Knoxville

Regional ITS Architecture

Regional ITS Deployment Plan

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December 2012
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REGIONAL ITS DEPLOYMENT PLAN

AD	Archived Data
APTS	Advanced Public Transportation System
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
CCTV	Closed Circuit Television
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Sign
EM	Emergency Management
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ITS	Intelligent Transportation System
MC	Maintenance and Construction
TDOT	Tennessee Department of Transportation
TMC	Traffic Management Center
TOC	Traffic Operations Center
TPO	Transportation Planning Organization

1. INTRODUCTION

1.1 Project Overview

In 2012 the Knoxville Regional Intelligent Transportation System (ITS) Architecture was updated under the direction of the Knoxville Regional Transportation Planning Organization (TPO) in coordination with the Tennessee Department of Transportation (TDOT). The Regional ITS Architecture provides a framework for implementing ITS projects, encourages interoperability and resource sharing among agencies, identifies applicable standards to apply to projects, and allows for cohesive long-range planning among regional stakeholders. The Knoxville Regional ITS Architecture focuses on the functionality that ITS provides in the Region as well as how those functions are operated by agencies in and around the Region. The Regional ITS Architecture also satisfies an important requirement from the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA) regarding transportation funding. An FHWA Final Rule and an FTA Final Policy issued in 2001 requires that regions have an updated regional ITS architecture and show how ITS projects conform to that regional ITS architecture in order to receive federal funding for those projects.

The 2012 Knoxville Regional ITS Deployment Plan was developed as a companion document to the Knoxville Regional ITS Architecture. Although it is not required by FHWA and FTA, the Regional ITS Deployment Plan is a useful tool for regions to identify specific projects that should be deployed in order to achieve the desired functionality identified in their Regional ITS Architecture. The Regional ITS Deployment Plan builds on the Regional ITS Architecture by outlining specific ITS project recommendations for the Region and identifying deployment timeframes so that the recommended projects and strategies can be implemented over time.

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

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

The Knoxville Regional ITS Architecture geographic boundaries are comprised of the Knoxville Regional TPO planning area, which included all of Knox County and a portion of Anderson, Blount, Loudon, and Sevier Counties at the time the Knoxville Regional ITS Architecture was developed. In addition, the geographic boundaries also included the remaining portions of Anderson, Blount, Loudon, and Sevier Counties. The Knoxville Regional ITS Architecture geographic boundaries for the Knoxville Region are shown in **Figure 1**.

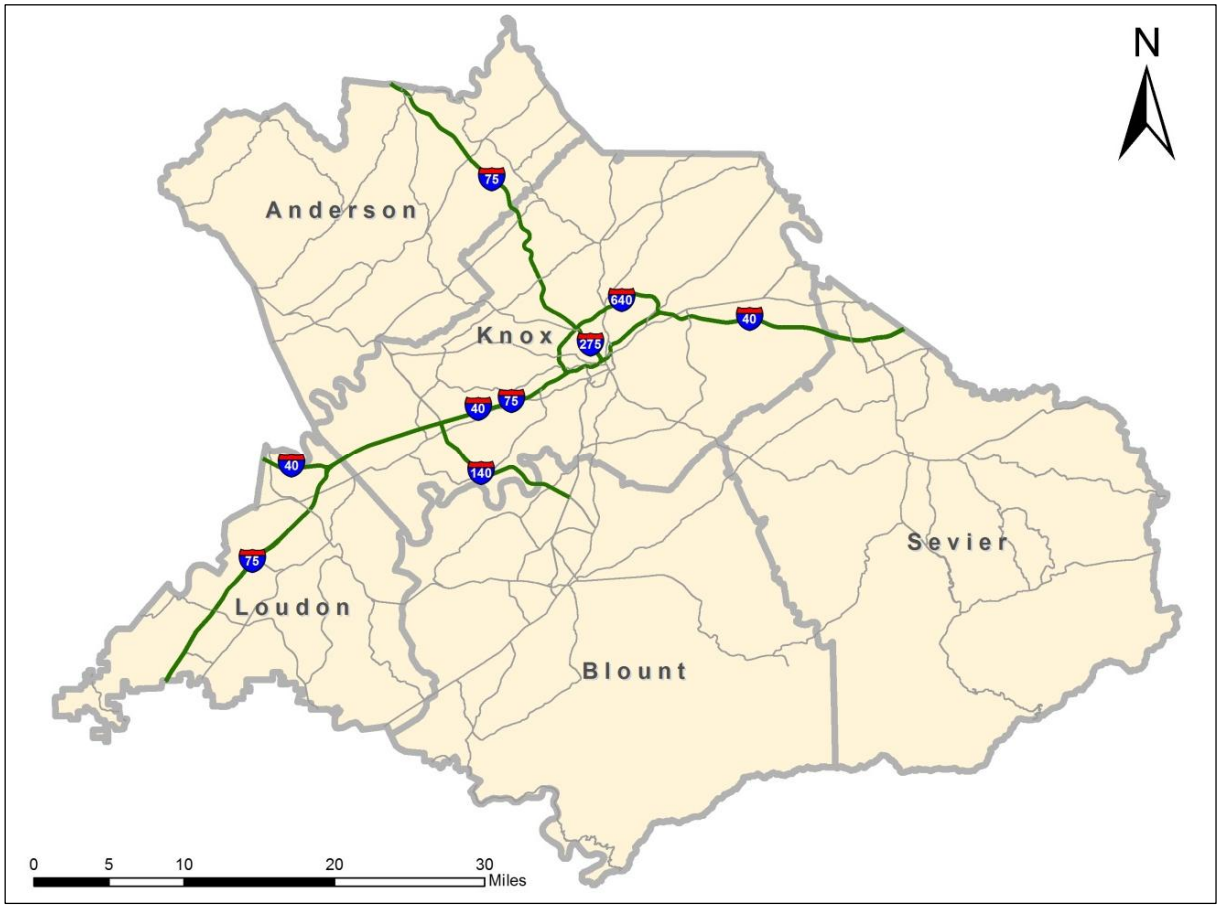

Figure 1 – Knoxville Regional TPO Planning Area

Stakeholders that participated in the update of the Regional ITS Architecture and Deployment Plan process included representatives from city, county, regional, state, and federal agencies. Groups such as traffic, transit, and emergency management were represented. Stakeholders included representatives located within the Region as well as representatives from Nashville including the TDOT Division of Multimodal Transportation Resources, TDOT Long Range Planning Division, TDOT Office of Incident Management, and the FHWA Tennessee Division Offices. A list of the participating stakeholder agencies is provided below. A complete list of individuals representing the agencies has been provided in the Knoxville Regional ITS Architecture document.

- Blount County Emergency Management/Homeland Security
- Cambridge Systematics, Inc.
- City of Alcoa Public Works and Engineering Department
- City of Knoxville Engineering Department
- City of Knoxville Fire Department
- City of Knoxville Police Department
- City of Knoxville Public Works
- City of Maryville Public Works and Engineering

- City of Oak Ridge Public Works
- City of Sevierville Public Works
- East Tennessee Human Resource Agency
- Federal Highway Administration
- Knox County Engineer and Public Works
- Knoxville Area Transit
- Knoxville-Knox County Emergency Management Agency
- Knoxville-Knox County Community Action Committee Transit
- Knoxville Regional Transportation Planning Organization
- Lakeway Area Metropolitan Transportation Planning Organization
- Oak Ridge National Laboratory Center for Transportation Analysis
- Rural Metro Fire Department
- TDOT Division of Multimodal Transportation Resources
- TDOT Long Range Planning Division
- TDOT Office of Incident Management
- TDOT Region 1
- Town of Farragut Engineering
- University of Tennessee
- CDM Smith Associates

1.2 Deployment Plan Project Development Process

An overview of the process used to develop the Regional ITS Deployment Plan is provided in **Figure 2**. This figure demonstrates that a variety of inputs were used to gather information and develop a set of ITS projects for selection by stakeholders. Through an ITS Deployment Plan Workshop with regional stakeholders in February 2012, a review of project prioritization at a Final ITS Architecture Workshop in April 2012, and subsequent review of the projects by the stakeholders, the projects for inclusion in the ITS Deployment Plan were selected and defined. The resulting Knoxville Regional ITS Deployment Plan will provide stakeholders with a list of regionally significant ITS projects that are consistent with the Regional ITS Architecture and assist with addressing transportation needs in the Region.

The inputs identified in Step 1 of **Figure 2** include regional ITS needs, ITS service package priorities, regional and local plans, and stakeholder recommendations. Each of these is expanded on in Section 2 of this report. The ITS needs were gathered through the Regional ITS Architecture Kickoff Workshop which was held in October 2011 with all stakeholders. In the second Regional ITS Architecture Workshop, which was held in November and December 2011, stakeholders discussed and selected ITS service packages for the Knoxville Region. ITS service packages represent the services that ITS can provide, such as Network Surveillance and Traffic Information Dissemination. In the Regional ITS Architecture, the Knoxville Region stakeholders identified 45 service packages for consideration in the Region and later ranked those service packages as high, medium, or low priority. Planning documents, such as the earlier version of the Knoxville Regional ITS Architecture (2003) and the Great Smoky Mountains ITS Architecture (2007), were reviewed by the project team to identify other needs and priorities not specifically discussed in the workshops. Finally, stakeholders were asked directly for their project ideas to include in the Regional ITS Deployment Plan Workshop.

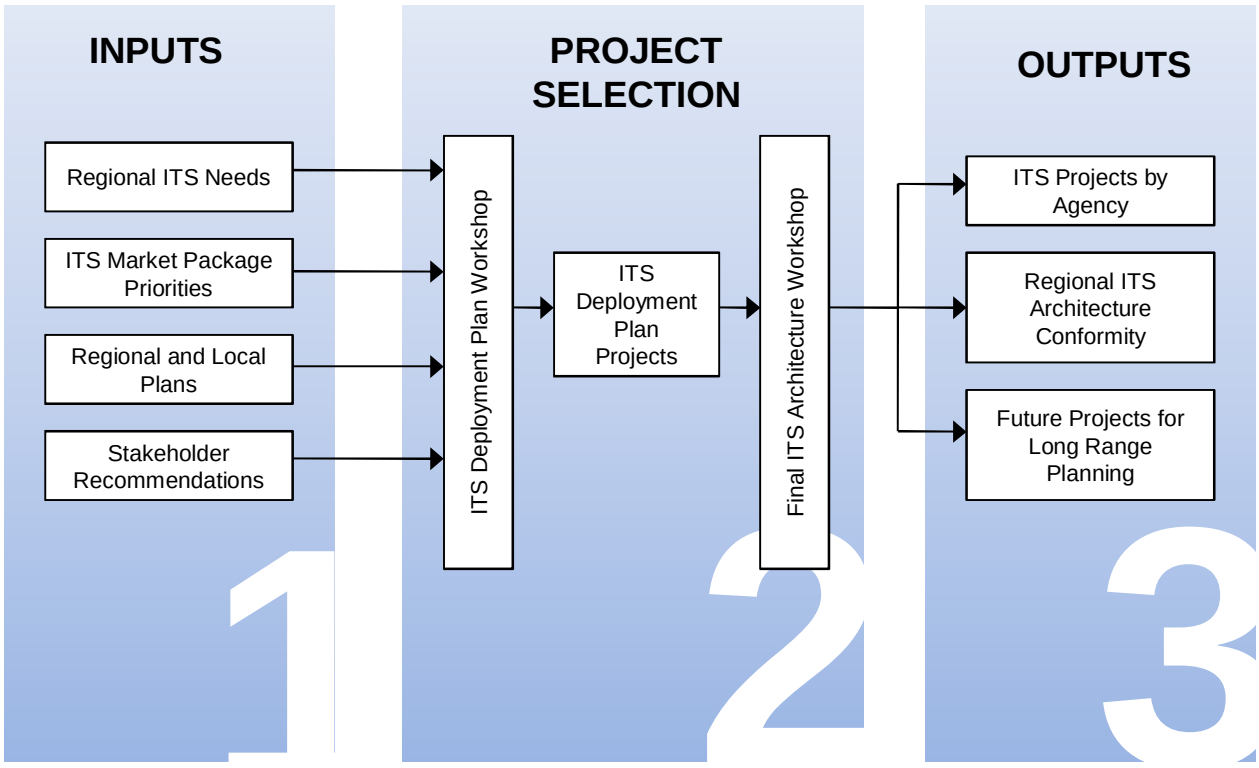

Figure 2 – Knoxville Regional ITS Deployment Plan Development Process

The inputs in Step 1 led to the project selection in Step 2. Project selection was completed through a combination of the ITS Deployment Plan Workshop held with stakeholders in February 2012, a review of project prioritization at the Final ITS Architecture Workshop in April 2012, and stakeholder review of the Draft and Draft Final Regional ITS Deployment Plan versions. Through this multi-step process the final projects were selected and further defined for the plan.

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

1.3 Document Overview

The Knoxville Regional ITS Deployment Plan is organized into four sections:

Section 1 – Introduction

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

Section 2 – ITS Project Identification and Selection

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

Section 3 – ITS Project Recommendations

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

Section 4 – System Engineering Analysis

This section contains an overview of the systems engineering analysis process and how the Regional ITS Architecture and Deployment Plan fits into the process. Maintenance of the ITS Deployment Plan is also discussed.

2. ITS PROJECT IDENTIFICATION AND SELECTION

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

2.1 Project Development Inputs

Section 2.1.1 through 2.1.4 provides an overview of the four primary types of project inputs gathered to develop the Knoxville Regional ITS Deployment Plan. While each input was important, the primary driver of the Regional ITS Deployment Plan was the direct input from the stakeholder agencies. Each of the recommended ITS projects in the Regional ITS Deployment Plan was discussed with the stakeholders at the February 2012 ITS Deployment Plan Workshop and the projects presented in this plan are intended to directly reflect the decisions made by the stakeholders.

2.1.1 Regional ITS Needs

Regional needs were documented throughout the Regional ITS Architecture and Deployment Plan development process. Needs ranged from those that were very general, such as the need for interagency coordination, to very specific needs such as the need in the City of Oak Ridge to address peak traffic demands created by the Department of Energy facilities. Many of the needs identified are addressed in the Knoxville Regional ITS Deployment Plan directly through recommended ITS projects.

Some of the primary regional ITS needs that were identified for the Knoxville Region are included below. These represent many of the needs that were first identified at the ITS Architecture Kick-off Workshop held in October 2011 and continued to be discussed throughout the project.

- Need to expand TDOT Region 1 SmartWay geographic coverage, including freeway management system infrastructure and deployment of HELP service patrol vehicles.
- Need to improve coordination between the TDOT Region 1 SmartWay system and public safety computer aided dispatch systems in the in the Region.
- Need to include transit information on the TDOT SmartWay 511 Traveler Information System.
- Need to add municipal and county traffic operation centers (TOCs) for traffic signal system monitoring.
- Need to upgrade traffic signal systems to improve signal coordination and the ability of TOCs to communicate with signal systems.
- Need to add closed circuit television (CCTV) camera monitoring capabilities in municipalities.
- Need limited number of DMS on arterial streets.
- Need to be able to monitor speeds along corridors.
- Need to improve coordination between municipal TOCs and public safety dispatchers to share information on the transportation network.
- Need to add traffic signal preemption capabilities for emergency vehicles.

- Need to provide real-time schedule information to transit users.
- Need to provide transit signal priority on key transit routes in urban areas.
- Need to archive transportation data in the Region.

2.1.2 ITS Service Package Prioritization

Of the 97 ITS service packages available in Version 7.0 of the National ITS Architecture, 44 were selected by stakeholders and customized for deployment in the Knoxville Region as part of the Regional ITS Architecture update process. The service packages outline the services that ITS can provide in the Region and include the agencies that will be involved, elements that need to be deployed, and the interfaces that need to be established to integrate functionality and share data. The selected service packages were prioritized as high, medium, or low by stakeholders at the ITS Deployment Plan Workshop held in February 2012 and the Final ITS Architecture Workshop held in April 2012.

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

Table 1 – Knoxville Region ITS Service Package Prioritization by Functional Area

High Priority Service Packages	Medium Priority Service Packages	Low Priority Service Packages
Traffic Management		
ATMS01 Network Surveillance ATMS03 Surface Street Control ATMS06 Traffic Information Dissemination ATMS07 Regional Traffic Management ATMS08 Traffic Incident Management System	ATMS04 Freeway Control ATMS13 Standard Railroad Grade Crossing ATMS16 Parking Facility Management ATMS17 Regional Parking Management	ATMS19 Speed Monitoring ATMS21 Roadway Closure Management ATMS22 Variable Speed Limits ATMS24 Dynamic Roadway Warning
Emergency Management		
EM01 Emergency Call-Taking and Dispatch EM02 Emergency Routing EM04 Roadway Service Patrols EM06 Wide-Area Alert	EM08 Disaster Response and Recovery EM09 Evacuation and Reentry Management EM10 Disaster Traveler Information	
Maintenance and Construction Management		
MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution MC10 Maintenance and Construction Activity Coordination	MC01 Maintenance and Construction Vehicle and Equipment Tracking MC08 Work Zone Management MC09 Work Zone Safety Monitoring	MC12 Infrastructure Monitoring
Public Transportation Management		
APTS01 Transit Vehicle Tracking APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations APTS07 Multi-Modal Coordination APTS08 Transit Traveler Information APTS10 Transit Passenger Counting	APTS04 Transit Fare Collection Management APTS05 Transit Security APTS06 Transit Fleet Management APTS09 Transit Signal Priority	
Traveler Information		
ATIS01 Broadcast Traveler Information ATIS02 Interactive Traveler Information ATIS08 Dynamic Ridesharing		
Commercial Vehicle Operations		
	CVO06 Weigh-in-Motion	
Archived Data Management		
AD1 ITS Data Mart	AD2 ITS Data Warehouse AD3 ITS Virtual Data Warehouse	

2.1.3 Existing Infrastructure and Planning Efforts

The Knoxville Region has undertaken several deployments of ITS programs throughout the Region. These programs were identified in the Knoxville Regional ITS Architecture and are also presented here in the Regional ITS Deployment Plan because of their relevance to the recommended ITS projects. The following are some of the larger ITS initiatives underway or existing within the Knoxville Region:

- **TDOT SmartWay ITS Program** – The TDOT SmartWay ITS Program has been operational since 2005 and provides coverage to approximately 45 miles of freeway. A majority of the urban freeway system in Knoxville is covered by SmartWay ITS. It includes a traffic management center (TMC) that operates 24-hours per day seven days a week, freeway detection systems, CCTV cameras, dynamic messages signs, and highway advisory radios connected by a Gigabit Ethernet fiber optic communication network. TDOT does not currently include ramp metering or integration with adjacent local signal systems along parallel arterial networks but it has been considered and could possibly be added at some point in the future. The SmartWay TMC staff work closely with the TDOT HELP Service Patrol operators as well as public safety officials to manage incidents, special events, severe weather events, and construction closures. Information about traffic conditions, including travel times, is included on the dynamic message signs and highway advisory radio at the roadside as well as through the SmartWay website and 511 traveler information system to alert motorists as early as possible. A map of the SmartWay system is included in **Figure 3**.
- **TDOT HELP Service Patrol** – The TDOT HELP Service Patrol Program has been in operation in the Knoxville Region since the year 2000. The HELP Service Patrol Program trucks patrol freeways including I-40, I-75, I-640, I-275 I-140, and US 129 (SR 115) to assist motorist with minor repairs such as flat tire changes, fuel, and push services to move disabled vehicles out of the through lanes. HELP operators also assist with traffic control and detours during major incidents. The service operates from 5:00 AM through 11:00 PM Monday through Friday, and on weekends from 7:00 AM until 9:00 PM.
- **511 Traveler Information Number** – TDOT currently operates a statewide traveler information number that provides real-time traveler information throughout the state. Information is put into 511 through the TDOT SmartWay Information System (TSIS), which is updated by the TDOT SmartWay TMC operators and the Tennessee Highway Patrol (THP) dispatchers. 511 information can also be accessed through a 511 website and several social media sites such as Twitter and Facebook.
- **TDOT Center-to-Center Communication** – The TDOT SmartWay communication backbone has facilitated center-to-center (C2C) communication links between the TDOT TMC, the THP District 1 Headquarters, and the Knox County E-911 Emergency Management Center.
- **Knoxville Area Incident Management Task Force** – The Knoxville TPO and TDOT are leading an Incident Management Task Force that focuses on issues related to the management of crashes on freeways. The Task Force is made up of representatives from police and fire departments, emergency medical services, state and local transportation departments, towing and recovery companies, environmental agencies, and hazardous spill and containment companies. The Incident Management Task Force provides a forum for these agencies to review responses to incidents and promote better communication and cooperation. The group is meeting at regular intervals to discuss how incident management can be improved in the region, ensure continued coordination between agencies involved in incident management, and review responses to major incidents.

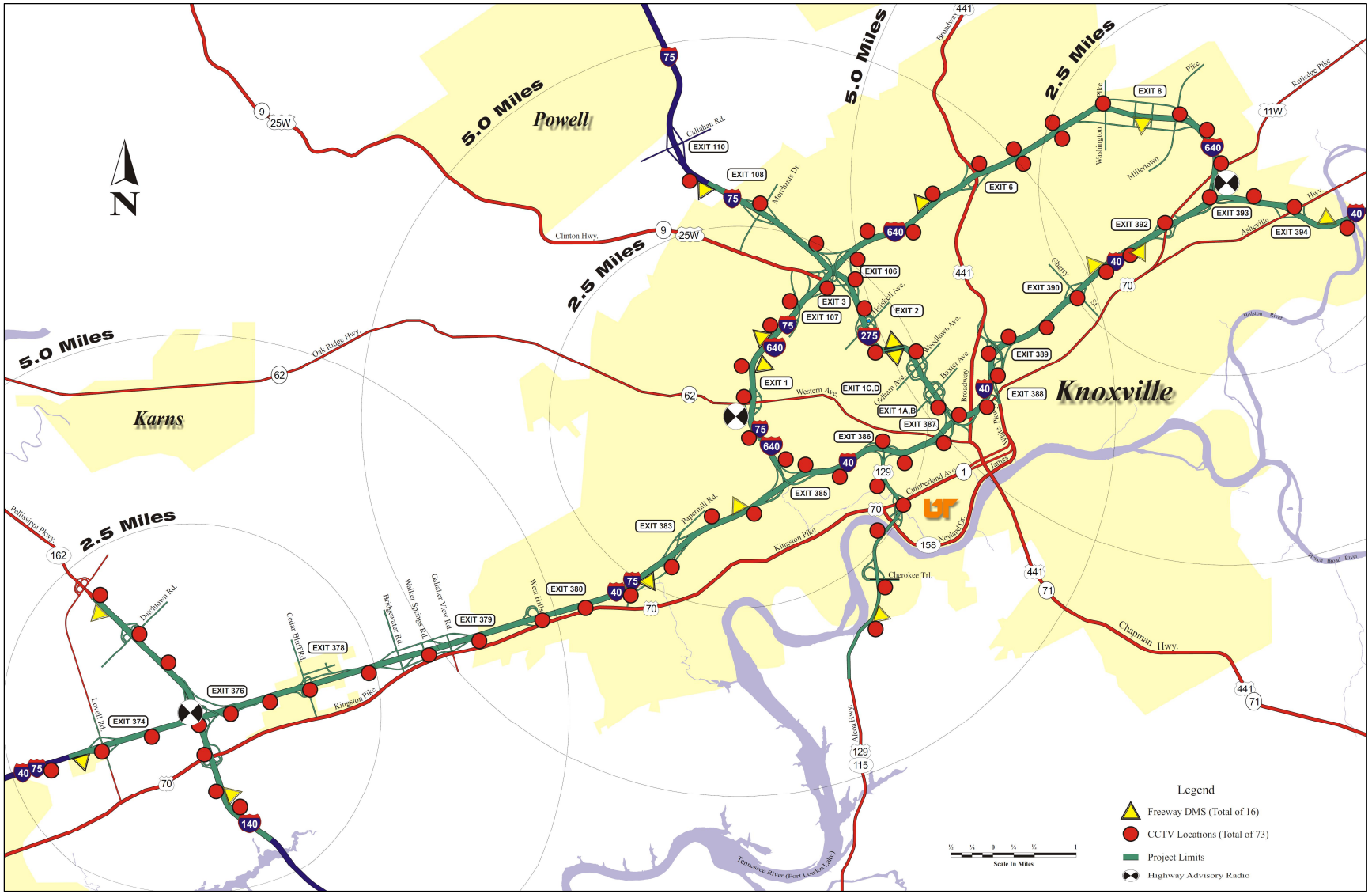

Figure 3 – TDOT Region 1 SmartWay ITS System

- **Local TMCs and ATMS** – Several cities and counties in the Knoxville Region have implemented or are in the process of implementing TMCs and advanced traffic management systems for their arterial traffic signal systems. These include the City of Knoxville, City of Oak Ridge, combined systems for the Cities of Maryville-Alcoa, and Knox County. These TMCs are generally single workstations that allow some level of signal monitoring and control, however in some cases such as the City of Knoxville the TMC may be upgraded to include additional features in the future. Many of the other cities and counties have implemented programs to coordinate traffic signal systems to improve efficiency of arterial operations.
- **Knoxville Area Transit** – KAT has extensively implemented ITS on their buses to improve operations and safety. KAT's deployments include automated vehicle location (AVL), mobile data terminals (MDTs), electronic fare collection, on-board video surveillance and on-board alarm systems.

2.1.4 Stakeholder Input

The primary source of stakeholder input came from discussions at the four stakeholder workshops conducted in Knoxville as part of the update of the Knoxville Regional ITS Architecture and Deployment Plan. In particular, the ITS Deployment Plan Workshop held in February 2012 focused almost entirely on identifying and discussing ITS projects that could be deployed in the Region to assist in implementing the services identified through the ITS service packages. At this workshop stakeholders identified specific projects and timeframes for deployment by their agencies. The ITS Deployment Plan is not fiscally constrained so even though many of the ITS projects identified do not have any funding associated with them, they do represent projects that are important in the Region.

In addition to the ITS Deployment Plan Workshop, stakeholders were also provided with a form for providing input to the project team on any ITS projects that were planned or desired by their agency, and a stakeholder workshop held in April 2012 focused a portion of the workshop on discussion of ITS project timeframes for deployment.

2.2 Project Types for Consideration

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

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

In Section 2.2.1 through 2.2.5, some of the common project types that were discussed with stakeholder are presented. The ITS service packages that correspond to each project type have also been provided.

2.2.1 Traffic Management and Traveler Information Project Types

TDOT SmartWay ITS Geographic Expansion

Projects to extend the TDOT SmartWay ITS coverage area or add functionality include a combination of ITS deployments. These projects typically include the deployment of CCTV cameras, DMS, vehicle detection systems, and the communications to support the expansion.

Associated Service Packages: ATMS01–Network Surveillance, ATMS06–Traffic Information Dissemination, ATMS08 – Traffic Incident Management System

Traffic Management Center or Traffic Operations Center

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

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

Interagency Traffic Information Coordination

Through either a direct communication link or web-based information exchange portal, interagency information coordination projects support regional traffic management. Information shared can include video feeds, traffic conditions, incident locations, and transit vehicle locations. Examples of data exchanges include exchanges between municipalities and states, such as a TDOT Region 1 SmartWay TMC and municipal TOC connection; between municipalities and transit agencies, such as a connection between the City of Knoxville and Knoxville Area Transit (KAT); and between multiple transit agencies such as coordination of rides between KAT and Knoxville-Knox County Community Action Committee.

Associated Service Packages: ATMS07–Regional Traffic Management, ATMS08–Traffic Incident Management System, APTS07-Multimodal Coordination

Traffic Signal System Upgrades and Coordination

Traffic signal system upgrades can include the communication system, field hardware, traffic signal control software, and infrastructure improvement to allow real-time monitoring and control the traffic signal systems as well as traffic signal coordination. At the municipal level, signal control software is typically chosen as part of the signal system selection process and modules are added to that software as needed to support other ITS deployments.

Associated Service Packages: ATMS03–Surface Street Control

Closed Circuit Television Camera Deployment

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

Associated Service Packages: ATMS01–Network Surveillance

Dynamic Message Sign Deployment

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

Associated Service Packages: ATMS06–Traffic Information Dissemination

Railroad Grade Crossing Advance Notification System

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

Associated Service Packages: ATMS13–Standard Railroad Control

2.2.2 Emergency Management Project Types

Interagency Incident Management Information Coordination

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

Associated Service Packages: ATMS08–Traffic Incident Management System

Emergency Vehicle Traffic Signal Preemption

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

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

Speed Monitoring

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

Associated Service Packages: ATMS19–Speed Monitoring

2.2.3 Maintenance and Construction Management Project Types

Road Weather Information System

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

Associated Service Packages: MC03–Road Weather Data Collection

2.2.4 Transit Management Project Types

Interagency Information Coordination for Transit Operations

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

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

Transit Vehicle Tracking

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

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

Transit On-board Security Cameras

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

Associated Service Packages: APTS05–Transit Security

Transit Alarm System

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

Associated Service Packages: APTS05–Transit Security

Automated Passenger Counters

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

Associated Service Packages: APTS10–Transit Passenger Counting

Real-Time Next-Bus Arrival Information

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

Associated Service Packages: APTS08–Transit Traveler Information

Real-Time Transit Traveler Information Website

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

Associated Service Packages: APTS08–Transit Traveler Information

Transit Signal Priority

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

Associated Service Packages: APTS09–Transit Signal Priority

2.2.5 Archived Data Management Project Types

Data Archive

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

Associated Service Packages: AD1–ITS Data Mart

Data Warehouse

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

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

2.3 Project Selection

As mentioned previously in Section 2.1.4, the majority of project selection took place at the ITS Deployment Plan Workshop held with stakeholders in February 2012. The regional needs provided the foundation for the first draft of project recommendations and the ITS Deployment Plan discussions gave stakeholders an opportunity to build on each other's ideas and identify opportunities to incorporate interagency coordination into the projects. With the potential project types described in Section 2.2 as a springboard, the group modified and added projects to develop the lists presented in Section 3.

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

3. ITS PROJECT RECOMMENDATIONS

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

Input from all stakeholders is required for stakeholders to have ownership of the ITS Deployment Plan and to ensure that the plan has realistically identified projects and timeframes for deployment. Cost is another important factor—cost can vary a great deal for many ITS elements, depending on the level of deployment, maturity of the technology, type of communications, etc. For example, the need for network surveillance may be accomplished in a jurisdiction simply by adding vehicle detection to an existing traffic signal, while in another jurisdiction it may require the deployment of multiple CCTV cameras as well as mid-block vehicle detection.

To gather input from stakeholders, an ITS Deployment Plan Workshop was held with stakeholders in Knoxville on February 15, 2012 to discuss potential projects. Each project recommended for the Regional ITS Deployment Plan was discussed, and consensus was reached by the stakeholders on the project general description and the timeframe for deployment. A Final ITS Architecture workshop was also held with stakeholders on April 18, 2012. In that workshop projects were broken out by each agency and timeframe and reviewed with stakeholders to provide another opportunity for comments. In addition, stakeholders were also provided with a form to use to provide the project team with a summary of any existing or planned ITS projects they were considered. The feedback received on those forms has been incorporated into this plan.

Regional ITS Deployment Plan projects are identified in Sections 3.1 through 3.8. Projects are identified for the following agencies.

- Section 3.1 TDOT Projects
- Section 3.2 Anderson County Projects – City of Oak Ridge
- Section 3.3 Blount County Projects – Cities of Alcoa and Maryville
- Section 3.4 Knox County Projects – Knox County, City of Knoxville, and Town of Farragut
- Section 3.5 Loudon County Projects – City of Lenoir City
- Section 3.6 Sevier County Projects – Cities of Gatlinburg, Pigeon Forge, and Sevierville
- Section 3.7 Transit Projects – KAT, Knoxville-Knox County CAC, ETHRA
- Section 3.8 Knoxville Regional TPO ITS Projects

The projects identified in the tables represent priority projects for each agency that are needed in order to implement the ITS services that were identified as part of the Regional ITS Architecture development. Many of the projects identified are not funded and identification of a funding source will likely be the most significant challenge in getting the projects implemented.

For each project, the following categories are discussed:

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

agency had begun detailed planning for a project. If prerequisite projects are required before a project can be deployed, these projects are identified.

- **Deployment Timeframe and Funding Status** – Provides a recommended timeframe for deployment for each project. Timeframes have been identified as short-term (deployment recommended in 0-5 years), mid-term (deployment recommended in 5-10 years), and long-term (deployment recommended beyond 10 years). Recommendations for deployment timeframes were based on input from each agency and considered the project priority, possibility of funding, and dependency on other project deployments. The current funding status is also included, which indicates whether or not projects are funded and if they are included in the TIP.
- **Opinion of Probable Cost and Funding Status** – Provides an opinion of probable cost of each project. Because design has not been undertaken for any projects, the opinion of probable cost should not be considered an estimate and should only be used for planning purposes.
- **Applicable Service Packages** – Identifies the primary ITS service packages from the Regional ITS Architecture that each project will assist in implementing. Knowing which service package each project is implementing is an important part of an ITS architecture conformance review. The ITS service packages identified for the projects can be used to show how the project conforms to the Regional ITS Architecture. The ITS service packages that are identified represent the primary reasons for deploying the project, although in many cases the project can also assist an agency with delivering other ITS services. For example, the expansion of the TDOT SmartWay freeway management system provides TDOT with the ability to implement three primary service packages: ATMS01 – Network Surveillance, ATMS06 – Traffic Information Dissemination, and ATMS08 – Incident Management. These ITS services represent TDOT's primary reason for expanding the SmartWay system, however the SmartWay expansion will also provide TDOT with the ability to accomplish other ITS service packages, such as EM09 - Evacuation and Reentry Management

3.1 Tennessee Department of Transportation Projects

Table 2 – TDOT Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
TDOT				
TDOT Region 1 SmartWay Geographic Expansion: I-40 and I-75 West of Knoxville	Expand the existing coverage of freeways with the TDOT SmartWay system implementation. The expansion will include CCTV cameras, DMS, vehicle detection systems, and all necessary communications equipment to support the expansion. Design is complete but funding is not in place. A majority of the elements deployed as part of this project will be located on the I-40 and I-75 corridors. On the eastern side the project will terminate on I-40/I-75 about midway between the Lovell and Campbell Station interchanges. On the western side, the project will terminate on I-40 and on I-75 at their respective interchanges with US 321. Mileage on these corridors is approximately 14.6 miles. In addition, there will be an isolated DMS, CCTV cameras, and detector stations implemented outside of the primary project limits.	Timeframe: Short-Term Funded: Yes Included in TIP (2011-085)	$4,750,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
TDOT Region 1 SmartWay Communications System Upgrade	This project will reconfigure the communications connection from the SmartWay TMC to the ITS devices in the field so that each device is directly connected to the fiber optic backbone. This will remove the need for field hub cabinets, and will allow the TDOT SmartWay TMC to directly communicate with all ITS devices rather than communicating through a field hub cabinet. Communications upgrades will be implemented on the existing SmartWay system in the Knoxville urban area.	Timeframe: Short-Term Funded: Yes Included in TIP (2011-086)	$1,100,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System

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

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

Table 2 – TDOT Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
TDOT (Continued)				
TDOT Region 1 SmartWay Geographic Expansion: US 129 / SR 115	Expand the existing coverage of freeways with the TDOT SmartWay system implementation. The expansion will include CCTV cameras, DMS, vehicle detection systems, and all necessary communications equipment to support the expansion. Design is complete but funding is not in place. This project has not been formally defined but the northern termini would begin at the southern termini of the original urban deployment roughly a mile south of the Cherokee Trails interchange. The southern termini would likely be at I-140 but would likely include an isolated DMS a mile or two south of that point.	Timeframe: Mid-Term Funded: No	$5,500,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
TDOT Region 1 SmartWay Geographic Expansion: I-75 North of Knoxville	Expand the existing coverage of freeways with the TDOT SmartWay system implementation. The expansion will include CCTV cameras, DMS, vehicle detection systems, and all necessary communications equipment to support the expansion. This project was originally identified in the I-75 Corridor Study. This project has not been formally defined but the southern termini will likely be located between the I-75 Merchant and Callahan interchanges, and the northern termini will likely extend beyond the I-75 Emory interchange by a mile or two. There may also be a series of isolated interchange instrumentations on I-75 north of this project area, but they will be expansions associated with the Region 1 Rural ITS program and are outside the Knoxville Urban Area boundaries.	Timeframe: Mid-Term Funded: No	$1,300,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System

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

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

Table 2 – TDOT Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
TDOT (Continued)				
TDOT Region 1 SmartWay Geographic Expansion: I-140 South of Knoxville	Expand the existing coverage of freeways with the TDOT SmartWay system implementation. The expansion will include CCTV cameras, DMS, vehicle detection systems, and all necessary communications equipment to support the expansion. 2015 – 2018 planned roadway improvements will drive this project. This project was originally identified in the I-75 Corridor Study. This project has not been formally defined but most likely the western termini will be current termini of the Region 1 SmartWay Urban deployment around the I-140 interchange with Westland. The eastern termini would likely be generally near US 129. The project would also likely include another isolated DMS location that may be located approximately a mile or two east of the project termini.	Timeframe: Mid-Term Funded: No	$3,600,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATMS08 – Traffic Incident Management System
TDOT HELP Service Patrol Expansion	Expand the existing HELP Service Patrol program including additional freeway miles of coverage and hours of operation. Additional coverage of HELP would likely follow expansion of SmartWay FMS. Hours of operation would likely not expand beyond current hours of operation. The cost of the program is split between short-term and mid-term. Prerequisite projects: Deployment of SmartWay is required prior to the HELP Service Patrol adopting the new freeway corridors.	Timeframe: Short to Mid-Term Funded: Partially Funding available for coverage of I-40/I-75 expansion	Per 10 Miles of Coverage[3] Capital Cost: $300,000 Annual Cost: $200,000	EM04 – Roadway Service Patrols

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

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

[3]HELP Service Patrol costs are based on 10 miles of coverage and include the following items. Capital costs: Three vehicles at $100,000 per vehicle. Annual Costs: Three HELP operators at $50,000 per year salary, $50,000 per year for fuel and maintenance of the vehicles.

Table 2 – TDOT Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
TDOT (Continued)				
TDOT Ramp Metering	Implement ramp metering on urban freeway on-ramps to improve mainline traffic flow. Assume approximately 10 sites for implementation a cost of approximately $20,000 per site. TDOT does not have any formal plans for implementation of ramp metering. This project was listed as a long-term project (10-20 years away) as a placeholder to show the potential need for ramp metering assuming congestion grows on the freeway system. The most likely location will be on I-40 on the western portion of Knoxville. Locations have not been defined for this project.	Timeframe: Long-Term Funded: No	$200,000	ATMS04 – Freeway Control
TDOT Region 1 SmartWay TMC Coordination with County EMAs and 911 Dispatch	Establish a communications connection between the TDOT SmartWay TMC and County EMAs/911 Dispatch. This communications connection will provide the EMAs/911 Dispatch with access to TDOT video feeds and roadway condition information and facilitate coordination between TDOT and the EMAs during major incidents. Basic linkages already exist. TDOT would like to get additional CAD data when possible from the 911 Dispatch Centers. Cost for this project will vary depending on the existing communications infrastructure available. Agencies that can access TDOT's fiber backbone with little or no additional communications infrastructure will likely use that existing backbone. Other agencies that do not have access to existing communications may need to consider leased lines or other means of connecting. An assumption is made that leased lines will be used with an annual cost of $5,000.	Timeframe: Short to Long-Term Funded: No	Annual Cost: $5,000	ATMS01 – Network Surveillance ATMS08 – Traffic Incident Management System EM01 – Emergency Call-Taking and Dispatch

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

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

3.2 Anderson County Projects – City of Oak Ridge

Table 3 – Anderson County Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Oak Ridge				
Traffic Signal System Upgrades	Upgrade the City of Oak Ridge traffic signal system including controller upgrades, signal infrastructure improvements, signal timing, and geometric improvements to the intersections. For planning purposes, approximately $30,000 per intersection was used for 24 signalized intersections. The City has indicated three corridors (24 signals total) will be upgraded. The corridors create a triangle shape through the City and are comprised of the following: -Illinois Avenue from Robertsville Road to Lafayette Drive -Oak Ridge Turnpike from Illinois Avenue to Florida Avenue -Lafayette Drive from Oak Ridge Turnpike to Bear Creek Road	Timeframe: Short-Term Funded: No	$720,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Communication System Upgrades	Upgrade the existing City of Oak Ridge communication system to include fiber optic interconnects for traffic signal systems.	Timeframe: Short-Term Funded: No	$1,000,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination
Traffic Operations Center	Implement a TOC for monitoring and control of the City of Oak Ridge traffic signal system. The TOC will include a central control system and a dedicated workstation in an existing space within the City of Oak Ridge Offices. Prerequisite projects: The traffic signal system and communication upgrades should be completed prior to or in coordination with the TOC implementation.	Timeframe: Short-Term Funded: No	$25,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination

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

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

Table 3 – Anderson County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Oak Ridge (Continued)				
CCTV Camera Deployment	Implement CCTV cameras as needed within the City of Oak Ridge to monitor traffic conditions and signal operations. For planning purposes, 5 CCTV cameras were estimated using a cost of approximately $30,000 per camera for the camera, pole, and communications. Project limits and specific locations have not been defined for this deployment. Prerequisite projects: The TOC should be completed prior to or in coordination with the CCTV camera deployment so there is a central monitoring station available.	Timeframe: Mid-Term Funded: No	$150,000	ATMS01 – Network Surveillance
DMS Deployment	Implement DMS to provide real-time travel information to motorists. Specific locations have not been determined by the City, although the need to provide information to motorist traveling to Knoxville was noted. For planning purposes 2 DMS were estimated using a cost of approximately $75,000 per DMS for the sign, mount, and communications. Project limits and specific locations have not been defined for this deployment. Prerequisite projects: The TOC should be completed prior to or in coordination with the DMS deployment so there is a central station available for monitoring traffic conditions and placing messages on the DMS.	Timeframe: Mid-Term Funded: No	$150,000	ATMS06 – Traffic Information Dissemination
Emergency Vehicle Traffic Signal Preemption	Implement emergency vehicle signal preemption for Fire Department vehicles to improve incident response times and safety. A cost estimate of approximately $6,000 per intersection was used. An additional $1,500 per vehicle may also be needed to complete the project. Project limits would primarily follow the project limits established for the traffic signal system upgrade.	Timeframe: Short-Term Funded: No	$150,000	EM02 – Emergency Routing

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

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

Table 3 – Anderson County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Oak Ridge (Continued)				
Emergency Vehicle Traffic Signal Preemption	Implement emergency vehicle signal preemption for Fire Department vehicles to improve incident response times and safety. A cost estimate of approximately $6,000 per intersection was used. An additional $1,500 per vehicle may also be needed to complete the project. Project limits would primarily follow the project limits established for the traffic signal system upgrade.	Timeframe: Short-Term Funded: No	$150,000	EM02 – Emergency Routing

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

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

3.3 Blount County Projects – Cities of Alcoa and Maryville

Table 4 – Blount County Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Cities of Maryville and Alcoa				
Traffic Signal System Upgrade	Upgrade individual traffic signals system in the Cities of Alcoa and Maryville, including controller upgrades, signal infrastructure improvements, signal timing, and geometric improvements to the intersections. The Cities recently completed a system wide upgrade that incorporated many of their traffic signals. This project will focus on remaining traffic signals that were not upgraded in the initial project.	Timeframe: Mid-Term Funded: No	$250,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Joint Traffic Operations Center	Implement a joint TOC for monitoring and control of the traffic signal system in Alcoa and Maryville. The TOC will include a central control system and a dedicated workstation in an existing space within the offices of either Alcoa or Maryville.	Timeframe: Short-Term Funded: No	$150,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS07 – Regional Traffic Management
CCTV Camera Deployment	Implement CCTV cameras as needed within Alcoa and Maryville to monitor traffic conditions and signal operations. For planning purposes, 10 CCTV cameras were estimated using a cost of approximately $30,000 per camera for the camera, pole, and communications. Project limits and specific locations have not been defined for this deployment. Prerequisite projects: The Joint TOC should be completed prior to or in coordination with the CCTV camera deployment so there is a central monitoring station available.	Timeframe: Short-Term Funded: No	$300,000	ATMS01 – Network Surveillance

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

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

Table 4 – Blount County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Cities of Maryville and Alcoa (Continued)				
Joint TDOT-Alcoa/Maryville Corridor Management	Implement a link between the TDOT Region 1 SmartWay TMC and the TOC for Alcoa and Maryville to provide coordination of freeway and arterial operations. The link will allow TDOT and the Cities to coordinate during freeway closures to divert traffic onto parallel routes, including sharing of video feeds and current travel conditions on freeways and arterials. Communications may initially need to be through a leased communications line with a recurring cost of approximately $2,000 to $5,000 annually. Longer term as the fiber networks grow for TDOT and the Cities it is expected that the leased circuits could be abandoned in lieu of a direct fiber connection. Specific project limits have not been established, but this project would primarily focus on the Alcoa Highway and parallel routes.	Timeframe: Long-Term Funded: No	Annual Cost: $5,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS07 – Regional Traffic Management
Emergency Vehicle Traffic Signal Preemption	Implement emergency vehicle signal preemption on traffic signals within the Cities of Maryville and Alcoa. A placeholder of $75,000 has been included in this plan to account for implementation of preemption equipment based on cost estimates of $6,000 per intersection and $1,500 per vehicle. Project limits and specific locations have not been defined for this deployment.	Timeframe: Short-Term Funded: No	$75,000	EM02 – Emergency Routing

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

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

3.4 Knox County Projects – Knox County, City of Knoxville, and Town of Farragut

Table 5 – Knox County Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Knox County				
Traffic Signal System Upgrades	Upgrade the Knox Country traffic signal system including controller upgrades, signal infrastructure improvements, signal timing, and geometric improvements to the intersections. For planning purposes, approximately 50 intersections were estimated at $30,000 per intersection. This project will focus on a number of different routes throughout the County where groups of signals have been identified for coordination, including Clinton Highway, Maynardville Pike, Hardin Valley Road, Campbell Station Road, Ebenezer Road, and Dutchtown Road.	Timeframe: Short-Term Funded: Partially – Hardin Valley Road Included in TIP (2011-078)	$1,500,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Communication System Upgrades	Upgrade the existing Knox County traffic signal system communication. This project will include an expansion of the fiber optic backbone as well as improvements or replacement of communications linking existing traffic signals. An estimate of $700,000 for this effort was provided by Knox County. Project will provide access to the signal systems identified in the traffic signal system upgrade project.	Timeframe: Short-Term Funded: No	$700,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS19 – Speed Monitoring
Traffic Operations Center	Implement a TOC for monitoring and control of the Knox County traffic signal system. The TOC will include a central control system and a dedicated workstation in an existing space with the Knox County Offices. Prerequisite projects: The traffic signal system and communication upgrades should be completed prior to or in coordination with the TOC implementation.	Timeframe: Short-Term Funded: No	$25,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS19 – Speed Monitoring

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

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

Table 5 – Knox County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Knox County (Continued)				
CCTV Camera Deployment	Implement CCTV cameras as needed within Knox County to monitor traffic conditions and signal operations. For planning purposes, 10 CCTV cameras were estimated using a cost of approximately $30,000 per camera for the camera, pole, and communications. Preliminary sites that have been identified as potential CCTV camera locations include Lovell Road north of I-40, Hardin Valley Road and Pellissippi Parkway, E. Emory Road and Maynardville Pike, and N. Cedar Bluff Road and Middlebrook Pike. Prerequisite projects: The TOC should be completed prior to or in coordination with the CCTV camera deployment so there is a central monitoring station available.	Timeframe: Long-Term Funded: No	$300,000	ATMS01 – Network Surveillance
Speed Monitoring System	Implement vehicle detection location to monitor roadway speeds and determine if additional enforcement is needed. The need for speed monitoring was identified by Knox County on the Oak Ridge Highway near the Anderson County Line.	Timeframe: Long-Term Funded: No	$20,000	ATMS19 – Speed Monitoring

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

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

Table 5 – Knox County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Knoxville				
Traffic Signal System Upgrade	Upgrade the City of Knoxville traffic signal system including controller upgrades, signal infrastructure improvements, signal timing, and geometric improvements to the intersections. This project will begin in the short-term but is expected to continue through the mid-term. The City of Knoxville currently has a study underway to plan for traffic signal and communication upgrades and has developed a cost estimate of $14,000,000 for the upgrades. For planning purposes this cost has been divided between the short-term and mid-term.	Timeframe: Short-Term to Mid-Term Funded: Partially $1 M Included in TIP	Short-Term: $7,000,000 Mid-Term: $7,000,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Communication System Upgrades	Upgrade the existing City of Knoxville traffic signal system communication. This project will include an expansion of the fiber optic backbone as well as improvements or replacement of communications linking existing traffic signals. This project will begin in the short-term but is expected to continue through the mid-term. The City of Knoxville currently has a study underway to plan for traffic signal and communication upgrades and has developed a total cost estimate of $14,000,000. This cost is included in the Traffic Signal System Upgrade project shown above.	Timeframe: Short-Term to Mid-Term Funded: No	Included in Knoxville Traffic Signal System Upgrade Project	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS07 – Regional Traffic Management ATMS19 – Speed Monitoring
Traffic Operations Center	Implement a TOC for monitoring and control of the City of Knoxville's traffic signal system. The TOC will include a central control system and a dedicated workstation in an existing space within the City of Knoxville Offices. Prerequisite projects: The traffic signal system and communication upgrades should be completed prior to or in coordination with the TOC implementation.	Timeframe: Short-Term Funded: No	$50,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS06 – Traffic Information Dissemination ATMS07 – Regional Traffic Management ATMS19 – Speed Monitoring

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

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

Table 5 – Knox County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Knoxville (Continued)				
CCTV Camera Deployment	Implement CCTV cameras as needed within the City of Knoxville to monitor traffic conditions and signal operations. For planning purposes, 10 CCTV cameras were estimated using a cost of approximately $30,000 per camera for the camera, pole, and communications. Project limits and specific locations have not been defined for this deployment. Prerequisite projects: The TOC should be completed prior to or in coordination with the CCTV camera deployment so there is a central monitoring station available.	Timeframe: Mid-Term Funded: No	$300,000	ATMS01 – Network Surveillance
DMS Deployment	Implement DMS to provide real-time travel information to motorists. For planning purposes 5 DMS were estimated using a cost of approximately $75,000 per DMS for the sign, mount, and communications. Specific locations have not been determined by the City, although the need to provide information to motorist traveling in the downtown area near the University of Tennessee was noted. Prerequisite projects: The TOC should be completed prior to or in coordination with the DMS deployment so there is a central station available for monitoring traffic conditions and placing messages on the DMS.	Timeframe: Long-Term Funded: No	$375,000	ATMS06 – Traffic Information Dissemination
Railroad Grade Crossing Advance Notification System	Implement advanced warning signs at railroad crossings to alert motorists of road blockages due to stopped trains. An estimate of 10 sites is used for planning purposes at a cost of $20,000 per site for detection and notification signs. Project limits and specific locations have not been defined for this deployment.	Timeframe: Long-Term Funded: No	$200,000	ATMS13 – Standard Railroad Grade Crossing

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

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

Table 5 – Knox County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Knoxville (Continued)				
Joint TDOT-City of Knoxville Corridor Management	Implement a link between the TDOT Region 1 SmartWay TMC and the City of Knoxville TOC to provide coordination of freeway and arterial operations. The link will allow TDOT and the City to coordinate during freeway closures to divert traffic onto parallel routes, including sharing of video feeds and current travel conditions on freeways and arterials. Communications to allow coordination may be implemented as part of the City of Knoxville Communication System Upgrade. If a communication link is implemented, this project will consist primarily of operational changes with limited or no cost. Project limits and specific locations have not been defined for this deployment. Prerequisite projects: The TOC and upgrades to the signal system and communications should be completed prior to the corridor deployment project so that the City staff has ability to control arterial traffic signal systems.	Timeframe: Mid-Term Funded: No	NA	ATMS07 – Regional Traffic Management ATMS08 – Traffic Incident Management System
Emergency Vehicle AVL and MDTs	Implement mobile data terminals (MDTs) and automated vehicle location (AVL) on emergency vehicles to provide enhanced communication and the ability to track vehicles. The Knoxville Fire Department has estimated the need for approximately 55 MDTs and 70 AVL units for their fleet. The cost estimates for this equipment were provided by the Knoxville Fire Department and include infrastructure cost as well as an annual recurring cost of $2,500 for MDT air cards.	Timeframe: Short-Term Funded: No	MDT Cost: $140,000 Annual Cost of MDT Air Cards: $2,500 AVL Cost: $130,000	EM01 – Emergency Call-Taking and Dispatch EM02 – Emergency Routing

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

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

Table 5 – Knox County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Knoxville (Continued)				
Emergency Vehicle Traffic Signal Preemption	Implement emergency vehicle signal preemption for the Knoxville Fire Department. The Knoxville Fire Department has estimated a need for 25 – 30 preemption locations and 37 vehicles with preemption capabilities. A general cost estimate of $6,000 per intersection and $1,500 per vehicle was used to develop costs. Project limits and specific locations for field deployments have not been defined for this project.	Timeframe: Short-Term Funded: No	$235,000	EM02 – Emergency Routing
Town of Farragut				
Traffic Signal System Upgrades	Upgrade the Town of Farragut traffic signal system including controller upgrades and signal infrastructure improvements. The Town of Farragut operates 22 traffic signals, of which 12 are part of one of 3 separate systems and the remaining 10 operate independently. 2 additional signals will come on line this year. Project limits and specific locations for field deployments have not been defined for this project.	Timeframe: Long-Term Funded: No	$100,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Communication System Upgrades	Upgrade the Town of Farragut communication system to provide connectivity to existing traffic signal and allow traffic signal coordination. A study has not been completed to determine communication costs. The Town would like to complete this effort in the short-term if funding allows, but funding is not currently in place. As a placeholder only, a cost of $500,000 has been included in this plan to represent the future communication need.	Timeframe: Long-Term Funded: No	$500,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Emergency Vehicle Traffic Signal Preemption	Implement emergency vehicle signal preemption on traffic signals within the Town of Farragut. The Town of Farragut provided an estimated a cost of approximately $12,000 per signal for 4 traffic signals. An additional $12,000 has been added in this report to account for additional emitters for emergency vehicles.	Timeframe: Short-Term Funded: No	$60,000	EM02 – Emergency Routing

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

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

3.5 Loudon County Projects – City of Lenoir City

Table 6 – Loudon County Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Lenoir City				
Traffic Signal System Upgrades	Upgrade the Lenoir traffic signal system including controller upgrades, signal infrastructure improvements, signal timing, and geometric improvements to the intersections. For planning purposes, approximately $30,000 per intersection was used for 4 signalized intersections. This project will focus on traffic signs on US 321 and Lee Highway through downtown.	Timeframe: Short-Term Funded: No	$120,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Communication System Upgrades	Upgrade the City of Lenoir communication system to provide connectivity to existing traffic signal and allow traffic signal coordination. An estimate of 6 miles of fiber optic communications at approximately $85,000 per mile was used for planning purposes. This project will focus primarily on the US 321 corridor and Lee Highway corridors.	Timeframe: Short-Term Funded: No	$500,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control

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

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

3.6 Sevier County Projects – Cities of Gatlinburg, Pigeon Forge, and Sevierville

Note: Project recommendations for the projects in Sevier County have been included in more detail in the Sevier County Tourist Corridor ITS Master Plan, which was developed in 2012 in coordination with the Knoxville Regional ITS Architecture update.

Table 7 – Sevier County Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Combined City of Gatlinburg, Pigeon Forge, and Sevierville				
Combined Sevier County Tourist Corridor Traveler Information System	Implement a real-time information system in Sevier County to provide information on travel conditions and alternate routes for the Sevier Tourist Corridor. The system could include third party traffic information, CCTV cameras, DMS, and coordination with the SmartWay Traveler Information System, including the website and 511 traveler information number. Estimates included 7 DMS and 10 CCTV cameras, as well as upgrades to an existing TOC. Total infrastructure and data acquisition costs have been split between short-term and mid-term. This project will primarily focus on the Sevier County Tourist Corridor. Prerequisite projects: TOCs for Pigeon Forge/Sevierville and Gatlinburg should be completed and upgrades to all signal systems should be in place prior to the implementation of the traveler information system.	Timeframe: Short to Mid-Term Funded: No	Infrastructure Costs and Initial Data Acquisition Cost Short-Term: $650,000 Mid-Term: $650,000 Annual Data Costs: $100,000	ATMS01 – Network Surveillance ATMS06 – Traffic Information Dissemination ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information

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

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

Table 7 – Sevier County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Combined City of Pigeon Forge and Sevierville				
Traffic Responsive System Upgrade or Transition to Adaptive Traffic Signal System	Upgrade the existing traffic responsive system or transition to an adaptive traffic signal system in the Cities of Pigeon Forge and Sevierville. The system will include improvements to traffic signal control hardware, detection, and communications upgrades, as well as central software for control. A joint City of Pigeon Forge and Sevierville TOC to operate the system may be needed and has been included as a separate project. This project will primarily focus on the Sevier County Tourist Corridor through the Cities of Sevierville and Pigeon Forge.	Timeframe: Short-Term Funded: No	Adaptive: $1,350,000 Traffic Responsive: $950,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS07 – Regional Traffic Management
Joint Traffic Operations Center	Implement a joint City of Pigeon Forge and Sevierville TOC to operate the adaptive traffic signal system. The TOC will be implemented in existing office space at one of the cities. Software should be added to the other city to provide the capability for both cities to monitor and control the system if needed. Prerequisite projects: The traffic signal system upgrades should be completed prior to or in coordination with the TOC implementation.	Timeframe: Short-Term Funded: No	$50,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control ATMS07 – Regional Traffic Management

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

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

Table 7 – Sevier County Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
City of Gatlinburg				
Traffic Signal System Upgrade	Upgrade the City of Gatlinburg traffic signal system including controller upgrades, signal infrastructure improvements, signal timing, and communications upgrades. Central control software system will also be implemented. This project will primarily focus on the Sevier County Tourist Corridor through the City of Gatlinburg.	Timeframe: Short-Term Funded: No	$475,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control
Traffic Operations Center	Implement a TOC for monitoring and control of the Gatlinburg traffic signal system. The TOC will include a central control system and a dedicated workstation in an existing space with the City of Gatlinburg Offices. Prerequisite projects: The traffic signal system upgrades should be completed prior to or in coordination with the TOC implementation.	Timeframe: Short-Term Funded: No	$25,000	ATMS01 – Network Surveillance ATMS03 – Surface Street Control

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

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

3.7 Transit Projects – KAT, Knoxville-Knox County CAC, ETHRA

Table 8 – Transit Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Knoxville Area Transit (KAT)				
KAT On-Board Passenger Counters	Implement passenger counters on the fixed route fleet of buses (86 buses). The system should be tied to the existing AVL system to identify the stops where each boarding and alighting takes place. Cost is estimated at approximately $7,000 per bus.	Timeframe: Short-Term Funded: Yes	$600,000	APTS10 – Transit Passenger Counting
KAT On-Board Security Cameras	Implement on-board security cameras on demand-response buses (22 buses). Cost is estimated at approximately $8,000 per bus.	Timeframe: Short-Term Funded: Yes	$176,000	APTS05 – Transit Security
KAT On-Board Transit Fare Box Upgrades	Implement fare box upgrades on fixed-route buses that provide proximity reader capability. KAT has developed a cost estimate of approximately $500,000 for this effort and is actively implementing this project.	Timeframe: Short-Term Funded: Yes	$500,000	APTS04 – Transit Fare Collection Management
KAT Computer Aided Maintenance System	Implement a computer aided maintenance system that automates the maintenance schedule and activities on buses. KAT has developed a cost preliminary estimate of approximately $300,000 for this effort and is actively implementing this project.	Timeframe: Short-Term Funded: Yes	$300,000	APTS06 – Transit Fleet Management
KAT Paratransit MDTs	Implement mobile data terminals (MDTs) on The Lift paratransit vans. Approximately 22 vans with a cost estimate of $1,200 per MDT.	Timeframe: Short-Term Funded: Yes	$265,000	APTS03 – Demand Response Transit Operations APTS08 – Transit Traveler Information
KAT Real-Time Bus Arrival Information	Implement kiosks or other systems at sheltered stops to provide information on next bus arrival for fixed-route buses. The number of kiosks to be deployed has not yet been determined. Cost is estimated using an assumption of approximately 10 sites at $25,000 per site for equipment and communications.	Timeframe: Short-Term Funded: No	$250,000	APTS08 – Transit Traveler Information

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

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

Table 8 – Transit Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Knoxville Area Transit (KAT) (Continued)				
KAT Real-Time Smart Phone Transit Information	KAT is developing the capability to push real-time information on bus arrival, routes, and other transit data to Smart Phones. A specific system has not yet been specified but a budget of $150,000 has been established.	Timeframe: Short-Term Funded: No	$150,000	APTS08 – Transit Traveler Information
KAT Transit Traffic Signal Priority	Implement transit signal priority on existing bus route. An approximately 4 mile corridor on Cumberland Avenue/Kingston Pike is being considered. Additional corridors may also be considered. They type of technology used for signal priority has not yet been determined. The cost for this project will vary widely depending on the length of corridor, the type of technology used to provide bus priority, and infrastructure improvements that may be made at bus stops. As a placeholder, $250,000 has been included for cost.	Timeframe: Mid-Term Funded: No	$250,000[3]	APTS09 – Transit Signal Priority
KAT Transit Dispatch Coordination with the Knoxville TOC	Implement communications connection between the KAT Transit Dispatch and the Knoxville TOC. Communications connection will allow the TOC to provide KAT with real-time traffic information including access to video, information on incidents, and information on existing and planned closures that impact routes. Cost will be primarily a function of existing communications availability. Knoxville is in the process of developing a communications master plan that may provide a communications system that would allow connections with little additional infrastructure. For planning purposes, an assumption is made that a leased line will be used for communications. Prerequisite projects: The coordination project cannot be completed until the Knoxville TOC and communications upgrades are complete.	Timeframe: Mid-Term Funded: No	Annual Cost: $5,000	APTS02 – Transit Fixed Route Operations APTS03 – Demand Response Transit Operations

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

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

[3]The scope and size of this project has not yet been determined and this cost could vary widely.

Table 8 – Transit Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Knoxville-Knox County Community Action Committee (CAC)				
CAC On-Board Security Cameras	Implement on-board security cameras on existing vehicles (75 vehicles). Cost is estimated at approximately $8,000 per bus.	Timeframe: Short-Term Funded: No	$600,000	APTS05 – Transit Security
CAC On-Board Vehicle Alarms	Implement on-board silent alarm system on existing vehicles (75 vehicles.) Cost is estimated at approximately $3,000 per vehicle.	Timeframe: Short-Term Funded: No	$225,000	APTS05 – Transit Security
CAC Link to SmartWay 511 Traveler Information Number	Add CAC as an option for callers using the SmartWay 511 Traveler Information Number. There is no cost expected with this project.	Timeframe: Short-Term Funded: No	No Cost	APTS08 – Transit Traveler Information ATIS02 – Interactive Traveler Information
CAC Transit Dispatch Coordination with KAT Dispatch	Implement a communication link to allow coordination between CAC and KAT for paratransit trips. Cost will be primarily a function of existing communications availability. For planning purposes, an assumption is made that a leased line will be used for communications.	Timeframe: Short-Term Funded: No	Annual Cost: $5,000	APTS03 – Transit Fixed-Route Operations APTS07 – Multimodal Coordination

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

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

Table 8 – Transit Recommended ITS Projects (Continued)

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
East Tennessee Human Resource Agency (ETHRA)				
ETHRA On-Board Security Cameras	Implement on-board security cameras on existing vehicles (50 vehicles). Cost is estimated at approximately $8,000 per bus.	Timeframe: Short-Term Funded: No	$400,000	APTS05 – Transit Security
ETHRA Link to SmartWay 511 Traveler Information Number	Add ETHRA as an option for callers using the SmartWay 511 Traveler Information Number. There is no cost expected with this project.	Timeframe: Short-Term Funded: No	No Cost	APTS08 – Transit Traveler Information ATIS02 – Interactive Traveler Information
ETHRA Transit Dispatch Coordination with KAT Dispatch	Implement a communication link to allow coordination between ETHRA and KAT for demand response trips. Cost will be primarily a function of existing communications availability. For planning purposes, an assumption is made that a leased line will be used for communications.	Timeframe: Mid-Term Funded: No	Annual Cost: $5,000	APTS03 – Transit Fixed-Route Operations APTS07 – Multimodal Coordination

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

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

3.8 Knoxville Regional TPO Projects

Table 9 – Knoxville Regional TPO Recommended ITS Projects

Project	Description	Deployment Timeframe[1] and Funding Status	Opinion of Probable Cost[2]	Applicable ITS Service Packages
Knoxville Regional TPO				
Knoxville Regional TPO Archive Data Warehouse	Establish a data warehouse to archive data from traffic and transit agencies within the TPO boundaries for use in regional planning. Cost for this project represents an average range for developing a data warehouse system. Cost could vary widely depending on the level of detail and functionality of the system as well as the amount of development that is done in-house by the TPO. The system could be set up as either a data warehouse (all data stored in one location) or a virtual data warehouse (data is stored with agency that collects data and the TPO provides a portal for accessing all available data.)	Timeframe: Short-Term Funded: No	$200,000 to $400,000	AD2 – ITS Data Warehouse AD3 – ITS Virtual Data Warehouse
Knoxville Smart Trips Ridesharing Automated System	The Smart Trips program is operated by the TPO and provides assistance to travelers looking for alternate modes of transportation, such as transit, carpooling, biking, and walking. Carpooling is currently done by matching drivers and riders together for daily routes, such as commuting to work, but the system does not work well for dynamic ridesharing. Smart Trips is planning to move to a more dynamic system that will allow users to go into the system and find potential ridesharing partners in real-time for trips planned in the very near future, such as that same day. The system specifications have not been determined and a budget has not yet been established. The Knoxville TPO is planning to move forward with specifying a system by Fall 2012.	Timeframe: Short-Term Funded: Yes Included in TPO Smart Trips Program	To Be Determined Later	ATIS08 – Dynamic Ridesharing

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

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

3.9 ITS Project Recommendation Summary

Table 10 includes a summary of all project costs identified in the Knoxville Regional ITS Deployment Plan. The categories for counties include all incorporated cities within the county that included ITS projects identified in in the plan. In general stakeholder focused a majority of their efforts on identifying short-term projects (projects identified for the 0-5 year time frame) rather than mid-term (5-10 years) or long-term (10+ years) projects. As was noted in the earlier tables, designs have not been undertaken for projects and thus costs are only an opinion of probable costs and should be used only for planning purposes.

Table 10 – ITS Project Recommendation Summary

Project Category	Short-Term Project Costs[1]	Mid-Term Project Costs[1]	Long-Term Project Costs[1]	Total Cost[2]
TDOT Projects	$6,000,000[3]	$10,550,000[3]	$200,000	**$16,750,000**
Anderson County Projects				
City of Oak Ridge	$2,045,000	$300,000	$0	**$2,345,000**
Blount County Projects				
Alcoa-Maryville	$525,000	$250,000	$0	**$775,000**
Knox County Projects				
Knox County	$2,225,000	$0	$320,000	**$2,545,000**
City of Knoxville	$7,555,000	$7,300,000	$575,000	**$15,430,000**
Town of Farragut	$60,000	$600,000	$0	**$660,000**
Loudon County Projects				
City of Lenoir City	$620,000	$0	$0	**$620,000**
Sevier County Projects				
Region Wide	$650,000	$650,000	$0	**$1,300,000**
Pigeon Forge/Sevierville	$1,400,000	$0	$0	**$1,400,000**
Gatlinburg	$500,000	$0	$0	**$500,000**
Transit Projects				
KAT	$2,241,000	$250,000	$0	**$2,491,000**
CAC	$825,000	$0	$0	**$825,000**
ETHRA	$400,000	$0	$0	**$400,000**
Knoxville Regional TPO Projects	$400,000	$0	$0	**$400,000**
TOTALS	**$25,446,000**	**$19,900,000**	**$1,095,000**	**$46,441,000**

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

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

[3]The cost for HELP Service Patrol expansion was divided between short-term and mid-term TDOT project costs.

4. SYSTEMS ENGINEERING ANALYSIS

In 2001 the FHWA issued Final Rule 23 CFR 940, which required that ITS projects using federal funds (or ITS projects that integrate with systems that were deployed with federal funds) conform to a regional ITS architecture and also be developed using a systems engineering process. The purpose of this Section is to discuss how the Knoxville Regional ITS Architecture and ITS Deployment Plan can be used to support the systems engineering requirements. A process for maintaining the ITS Deployment Plan is also briefly discussed.

4.1 Systems Engineering Analysis Process

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

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

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

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

- Portions of the Regional ITS Architecture being implemented (discussed in Sections 3.1 through 3.8 of the Knoxville Regional ITS Deployment Plan document as part of the project recommendations);
- Participating agencies roles and responsibilities (identified in the Knoxville Regional ITS Architecture document);
- Definition of system requirements (identified in the Knoxville Regional ITS Architecture Turbo Architecture database equipment packages); and

- Applicable ITS standards (identified using the ITS service package data flows from the Knoxville Regional ITS Architecture document and the National standards associated with the ITS service package data flows).

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

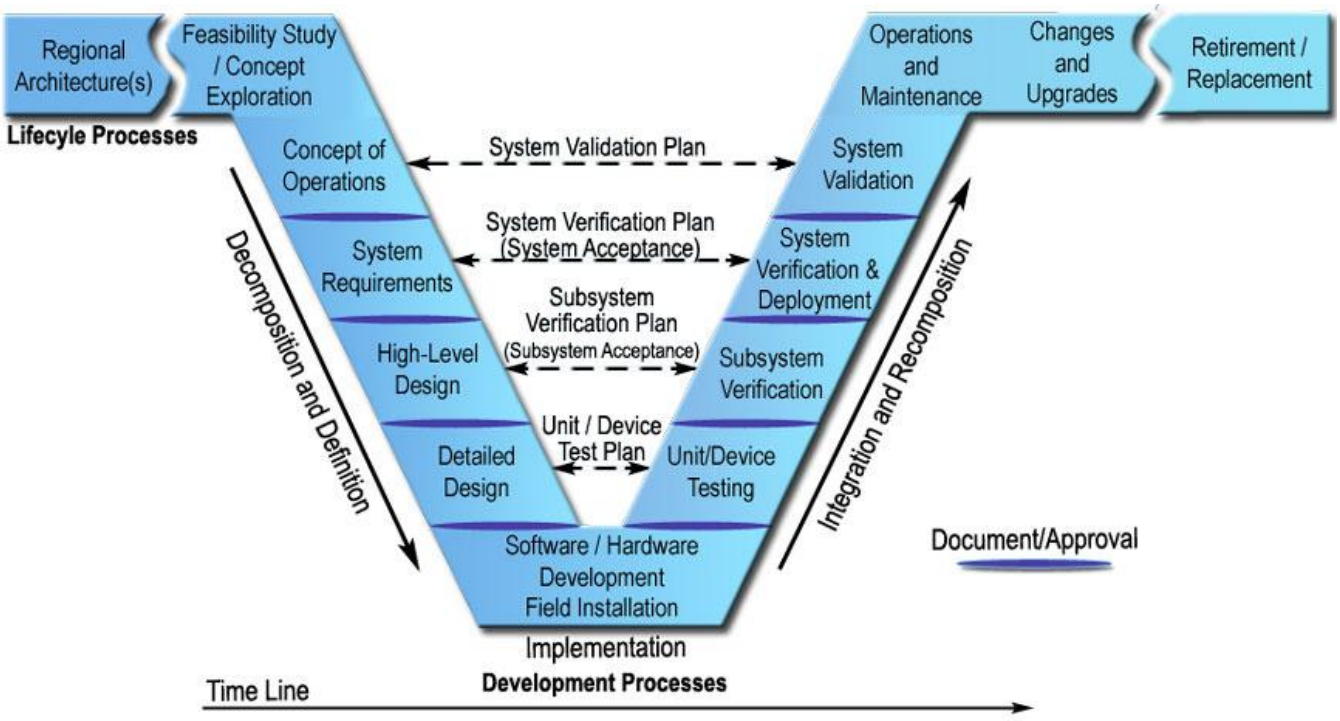

Figure 4 – Systems Engineering Vee Diagram

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

4.2 ITS Deployment Plan Maintenance

Just as the ITS Architecture developed for the Knoxville Region documents the Region's goals for ITS implementation at the time it was developed, the ITS Deployment Plan addresses the projects that stakeholders agreed were necessary to implement at the time the plan was developed in order to reach their ITS deployment goals. As the Region grows, needs will change and as technology progresses new ITS opportunities will arise. Shifts in regional focus as well as changes in the National ITS Architecture will necessitate that the Knoxville Regional ITS

Architecture be updated to remain a useful resource for the Region. These same changes will create new project opportunities and revisions to the projects in the ITS Deployment Plan.

Stakeholders agreed upon a procedure for updating the Regional ITS Architecture and Deployment Plan. The procedure, documented in detail in the Knoxville Regional ITS Architecture, outlines how to document ITS architecture changes that may be needed for inclusion in the next plan update. While complete plan updates are scheduled to occur approximately every four years prior to the Long Range Transportation Plan update, stakeholders agreed that it would be beneficial to review the projects identified in the ITS Deployment Plan once a year. The Knoxville Regional TPO will lead the annual project reviews, which may occur as part of a Planning for Operations committee the TPO is organizing. The purpose of the reviews will be to update project status, remove projects that are completed, add project detail when available, and add any new projects into the ITS Deployment Plan. Any corresponding changes to the Knoxville Regional ITS Architecture will be documented and retained by the Knoxville TPO for inclusion during the next complete update as outlined in the Knoxville Regional ITS Architecture document.