	ATMS01 – Network Surveillance MC03 – Road Weather Data Collection – TDOT RWIS
Overheight Vehicle Detection System	Implement a detection system at restricted height underpasses to notify and detour overheight vehicles. The system will help to minimize or prevent damage to structures caused by overheight vehicles.	TDOT	$100,000/ location	EM05 – Transportation Infrastructure Protection
TDOT Connection to Weather Information Service(s)	Establish a connection between TDOT Maintenance, TDOT TMCs, and weather information service providers such as NOAA and the National Weather Service (NWS) to obtain forecasted weather conditions data feed. Connections of this type already exist in some locations.	TDOT	TBD	MC04 – Weather Information Processing and Distribution
Work Zone Monitoring and Safety Systems (SmartFix)	Procure portable or vehicle-mounted technologies such as CCTV and DMS, to support enhanced on-site work zone management and monitoring. Implement communications links to allow remote monitoring of work zones by TMCs or TDOT Construction Offices. Establish interface with contractor work zone monitoring and safety systems. A SmartFix project in Knoxville is already underway utilizing this technology.	TDOT	$500,000	ATMS01 – Network Surveillance MC08 – Work Zone Management – TDOT Region Construction MC09 – Work Zone Safety Monitoring

Table 8 – Recommended Projects (continued)

Maintenance and Construction Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Mid-Term (2011-2015)				
TDOT Maintenance Vehicle AVL	Install automated vehicle location technology on TDOT maintenance vehicles to allow maintenance dispatch to view and track vehicle locations in real-time. Implement GIS-based mapping tools at Region and District Maintenance offices to monitor vehicle activity and location in real-time.	TDOT	$5,000/vehicle (assuming mapping software/ application)	MC01 – Maintenance Vehicle Tracking
RWIS Expansion Phase 2	Implement additional RWIS at key locations throughout the state to provide TDOT Maintenance with real-time weather and pavement condition data. Identify potential locations for CCTV to supplement RWIS.	TDOT	$25,000/each	ATMS01 – Network Surveillance MC03 – Road Weather Data Collection – TDOT RWIS
TDOT Maintenance Connection to USGS	Establish a connection between TDOT Maintenance and USGS to provide TDOT with USGS flood sensor data. The USGS monitors flood sensors in streams and rivers (in real-time), and can provide TDOT with up-to-the-minute information about dangerous water levels or flooding, particularly any flooding hazards that could impact the state's roadway system.	TDOT, USGS	TBD	MC03 – Road Weather Data Collection – USGS Flood Sensors MC04 – Weather Information Processing and Distribution
TDOT Anti-Icing System	Identify locations where anti-icing technologies and systems can be implemented. These would include pavement sensors, anti-icing chemical disbursement systems, and motorist advisory systems.	TDOT	$300,000/ location	MC03 – Road Weather Data Collection – TDOT RWIS MC05 – Roadway Automated Treatment

Table 8 – Recommended Projects (continued)

Public Transportation Management

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010)				
Transit Vehicle AVL and CAD Enhancements for Demand-Response Transit Operations	Install automatic vehicle location technology on-board demand-response transit vehicles to support real-time vehicle location and status. Implement enhanced CAD dispatch systems to improve communication between dispatch center and drivers, improve schedule monitoring and adherence, and support incident management.	Demand Response Transit Operators	$5,000/vehicle (assuming mapping software/ application) $200,000/ center	APTS1 – Transit Vehicle Tracking APTS3 – Demand Response Transit Operations APTS5 – Transit Security
Automated Fare Payment Systems for Transit	Procure and install automated fare payment systems on-board transit vehicles to allow patrons to pay fares using swipe card or smart card technology.	Transit Operators	$2500/vehicle	APTS4 – Transit Passenger and Fare Management
Transit Link to TN 511	Implement links between demand-response transit operators in the rural areas to Tennessee's 511 Central Server so that information about schedule and available services is automatically transmitted to the server and made available via the 511 phone and web service.	TDOT, Transit Operators	TBD	APTS3 – Demand-Response Transit Operations APTS8 – Transit Traveler Information ATIS2 – Interactive Traveler Information – Tennessee 511
Transit Travel Information Web Page	Develop and operate regional transit web pages that provide access to transit schedules, fares, service areas, and other information.	Transit Operators	$50,000/each	APTS8 – Transit Traveler Information
Transit Kiosks	Develop and implement interactive kiosks that can provide information on a range of transit operators and available services, be capable of supporting electronic payment coordination, and include links to real-time transportation network conditions (weather, closures, incidents, etc.).	Transit Operators	$25,000/each	APTS4 – Transit Passenger and Fare Management APTS7 – Multi-modal Coordination APTS8 – Transit Traveler Information

Table 8 – Recommended Projects (continued)

Public Transportation Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010) (continued)				
Demand-Response Transit Security System	Implement on-board security surveillance and alarms that will notify demand-response dispatch of incidents or emergencies on-board vehicles.	Demand Response Transit Operators	$5,000/vehicle	APTS5 – Transit Security
Mid-Term (2011-2015)				
Transit Coordination and Communications Network	Connect demand-response transit operators in the rural areas to better share information, coordinate schedules, and support regional incident management or emergency response.	Transit Operators	TBD	APTS3 – Demand-Response Transit Operations APTS7 – Multi-modal Coordination

Table 8 – Recommended Projects (continued)

Traveler Information

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010)				
TN511 Enhancements Phase 1	Upgrade and enhance the statewide 511 service.	TDOT	$100,000	ATIS2 – Interactive Traveler Information – Tennessee 511 EM10 – Disaster Travel Information – Tennessee 511
TN Web Page Enhancements	Upgrade and enhance the TDOT Traveler Information web site to include additional real-time information and new data sources as they become available.	TDOT	$100,000	ATIS2 – Interactive Traveler Information – Tennessee 511 EM10 – Disaster Travel information – Tennessee 511 and TSIS
GoSmart Kiosks	Implement additional GoSmart interactive kiosks at rest areas throughout the state to provide road and travel conditions information, weather, tourism/travel services information and other types of data. (Note: Four were implemented in 2005. An additional 8 are already funded and will be deployed by the end of 2007.)	TDOT	$25,000/each	ATIS1 – Broadcast Traveler Information – Tennessee 511 and TSIS
Mid-Term (2011-2015)				
TN511 Enhancements Phase 2	Upgrade and enhance the statewide 511 service.	TDOT	$100,000	ATIS2 – Interactive Traveler Information – Tennessee 511 EM10 – Disaster Travel Information – Tennessee 511 and TSIS
TN Web Page Continued Enhancements	Continue to upgrade and enhance the TDOT Traveler Information web site to include additional real-time information and new data sources as they become available.	TDOT	$100,000	ATIS1 – Interactive Traveler Information – Tennessee 511 and TSIS EM10 – Disaster Travel information – Tennessee 511 and TSIS

Table 8 – Recommended Projects (continued)

Commercial Vehicle Operations

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010)				
Commercial Vehicle Electronic Clearance	Implement additional pre-pass electronic clearance technologies along mainlines near weigh and inspection stations. Pre-pass allows commercial vehicle drivers with their credentials in-check to bypass inspection stations. (Note: Giles County is the next weigh and inspection station with plans to implement Pre-Pass)	TDOT, THP	TBD	CVO03 – Electronic Clearance – Mainline Enforcement
Commercial Vehicle Traveler Information Program	Create an interface on the web that provides CVO-specific information, such as truck route restrictions, HAZMAT route restrictions, links to permit information, etc. This could be an extension of TSIS, and could be designed to support both web and phone based traveler information tools.	TDOT	TBD	ATIS1 – Interactive Traveler Information – Tennessee 511 and TSIS
Weigh in Motion	Implement additional weigh in motion sites on key corridors and near CVO weigh and inspection stations. Weigh in motion allows a vehicle to pass over scales at mainline speeds. WIM can be used as a stand-alone technology (to gather data for planning purposes) or to augment the Electronic Clearance capability and support CVO enforcement. TDOT is exploring virtual weigh in motion for potential application.	TDOT, THP	$8,000,000/ station	CVO03 – Electronic Clearance – Weigh and Inspection Station Enforcement CVO06 – Weigh-in-Motion – Weigh and Inspection Station

Table 8 – Recommended Projects (continued)

Commercial Vehicle Operations (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Mid-Term (2011-2015)				
HAZMAT Tracking and Coordination System	Implement a system and processes for coordinating information about HAZMAT vehicle permits, routes, location, and incidents. This system will support notification of TDOT TMCs about HAZMAT vehicles traveling through their regions and on which routes. It will also support enhanced incident notification and response in the event of a HAZMAT incident on one of the state's highways and improved coordination with CVO fleet managers.	TDOT, THP	$500,000	CVO10 – HAZMAT Management
Permit Notification Coordination System for Oversize Vehicles	Implement a system and processes for coordinating information about oversize vehicle permits to local jurisdictions. This system will facilitate local traffic management.	TDOT, THP	$250,000	CVO04 – CV Administrative Processes

Table 8 – Recommended Projects (continued)

Archived Data/Information Management

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Short-Term (2006-2010)				
ITS Archive Database for Traffic Management	Develop and implement an archived data management system that will house archived rural area transportation management data, including that from detectors, infrastructure/ device usage, etc. This data archive will be utilized primarily by TDOT's Long-Range Planning Division and shall be capable of supporting queries and generating outputs to support planning functions.	TDOT	$1,000,000	AD1 – ITS Data Mart – TDOT
Transit Data Archive	Develop and implement a statewide transit database that will store archived data (fleet, activity, passenger counts, etc.). This data will be accessible by TDOT Public Transportation staff as well as transit operators (both fixed route and demand response). The transit data archive shall be capable of supporting queries and generating outputs to support planning and reporting functions.	TDOT, Transit Operators	$750,000	AD1 – ITS Data Mart – Transit
TSIS Archive	Develop and implement an archived data management system that will house archived TSIS data including weather information and construction closure history.	TDOT	$500,000	AD1 – ITS Data Mart – TSIS

Table 8 – Recommended Projects (continued)

Archived Data/Information Management (continued)

Project Name	Description	Responsible Agency	Project Costs	Market Packages
Mid-Term (2011-2015)				
ITS Data Warehouse	This ITS Data Warehouse will consolidate data from various archives (traffic management, transit, RWIS/weather, 511 and others) into a centralized data warehouse. It will support various queries for information as well as have the capability to generate reports, statistics, and other functions to provide historical information on system performance. It will be critical to establish common access standards for interoperability.	TDOT	$1,500,000	AD2 – ITS Data Warehouse – TDOT

6.2 Agency Agreements for Operations

Agency interfaces and data exchanges identified in the Tennessee Statewide ITS Architecture will help to support key operations functions including traffic management, incident management and coordination, traveler information, and interagency communications. With the envisioned integration among agencies at a statewide and inter-regional level in Tennessee, there will need to be formal agreements in place to govern the sharing of data and information, access to TDOT systems and system-generated information, and multi-jurisdictional resource sharing and cooperation. Agreements are needed to:

- Establish parameters and quality guidelines for data that is to be shared;
- Identify agency responsibilities for data and information sharing;
- Clearly outline expectations, restrictions, or limitations on how information can be used;
- Establish privacy and security measures to protect the integrity of the data as well as adhere to established guidelines and security provisions;
- Establish level of authority or operational hierarchy;
- Outline any cost requirements or mutual funding arrangements that might need to be addressed (such as one-time costs, recurring costs or in-kind expectations); and
- Establish joint operations strategies where applicable.

TDOT has already entered in to several agreements with law enforcement, neighboring states, and the private sector, and these agreements establish a sound basis for operational relationships. A representative list of existing agreements includes:

- Media has access to CCTV images in Nashville and Knoxville (can view and display, but do not have control of TDOT cameras along freeways);
- TDOT and the Tennessee Bureau of Investigation for AMBER Alerts;
- AMBER Alert Agreements with local Police;
- Arkansas/Georgia;
- Cumberland Gap Tunnel – Shared Control;
- Wireless infrastructure (TDOT and DPS);
- Resource sharing for fiber (Knoxville); and
- HELP mutual aid agreements with Public Safety.

Based on the functions and interfaces identified for the Statewide ITS Architecture, **Table 9** provides an overview of additional agreements that are envisioned to be needed to support operations and information sharing among public (and private) entities in the state.

Table 9 – Agreements for Operations

Agreement	Description	Costs or Considerations
Data Sharing Agreements (Public Sector) – **TDOT sharing data with other public agencies** – **Public agencies providing data to TDOT**	Formal agreement to govern data sharing among public agencies. This agreement should address items such as: – Type and format of data to be shared – How the information will be used – Data quality, security, and privacy issues *Examples:* – TDOT providing local and other state agencies with planned closures, weather, roadway restrictions, etc. – Public safety providing incident information to transportation management agencies – Transit providing information about schedules and services for inclusion on 511	Although these agreements among public sector partners are typically zero dollar (no charge for the data itself), there could be some cost incurred to establish communications or develop software/interfaces to enable data exchange between public agencies.
Video Access and Monitoring Agreements – Public sector – Private sector	These agreements govern use and access to TDOT CCTV video feeds and images. Agreements for shared access and monitoring does NOT include shared control. Agreements are needed to allow shared monitoring and viewing of TDOT CCTV video by other public agencies, such as THP, local law enforcement, cities, counties, TEMA, and others. These agreements should specify: – How agencies can access TDOT video images and feeds – Usage policies and limitations, including any restrictions on redistributing – TDOT's policies for restricting access or prioritizing access to video feeds – Disclaimers – Privacy policies TDOT has existing agreements with media in the metro areas where SmartWay cameras are deployed (media has access to be able to broadcast video feeds during traffic reports, but they do not have control of CCTV). Media will likely have a desire to access CCTV feeds or images for cameras on rural highways, particularly if there is an incident or hazardous weather. Agreements with private entities (such as media) need to address similar parameters as the access and shared monitoring agreements with other public partners, and should also include: – Restricting access to video at TDOT's discretion – Media responsibility for providing infrastructure to enable them to access video (TDOT can make video feeds available but it is up to the media to pay costs to implement the infrastructure to enable access, such as a video switch or communications line).	TDOT will have discretion over which public or private entities will have access to the images or feeds from its CCTV cameras. While there is typically no charge for the actual video images or feeds, there may be some expenses incurred to enable access, such as installing and maintaining a video switch or communications infrastructure. Similarly, for other public agencies to be able to have access to video, there may be some expenses incurred to develop software or interfaces to TDOT TMCs.

Table 9 – Agreements for Operations (continued)

Agreement	Description	Costs or Considerations
Infrastructure Shared Control/Joint Operations Agreements between TDOT and other Public Sector Agencies	There are likely to be limited instances where shared control of field infrastructure will be an issue. An example is the Cumberland Gap Tunnel which includes shared monitoring of CCTV and shared control of DMS. For shared control of infrastructure, formal agreements are needed to outline agency responsibilities for: – Operating and maintaining infrastructure – Hours of operation – Circumstances where shared control and operations is required or restricted – Procedures for coordinating device operations and/or maintenance between agencies	These agreements could be zero dollar, but if there is shared infrastructure the agreements could specify funding parameters (installation, O&M). Appropriate software and interfaces for both agencies to enable control and joint operations would also need to be developed, and could result in additional expenses.
Mutual Call Transfer Agreements for 511 between TDOT and Neighboring States	TDOT is planning to enter into mutual call transfer agreements with North Carolina, Virginia and Kentucky to allow 511 callers to access the 511 services in other states. These agreements are being developed as part of the initial implementation of Tennessee's statewide 511 service. As more of Tennessee's neighboring states implement 511, additional agreements will be developed with those states.	These agreements are typically zero dollar and work on the 'exchange' system – TDOT will agree to transfer 511 callers that request NC, VA or KY information, and in turn, those states will also agree to transfer callers that request TN.
Call Transfer Agreements for 511 with Tennessee Agencies (i.e., Transit, Tourism)	To expand the amount of information available via Tennessee's 511 service, future enhancements will likely include call transfer capability to other Tennessee agencies, particularly transit (in the urban and rural areas) and tourism. Callers requesting this information will be transferred to the appropriate call center. Agreements will need to specify transfer point-to numbers, and also may include provisions for the end-points to agree to answer calls and perhaps have the capability to transfer callers back to 511.	For these call transfers, costs will need to be monitored. TDOT may elect to specify that the end-point provide a toll-free number for transfers, or agree to pay costs associated with transferring to a number that is long-distance.
Additional Mutual Aid Agreements between HELP and Local Law Enforcement	Currently, TDOT's HELP service provides motorist assistance and support for incident management on freeways in urban areas. HELP has agreements with public safety agencies in those areas for mutual aid. If the HELP program expands to include rural area highways, additional agreements for mutual aid may be needed between TDOT and local law enforcement (such as additional county sheriffs or EMS).	Mutual aid agreements could include provisions for cost sharing or cost recovery depending on the level of incident management support. TDOT should build on the terms that are part of the urban area agreements in developing any additional HELP mutual aid agreements.

6.3 ITS Standards

Standards are an important tool that will allow efficient implementation of the elements in the Tennessee Statewide ITS Architecture over time. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances, vendors change, and as new approaches evolve.

The USDOT's ITS Joint Program Office is supporting Standards Development Organizations (SDOs) with an extensive, multi-year program of accelerated, consensus-based standards development to facilitate successful ITS deployment in the United States. They are required as part of the architecture development processes to specify key standards that should be utilized as part of the system design and implementation. Some standards are mandatory requirements, while others are recommended practices or specifications.

Key entities involved in the standards development effort include:

- AASHTO – American Association of State Highway and Transportation Officials;
- ANSI – American National Standards Institute;
- APTA – American Public Transportation Organization;
- ASTM – American Society for Testing and Materials;
- IEEE – Institute of Electrical and Electronics Engineers;
- ITE – Institute of Transportation Engineers;
- NEMA – National Electrical Manufacturers Association; and
- SAE – Society of Automotive Engineers.

The standards development process is a rigorous one, and standards must go through several stages of review, revision, and trial uses/tests before being formally published and recommended. Each SDO has slightly different development process; in some cases (such as with NTCIP and DSRC) multiple Standards Development Organizations will participate in the development and publication process. The development process is ongoing, and there are more than 100 standards that are in various stages of development, review, testing and balloting (approval).

Based on the selected functions, interfaces and interconnects established in the Tennessee Statewide ITS Architecture, recommended and applicable standards for Tennessee are included in **Table 10**. *Definitions for the Standard Groups (NTCIP, IEEE Incident Management, DSRC, ATIS General Use) have been sourced from the National ITS Architecture, version 5.1.*

Table 10 – Applicable ITS Standards

SDO	Title	Document ID	Type
AASHTO/ITE/NEMA	**NTCIP Center-to-Center Standards Group** The NTCIP Center-to-Center (NTCIP C2C) Group of Standards (AASHTO, ITE, and NEMA) addresses the communications protocols between two centers (e.g. two traffic management centers exchanging information to facilitate regional coordination of traffic signals). Some of the communication protocols covered by this family are DATEX-ASN, XML, and FTP. These protocols are common across all Center-to-Center interfaces in the National ITS Architecture. The standards that describe the "vocabulary" (data elements and messages) are mapped to specific architecture flows rather than the entire set of NTCIP C2C interfaces. In order to satisfy a wide spectrum of system and regional communications requirements, Center-to-Center ITS deployments should each implement the combinations of the following NTCIP C2C communications protocols that best meet their needs.	This Group includes the following Standards Activities: – NTCIP 1102: Octet Encoding Rules (OER) Base Protocol – NTCIP 1104: Center-to-Center Naming Convention Specification – NTCIP 2104: Ethernet Subnetwork Profile – NTCIP 2202: Internet (TCP/IP and UDP/IP) Transport Profile – NTCIP 2303: File Transfer Protocol (FTP) Application Profile – NTCIP 2304: Application Profile for DATEX-ASN (AP-DATEX) – NTCIP 2306: Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (C2C XML)	Group

Table 10 – Applicable ITS Standards (continued)

SDO	Title	Document ID	Type
AASHTO/ITE/NEMA (continued)	**NTCIP C2F: NTCIP Center-to-Field Standards Group** The NTCIP Center-to-Field (NTCIP C2F) Group of Standards (AASHTO, ITE, and NEMA) addresses the communications protocols between a center and the ITS field devices it manages. The family includes the communications profiles that cover the interfaces between a traffic management center and dynamic message signs, ramp meters, environmental sensors, CCTVs, and other field equipment under its control. These protocols are common across all Center-to-Field interfaces in the National ITS Architecture. The "vocabulary" (objects) is specific to the actual architecture flow in the National ITS Architecture and is therefore mapped to the corresponding Data Object standard. In order to satisfy a wide spectrum of system and regional communications requirements, Center-to-Field ITS deployments should each implement the combinations of the following NTCIP C2F communications protocols that best meet their needs.	This Group includes the following Standards Activities: – NTCIP 1101: Simple Transportation Management Framework (STMF) – NTCIP 1102: Octet Encoding Rules (OER) Base Protocol – NTCIP 1103: Transportation Management Protocols (TMP) – NTCIP 2101: Point to Multi-Point Protocol Using RS-232 Subnetwork Profile – NTCIP 2102: Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile – NTCIP 2103: Point-to-Point Protocol Over RS-232 Subnetwork Profile – NTCIP 2104: Ethernet Subnetwork Profile – NTCIP 2201: Transportation Transport Profile – NTCIP 2202: Internet (TCP/IP and UDP/IP) Transport Profile – NTCIP 2301: Simple Transportation Management Framework (STMF) Application Profile – NTCIP 2302: Trivial File Transfer Protocol (TFTP) Application Profile – NTCIP 2303: File Transfer Protocol (FTP) Application Profile	Group
	Global Object Definitions	NTCIP 1201	Message/Data
	Object Definitions for Actuated Traffic Signal Controller Units	NTCIP 1202	Message/Data
	Object Definitions for Dynamic Message Signs (DMS)	NTCIP 1203	Message/Data
	Environmental Sensor Station (ESS) Interface Standard	NTCIP 1204	Message/Data
	Object Definitions for Closed Circuit Television (CCTV) Camera Control	NTCIP 1205	Message/Data
	Data Element Definitions for Transportation Sensor Systems (TSS)	NTCIP 1209	Message/Data
	Field Management Stations – Part 1: Object Definitions for Signal System Masters	NTCIP 1210	Message/Data
	Object Definitions for Signal Control and Prioritization	NTCIP 1211	Message/Data
	TCIP Common Public Transportation (CPT) Objects	NTCIP 1401	Message/Data

Table 10 – Applicable ITS Standards (continued)

SDO	Title	Document ID	Type
AASHTO/ITE/NEMA (continued)	TCIP Incident Management (IM) Objects	NTCIP 1402	Message/Data
	TCIP Passenger Information (PI) Objects	NTCIP 1403	Message/Data
	TCIP Scheduling/Runcutting (SCH) Objects	NTCIP 1404	Message/Data
	TCIP Spatial Representation (SP) Objects	NTCIP 1405	Message/Data
	TCIP On-Board (OB) Objects	NTCIP 1406	Message/Data
	TCIP Control Center (CC) Objects	NTCIP 1407	Message/Data
	TCIP Fare Collection (FC) Business Area Objects	NTCIP 1408	Message/Data
ANSI	Commercial Vehicle Safety and Credentials Information Exchange	ANSI TS285	Message/Data
	Commercial Vehicle Credentials	ANSI TS286	Message/Data
ASTM	**DSRC 915MHz: Dedicated Short Range Communication at 915 MHz Standards Group** Dedicated Short Range Communications (DSRC) is a general purpose RF communications link between the vehicle and the roadside, or between two vehicles. The set of standards developed to support this interface provide a short to medium range communications service for a variety of applications, including public safety (obstacle detection, collision avoidance), commercial vehicle applications (weigh-in-motion/inspection clearances, border crossing), electronic toll collection, parking lot payment, and many others. A set of 915 MHz DSRC standards was completed several years ago and formed the basis for commercial vehicle applications, electronic toll collection, and other applications. The DSRC 915MHz Standards Group includes standards covering the rules for communicating between in-vehicle ITS systems and roadside equipment, and are common across all of the vehicle-to-roadside interfaces in the National ITS Architecture. The standards that describe the "vocabulary" (called data elements and messages) are specific to certain architecture flows, and are therefore only mapped to the relevant flows.	In commercial vehicle (CVO) applications, this standards group covers the interface between commercial vehicles and roadside equipment and includes the following standards: – ASTM E2158-01: Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band – ASTM Draft Standard for Dedicated Short Range, Two-Way Vehicle to Roadside Communications Equipment, Draft 6, 23 February 1996, Layer 2 Data Link Layer For non-commercial vehicle (CVO) applications, the 915 MHz standards group includes the following Standards Activities: – ASTM E2158-01: Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band – ASTM PS 105-99: Standard Provisional Specification for Dedicated Short Range Communication (DSRC) Data Link Layer	Group

Table 10 – Applicable ITS Standards (continued)

SDO	Title	Document ID	Type
ASTM (continued)	Standard Specification for Metadata to Support Archived Data Management Systems	ASTM E2259-xx	Other
	Standard Specification for Archiving ITS Generated Travel Monitoring Data	ASTM E2259-yy	Message/Data
IEEE	**IEEE IM: Incident Management Standards Group** The Incident Management family of standards, created primarily by the IEEE standards development organization, addresses the interfaces between an emergency management center and other centers. They provide the vocabulary (called data elements and messages) necessary to exchange information between ITS systems. Together, the ITS standards in this group apply to emergency management center interfaces (such as with a traffic management center, an emergency management center, or other centers). There is also a significant amount of reuse of data elements and messages across multiple interfaces; rather than repeat the entire list of standards for each architecture flow, we have created this summary entry – the Incident Management (IEEE IM) Group of standards.	This Group includes the following Standards Activities: – IEEE 1512-2000: Standard for Common Incident Management Message Sets for use by Emergency Management Centers – IEEE 1512.1-2003: Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers – IEEE 1512.2-2004: Standard for Public Safety Traffic Incident Management Message Sets for Use by Emergency Management Centers – IEEE 1512.3-2002: Standard for Hazardous Material Incident Management Message Sets for Use by Emergency Management Centers – IEEE P1512.4: Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers	Group
	Standard for Message Sets for Vehicle/Roadside Communications	IEEE Std 1455-1999	Message/Data
ITE	Standard for Functional Level Traffic Management Data Dictionary (TMDD)	ITE TM 1.03	Message/Data
	Message Sets for External TMC Communication (MS/ETMCC)	ITE TM 2.01	Message/Data

Table 10 – Applicable ITS Standards (continued)

SDO	Title	Document ID	Type
SAE	**ATIS General Use: Advanced Traveler Information Systems (ATIS) General Use Standards Group** The Advanced Traveler Information Systems (ATIS) General Use family of standards, created by the SAE standards development organization, is for general exchange of data independent of bandwidth limitations. This standards group addresses primarily the interfaces between the Information Service Provider and other ITS centers such as traffic management centers, transit management centers, etc., and is therefore mapped to the relevant architecture flows in the National ITS Architecture. This group provides the vocabulary (called data elements and messages) necessary to exchange information between these ITS systems.	This Group includes the following Standards Activities: – SAE J2354: Message Set for Advanced Traveler Information System (ATIS) – SAE J2540: Messages for Handling Strings and Look-Up Tables in ATIS Standards – SAE J2540/1: RDS (Radio Data System) Phrase Lists – SAE J2540/2: ITIS (International Traveler Information Systems) Phrase Lists – SAE J2540/3: National Names Phrase List – SAE J2266: Location Referencing Message Specification (LRMS)	Group

Table 10 – Applicable ITS Standards (continued)

SDO	Title	Document ID	Type
SAE/IEEE	**DSRC 5GHz: Dedicated Short Range Communication at 5.9 GHz Standards Group** The set of 5.9 GHz DSRC standards is still under development, and is being designed to support a larger variety of applications, including advanced vehicle control, traveler information, increased freight/cargo transport support, transit, parking, and traffic management (this DSRC 5GHz Standards Group). The DSRC 5GHz Standards Group includes standards covering the protocols for communicating between in-vehicle ITS systems and roadside equipment. The standard that describes the vocabulary (called data elements and messages) is at the early stages of development by SAE and is entitled "SAE J2735: Standard for Data Dictionary and Message Sets for Dedicated Short Range Communications (DSRC)". The standards within the DSRC 5GHz Standards Group offer a significantly higher information capacity than DSRC in the 915 MHz band, and have a longer range. Although envisioned primarily for public safety applications, the possible ITS uses for this spectrum vary widely. The equipment required to support 5.9 GHz DSRC is different from that required for 915 MHz DSRC, and therefore early deployment and migration decisions should be made.	The ITS standards in this group are currently under development, although significant progress has been made since they are based on IEEE's wireless LAN industry standard 802.11. – ASTM E2213-03: Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems – 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications – IEEE 802.2-1998: Logical Link (Layer 2) for DSRC 5.9 GHz – IEEE P1609.4: Standard for Wireless Access in Vehicular Environments (WAVE) – Multi-Channel Operations – ISO 21210: Networking Services (Layer 3) for DSRC 5.9 GHz – IEEE P1609.3: Standard for Wireless Access in Vehicular Environments (WAVE) – Networking Services – IEEE P1609.2: Standard for Dedicated Short Range Communications (DSRC) Application Layer for 5.9 GHz – IEEE P1609.1: Standard for Wireless Access in Vehicular Environments (WAVE) – Resource Manager	Group

7. ITS ARCHITECTURE USE AND MAINTENANCE PLAN

Tennessee's Statewide ITS Architecture can serve TDOT as a valuable planning tool to guide near-term and longer-range ITS deployment and integration throughout the state. The effort that TDOT and its partner agencies have invested in identifying the priority functions, agency information exchanges and interfaces, as well as ITS project and deployment priorities provides a valuable and comprehensive vision for TDOT's statewide ITS program over the next 15 years.

This section outlines strategies for TDOT and other stakeholders for how to use the Statewide ITS Architecture, as well as key steps for maintaining the ITS architecture to reflect current priorities and needed integration of systems and technologies.

7.1 Architecture Use

In order for the Statewide ITS Architecture to serve TDOT and other agencies in Tennessee, it will be important for stakeholders to understand how the architecture can and should be used. There are several important aspects of the Statewide ITS Architecture that support project programming, system deployment and integration, as well as comprehensive planning for both TDOT and other agencies.

- The Statewide ITS Architecture outlines ITS priorities for implementation and integration, which can be aligned with state and local programming processes. With these priorities identified, agencies can look for opportunities to mainstream ITS as part of other capital improvement projects;
- The Architecture identifies near-term and longer-term ITS needs (in the case of the Tennessee Statewide ITS Architecture, a 15-year horizon was identified). It supports short-range planning activities for STIP cycles, as well as longer-term, strategic development plans such as the Long-Range Transportation Plan;
- A sequence of projects is included with the Statewide ITS Architecture that provides a starting point for project priorities, as well as planning-level cost estimates. This provides important input to the TDOT Long-Range Planning Division which evaluates and assesses a range of potential projects before recommending priorities that will go into the five-year plan.
- The ITS architecture identifies operational priorities and responsibilities for existing and future systems. This can help support agency resource planning as well as identify where partnering opportunities should be sought.

The following subsection identify key areas where TDOT as well as local agencies can use the Statewide ITS Architecture to support their planning and implementation needs.

7.1.1 Who Will Use the Statewide ITS Architecture

Tennessee's Statewide ITS Architecture includes functions and services that transcend TDOT's transportation management role. Key needs for public safety and emergency management, demand-response transit operations, traveler information and system maintenance were also addressed. Furthermore, because the Statewide ITS Architecture was developed to encompass rural areas of the state not already documented as part of an established regional ITS architecture, there are provisions for municipal and county ITS projects and systems. In doing so, TDOT is helping local agencies to demonstrate their compliance with Tennessee requirements as well as federal requirements for funding eligibility (see section 7.1.2 below).

Tennessee DOT:

TDOT will likely serve as the lead agency for ITS project implementation and operations on state-owned facilities in Tennessee. This would include corridor ITS projects (such as highway DMS, CCTV, or road weather information systems), expansion of the HELP service patrol, connecting SmartWay Centers across the four TDOT Regions, enhancements to the Tennessee 511 service and others. A majority of the projects identified in the Statewide ITS Architecture show TDOT as the lead agency.

By identifying project these ITS project priorities, TDOT can more effectively program for the short-term STIP (three years) as well as establish mid-term goals (5-10 years). Several projects identified for TDOT in the Statewide ITS Architecture were identified over several implementation phases. This way, TDOT can incrementally deploy and integrate technologies and systems, and plan for that incremental phasing in their programming process.

Counties and Municipalities:

Although a substantial focus of the Statewide ITS Architecture is on TDOT-led and operated systems, there are provisions for county and municipal projects as well. Regional ITS Architectures in Tennessee outline specific functions and integration needs for those respective metropolitan planning areas; however, there are several cities and counties that are not included in these Regional ITS Architectures. Typical ITS projects requiring federal ITS funds that would be led by cities and counties include:

- Traffic signals and traffic signal systems;
- Highway/rail coordination; and
- Regional AMBER Alert networks.

The Statewide ITS Architecture includes market packages, interfaces and requirements that support these projects. Cities and counties that submit these ITS projects to TDOT and that would be required to conform with the Tennessee Procedures for Implementing ITS Regulations (23CFR940) can use the architecture to support project development and implementation. Local agencies submitting ITS project request will be able to:

- Demonstrate compliance with the established Statewide ITS Architecture;
- Identify key requirements that can be further customized for the local context;
- Identify important links to other agencies and what information could (or should) be exchanged; and
- Identify ITS standards that should be incorporated in the design and requirements development process.

Demand-Response Transit Agencies:

The Statewide ITS Architecture was developed to help support demand-response transit agencies in their ITS implementation and integration efforts. Market packages to support Demand-Response Transit Operations, Transit Vehicle Tracking, Transit Security, Transit Traveler Information and Multi-Modal Coordination were included in the Statewide ITS Architecture. In order to be eligible for Federal Transit Administration funding for ITS projects, transit is subject to the same architecture conformity requirements as state and local departments of transportation. By including these transit-focused elements, the Statewide ITS Architecture will help support this compliance requirement.

When submitting ITS projects for federal funding, transit agencies will be able to identify:

- How their project fits within the Statewide ITS Architecture;
- Key requirements that can be further customized for the local context and for transit operator specific needs;
- Applicable ITS Standards;
- Key interfaces and interconnects that will be established; and
- Connectivity to other agencies, including transportation management, public safety, as well as information service providers.

7.1.2 Demonstrating Compliance for Federal ITS Funding

Compliance with FHWA/FTA ITS architecture requirements is a necessity to remain eligible for federal ITS funding, and this applies to TDOT, municipalities, counties, transit agencies, and others that are dependent on federal funds to implement their ITS programs and systems.

TDOT and the FHWA Tennessee Division Office have developed a *Stewardship and Oversight Plan* (Sept. 2006) that outlines the roles and responsibilities for ITS programming, oversight, and reporting compliance with established ITS architectures. In addition, there are procedures and requirements developed by FHWA Tennessee Division to ensure that agencies developing and implementing ITS projects have successfully met architecture conformity requirements and performed a systems engineering analysis for applicable ITS projects. The *Tennessee Procedures for Implementing ITS Regulations 23CFR940* outline the steps that agencies are required to take to demonstrate that their proposed projects satisfy the ITS Regulations. These procedures were developed and are required in Tennessee for federally funded ITS projects in an effort to help agencies:

- Reduce project risks;
- Leverage project funding;
- Identify operations and maintenance requirements early in the project planning process;
- Identify roles and responsibilities for primary agencies and others that will be involved in the project; and
- Begin to establish project requirements.

7.2 Maintaining the Statewide ITS Architecture

Developing a plan for maintaining the ITS architecture is a requirement set forth in the ITS Architecture Final Rule/Final Policy:

> *"The agencies and other stakeholders participating in the development of the [regional] ITS architecture shall develop and implement procedures and responsibilities for maintaining it, as needs evolve within the region."*

This ITS Architecture Maintenance Plan outlines key roles and responsibilities for maintaining Tennessee's Statewide ITS Architecture, as well as outlines the timeline and procedures for initiating review and changes to the architecture. **The TDOT Long-Range Planning Division will have primary responsibility for maintaining the Statewide ITS Architecture.**

Separate from but related to the ITS Architecture are the ITS projects recommended for deployment. It is anticipated that the project tables and deployment priorities will require more frequent review and modifications due to anticipated ITS deployment in the rural areas, particularly in the near term.

The Tennessee Statewide ITS Architecture and ITS deployment recommendations reflect the needs and priorities of stakeholders at the time it was developed. In order for the ITS architecture to remain a valuable ITS planning and project programming tool for TDOT and other agencies, it is important that the both the architecture and deployment plan be periodically reviewed and updated to reflect changes in priorities, policies or needs in Tennessee as they relate to the state's ITS program.

There are several factors or events that influence the need and decision to update an ITS architecture, and as part of Tennessee's ITS Architecture Maintenance Plan, these should be considered:

- **Changes in statewide ITS priorities or objectives:** ITS is becoming very established in the urban areas of Tennessee, and there is significant focus on expanding the program to include major corridors outside of the urban areas, as well as on inter-regional connectivity needs. As Tennessee's ITS program evolves, and as more agencies partner for emergency management, transportation management, traveler information, maintenance and other operations-focused activities, new priorities and relationships will emerge that should be documented as part of the Statewide ITS Architectures.
- **New stakeholders:** As the rural ITS program expands in Tennessee, it is feasible and highly likely that new stakeholders could play a role in future ITS plans and programs. These could include agencies or TDOT divisions that were not part of the original architecture development, or additional representatives from current stakeholders. New stakeholders will require some effort to educate about the architecture and architecture development process, and how their agency or division fits within the context of the statewide ITS architecture.
- **Coordination with regional ITS architectures in Tennessee:** At the time the Statewide ITS Architecture was developed, regional ITS architectures were in place in Nashville, Memphis, Knoxville, Chattanooga, Clarksville and Johnson City metropolitan planning areas. The Jackson regional ITS architecture was underway, and there are additional regional architectures planned. Periodic coordination among the champions of each of these architectures (particularly during the review/update processes) will help maintain consistency in how elements and stakeholders are depicted, as well as to identify where there are gaps or required synergies between the regional and statewide architectures.
- **Updates to the National ITS Architecture:** The National ITS Architecture is periodically updated to reflect new functions or services, and these updates or enhancements should be reviewed to determine their applicability to Tennessee's Statewide ITS Architecture. As an example, version 5.1 of the National Architecture (the version used as a basis for Tennessee's Statewide Architecture) included additional Emergency Management market packages and functions that addressed evacuations, disaster response and recovery, security issues and large-scale alerts. Using the most current version of the National ITS Architecture will ensure that future updates to Tennessee's Statewide Architecture will comply with national-level standards and guidelines.
- **Changes in Federal Policy or Legislation:** If there are any changes or modifications to the Final Rule and Policy from FHWA/FTA, states might need to modify their architectures in order to remain eligible for ITS funding. SAFETEA-LU, Section 5307, continues the architecture conformity requirement set forth in TEA21. While it is unlikely this requirement will be eliminated in future federal legislation, there could be modifications to the requirement that might necessitate a change or revision to Tennessee's Statewide ITS Architecture to remain compliant with current federal architecture requirements and standards.

- **Changes in State Policies or Legislation:** State legislation or changes in state policy could dictate changes in how interfaces or agency relationships are shown in the Statewide ITS Architecture. For example, toll collection was identified as a potential future function for Tennessee. Legislative action that would enable toll functions or capabilities will also likely identify and set forth requirements for the entity that would be responsible for overseeing any toll functions. Within this Statewide ITS Architecture, electronic toll collection is depicted at a very high level – pending legislation that could potentially establish a tolling authority within the state, the entities and interfaces would need to be updated accordingly.
- **ITS Deployment and Integration:** With increased deployment of ITS throughout the state, periodically reviewing project status as it relates to the architecture and the deployment plan will be extremely important in order to keep these documents up to date to reflect current project and program status. Similarly, project priorities may shift over time – due to funding, dependencies on other projects, or other considerations – and these adjustments should be reviewed to assess their impact. While the architecture might require more infrequent updating as a result of ITS project implementation or shift in priorities, the project deployment plan will likely need to be reviewed and/or updated on a more frequent basis to keep pace with actual project implementation.

7.3 ITS Architecture Maintenance Procedures

This section outlines the process and methodologies for keeping Tennessee's Statewide ITS Architecture current and up-to-date.

Scheduled Reviews:

Statewide ITS Architecture

Stakeholders agreed that the Statewide ITS Architecture shall go through a comprehensive review and update within 4 years of completion of the initial Statewide Architecture. This first comprehensive review/update is scheduled for 2010. This review applies to:

- Turbo Architecture Database (dated October, 2006)[1]
- Architecture documentation (dated October, 2006)[2]

This review/update should include TDOT Divisions and partner agencies that participated in the original architecture, as well as any additional stakeholders that might have a vested interest or potential role in services and functions documented within the architecture.

[1]By 2010, the National ITS Architecture (currently version 5.1.1) will likely have been updated with a new release (version 6.0 or later). The most current version of the National ITS Architecture should be used to review/update Tennessee's Statewide ITS Architecture.

[2] Similarly, Turbo Architecture (currently version 3.1) will likely go through one or more significant updates between 2006 and 2010. The most current version of Turbo Architecture should be used to update Tennessee's Statewide ITS Architecture.

Deployment Plan

Stakeholders indicated that the project sequencing and recommendations in the Deployment Plan will require more frequent reviews and updates. It was agreed that the Deployment Plan shall be reviewed for potential updates prior to the State Transportation Improvement Program (STIP). The current STIP is in effect through September 30, 2007.

Change Requests and Interim Reviews:

In order to track incoming requests from TDOT Divisions and Groups, as well as from other stakeholders and agencies, an Architecture Maintenance form will be required to initiate a request for a potential change to the Tennessee Statewide ITS Architecture. An example Architecture Maintenance form is included at the end of this section.

Change Request and Architecture Maintenance documentation should include:

- Date request is submitted;
- Contact information of individual proposing change (name, title, agency, address, e-mail, phone);
- Identify whether change request is for the architecture, deployment plan or both;
- Type of change proposed to architecture (such as element to be added, removed; change in stakeholder; change status from planned to existing, etc.); and
- Type of change requested to deployment plan (such as project name or agency, change in project status, change in project timeframe).

Change requests shall be submitted to TDOT's Long-Range Planning Division:

Attn: Joe Armstrong, PhD
Suite 900, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0344
Phone: 615.253-2435
Fax: 615.532.8451

Interim Reviews

Based on feedback from stakeholders, coordination with FHWA and FTA, ITS deployment in Tennessee, or significant changes within TDOT that could shift priorities within the ITS program, interim reviews and potential updates of the Statewide ITS Architecture and Deployment Plan may be warranted. It will be up to the discretion of TDOT's Long-Range Planning Division, and in consultation with the Design Division and others as to the timing and impact of any interim reviews.

Twice per year, the TDOT Long-Range Planning Division will provide FHWA Tennessee Division with status reports identifying all areas with programmed ITS projects, status of regional ITS architectures, and the date the regions first ITS project advanced to final design (only if a regional ITS architecture is not in place for that region). As part of this semi-annual report and assessment process, the TDOT Long-Range Planning Division will be assessing potential changes that should be reflected in the Statewide ITS Architecture, and can determine if updates or modifications are warranted.

TDOT's Long-Range Planning Division will also review and compile Architecture Maintenance request forms submitted by TDOT divisions, regions, counties, municipalities, transit agencies and others. It will be the responsibility of the Long-Range Planning Division to determine if a change can be made without input from additional stakeholder entities (such as updating a status flow) or if broader input is needed (such as adding a new market package).

Other factors that could necessitate an interim review and potential update include:

- Significant update to the National ITS Architecture prior to 2010;
- Federal or Tennessee legislation or policies that could impact the ITS program;
- New funding opportunities;
- Significant reorganization or shift in the ITS program or program priorities in Tennessee; and/or
- Substantial change in urban area architectures that could impact the Statewide ITS Architecture or priorities.

7.4 ITS Architecture Maintenance Roles and Responsibilities

TDOT's Long-Range Planning Division has been designated as the entity responsible for updating and maintaining the Statewide ITS Architecture. In this role they will:

- Serve as the champion for coordinating the review and update process for both the ITS Architecture and the ITS Project Deployment plan;
- Establish a process for review and procedures for updating and implementing changes;
- Coordinate with FHWA and FTA as it relates to potential federal policy impacts or considerations that might need to be addressed in the Statewide ITS Architecture;
- Maintain a current list of stakeholders and contact information;
- Serve as the central point of contact for stakeholder requests to review or make changes to Tennessee's Statewide ITS Architecture or deployment plan;
- Initiate reviews and updates, including interim reviews (as needed) and comprehensive reviews/updates per the schedule in this section;
- Review ITS project requests from MPOs, cities, counties, transit and other agencies that are seeking federal funding or seeking TDOT as a partner;
- Convene stakeholders (existing and potential new stakeholders) to provide feedback and consensus on major changes to the Statewide ITS Architecture or deployment plan;
- Determine formal schedule for reviews and updates; and
- Serve as the 'gatekeeper' for the most current version of both the architecture documentation and the Turbo Architecture database.

Maintaining and updating Tennessee's Statewide ITS Architecture will require:

- Periodic review of architecture elements and stakeholders;
- Periodic review and assessment of ITS deployment status within Tennessee;
- Reviewing updates to the National ITS Architecture, Turbo Architecture as well as national and Tennessee-specific policies to determine if there are changes warranted to Tennessee's Statewide ITS Architecture;
- Coordinating with stakeholder agencies and other TDOT Divisions to obtain input on new priorities, needed functions, ITS project status or changes in project scopes;
- Tracking and maintaining a list of proposed changes; and
- Modifying the Turbo Architecture database to reflect new stakeholders, functions and other changes. TDOT's Long-Range Planning Division should obtain a copy of Turbo Architecture version 3.1 and any subsequent updates so that the architecture databases can be viewed and modified as needed.

Tennessee Statewide ITS Architecture
Architecture Maintenance Form

Tennessee DOT periodically reviews the Statewide ITS Architecture (current version 10/2006) for potential updates, changes and additions. If you have a request to add an element or modify an existing element in the Statewide ITS Architecture, please complete the following questionnaire and submit to TDOT for review and consideration.

Please use this form to:

- Submit a request for element update or change
- Submit a request for a new element or market package*
- Modify or add a project to the Deployment Plan*

*Any requests to add a new element to the Statewide ITS Architecture or add a new project to the Deployment Plan will be reviewed by a committee for applicability.

Agency	
Agency Contact Person	
Street Address	
City	
State, Zip Code	
Telephone	
Fax	
E-Mail	

1. Requested Changes and Modifications to the Statewide ITS Architecture:

Please indicate the type of change:
____ new market package (please describe or attach sketch if possible)
____ modification to an existing market package (please attach marked up market package)
____ change status or connection of an information flow (please attach marked up market package)
____ other: ____

Please indicate the reason for the change:
____ new stakeholder
____ new project/element(s)
____ status update (was planned but now implemented)

Market Package(s) Impacted	
Describe requested change	
Have you coordinated with any other stakeholders on this change? If so, who?	
Are there any additional stakeholders that could be affected by this change?	

2. Requested Changes and Modifications to the Recommended Projects for Deployment:

____ Change status or timeframe of a project already identified in the Recommended Projects
Please include a description of the requested changes

____ Add a project to the Recommended Projects for Deployment*

Timeframe	
Name of Project	
Description	
Lead Agency	
Has a Systems Engineering Analysis been performed? (if yes, please attach)	
Anticipated Project Costs (if known)	
Market Packages associated with this project	

*Submitting a request for a project on this Architecture Maintenance Form does not guarantee that the project will be included in the Statewide ITS Architecture, nor does it serve as a formal request for funding

Please submit change forms to:

Date Request Filed: ___________

Joe Armstrong, PhD
Tennessee Department of Transportation
Suite 900, James K. Polk Building
505 Deaderick Street
Nashville, Tennessee 37243-0344
Phone: 615.741.5789
Fax: 615.532.8451