Tennessee Statewide ITS Architecture

Executive Summary

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1. INTRODUCTION

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.

In order for Tennessee to remain eligible to use federal funding for ITS projects that it plans to implement in the rural areas, a Statewide ITS Architecture is required. A Final Rule and Policy on ITS Standards and Conformity enacted by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) establishes requirements and a process for what constitutes a compliant architecture.

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

The process to develop the Statewide ITS Architecture as well as the resulting documentation follows the requirements and guidance established by the FHWA for ITS architecture conformity. Tennessee's architecture was developed using the National ITS Architecture (version 5.1) and Turbo Architecture (version 3.1).

Table 1 – Tennessee Statewide ITS Architecture Final Rule Conformity

Final Rule/Policy Requirement	Final Report Document	Turbo Database
Description of the region	Yes	Yes
Identification of agencies and other stakeholders	Yes	Yes
Operational concept that identifies roles and responsibilities of stakeholders	Yes	Yes
Agreements required for operations	Yes	Yes
System functional requirements	Yes (and Appendix)	Yes
Interface requirements and information exchanges with planned and existing systems and subsystems	Yes (and Appendices)	Yes
Identification of ITS standards supporting regional and national interoperability	Yes	Yes
Sequence of projects required for implementation	Yes	No (not applicable to Turbo)
Procedures and responsibility for maintaining the Regional Architecture	Yes	No (not applicable to Turbo)

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.

2. TENNESSEE STATEWIDE ITS INVENTORY, NEEDS, AND STAKEHOLDERS

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:

- Existing regional ITS architectures in Tennessee;
- TDOT 2004 SmartWay ITS Strategic Plan (March, 2005);
- Tennessee CVISN (Commercial Vehicle Information System Network);
- TDOT 2030 Long Range Transportation Plan; and
- Transit ITS Needs Assessment Draft Functional Specifications.

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 2**, along with corresponding 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 2 – 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)

Table 2 – Summary of Statewide ITS Needs (continued)

ITS Need	Market Package
Travel and Traffic Management (continued)	
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
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

Table 2 – Summary of Statewide ITS Needs (continued)

ITS Need	Market Package
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

The Tennessee Statewide ITS Architecture included input from a variety of perspectives, including traffic management, telecommunications, maintenance, public safety/incident management, planning, public transportation, 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.

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 State of 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).

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.

3. MARKET PACKAGES AND SYSTEM INTERCONNECTS

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. They focus on how ITS services will be delivered to the users, but stay relatively technology neutral to allow for a range of implementation options.

The National ITS Architecture (version 5.1) includes 85 market packages. Stakeholders agreed that not all 85 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 represent services that are not envisioned for Tennessee. For the Statewide ITS Architecture, 39 market packages were identified as candidates for implementation. They 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. Market packages were customized for Tennessee-specific agencies and needs. An example is shown below in **Figure 1**.

Table 3 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, to 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.

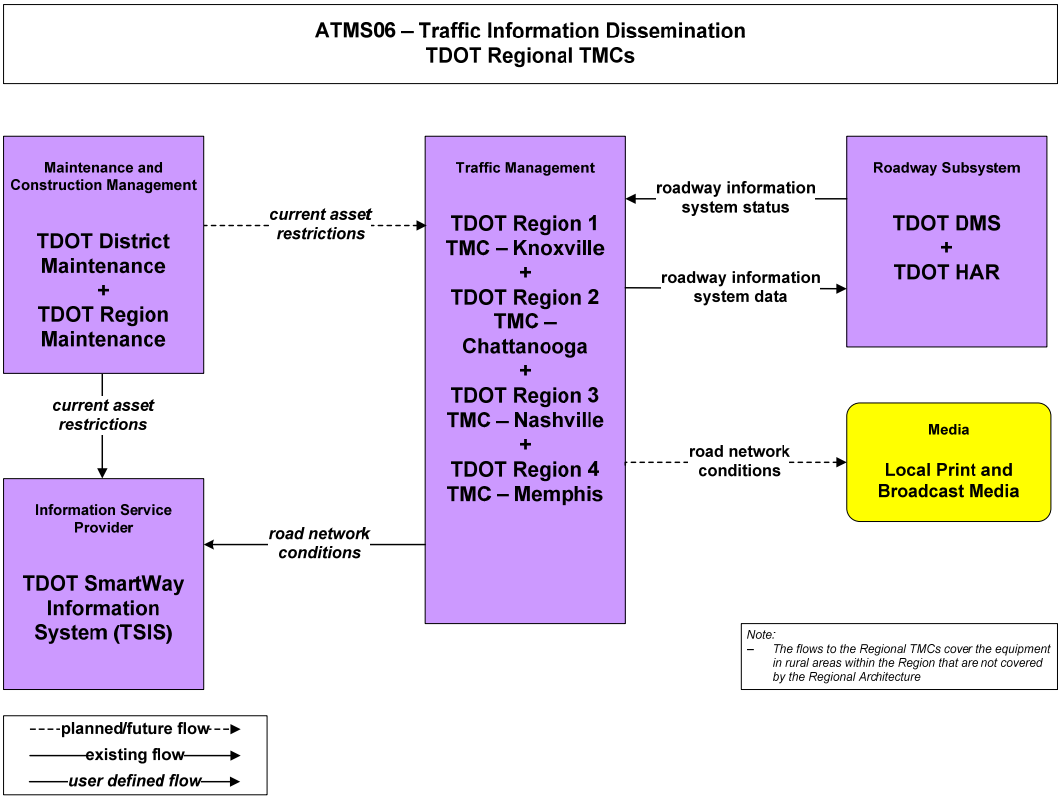

Figure 1 – Example Customized ATMS Market Package

Table 3 – Tennessee Market Package Priorities and Timeframes

High Priority (2006-2010)	Medium Priority (2011-2015)	Low Priority (Beyond 2015)
Network Surveillance	Surface Street Control	Standard Railroad Grade Crossing
Traffic Information Dissemination	Electronic Toll Collection	Railroad Operations Coordination
Regional Traffic Control	Roadway Automated Treatment	ITS Data Warehouse
Traffic Incident Management System	Maintenance and Construction Activity Coordination	
Speed Monitoring	Transit Passenger and Fare Management	
Roadway Closure Management	Transit Traveler Information	
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		

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 customized interconnect diagram was developed for Tennessee based on the statewide elements, inventory, agencies and future interconnectivity requirements. **Figure 2** 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.

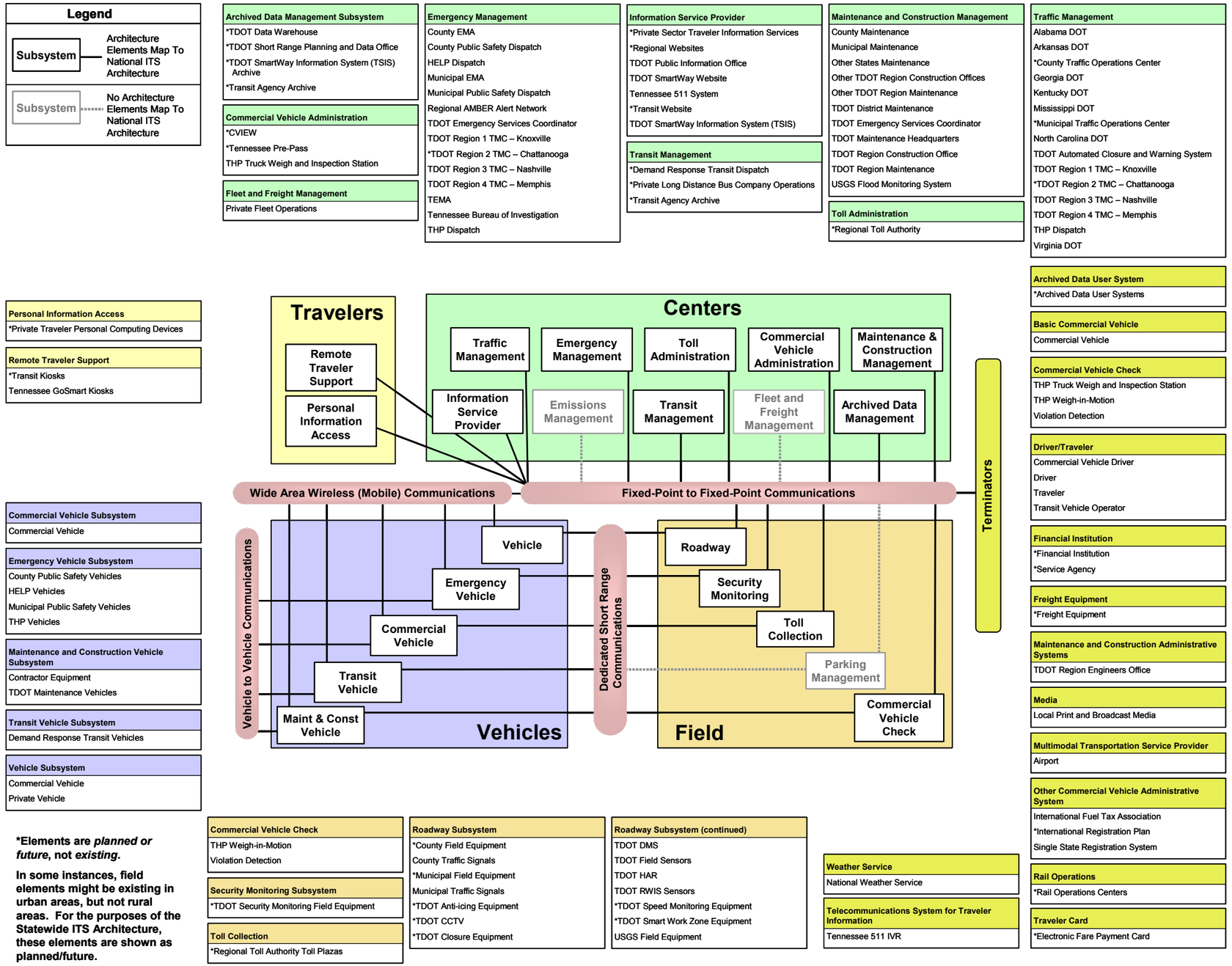

Figure 2 – Tennessee Statewide System Interconnect Diagram

Interfaces were 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.

4. OPERATIONS CONCEPTS AND FUNCTIONAL REQUIREMENTS

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 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:

TDOT Transportation Management Centers

- TMCs support several key functions – operations, coordination, incident management, traveler information
- Expanded role of SmartWay TMCs (functionally and geographically, expanded hours)
- Hub for regional traveler information, incident management support, weather system monitoring, coordination with local jurisdictions
- Center-to-Center connectivity of TDOT SmartWay TMCs

TDOT Wireless Network

- Implement statewide wireless backbone
- Wireless network not represented in market packages, but enables many functions identified in the statewide architecture
- Support TDOT center-to-center and center-to-field communications
- Support public safety communications
- Support additional state agency needs
- Phased approach (first phase underway from Jackson to Memphis)

ITS to Support Incident and Emergency Management Coordination

- Technology and connectivity as an incident management tool
- Improved agency information sharing for incident and emergency management (TEMA, TDOT, Public Safety, Transit, Local Agencies, Neighboring States)
- Real-time system monitoring, communications
- Supplement current processes, 'chain of command'

Public Transportation in Rural Areas

- Public transportation has already developed ITS priorities and requirements, as well as needed technology and integration enhancements
- ITS can improve operations at dispatch centers, communication between centers, and between dispatch centers and transit drivers
- Vehicle location and monitoring to locate demand-response transit vehicles in the field
- Transit traveler information enhancements, including web, kiosk
- Coordination among demand-response transit providers
- Transit is a key responder for emergency/evacuation strategies – links between transit and public safety/emergency management to streamline communication and coordination
- Transit security

Role of TDOT Maintenance

- Maintenance is a 24/7 function to support planned and unplanned maintenance activities
- Maintenance resources for incident management – DOT is often a first responder to major incidents or disasters that impact highways and roadway networks
- Real-time road weather conditions monitoring and future automated road treatment (anti-icing) applications
- Coordination with other agencies, including traffic management, public safety/emergency management
- Maintenance fleet monitoring
- Enhancements to work zones and work zone monitoring to improve safety

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.

5. PROJECT SEQUENCING AND IMPLEMENTATION

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 4 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. This candidate list provides TDOT and other stakeholders with a priority punchlist of potential projects that should be considered for implementation as funding opportunities arise, or as opportunities arise to streamline ITS infrastructure as part of other capital improvements. Several projects 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. The benefit of a multi-year deployment plan is that is can be used to support mainstreaming initiatives by TDOT. 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.

Table 4 – Recommended Projects

Traffic and Travel Management

Project Name	Responsible Agency	Project Costs
Short-Term (2006-2010)		
24/7 TMC Operations	TDOT	TBD
Region 1 Rural ITS Deployment	TDOT	$2,000,000
Region 2 Rural ITS Deployment	TDOT	$2,000,000
Region 3 Rural ITS Deployment	TDOT	$2,000,000
Region 4 Rural ITS Deployment	TDOT	$2,000,000
TDOT Speed Monitoring Equipment	TDOT	$7,500/per
Rural Fog Detection Systems	TDOT	$5,000,000
TDOT Statewide Communications Plan	TDOT	$100,000
TDOT Statewide Wireless Network Phase 1	TDOT	TBD
TDOT Statewide Wireless Network Phase 2	TDOT	TBD
TDOT TMC to Local TOC Connections Phase 1	TDOT, Cities, Counties	TBD (will vary)
TSIS Enhancements	TDOT	$50,000
SmartWay Expansion and Integration	TDOT	TBD
HRI Crossing Warning System	Cities, Counties, and TDOT	$200,000
Mid-Term (2011-2015)		
TDOT TMC Center-to-Center Communications	TDOT	TBD
TDOT TMC to Local TOC Connections Phase 2	TDOT, Cities, Counties	TBD
Electronic Toll Collection	TDOT	TBD
TDOT Statewide Wireless Network Phase 3	TDOT	TBD
TSIS Enhancements Phase 2	TDOT	$100,000
SmartWay Expansion and Integration	TDOT	TBD
Long-Term (Beyond 2015)		
TDOT TMC to Local TOC Connections Phase 3	TDOT, Cities, Counties	TBD
TSIS Enhancements Phase 3	TDOT	$100,000
SmartWay Expansion and Integration	TDOT	TBD

Table 4 – Recommended Projects (continued)

Emergency Management and Incident Coordination

Project Name	Responsible Agency	Project Costs
Short-Term (2006-2010)		
TMC Connection to TBI for AMBER Alerts	TDOT, TBI	TBD
TMC Connection to County Public Safety Dispatch (911)	TDOT, County 911 Dispatch Centers	TBD
TDOT ITS Incident/Emergency Management Plan	TDOT	$250,000
TDOT HELP Program Expansion Phase 1	TDOT	$5,000,000 ($1M/year above current operations costs)
TDOT HELP Program 24/7 Operations	TDOT	$2,000,000
TDOT HELP Program AVL and MDTs	TDOT	$5,000/vehicle (leveraged to assume mapping software and on-board equipment cost)
Mid-Term (2011-2015)		
TDOT Maintenance Connections to Emergency Management Agencies	TDOT, THP, TEMA, County EOCs, County and Municipal Public Safety Dispatch	$2,000,000
TDOT HELP Program Expansion Phase 2	TDOT	$5,000,000 ($1M/year above current operations costs)
Long-Term (Beyond 2015)		
TDOT HELP Program Expansion Phase 3	TDOT	$5,000,000 ($1M/year above current operations costs)

Table 4 – Recommended Projects (continued)

Maintenance and Construction Management

Project Name	Responsible Agency	Project Costs
Short-Term (2006-2010)		
RWIS Expansion Phase 1	TDOT	$25,000/each
Overheight Vehicle Detection System	TDOT	$100,000/location
TDOT Connection to Weather Information Service(s)	TDOT	TBD
Work Zone Monitoring and Safety Systems (SmartFix)	TDOT	$500,000
Mid-Term (2011-2015)		
TDOT Maintenance Vehicle AVL	TDOT	$5,000/vehicle (assuming mapping software/application)
RWIS Expansion Phase 2	TDOT	$25,000/each
TDOT Maintenance Connection to USGS	TDOT, USGS	TBD
TDOT Anti-Icing System	TDOT	$300,000/location

Public Transportation Management

Project Name	Responsible Agency	Project Costs
Short-Term (2006-2010)		
Transit Vehicle AVL and CAD Enhancements for Demand-Response Transit Operations	Demand Response Transit Operators	$5,000/vehicle (assuming mapping software/ application) $200,000/center
Automated Fare Payment Systems for Transit	Transit Operators	$2500/vehicle
Transit Link to TN 511	TDOT, Transit Operators	TBD
Transit Travel Information Web Page	Transit Operators	$50,000/each
Transit Kiosks	Transit Operators	$25,000/each
Demand-Response Transit Security System	Demand Response Transit Operators	$5,000/vehicle
Mid-Term (2011-2015)		
Transit Coordination and Communications Network	Transit Operators	TBD

Table 4 – Recommended Projects (continued)

Traveler Information

Project Name	Responsible Agency	Project Costs
Short-Term (2006-2010)		
TN511 Enhancements Phase 1	TDOT	$100,000
TN Web Page Enhancements	TDOT	$100,000
GoSmart Kiosks	TDOT	$25,000/each
Mid-Term (2011-2015)		
TN511 Enhancements Phase 2	TDOT	$100,000
TN Web Page Continued Enhancements	TDOT	$100,000

Commercial Vehicle Operations

Project Name	Responsible Agency	Project Costs
Short-Term (2006-2010)		
Commercial Vehicle Electronic Clearance	TDOT, THP	TBD
Commercial Vehicle Traveler Information Program	TDOT	TBD
Weigh in Motion	TDOT, THP	$8,000,000/station
Mid-Term (2011-2015)		
HAZMAT Tracking and Coordination System	TDOT, THP	$500,000
Permit Notification Coordination System for Oversize Vehicles	TDOT, THP	$250,000

Archived Data/Information Management

Project Name	Responsible Agency	Project Costs
Short-Term (2006-2010)		
ITS Archive Database for Traffic Management	TDOT	$1,000,000
Transit Data Archive	TDOT, Transit Operators	$750,000
TSIS Archive	TDOT	$500,000
Mid-Term (2011-2015)		
ITS Data Warehouse	TDOT	$1,500,000

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.

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.

Based on the functions and interfaces identified for the Statewide ITS Architecture, the following 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.

- **Data Sharing Agreements (Public Sector)** – Formal agreement to govern data sharing among public agencies.
- **Video Access and Monitoring Agreements** – Agreements to govern use and access to TDOT CCTV video feeds and images—this does NOT include shared control.
- **Infrastructure Shared Control/Joint Operations Agreements** – There are likely to be limited instances where shared control of field infrastructure will be an issue. 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, and procedures for coordinating device operations and/or maintenance between agencies.
- **Mutual Call Transfer Agreements** – Planned mutual call transfer agreements with North Carolina, Virginia and Kentucky to allow 511 callers to access the 511 services in other states. As more of Tennessee's neighboring states implement 511, additional agreements will be developed with those states.
- **Call Transfer Agreements** – Future enhancements to Tennessee's 511 service will likely include call transfer capability to other Tennessee agencies, particularly transit (in the urban and rural areas) and tourism. 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.
- **Additional Mutual Aid Agreements** – 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).

ITS Standards to Support Operations and Interoperability:

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.

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 5**.

Table 5 – Applicable ITS Standards

SDO	Title	Document ID	Type
AASHTO/ITE/NEMA	NTCIP Center-to-Center Standards Group	Various	Group
	NTCIP Center-to-Field Standards Group	Various	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
	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

Table 5 – Applicable ITS Standards (continued)

SDO	Title	Document ID	Type
ASTM	Dedicated Short Range Communication at 915 MHz Standards Group	Various	Group
	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	Incident Management Standards Group	Various	Group
	Standard for Message Sets for Vehicle/Roadside Communications	IEEE Std 1 455-1999	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
SAE	Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group	Various	Group
SAE/IEEE	Dedicated Short Range Communication at 5.9 GHz Standards Group	Various	Group

6. USING AND MAINTAINING THE STATEWIDE ITS ARCHITECTURE

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.

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;
- 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;
- 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 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, 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;
- New stakeholders;
- Coordination with regional ITS architectures in Tennessee;
- Updates to the National ITS Architecture;
- Changes in Federal Policy or Legislation;
- Changes in State Policies or Legislation; and
- ITS Deployment and Integration.

TDOT's Long-Range Planning Division has been designated as the entity responsible for updating and maintaining the Statewide ITS Architecture. In this role, this group 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;
- 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 has a copy of Turbo Architecture version 3.1 and any subsequent updates so that the architecture databases can be viewed and modified as needed.

In order to track incoming requests from TDOT Divisions and Groups, as well as from other stakeholders and agencies, an Architecture Maintenance form submitted to the Long-Range Planning

Division will be required to initiate a request for a potential change to the Tennessee Statewide ITS Architecture.

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).