Tennessee Department of Transportation
Regional ITS Architectures and Deployment Plans

Bristol Region

Regional ITS Architecture Report

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LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AD	Archived Data
AMBER	America's Missing: Broadcast Emergency Response
APTA	American Public Transportation Association
APTS	Advanced Public Transportation System
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
BTT	Bristol Tennessee Transit
BMS	Bristol Motor Speedway
BVT	Bristol Virginia Transit
CCTV	Closed Circuit Television
CVISN	Commercial Vehicle Information Systems and Networks
DMS	Dynamic Message Sign
EM	Emergency Management
EMA	Emergency Management Agency
EMS	Emergency Medical Services
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HAR	Highway Advisory Radio
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
IVR	Interactive Voice Response
LRTP	Long Range Transportation Plan
MC	Maintenance and Construction
MEOC	Mountain Empire Older Citizens
MOU	Memorandum of Understanding

LIST OF ACRONYMS

MPO	Metropolitan Planning Organization
NEMA	National Electrical Manufacturers Association
NET Trans	Northeast Tennessee Transportation
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
PSAP	Public Safety Answering Point
RPO	Rural Planning Organization
RTMS	Remote Traffic Microwave Sensor
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible and Efficient Transportation Equity Act – A Legacy for Users
SDO	Standards Development Organization
SSP	Safety Service Patrol
TDOT	Tennessee Department of Transportation
TEA-21	Transportation Equity Act for the 21st Century
TEMA	Tennessee Management Emergency Agency
THP	Tennessee Highway Patrol
TIP	Transportation Improvement Program
TMC	Transportation Management Center or Traffic Management Center
TOC	Traffic Operations Center
TraCS	Traffic and Criminal Software
TSIS	TDOT SmartWay Information System
USDOT	United States Department of Transportation
VDOT	Virginia Department of Transportation
VIVDS	Video Image Vehicle Detection Systems
VSP	Virginia State Police
WAVE	Wireless Access in Vehicular Environments

1. INTRODUCTION

1.1 Project Overview

Development of a regional intelligent transportation system (ITS) architecture is one of the most important steps in planning for and implementing ITS in a region. ITS architectures provide a framework for implementing ITS projects, encourage interoperability and resource sharing among agencies, identify applicable standards to apply to projects, and allow for cohesive long-range planning among regional stakeholders. The ITS architecture allows stakeholders to plan for what they want their system to look like in the long-term and then break out the system into smaller pieces that can be implemented as funding permits.

ITS architectures satisfy the conformity requirements first established in the Transportation Equity Act for the 21st Century (TEA-21) highway bill and continued in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) bill passed in 2005. In response to Section 5206(e) of TEA-21, the Federal Highway Administration (FHWA) issued a final rule and the Federal Transit Administration (FTA) issued a final policy that required regions implementing any ITS project to have an ITS architecture in place by April 2005. After this date, any ITS projects must show conformance with their regional ITS architecture in order to be eligible for funding from FHWA or FTA. Regions that had not yet deployed ITS were given four years to develop an ITS architecture after their first ITS project proceeded to final design.

In October 2007 the Tennessee Department of Transportation (TDOT), in coordination with the Bristol Metropolitan Planning Organization (MPO) and Virginia Department of Transportation (VDOT), began development of the Bristol Regional ITS Architecture. The Bristol Regional ITS Architecture included the same geographic boundaries as the Bristol MPO plus the remainder of Washington County, Virginia. Stakeholders developed the Regional ITS Architecture based on a 20-year vision of how they wanted to implement ITS in the Region. In addition to the Regional ITS Architecture, a separate ITS Deployment Plan was developed to identify and prioritize specific ITS projects recommended for the Region in order to implement the ITS Architecture.

The ITS Architecture and the ITS Deployment Plan were both developed with significant input from local, state, and federal officials. A series of four workshops were held to solicit input from stakeholders and ensure that the plans reflected the unique needs of the Region. Copies of the draft reports were provided to all stakeholders. The Regional ITS Architecture and Deployment Plan developed reflects an accurate snapshot of existing ITS deployments and future ITS plans in the Region. Needs and priorities of the Region will change over time and in order to remain effective this plan should be periodically reviewed and updated.

1.2 Document Overview

The Bristol Regional ITS Architecture report is organized into five key sections:

Section 1 – Introduction

This section provides an overview of the National ITS Architecture requirements, the Bristol Regional ITS Architecture, and the key features and stakeholders in the Bristol Region.

Section 2 – Regional ITS Architecture Development Process

An overview of the key steps involved in developing the ITS architecture for the Bristol Region is provided in this section. It includes a discussion of stakeholder involvement, architecture workshops, and the architecture development process.

Section 3 – Customization of the National ITS Architecture for the Bristol Region

This section contains a summary of regional needs and details the customization of the National ITS Architecture to meet the ITS vision for the Region. The market packages that were selected for the Region are included in this section and interconnects are presented, including the "sausage diagram" showing the relationships of the key subsystems and elements in the Region.

Section 4 – Application of the Regional ITS Architecture

Functional requirements and standards that apply to the Region, as indicated by the Regional ITS Architecture, are presented in Section 4. Operational concepts identifying stakeholder roles and responsibilities have been prepared and potential agreements to support the sharing of data and resources have been identified.

Section 5 – Maintaining the Regional ITS Architecture

A maintenance plan has been developed for the Bristol Regional ITS Architecture and is included in this section. The plan outlines the procedure for updating the ITS architecture over time. The Bristol Regional ITS Architecture also contains five appendices:

- Appendix A – Market Package Definitions;
- Appendix B – Customized Bristol-Kingsport Overlap Market Packages;
- Appendix C – Customized Bristol Region Market Packages;
- Appendix D – Element Functions;
- Appendix E – Stakeholder Database; and
- Appendix F – Architecture Maintenance Documentation Form.

1.3 Bristol Region

1.3.1 Geographic Boundaries

The Bristol Region is defined by the boundaries of the Bristol MPO plus Washington County, Virginia as shown in **Figure 1**. The boundaries were extended to include all of Washington County, Virginia to include the Town of Abingdon, Virginia.
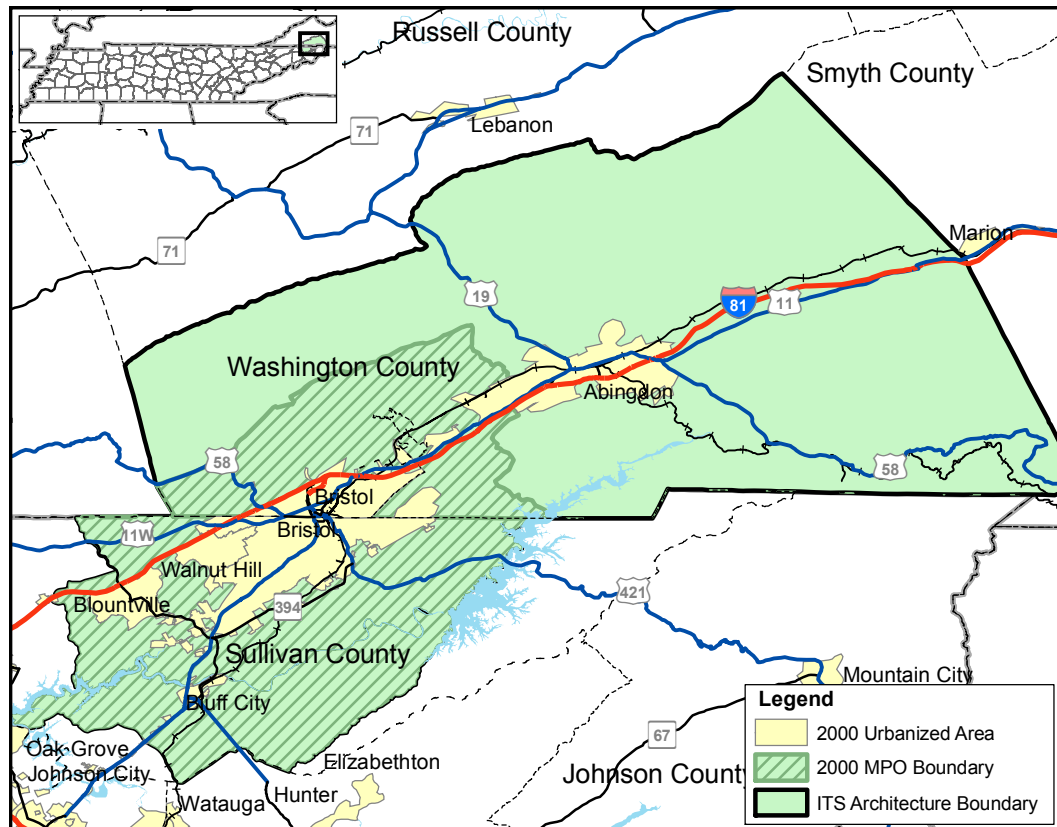
Figure 1 – Bristol Regional Boundaries

When developing the stakeholder group, the project team coordinated with the MPO to invite the appropriate city, county, regional, state and federal agencies. **Table 1** in Section 1.3.4 identifies the stakeholders that participated in the process.

1.3.2 Adjacent Regional ITS Architectures

The Bristol Region is adjacent to the Johnson City Region and Kingsport Region. The Johnson City Regional ITS Architecture was completed in 2006 and the Kingsport Regional ITS Architecture was developed concurrently with the Bristol Region. The close proximity to the Kingsport Region and the fact that both Regions include portions of Sullivan County, Tennessee, TDOT Region 1, and the VDOT Bristol District created an overlap in many of the stakeholders. As detailed in Section 2, three of the four workshops held during the development process were conducted in coordination with workshops being held for the Kingsport Region to facilitate coordination and consistency.

The naming convention used for elements in the Bristol Regional ITS Architecture is consistent with the naming convention used in the Statewide ITS Architecture and

neighboring Johnson City and Kingsport Regions. This consistency provides seamless connections to those adjacent architectures without requiring that they be specifically called out.

Several services in the Bristol Region overlap with services provided in the Kingsport Region. During the architecture customization process, stakeholders from both Regions agreed that the most appropriate way to maintain consistency was to document these services together, in a single set of market package diagrams that would be included in both Regional ITS Architectures. Section 3.4 addresses the market package customization process and identifies the market packages that have been included in both architectures.

1.3.3   Transportation Infrastructure

As illustrated previously in **Figure 1**, the Region is served by several State and Federal highways. The primary roadway facilities include I-81, US 11, and SR 34 (also designated as US 11E).

I-81 is a divided north-south interstate highway that begins at I-40 east of Knoxville and continues north to Canada through New York State. In the Region, I-81 connects Bristol Tennessee, Bristol Virginia and the Town of Abingdon. From I-81, travelers can connect to I-40 and drive west across the State of Tennessee to Knoxville, Nashville, and Memphis. US 11 also runs north-south through the Region and provides a valuable alternate route in the event of a large-scale incident on I-81.

Together, Johnson City, Kingsport, and Bristol form the Tri-Cities Area. The roads that connect the Tri-Cities are important to the economic health of these communities. SR 34 provides the connection to Johnson City, Tennessee and US 11W connects Bristol to Kingsport, Tennessee.

In addition to the roadway network, the area is served by the Tri-Cities Regional Airport and several public transit agencies.

1.3.4   Bristol Region ITS Plans

The Bristol Region began the development of their Regional ITS Architecture in 2007 when TDOT contracted with a consultant to develop several regional ITS architectures and deployment plans in the State of Tennessee. Version 6.0 of the National ITS Architecture was used in the development of the Bristol Regional ITS Architecture.

It is important to recognize the initial deployment of ITS infrastructure in a region because as of April 2005, in order for a region to receive funding for ITS projects from the Highway Trust Fund, the United States Department of Transportation (USDOT) requires that the region have an ITS architecture developed. This requirement only applies to regions with existing ITS infrastructure deployed. For regions that do not have any ITS infrastructure deployed, the USDOT requires that they have an ITS architecture within four years of their first ITS project entering final design.

The Bristol Region has several ITS components deployed in the field. Examples of implementations in the Region include closed circuit television (CCTV) cameras and dynamic message signs (DMS) that were deployed to manage Bristol Motor Speedway events. As the Bristol Region pursues funding opportunities for proposed projects, it will be necessary to show that a project fits within the ITS architecture developed for the Region.

The Bristol Regional ITS Architecture, like many of the other regional ITS architectures developed in Tennessee, did not include statewide commercial vehicle operations as part of the plan. Tennessee has a separate statewide Commercial Vehicle Information Systems and Networks (CVISN) program that documents how ITS can be used consistently throughout Tennessee for statewide factions such as vehicle registration, fuel tax, or safety inspections.

1.3.5   Stakeholders

Due to the fact that ITS often transcends traditional transportation infrastructure, it is important to involve non-traditional stakeholders in the ITS architecture development and visioning process. Input from these stakeholders, both public and private, is a critical part of defining the interfaces, integration needs, and overall vision for ITS in a region.

Stakeholders from both Tennessee and Virginia were actively involved from the state, county, and local level covering transportation operations, emergency management, and transit operations service areas. The Bristol MPO, which includes both Bristol Tennessee and Bristol Virginia, serves as the agency responsible for the coordination of transportation planning within the Region. Agencies responsible for transportation operations on Interstates and many states routes are the Tennessee and Virginia DOTs. At the county level Sullivan County Tennessee and Washington County Virginia have varying levels of responsibility for transportation and emergency operations within their county boundaries. The Town of Abingdon and the Cities of Bristol Tennessee and Bristol Virginia also have operational responsibility for transportation and emergency operations within their respective incorporated jurisdictions in the Region.

In Tennessee, Bristol Tennessee Transit (BTT) and Northeast Tennessee Transportation (NET Trans) are the transit providers that operate within the Regional boundaries. BTT provides transit service within the Bristol corporate limits. NET Trans primarily operates in the rural areas of the Region, only entering the urban area on trips that originate outside the BTT service area. Since the majority of NET Trans' operations occur outside the Regional boundaries, they are included in a Rural Planning Organization (RPO). TDOT decided that RPOs are covered by the Statewide Architecture; therefore, NET Trans is only included in this ITS architecture where they interact with agencies in Bristol Region. Bristol Virginia Transit (BVT) provides transit service in Virginia in the Bristol corporate limits. Outside of the urban area in Virginia transit services are provided by the District 3 Governmental Cooperative which operates Washington County Public Transit and Abingdon Public Transit.

Table 1 contains a listing of stakeholders in the Bristol Region who have participated in the project workshops or provided input to the study team as to the needs and issues that should be considered as part of the Regional ITS Architecture. Other stakeholders that were invited to participate but were not able to attend were provided minutes of workshops and copies of reports to encourage their participation as much as possible. A complete listing of stakeholders invited to participate in the project and workshop attendance records are included in the stakeholder database in **Appendix E**.

Table 1 – Bristol Stakeholder Agencies and Contacts

Stakeholder Agency	Address	Contact
Bristol Metropolitan Planning Organization	P. O. Box 1189 Bristol, Tennessee 37621	Rex Montgomery
City of Bristol TN	P.O. Box 1189 Bristol, Tennessee 37621	David Metzger
City of Bristol TN Fire Department	211 Bluff City Highway Bristol, Tennessee 37620	Dwayne Honager
City of Bristol TN Police Department	801 Anderson Street Bristol, Tennessee 37620	Matt Austin
City of Bristol VA	300 Lee Street Bristol, Virginia 24201	Jay Detrick
City of Bristol VA	300 Lee Street Bristol, Virginia 24201	Jack Hurlbert
Federal Highway Administration – TN Division	640 Grassmere Park Road, Suite 112 Nashville, Tennessee 37211-3568	Don Gedge
Johnson City Metropolitan Transportation Planning Organization	209 Water Street Johnson City, Tennessee 37601	Glenn Berry
Sullivan County Sheriff's Office	P.O. Box 589 Blountville, Tennessee 37617	Wayne Anderson
Tennessee Department of Transportation Long-Range Planning Division	505 Deaderick Street Suite 900, James K. Polk Bldg. Nashville, Tennessee 37243	Ralph Comer
Tennessee Department of Transportation Long-Range Planning Division	505 Deaderick Street Suite 900, James K. Polk Bldg. Nashville, Tennessee 37243	Deborah Fleming
Tennessee Department of Transportation Long-Range Planning Division	505 Deaderick Street Suite 900, James K. Polk Bldg. Nashville, Tennessee 37243	Joseph Roach
Tennessee Department of Transportation Region 1 SmartWay Center	P.O. Box 58 Knoxville, Tennessee 37901	Mark Best
Tennessee Highway Patrol Fall Branch District	184 Joe McCrary Road Fall Branch, Tennessee 37656	Walt Owenby
Tennessee Highway Patrol Fall Branch District	184 Joe McCrary Road Fall Branch, Tennessee 37656	Danny Talley
Virginia Department of Transportation Bristol District	870 Bonham Road Bristol, Virginia 24201	Ronnie Hubble
Virginia Department of Transportation Bristol District	870 Bonham Road Bristol, Virginia 24201	Donny Necessary
Virginia Department of Transportation Bristol District	870 Bonham Road Bristol, Virginia 24201	Mike Phipps
Virginia Department of Transportation Operations and Securities Division	1401 East Broad Street Richmond, Virginia 23219	Chris Francis
Virginia Department of Transportation Southwestern Region	1596 Deborah Lane Salem, Virginia 24153	Ken King
Virginia Department of Transportation Southwestern Region	1596 Deborah Lane Salem, Virginia 24153	Tim Martin
Virginia Department of Transportation Southwest Regional Operations	731 Harrison Avenue Salem, Virginia 24153	Joe Hamed
Virginia State Police-Area 27 Office	868 Bonham Road Bristol, Virginia 24210	Frank McMurray

2. REGIONAL ITS ARCHITECTURE DEVELOPMENT PROCESS

Development of the Regional ITS Architecture and Deployment Plan for the Bristol Region relied heavily on stakeholder input to ensure that the architecture reflected local needs. A series of four workshops was held with stakeholders to gather input, and draft documents were made available to stakeholders for review and comment.

The process followed for the Bristol Region was designed to ensure that stakeholders could provide input and review for the development of the Region's ITS Architecture and Deployment Plan. **Figure 2** illustrates the process followed.
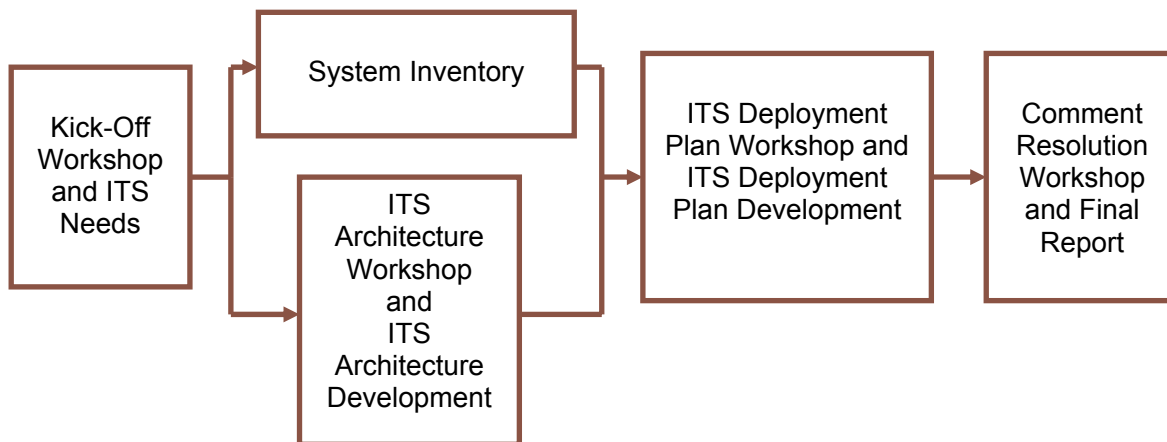
Figure 2 – Bristol Regional ITS Architecture and Deployment Plan Development Process

2.1 Stakeholder Workshops

A total of four workshops with stakeholders over a period of six months were used to develop the Bristol Regional ITS Architecture and Deployment Plan. These workshops included:

- Kick-Off Workshop;
- Regional ITS Architecture Development Workshop;
- ITS Deployment Plan Workshop; and
- Comment Resolution Workshop.

Key components of the process are described below:

Task 1 – Kick-Off Workshop and ITS Needs: A stakeholder group was identified that included representatives from regional transportation, transit, and emergency management agencies. The group was invited to the project Kick-Off Workshop where ITS needs for the Region were identified and dates for upcoming workshops agreed upon. This workshop was held jointly with stakeholders from the Kingsport Region to facilitate coordination and address the overlap introduced by both Regions including portions of Sullivan County, Tennessee, TDOT Region 1, and the VDOT Bristol District.

Task 2 – System Inventory: Collecting information for the system inventory began at the Kick-Off Workshop through discussions with the stakeholders to determine existing and planned ITS

elements in the Region. After the Kick-Off Workshop, follow-up calls were conducted with several local stakeholders to gather additional input.

Task 3 – ITS Architecture Workshop and ITS Architecture Development: The purpose of the Regional ITS Architecture Workshop was to review the system inventory with stakeholders and develop the Bristol Regional ITS Architecture. Version 6.0 of the National ITS Architecture was used as the starting point for the development of the ITS Architecture in Bristol. Training on the National ITS Architecture was integrated into the workshop so that key elements of the architecture, such as market packages, could be explained prior to the selection and editing of these elements. This workshop was also held concurrently with the Kingsport Regional ITS Architecture Workshop. After the training portion of the workshop, the joint group discussed those services that impacted both Regions and then split into their respective Regions for the remainder of the workshop. The result of the Regional ITS Architecture Workshop was an ITS architecture for the Bristol Region that included a system inventory, interconnect diagram, customized market packages, functional requirements, and relevant ITS standards. Following the workshop, a Draft Regional ITS Architecture document was prepared and sent to stakeholders for review and comment.

Task 4 – ITS Deployment Plan Workshop and ITS Deployment Plan Development: A draft project listing for the Region was presented to stakeholders at the Regional ITS Deployment Plan Workshop. Stakeholders were asked to provide input on the recommended projects, responsible agencies, associated costs, and deployment timeframe. Following the workshop, a Draft Regional ITS Deployment Plan document was prepared and sent to stakeholders for review and comment.

Task 5 – Comment Resolution Workshop and Final Report: A Comment Resolution Workshop was held with stakeholders to review the Draft Regional ITS Architecture and the Draft Regional ITS Deployment Plan. Next steps for the Region were also discussed including the use and maintenance of the Regional ITS Architecture. The Comment Resolution Workshop for the Bristol Region was held with the Kingsport Region to provide a final opportunity for regional coordination. Comments were incorporated and the final Regional ITS Architecture and Regional ITS Deployment Plan was developed.

2.2   Turbo Architecture

Turbo Architecture Version 4.0 was used to develop the Bristol Regional ITS Architecture. Turbo Architecture is a software application that was developed by the USDOT to be used as a tool for documenting and maintaining ITS architectures. Version 4.0 of Turbo Architecture was released in October 2007 and was developed to support Version 6.0 of the National ITS Architecture. Use of the Turbo Architecture software in development of the regional ITS architectures is recommended by both the FHWA and the FTA.

In the Bristol Region a Turbo Architecture database was developed based on the ITS market packages which are provided in Appendices B and C of this report. The ITS market packages provide a graphical representation of the services stakeholders in the Region would like ITS to provide. In each market package the elements, such as a Transportation Management Center (TMC) or a CCTV camera, and the data that is shared between them are shown. Turbo Architecture allows the Region to document all of the elements and data flows that exist or are planned in the Region. Turbo Architecture also allows the user to quickly access any standards that are associated with the data flows as well as generate reports and diagrams to assist in reviewing the data. Some examples of the useful reports and diagrams that may be generated using the Turbo Architecture software are included in **Table 2**.

Table 2 – Turbo Architecture Report and Diagrams

Report or Diagram Name	Functions
Stakeholder Report	Provides a description of the stakeholder and the associated elements for each stakeholder in the Regional ITS Architecture.
Inventory Report	Provides a description and status for each element in the Regional ITS Architecture.
Market Packages Report	Identifies each of the market packages selected for the Region and the elements associated with each market package.
Functional Requirements Report	Identifies the functions that each element provides.
Interconnect Report	Identifies for each element all of the other elements that are connected and the status of each connection.
Standards Activities Report	Identifies relevant standards associated with each of the data flows used in the Regional ITS Architecture.
Subsystem Diagram	Identifies the subsystems from the National ITS Architecture that are included in the Regional ITS Architecture.
Interconnect Diagrams	Identifies for each element all of the other elements that are connected and the status of each connection. The Interconnect Diagrams can be customized to show all elements in the Regional ITS Architecture or a single element can be selected so that only the connections it has with other elements are shown. Interconnect Diagrams can also be viewed by individual market packages to view all of the elements and connections in each market package.
Flow Diagrams	Flow Diagrams are similar to Interconnect Diagrams; however, the actual data flows that are part of each connection between elements are also shown.

Turbo Architecture saves data in Microsoft Access compatible data files. Turbo Architecture files can be accessed using Microsoft Access, although use of Access will not provide nearly the same amount of capabilities as accessing the files using the Turbo Architecture software. With the release of Version 4.0 of Turbo Architecture, the USDOT began offering the Turbo Architecture software free of charge and provides a link for downloading the software on the National ITS Architecture website. At the time this report was written that site was located at www.iteris.com/itsarch/.

3. CUSTOMIZATION OF THE NATIONAL ITS ARCHITECTURE FOR THE BRISTOL REGION

3.1 Systems Inventory

An important initial step in the architecture development process is to establish an inventory of existing ITS elements. At the Kick-Off Workshop and through subsequent discussions with agency representatives, Bristol Region stakeholders provided the team with information about existing and planned systems that would play a role in the Regional ITS Architecture.

The National ITS Architecture has eight groups of ITS service areas. Existing, planned, and future systems in the Region were identified in the following service areas:

- *Traffic Management* – includes the TDOT SmartWay TMC in Knoxville as well as other existing and future TMCs and traffic operations centers (TOCs), detection systems, CCTV cameras, fixed and portable DMS, and other related technologies.
- *Emergency Management* – includes emergency operations/management centers, improved information sharing among traffic and emergency services, automated vehicle location (AVL) on emergency vehicles, traffic signal preemption for emergency vehicles, and wide-area alerts.
- *Maintenance and Construction Management* – includes work zone management, roadway maintenance and construction information, and road weather detection systems.
- *Public Transportation Management* – includes transit and paratransit AVL, transit travel information systems, electronic fare collection, and transit security.
- *Commercial Vehicle Operations* – includes coordination with CVISN efforts.
- *Traveler Information* – includes broadcast traveler information, traveler information kiosks, and highway advisory radio (HAR).
- *Archived Data Management* – includes electronic data management and archiving systems.
- *Vehicle Safety* – these systems were discussed, but at this time this service group is primarily a private sector initiative to incorporate technologies such as intersection collision avoidance and automated vehicle operation systems into vehicles.

3.2 Regional Needs

Needs from the Region were identified by Stakeholders at the Kick-Off Workshop held in October of 2007. The needs identified provided guidance for determining which market packages should be included in the architecture. Stakeholders identified ITS needs for the Bristol Region in the following areas:

- Traffic management;
- Emergency management;
- Maintenance and construction management;
- Public transportation management;
- Traveler information; and
- Archived data management.

Section 3.4.3 contains additional information about the specific needs identified and relates those needs to the market packages that document the corresponding ITS service.

3.3 Element Customization

The inventory and needs documented at the Kick-Off Workshop are the starting point for developing an ITS architecture for the Bristol Region. These ITS systems and components are used to customize the National ITS Architecture and create the Regional ITS Architecture for the Bristol Region.

When developing customized elements, the stakeholder group agreed to create individual traffic, maintenance, and emergency management elements for the City of Bristol Tennessee, City of Bristol Virginia, and Town of Abingdon Virginia. The other smaller communities in the Region were documented as part of the Municipal/County elements. This documentation allows the communities to be included in the Regional ITS Architecture, and therefore eligible to use federal funding on potential future ITS projects.

To accommodate the overlap between the Bristol and Kingsport Regions, a single set of elements was created and then included in both Regional ITS Architectures.

3.3.1 Subsystems and Terminators

Each identified system or component in the Bristol Regional ITS inventory was mapped to a subsystem or terminator in the National ITS Architecture. Subsystems and terminators are the entities that represent systems in ITS.

Subsystems are the highest level building blocks of the physical architecture, and the National ITS Architecture groups them into four major classes: Centers, Field, Vehicles, and Travelers. Each of these major classes includes various subsystems that represent a set of transportation functions (or processes). Each set of functions is grouped under one agency, jurisdiction, or location, and corresponds to physical elements such as: traffic operations centers, traffic signals, or vehicles. **Figure 3** shows the National ITS Architecture subsystems. This figure, also known as the "sausage diagram," is a standard interconnect diagram, showing the relationships of the various subsystems within the architecture. A customized interconnect diagram for the Bristol Region is shown in **Figure 4** in Section 3.3.3. Communication functions between the subsystems are represented in the ovals. Fixed-point to fixed-point communications include not only twisted pair and fiber optic technologies, but also wireless technologies such as microwave and spread spectrum.

Terminators are the people, systems, other facilities, and environmental conditions outside of ITS that need to communicate or interface with ITS subsystems. Terminators help define the boundaries of the National ITS Architecture as well as a regional system. Examples of terminators include drivers, traffic operations personnel, and information service providers.
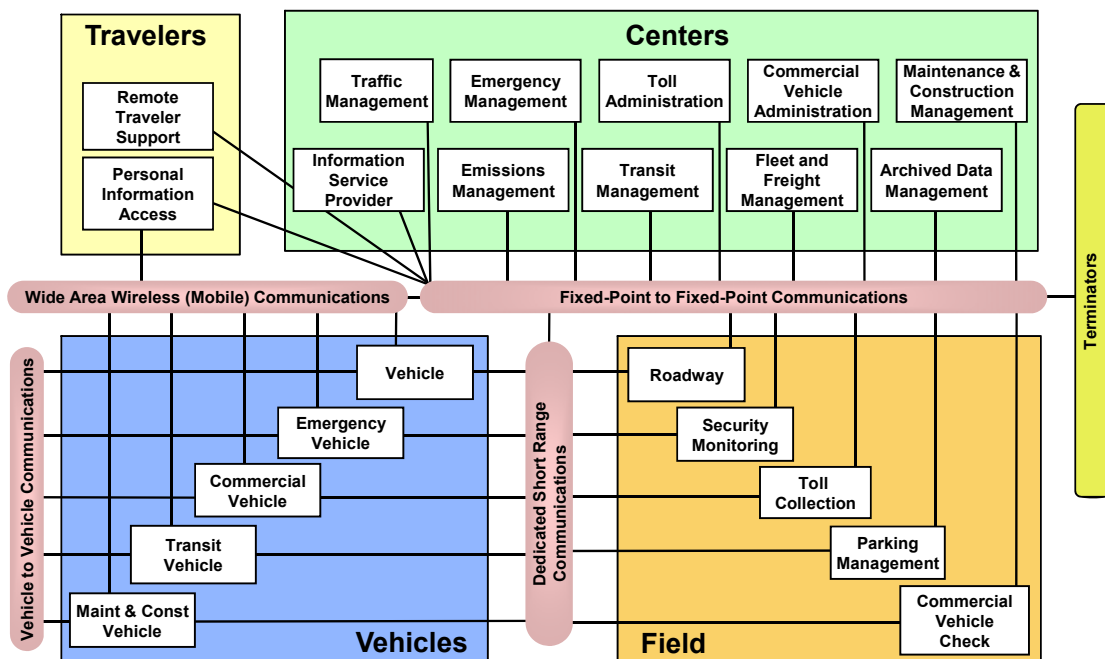
Figure 3 – National ITS Architecture Physical Subsystem Interconnect Diagram

3.3.2 ITS Inventory by Stakeholder

Each stakeholder is associated with one or more systems or elements (subsystems and terminators) that make up the transportation system in the Bristol Region. A listing of stakeholders as identified in the Bristol Regional ITS Architecture can be found in **Table 3** along with a description of the stakeholder. Rather than individually documenting each of the smaller municipalities in the Region, a single stakeholder was created for municipal agencies which represents the cities, towns and counties not specifically called out in the architecture. **Table 4** sorts the inventory by stakeholder so that each stakeholder can easily identify and review all of the architecture elements associated with their agency. The table includes the status of the element. In many cases an element classified as existing might still need to be enhanced to attain the service level desired by the Region.

Table 3 – Bristol Region Stakeholder Descriptions

Stakeholder	Stakeholder Description
Bristol MPO	Metropolitan planning organization for the Bristol TN and Bristol VA metropolitan area.
Bristol Tennessee Transit	Transit provider that operates fixed route and demand response transit service in the City of Bristol TN. Bristol Tennessee Transit (BTT) operates in close coordination with Bristol Virginia Transit (BVT) and several routes travel into Virginia. The transit agency is a department of the City of Bristol TN.
Bristol Virginia Transit	Transit provider that operates fixed route and demand response transit service in the City of Bristol VA. Bristol Virginia Transit (BVT) operates in close coordination with Bristol Tennessee Transit (BTT) and several routes travel into Tennessee. The transit agency is a department of the City of Bristol VA.
City of Bristol TN	Municipal government for the City of Bristol TN. Covers all city departments including those that deal with traffic and public safety.
City of Bristol VA	Municipal government for the City of Bristol VA. Covers all city departments including those that deal with traffic and public safety.
City of Kingsport TN	Municipal government for the City of Kingsport TN. Covers all city departments including those that deal with traffic and public safety.
District Three Governmental Cooperative	Agency that operates Washington County VA Public Transit and Abingdon VA Public Transit.
Financial Institution	Handles exchange of money for transit electronic fare collection.
First Tennessee Human Resource Agency	Regional agency that operates Northeast Tennessee Transportation (NET Trans). NET Trans provides demand response transit service outside of the urban areas in the TN portion of the Region.
Hawkins County TN	County government for Hawkins County TN. Includes all county departments including EMS, Fire, Sheriff and Highway Departments as well as the Hawkins County Emergency Management Agency.
Kingsport Area Transit Service	Transit provider that operates fixed route and demand response transit for the City of Kingsport.
Media	Local media outlets. This can include television stations, newspapers, radio stations and their associated websites.
Mountain Empire Older Citizens	Southwest Virginia Area Agency on Aging. The agency operates MEOC Transit in addition to providing other community services.
Municipal/County Government	Government for various municipalities and counties within the Region that are not specifically called out. Covers all departments including those that deal with traffic and public safety.
NOAA	The National Oceanic and Atmospheric Administration gathers weather information and issues severe weather warnings.
Other Agencies	This stakeholder represents a wide variety of agencies. The associated elements are groups of agencies or providers that do not have a primary stakeholder agency.
Other States	Emergency or traffic management agencies in other states adjacent to Tennessee.
Private Information Provider	Private sector business responsible for the gathering and distribution of traveler information. This service is typically provided on a subscription basis.
Rail Operators	Companies that operate trains and/or are responsible for the maintenance and operations of railroad tracks.
Scott County VA	County government for Scott Count VA. Includes all county departments including EMS and Fire, the Sheriff's Office and the Scott County Department of Emergency Services.

Table 3 – Bristol Region Stakeholder Descriptions (continued)

Stakeholder	Stakeholder Description
Sullivan County TN	County government for Sullivan County TN. Includes all county departments including the Sheriff's Office, EMS, Fire, and Highway Departments as well as the Sullivan County Emergency Management Agency.
System Users	All of the users of the transportation system.
TDOT	The Tennessee Department of Transportation is responsible for the construction, maintenance, and operation of state roadways in Tennessee.
TEMA	The Tennessee Emergency Management Agency is responsible for emergency operations during a disaster or large scale incident.
Tennessee Bureau of Investigation	Statewide law enforcement agency responsible for issuing statewide AMBER Alerts in TN.
Tennessee Department of Health and Human Services	State department that manages funding for medical transportation services.
THP	Tennessee Highway Patrol. State law enforcement agency that enforces traffic safety laws as well as commercial vehicle regulations.
Town of Abingdon VA	Municipal government for the Town of Abingdon VA. Covers all city departments including those that deal with traffic and public safety.
VDOT	The Virginia Department of Transportation is responsible for the construction, maintenance, and operation of roadways in the Commonwealth of Virginia.
VSP	Virginia State Police. State law enforcement agency that enforces traffic safety laws as well as commercial vehicle regulations.
Washington County TN	County government for Washington County TN. Includes all county departments including EMS, Fire, Sheriff and Highway Departments as well as the Washington County TN County Emergency Management Agency.
Washington County VA	County government for Washington County VA. Includes all county departments including EMS and Fire, the Sheriff's Office and the Washington County VA Department of Emergency Services.

Table 4 – Bristol Region Inventory of ITS Elements

Stakeholder	Element Name	Element Description	Status
Bristol MPO	Bristol MPO Data Archive	Archive for transportation information such as traffic counts or transit ridership data for use in regional transportation planning.	Planned
Bristol Tennessee Transit	BTT CCTV Camera Surveillance	Closed circuit television camera surveillance at transit transfer centers or other transit facilities.	Planned
	BTT Data Archive	Transit data archive for Bristol Tennessee Transit. Used by the National Transit Database, Federal Transit Administration, and TDOT Office of Public Transportation.	Planned
	BTT Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of fixed route and paratransit vehicles operated by Bristol Tennessee Transit.	Existing
	BTT Fixed Route Vehicles	Transit vehicles that operate on fixed routes within the City of Bristol TN and limited locations in Bristol VA.	Existing
	BTT Kiosks	Kiosks for dissemination of transit traveler information. Kiosks can also be used for the purchase and recharging of electronic fare payment cards.	Planned
	BTT Paratransit Vehicles	Bristol Tennessee Transit vehicles that provide transit means for disabled passengers.	Existing
	BTT Website	Website with information about fares and schedules. In the future real-time information could be incorporated.	Existing
Bristol Virginia Transit	BVT CCTV Camera Surveillance	Closed circuit television camera surveillance at transit transfer centers or other transit facilities.	Planned
	BVT Data Archive	Transit data archive for Bristol Virginia Transit. Used by the National Transit Database, Federal Transit Administration, and VDOT.	Planned
	BVT Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of fixed route and paratransit vehicles operated by Bristol Virginia Transit.	Existing
	BVT Fixed Route Vehicles	Transit vehicles that operate on fixed routes within the City of Bristol VA and limited locations in Bristol TN.	Existing
	BVT Kiosks	Kiosks for dissemination of transit traveler information. Kiosks can also be used for the purchase and recharging of electronic fare payment cards.	Planned
	BVT Paratransit Vehicles	Bristol Virginia Transit vehicles that provide transit means for disabled passengers.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
Bristol Virginia Transit (continued)	BVT Website	Website with information about fares and schedules. In the future real-time information could be incorporated.	Existing
City of Bristol TN	BMS Multi-Agency Command Center	Multi-agency command center led by the City of Bristol TN that is activated for use during Bristol Motor Speedway events.	Existing
	Bristol TN 911 Dispatch	911 Public Safety Answering Point (PSAP) responsible for answering all 911 calls made within the City of Bristol TN and dispatching emergency responders.	Existing
	Bristol TN Fire/EMS Vehicles	City of Bristol TN fire and emergency medical services vehicles.	Existing
	Bristol TN Police Department	Police department for the City of Bristol TN. The emergency dispatch functions for the Police Department are included in the Bristol TN 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
	Bristol TN Police Vehicles	City of Bristol TN Police Department vehicles.	Existing
	City of Bristol TN CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management. Additional cameras are monitored during Bristol Motor Speedway special events for crowd management.	Planned
	City of Bristol TN DMS	Dynamic message signs for traffic information dissemination operated by the City of Bristol TN.	Planned
	City of Bristol TN Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as Video Image Vehicle Detection Systems (VIVDS), Remote Traffic Microwave Sensors (RTMS) or traditional loops.	Planned
	City of Bristol TN Public Works Department	Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way.	Existing
	City of Bristol TN Public Works Department Vehicles	Vehicles used by the City of Bristol TN Public Works Department in maintenance and construction activities.	Existing
	City of Bristol TN Rail Notification System	Roadway equipment used to alert motorists that a crossing is currently blocked by a train.	Planned
	City of Bristol TN RWIS Sensors	Road weather information system sensors to monitor weather conditions at the roadway for the City of Bristol TN.	Planned
	City of Bristol TN TOC	Traffic operations center for the City of Bristol TN. Responsible for operations of the traffic signal system, CCTV cameras and DMS.	Planned

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
City of Bristol TN (continued)	City of Bristol TN Traffic Signals	Traffic signal system operated by the City of Bristol, TN.	Existing
	City of Bristol TN Website	Website for the City of Bristol, TN. Includes information on City departments and in the future it is envisioned that the website may have real-time information about roadway conditions.	Existing
City of Bristol VA	Bristol VA 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the City of Bristol VA and dispatching emergency responders.	Existing
	Bristol VA Fire Vehicles	Vehicles from the City of Bristol VA Fire Department.	Existing
	Bristol VA Lifesaving Crew	Emergency medical services vehicles serving the City of Bristol VA.	Existing
	Bristol VA Police Department	Police department for the City of Bristol VA. The emergency dispatch functions for the Police Department are included in the Bristol VA 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
	Bristol VA Police Vehicles	Police vehicles include City of Bristol VA Police Department patrol cars and helicopters.	Existing
	City of Bristol VA CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Planned
	City of Bristol VA DMS	Dynamic message signs for traffic information dissemination operated by the City of Bristol VA.	Planned
	City of Bristol VA Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, RTMS or traditional loops.	Planned
	City of Bristol VA Public Works Department	Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way.	Existing
	City of Bristol VA Public Works Department Vehicles	Vehicles used by the City of Bristol VA Public Works Department in maintenance and construction activities.	Existing
	City of Bristol VA Rail Notification System	Roadway equipment used to alert motorists that a crossing is currently blocked by a train.	Planned
	City of Bristol VA RWIS Sensors	Road weather information system sensors to monitor weather conditions at the roadway for the City of Bristol VA.	Planned
	City of Bristol VA TOC	Traffic operations center for the City of Bristol VA. Responsible for operations of the traffic signal system, CCTV cameras and DMS.	Planned

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
City of Bristol VA (continued)	City of Bristol VA Traffic Signals	Traffic signal system operated by the City of Bristol, VA.	Existing
	City of Bristol VA Website	Website for the City of Bristol, VA. Includes information on City departments and in the future it is envisioned that the website may have real-time information about roadway conditions.	Existing
City of Kingsport TN	City of Kingsport TN Public Works Department	Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way.	Existing
	City of Kingsport TN TOC	Traffic operations center for the City of Kingsport TN. Responsible for operations of the traffic signal system, CCTV cameras and DMS.	Planned
	Kingsport TN 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the City of Kingsport TN and dispatching emergency responders.	Existing
	Kingsport TN Police Department	Police department for the City of Kingsport TN. The emergency dispatch functions for the Police Department are included in the Kingsport TN 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
	Kingsport TN Police Vehicles	Police vehicles include City of Kingsport TN Police Department patrol cars and helicopters.	Existing
District Three Governmental Cooperative	Abingdon VA Public Transit CCTV Camera Surveillance	Closed circuit television camera surveillance at transit transfer centers or other transit facilities.	Planned
	Abingdon VA Public Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of fixed route and paratransit vehicles operated by the District Three Governmental Cooperative for Abingdon Transit.	Existing
	Abingdon VA Public Transit Fixed Route Vehicles	Transit vehicles that operate on fixed routes within the City of Abingdon.	Existing
	Abingdon VA Public Transit Paratransit Vehicles	Abingdon VA Public Transit vehicles that provide transit means for disabled passengers.	Existing
	Abingdon VA Public Transit Website	Website with information about fares and schedules.	Planned
	District Three Governmental Cooperative Transit Data Archive	Transit data archive for Abingdon VA Public Transit and Washington County VA Public Transit. Used by the National Transit Database, Federal Transit Administration, and VDOT.	Planned
	Washington County VA Public Transit CCTV Camera Surveillance	Closed circuit television camera surveillance at transit transfer centers or other transit facilities.	Planned

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
District Three Governmental Cooperative (continued)	Washington County VA Public Transit Demand Response Vehicles	Washington County Public Transit vehicles.	Existing
	Washington County VA Public Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of demand response transit vehicles operated by the District Three Governmental Cooperative for Washington County Public Transit.	Existing
	Washington County VA Public Transit Website	Website with information about fares and schedules.	Planned
Financial Institution	Financial Service Provider	Handles exchange of money for transit electronic payment collection.	Existing
First Tennessee Human Resource Agency	NET Trans Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of fixed route and paratransit vehicles operated by NET Trans.	Existing
Hawkins County TN	Hawkins County TN 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Hawkins County TN EMA	Emergency management agency for Hawkins County TN. Responsible for communications with the Tennessee Emergency Management Agency (TEMA) and coordination of local resources during a disaster or large scale incident.	Existing
	Hawkins County TN Public Safety Vehicles	Vehicles used by public safety in Hawkins County, including the Hawkins County Sheriff's Office.	Existing
	Hawkins County TN Sheriff's Office	Law enforcement agency for Hawkins County TN. The emergency dispatch functions for the Sheriff's Department are included in the Hawkins County TN 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
Kingsport Area Transit Service	Kingsport Area Transit Service Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of fixed route and paratransit vehicles operated by Kingsport Area Transit.	Existing
Media	Local Print and Broadcast Media	Local media that provide traffic or incident information to the public.	Existing
Mountain Empire Older Citizens	MEOC Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of fixed route and paratransit vehicles operated by Mountain Empire Older Citizens Transit.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
Municipal/County Government (continued)	Municipal Police Department	Municipal Police Department. The emergency dispatch functions for the Police Department are included in the County 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
	Municipal Public Safety Vehicles	Municipal law enforcement, fire, and emergency medical services (EMS) vehicles.	Existing
	Municipal/County Engineer's Office	Responsible for the administration of maintenance and construction projects within the municipality or County.	Existing
	Municipal/County Maintenance	Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way.	Existing
	Municipal/County Maintenance Vehicles	Vehicles used by Municipal/County maintenance departments in maintenance and construction activities.	Existing
	Municipal/County TOC	Traffic Operations Center responsible for the operation of municipal or county signal systems.	Planned
	Municipal/County Traffic Signals	Municipal or county traffic signal systems within the Bristol and Kingsport Regions. Includes Sullivan County TN, Hawkins County TN, Scott County VA, Mt Carmel TN, Church Hill TN, Weber City VA, and Gate City VA.	Existing
	Municipal/County Website	Municipal or county website that includes information on agency departments. In the future it is envisioned that the website would have real-time information about roadway conditions.	Existing
NOAA	National Weather Service	Provides official US weather, marine, fire and aviation forecasts, warnings, meteorological products, climate forecasts, and information about meteorology.	Existing
Other Agencies	Electronic Fare Payment Card	Medium for collection of transit fares electronically.	Planned
	Other Maintenance and Construction Management	Additional maintenance and construction operations agencies with which information is shared for coordination in an emergency situation.	Existing
	Other Traffic Management	Additional traffic management agencies with which information is shared for coordination in an emergency situation.	Existing
	Private Transportation Providers	Private providers of transportation services in the Region such as taxis and intercity bus service.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
Other States	Kentucky Transportation Cabinet	Responsible for the construction, maintenance and operations of roads in the State of Kentucky.	Existing
Private Information Provider	Private Sector Traveler Information Services	Traveler information service operated by a private entity.	Existing
	TrafficLand	Private provider of traffic information. Currently under contract with VDOT to provide CCTV camera images to the public and other media outlets.	Existing
Rail Operators	Rail Operations	Centers responsible for the operation and tracking of trains.	Existing
	Rail Operator Wayside Equipment	Equipment located along the tracks including railroad crossing gates, bells, and lights as well as the interface to the traffic signal controller indicating the presence of a train.	Existing
Scott County VA	Scott County VA 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Scott County VA Department of Emergency Services	Emergency management agency for Scott County VA. Responsible for communications with the Virginia Statewide Emergency Operations Center (EOC) and coordination of local resources during a disaster or large scale incident.	Existing
Sullivan County TN	Sullivan County TN 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Sullivan County TN EMA	Emergency management agency for Sullivan County TN. Responsible for disaster planning for the County and operating the emergency operations center.	Existing
	Sullivan County TN Public Safety Vehicles	Vehicles used by public safety in Sullivan County, including the Sullivan County Sheriff's Office.	Existing
	Sullivan County TN Sheriff's Office	Law enforcement agency for Sullivan County TN. The emergency dispatch functions for the Sheriff's Office are included in the Sullivan County TN 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
System Users	Archive Data User	Those who request information from the data archive systems.	Existing
	Personal Computing Devices	Computing devices that travelers use to access public information.	Existing
	Traveler	User of the transportation system.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
TDOT	Other TDOT Region Construction Office	Other Tennessee Department of Transportation regional construction offices besides the Region 1 Construction Office.	Existing
	Other TDOT Region Maintenance	Other Tennessee Department of Transportation regional maintenance offices.	Existing
	TDOT CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Planned
	TDOT District Maintenance	The district maintenance office handles most of the routine roadway maintenance and responds to incidents when services are requested by local emergency management.	Existing
	TDOT DMS	Dynamic message signs for traffic information dissemination.	Existing
	TDOT Emergency Services Coordinator	The Tennessee Department of Transportation emergency services coordinator is responsible for managing the TDOT response in a large scale incident or disaster in which TEMA activates the state EOC.	Existing
	TDOT Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, RTMS or traditional loops.	Planned
	TDOT HAR	Highway advisory radio for traffic information dissemination.	Planned
	TDOT HELP Vehicles	Roadway service patrol vehicles. Currently operate in Knoxville and are dispatched to the Region for special events such as Bristol Motor Speedway races or large incidents.	Existing
	TDOT Maintenance Headquarters	The Tennessee Department of Transportation maintenance headquarters.	Existing
	TDOT Maintenance Vehicles	The Tennessee Department of Transportation vehicles used in maintenance operations.	Existing
	TDOT Project Planning Division Archive	Data archive for the Project Planning Division. The Division is responsible for traffic data collection and analysis and includes the Short Range Planning Office.	Existing
	TDOT Public Information Office	The office responsible for the dissemination of traffic information to the media and the public.	Existing
	TDOT Region 1 Construction Office	The Tennessee Department of Transportation office responsible for oversight of construction projects in Region 1.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
TDOT (continued)	TDOT Region 1 Engineer's Office	Region 1 Engineer's office is responsible for administration of maintenance and construction projects within the Region as well as communicating work zone information to the public through the Public Information Office.	Existing
	TDOT Region 1 HELP Dispatch	Roadway service patrol dispatch center located in Knoxville. Currently service is limited to the Knoxville area except in the case of a large scale incident or special events such as those at the Bristol Motor Speedway.	Existing
	TDOT Region 1 Maintenance	Region 1 maintenance headquarters. Responsible for maintenance operations in the Region; however, most routine maintenance is handled by the district maintenance offices. There are several district maintenance offices within the Region.	Existing
	TDOT Region 1 TMC – Knoxville	Transportation management center for Region 1, located in Knoxville. Responsible for the operation of the ITS equipment located in Region 1. This includes the freeway management system in Knoxville as well as rural ITS deployments.	Existing
	TDOT Region 2 TMC – Chattanooga	Transportation management center for Region 2, located in Chattanooga. Responsible for the operation of the ITS equipment located in Region 2. This includes the freeway management system in Chattanooga as well as rural ITS deployments.	Existing
	TDOT Region 3 TMC – Nashville	Transportation management center for Region 3, located in Nashville. Responsible for the operation of the ITS equipment located in Region 3. This includes the freeway management system in Nashville as well as rural ITS deployments.	Existing
	TDOT Region 4 TMC – Memphis	Transportation management center for Region 4, located in Memphis. Responsible for the operation of the ITS equipment located in Region 4. This includes the freeway management system in Memphis as well as rural ITS deployments.	Existing
	TDOT RWIS Sensors	Road weather information system sensors to monitor weather conditions at the roadway.	Existing
	TDOT Smart Work Zone Equipment	Portable ITS equipment that can be used in work zones to more efficiently manage traffic and provide traveler information. Includes portable CCTV cameras, vehicle detection, and DMS.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
TDOT (continued)	TDOT SmartWay Information System (TSIS)	TSIS is a statewide roadway conditions database. Currently information can be entered by District and Regional maintenance personnel as well as staff at any of the TMCs and THP. TSIS feeds the Statewide 511 system and SmartWay website.	Existing
	TDOT SmartWay Website	Website providing road network conditions information. Much of the information for the website comes from TSIS. In areas that have an operational TDOT Region TMC, additional information may be available such as camera views.	Existing
	Tennessee 511 IVR	Tennessee 511 Interactive Voice Response. TDOT contracts the IVR operation to a vendor. The IVR accepts callers' requests and provides responses to specific traveler information needs. This is the customer interface component of the 511 phone system.	Existing
	Tennessee 511 System	511 traveler information system central server.	Existing
	Tennessee GoSmart Kiosks	Kiosks in rest areas that provide traveler information, including weather, road, and travel conditions.	Existing
TEMA	TEMA	The Tennessee Emergency Management Agency manages emergency operations during a disaster or large scale incident.	Existing
Tennessee Bureau of Investigation	Tennessee Bureau of Investigation	Responsible for issuing statewide AMBER Alerts in Tennessee.	Existing
Tennessee Department of Health and Human Services	Health and Human Services	Provides health related services including the subsidization of transportation to obtain medical services.	Existing
THP	THP Dispatch	Tennessee Highway Patrol dispatch center. There are several THP dispatch centers around the state of Tennessee.	Existing
	THP Vehicles	Tennessee Highway Patrol vehicles.	Existing
	TraCS Database	Traffic and Criminal Software owned by the Tennessee Department of Safety. THP operates the system.	Existing
Town of Abingdon VA	Town of Abingdon VA CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Planned
	Town of Abingdon VA Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, RTMS or traditional loops.	Planned

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
Town of Abingdon VA (continued)	Town of Abingdon VA Rail Notification System	Roadway equipment used to alert motorists that a crossing is currently blocked by a train.	Existing
	Town of Abingdon VA TOC	Traffic operations center for the Town of Abingdon. Responsible for operations of the traffic signal system and CCTV cameras.	Planned
	Town of Abingdon VA Traffic Signals	Traffic signal system for the Town of Abingdon.	Existing
	Town of Abingdon VA Website	Website for the Town of Abingdon VA. Includes information on City departments and in the future it is envisioned that the website will have real-time information about roadway conditions.	Existing
VDOT	VDOT Archive	Data archive for the transportation related data in Virginia.	Planned
	VDOT Bristol District	Responsible for the operation of the traffic signal system in the Bristol District and any future CCTV cameras or DMS.	Existing
	VDOT Bristol District Administrator's Office	The Bristol District administrator's office is responsible for administration of maintenance and construction projects within the Bristol District as well as communicating work zone information to the public through the Public Information Office.	Existing
	VDOT Bristol District Maintenance	The Virginia Department of Transportation's maintenance for the Bristol District.	Existing
	VDOT CB Wizard Broadcast Device	Portable CB broadcasting equipment used to disseminate traveler information to those with CB radios, primarily commercial vehicles. The equipment is used for Bristol Motor Speedway events and other large scale events and incidents.	Existing
	VDOT CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Existing
	VDOT DMS	Dynamic message signs for traffic information dissemination.	Existing
	VDOT Emergency Services Coordinator	The Virginia Department of Transportation emergency services coordinator is responsible for managing the VDOT response in a large scale incident or disaster in which the Virginia Statewide EOC is activated.	Existing
	VDOT Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, RTMS or traditional loops.	Existing
	VDOT HAR	Highway advisory radio for traffic information dissemination.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
VDOT (continued)	VDOT Maintenance Vehicles	Virginia Department of Transportation vehicles used in maintenance operations.	Existing
	VDOT Overheight Vehicle Detection	Sensors that detect overheight vehicles on the approach to a height restricted underpass. The sensors trigger beacon warning signs and DMS to notify the driver.	Existing
	VDOT Public Information Office	The office responsible for the dissemination of traffic information to the media and the public.	Existing
	VDOT RWIS Sensors	Road weather information system sensors to monitor road conditions for the Virginia Department of Transportation.	Planned
	VDOT Smart Work Zone Equipment	Portable ITS equipment that can be used in work zones to more efficiently manage traffic and provide traveler information. Includes portable CCTV cameras, vehicle detection, and DMS.	Planned
	VDOT Special Event Command Center	The special event command center combines traffic management and emergency management operations during special events in the Region, primarily for races at the Bristol Motor Speedway.	Existing
	VDOT SSP Dispatch	Currently the Safety Service Patrol comes to the Region for Bristol Motor Speedway events.	Existing
	VDOT SSP Vehicles	Vehicles operated by the VDOT Safety Service Patrol.	Existing
	VDOT TMC – Hampton Roads	VDOT traffic management center located in Hampton Roads and responsible for the operation of ITS equipment in the Hampton Roads region.	Existing
	VDOT TMC – Northern Virginia	VDOT traffic management center located in Northern Virginia and responsible for the operation of ITS equipment in the Northern Virginia region.	Existing
	VDOT TMC – Richmond	VDOT traffic management center located in Richmond and responsible for the operation of ITS equipment in the Richmond region.	Existing
	VDOT TMC – Salem	Traffic management center located in Salem. Responsible for the operation of the ITS equipment located in the Salem region, including the Bristol District.	Existing
	VDOT TMC – Staunton	VDOT traffic management center located in Staunton and responsible for the operation of ITS equipment in the Staunton region. The TMC in Staunton also has backup capability for the TMC in Salem.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
VDOT (continued)	VDOT Traffic Signals	Traffic signal system operated by the Virginia Department of Transportation.	Existing
	VDOT Website	Website for the Virginia Department of Transportation.	Existing
	Virginia 511	511 traveler information system central server.	Existing
	Virginia 511 IVR	Virginia 511 Interactive Voice Response. The IVR accepts callers' requests and provides responses to specific traveler information needs. This is the customer interface component of the 511 phone system.	Existing
	Virginia 511 Website	Website for the Commonwealth of Virginia's 511 traveler information system.	Existing
	Virginia Traffic	Virginia Traffic is a statewide roadway conditions database. Currently information can be entered by VDOT staff only. Virginia Traffic feeds the Statewide 511 system.	Existing
VSP	Virginia Statewide EOC	Emergency Operations Center for the Commonwealth of Virginia.	Existing
	VSP Crash Record Database	Database for the archiving of information on recordable crashes in Virginia. The database is maintained by the Virginia State Police.	Existing
	VSP Dispatch	Virginia State Police Dispatch.	Existing
	VSP Missing Children Clearinghouse	Division of the Virginia State Police that is responsible for AMBER Alerts.	Existing
	VSP Vehicles	Vehicles for the Virginia State Police.	Existing
Washington County TN	Washington County TN 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Washington County TN EMA	Emergency management agency for Washington County TN. Responsible for disaster planning for the County and operating the emergency operations center.	Existing
Washington County VA	Washington County VA 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Washington County VA Department of Emergency Services	Emergency management agency for Washington County VA. Responsible for communications with the Virginia Statewide EOC and coordination of local resources during a disaster or large scale incident.	Existing
	Washington County VA Public Safety Vehicles	Vehicles used by public safety in Washington County, including the Washington County Sheriff's Office.	Existing

Table 4 – Bristol Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
Washington County VA (continued)	Washington County VA Sheriff's Department	Law enforcement agency for Washington County VA. The emergency dispatch functions for the Sheriff's Department are included in the Washington County VA 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing

3.3.3 Top Level Regional System Interconnect Diagram

A system interconnect diagram, or "sausage diagram" (shown previously in **Figure 3**), shows the systems and primary interconnects in the Region. The National ITS Architecture interconnect diagram has been customized for the Bristol Region based on the system inventory and information gathered from the stakeholders. **Figure 4** summarizes the existing and planned ITS elements for the Bristol Region in the context of a physical interconnect. Subsystems and elements specific to the Region are called out in the boxes surrounding the main interconnect diagram, and these are color-coded to the subsystem with which they are associated.
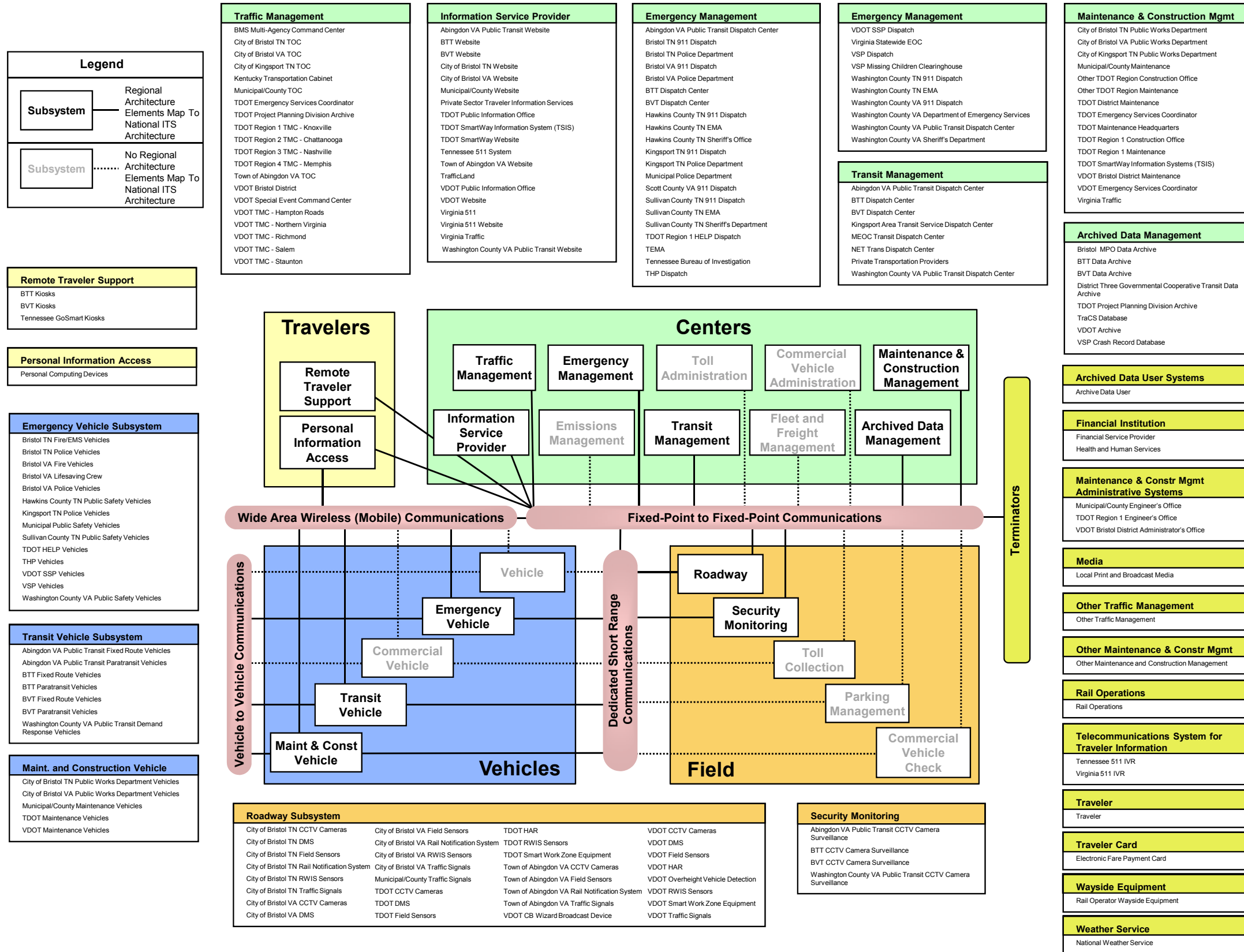
Legend

Subsystem	Regional Architecture Elements Map To National ITS Architecture
Subsystem	No Regional Architecture Elements Map To National ITS Architecture

Traffic Management
- BMS Multi-Agency Command Center
- City of Bristol TN TOC
- City of Bristol VA TOC
- City of Kingsport TN TOC
- Kentucky Transportation Cabinet
- Municipal/County TOC
- TDOT Emergency Services Coordinator
- TDOT Project Planning Division Archive
- TDOT Region 1 TMC - Knoxville
- TDOT Region 2 TMC - Chattanooga
- TDOT Region 3 TMC - Nashville
- TDOT Region 4 TMC - Memphis
- Town of Abingdon VA TOC
- VDOT Bristol District
- VDOT Special Event Command Center
- VDOT TMC - Hampton Roads
- VDOT TMC - Northern Virginia
- VDOT TMC - Richmond
- VDOT TMC - Salem
- VDOT TMC - Staunton

Information Service Provider
- Abingdon VA Public Transit Website
- BTT Website
- BVT Website
- City of Bristol TN Website
- City of Bristol VA Website
- Municipal/County Website
- Private Sector Traveler Information Services
- TDOT Public Information Office
- TDOT SmartWay Information System (TSIS)
- TDOT SmartWay Website
- Tennessee 511 System
- Town of Abingdon VA Website
- TrafficLand
- VDOT Public Information Office
- VDOT Website
- Virginia 511
- Virginia 511 Website
- Virginia Traffic
- Washington County VA Public Transit Website

Emergency Management
- Abingdon VA Public Transit Dispatch Center
- Bristol TN 911 Dispatch
- Bristol TN Police Department
- Bristol VA 911 Dispatch
- Bristol VA Police Department
- BTT Dispatch Center
- BVT Dispatch Center
- Hawkins County TN 911 Dispatch
- Hawkins County TN EMA
- Hawkins County TN Sheriff's Office
- Kingsport TN 911 Dispatch
- Kingsport TN Police Department
- Municipal Police Department
- Scott County VA 911 Dispatch
- Sullivan County TN 911 Dispatch
- Sullivan County TN EMA
- Sullivan County TN Sheriff's Department
- TDOT Region 1 HELP Dispatch
- TEMA
- Tennessee Bureau of Investigation
- THP Dispatch

Emergency Management
- VDOT SSP Dispatch
- Virginia Statewide EOC
- VSP Dispatch
- VSP Missing Children Clearinghouse
- Washington County TN 911 Dispatch
- Washington County TN EMA
- Washington County VA 911 Dispatch
- Washington County VA Department of Emergency Services
- Washington County VA Public Transit Dispatch Center
- Washington County VA Sheriff's Department

Transit Management
- Abingdon VA Public Transit Dispatch Center
- BTT Dispatch Center
- BVT Dispatch Center
- Kingsport Area Transit Service Dispatch Center
- MEOC Transit Dispatch Center
- NET Trans Dispatch Center
- Private Transportation Providers
- Washington County VA Public Transit Dispatch Center

Maintenance & Construction Mgmt
- City of Bristol TN Public Works Department
- City of Bristol VA Public Works Department
- City of Kingsport TN Public Works Department
- Municipal/County Maintenance
- Other TDOT Region Construction Office
- Other TDOT Region Maintenance
- TDOT District Maintenance
- TDOT Emergency Services Coordinator
- TDOT Maintenance Headquarters
- TDOT Region 1 Construction Office
- TDOT Region 1 Maintenance
- TDOT SmartWay Information Systems (TSIS)
- VDOT Bristol District Maintenance
- VDOT Emergency Services Coordinator
- Virginia Traffic

Archived Data Management
- Bristol MPO Data Archive
- BTT Data Archive
- BVT Data Archive
- District Three Governmental Cooperative Transit Data Archive
- TDOT Project Planning Division Archive
- TraCS Database
- VDOT Archive
- VSP Crash Record Database

Archived Data User Systems
- Archive Data User

Financial Institution
- Financial Service Provider
- Health and Human Services

Maintenance & Constr Mgmt Administrative Systems
- Municipal/County Engineer's Office
- TDOT Region 1 Engineer's Office
- VDOT Bristol District Administrator's Office

Media
- Local Print and Broadcast Media

Other Traffic Management
- Other Traffic Management

Other Maintenance & Constr Mgmt
- Other Maintenance and Construction Management

Rail Operations
- Rail Operations

Telecommunications System for Traveler Information
- Tennessee 511 IVR
- Virginia 511 IVR

Traveler
- Traveler

Traveler Card
- Electronic Fare Payment Card

Wayside Equipment
- Rail Operator Wayside Equipment

Weather Service
- National Weather Service

Remote Traveler Support
- BTT Kiosks
- BVT Kiosks
- Tennessee GoSmart Kiosks

Personal Information Access
- Personal Computing Devices

Emergency Vehicle Subsystem
- Bristol TN Fire/EMS Vehicles
- Bristol TN Police Vehicles
- Bristol VA Fire Vehicles
- Bristol VA Lifesaving Crew
- Bristol VA Police Vehicles
- Hawkins County TN Public Safety Vehicles
- Kingsport TN Police Vehicles
- Municipal Public Safety Vehicles
- Sullivan County TN Public Safety Vehicles
- TDOT HELP Vehicles
- THP Vehicles
- VDOT SSP Vehicles
- VSP Vehicles
- Washington County VA Public Safety Vehicles

Transit Vehicle Subsystem
- Abingdon VA Public Transit Fixed Route Vehicles
- Abingdon VA Public Transit Paratransit Vehicles
- BTT Fixed Route Vehicles
- BTT Paratransit Vehicles
- BVT Fixed Route Vehicles
- BVT Paratransit Vehicles
- Washington County VA Public Transit Demand Response Vehicles

Maint. and Construction Vehicle
- City of Bristol TN Public Works Department Vehicles
- City of Bristol VA Public Works Department Vehicles
- Municipal/County Maintenance Vehicles
- TDOT Maintenance Vehicles
- VDOT Maintenance Vehicles

Travelers
- Remote Traveler Support
- Personal Information Access

Centers
- Traffic Management
- Emergency Management
- Toll Administration
- Commercial Vehicle Administration
- Maintenance & Construction Management
- Information Service Provider
- Emissions Management
- Transit Management
- Fleet and Freight Management
- Archived Data Management

Terminators

Wide Area Wireless (Mobile) Communications — Fixed-Point to Fixed-Point Communications

Vehicle to Vehicle Communications

Vehicles
- Vehicle
- Emergency Vehicle
- Commercial Vehicle
- Transit Vehicle
- Maint & Const Vehicle

Dedicated Short Range Communications

Field
- Roadway
- Security Monitoring
- Toll Collection
- Parking Management
- Commercial Vehicle Check

Roadway Subsystem
- City of Bristol TN CCTV Cameras
- City of Bristol TN DMS
- City of Bristol TN Field Sensors
- City of Bristol TN Rail Notification System
- City of Bristol TN RWIS Sensors
- City of Bristol TN Traffic Signals
- City of Bristol VA CCTV Cameras
- City of Bristol VA DMS
- City of Bristol VA Field Sensors
- City of Bristol VA Rail Notification System
- City of Bristol VA RWIS Sensors
- City of Bristol VA Traffic Signals
- Municipal/County Traffic Signals
- TDOT CCTV Cameras
- TDOT DMS
- TDOT Field Sensors
- TDOT HAR
- TDOT RWIS Sensors
- TDOT Smart Work Zone Equipment
- Town of Abingdon VA CCTV Cameras
- Town of Abingdon VA Field Sensors
- Town of Abingdon VA Rail Notification System
- Town of Abingdon VA Traffic Signals
- VDOT CB Wizard Broadcast Device
- VDOT CCTV Cameras
- VDOT DMS
- VDOT Field Sensors
- VDOT HAR
- VDOT Overheight Vehicle Detection
- VDOT RWIS Sensors
- VDOT Smart Work Zone Equipment
- VDOT Traffic Signals

Security Monitoring
- Abingdon VA Public Transit CCTV Camera Surveillance
- BTT CCTV Camera Surveillance
- BVT CCTV Camera Surveillance
- Washington County VA Public Transit CCTV Camera Surveillance

Figure 4 – Bristol Regional System Interconnect Diagram

3.4 Market Packages

Upon completion of the system inventory, the next step in the development of the Regional ITS Architecture was to identify the ITS services that are important to the Bristol Region. In the National ITS Architecture, services are referred to as market packages. Market packages can include several stakeholders and elements that work together to provide a service in the Region. Examples of market packages from the National ITS Architecture include Network Surveillance, Traffic Information Dissemination, and Transit Vehicle Tracking. There are currently a total of 91 market packages identified in the National ITS Architecture Version 6.0.

The market packages are grouped together into eight ITS service areas: Traffic Management, Emergency Management, Maintenance and Construction Management, Public Transportation Management, Commercial Vehicle Operations, Traveler Information, Archived Data Management, and Vehicle Safety. As mentioned earlier in Section 3.1, Vehicle Safety was not included in the Bristol Regional ITS Architecture because implementation of those market packages would primarily be by private sector automobile manufacturers and information service providers.

3.4.1 Selection and Prioritization of Regional Market Packages

In the Bristol Region, the National ITS Architecture market packages were reviewed by the stakeholders and selected based on the relevance of the service that the market package could provide to the Region. Stakeholders selected 32 market packages for implementation in the Region. They are identified in **Table 5**. Stakeholders prioritized the selected market packages during the workshop, and the table organizes the market packages into service areas and priority groupings.

TDOT is leading a separate effort to develop and implement the CVISN program. CVISN addresses commercial vehicle operations, including ITS, on a statewide level and includes such applications as electronic clearance, safety enforcement, and registration. Unless a specific need was identified in the Bristol Region that could be addressed locally, the commercial vehicle operations market packages were not selected and instead will be covered in the CVISN effort to ensure consistency.

After selecting the market packages that were applicable for the Region, stakeholders reviewed each market package and the elements that could be included to customize it for the Region. This customization is discussed further in the following section.

Table 5 – Bristol Region Market Package Prioritization by Functional Area

High Priority Market Packages	Medium Priority Market Packages	Low Priority Market Packages
Travel and Traffic Management		
ATMS01 Network Surveillance ATMS03 Surface Street Control ATMS06 Traffic Information Dissemination ATMS08 Traffic Incident Management System	ATMS07 Regional Traffic Management ATMS13 Standard Railroad Grade Crossing	ATMS15 Railroad Operations Coordination
Emergency Management		
EM01 Emergency Call-Taking and Dispatch EM02 Emergency Routing EM06 Wide-Area Alert EM10 Disaster Traveler Information	EM04 Roadway Service Patrols EM08 Disaster Response and Recovery EM09 Evacuation and Reentry Management	
Maintenance and Construction Management		
MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution MC08 Work Zone Management MC10 Maintenance and Construction Activity Coordination	MC01 Maintenance and Construction Vehicle and Equipment Tracking	MC06 Winter Maintenance
Public Transportation Management		
APTS01 Transit Vehicle Tracking APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations APTS05 Transit Security	APTS04 Transit Fare Collection Management APTS07 Multi-modal Coordination APTS08 Transit Traveler Information APTS10 Transit Passenger Counting	
Traveler Information		
ATIS01 Broadcast Traveler Information ATIS02 Interactive Traveler Information		
Archived Data Management		
	AD1 ITS Data Mart	AD2 ITS Data Warehouse

3.4.2 Customized Market Packages

The market packages in the National ITS Architecture were customized to reflect the unique systems, subsystems, and terminators in the Bristol Region. Market packages represent a service that will be deployed as an integrated capability. Each market package is shown graphically with the market package name, local agencies involved, and desired data flows. The data flows are shown as either existing or planned/future. Data flows shown as existing indicate that in at least one location within the jurisdiction the connection exists. Data flows shown as existing should not be interpreted to mean that deployment of that service is complete as there are many cases where a data flow exists in a service but a need has been identified to expand the service to additional locations.

Figure 5 is an example of an Advanced Traffic Management System (ATMS) market package for Surface Street Control that has been customized for the Region. This market package shows the two subsystems, Traffic Management and Roadway, and the associated entities (City of Bristol TN TOC and City of Bristol TN Traffic Signals) for surface street control in the Region. Data flows between the subsystems indicate what information is being shared. The remainder of the market packages that were customized for the Bristol Region are shown in **Appendices B and C** along with a market package diagram component and terminology key.
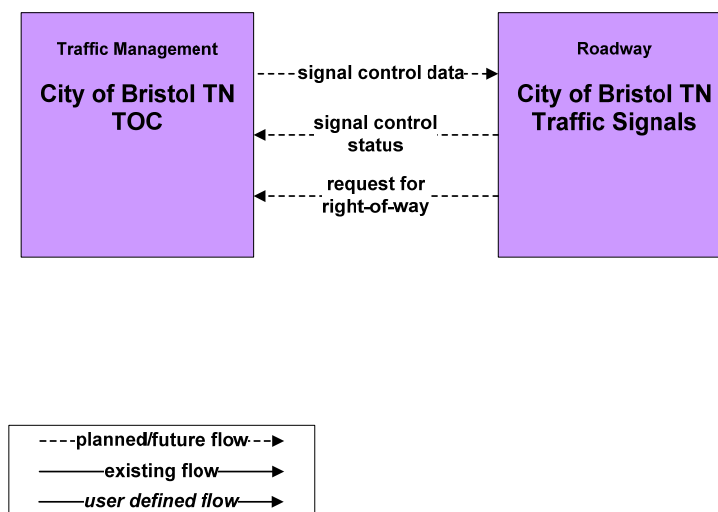
Figure 5 – Example Market Package Diagram: ATMS03 – Surface Street Control

3.4.3 Shared Bristol and Kingsport Market Packages

As mentioned previously in Section 1.3.2, stakeholders in the Bristol and Kingsport Regions determined that the best way to maintain consistency in the way that the market packages that impact both Regions were documented was to develop one set of diagrams that would be included in both Regions. The market packages shown in **Table 6** are shared between the Bristol and Kingsport Regions.

Table 6 – Bristol and Kingsport Regions Shared Market Packages

Market Package		Instance
ATMS01	Network Surveillance	TDOT Region 1 TMC – Knoxville
ATMS01	Network Surveillance	VDOT TMC – Salem
ATMS01	Network Surveillance	VDOT Bristol District
ATMS01	Network Surveillance	VDOT Overheight Vehicle Detection
ATMS03	Surface Street Control	VDOT Signal System
ATMS03	Surface Street Control	Municipal/County Signal System
ATMS06	Traffic Information Dissemination	TDOT Region 1 TMC – Knoxville
ATMS06	Traffic Information Dissemination	VDOT Bristol District
ATMS07	Regional Traffic Management	TDOT Region 1 TMC – Knoxville
ATMS07	Regional Traffic Management	VDOT TMC – Salem
ATMS07	Regional Traffic Management	VDOT Bristol District
ATMS07	Regional Traffic Management	Municipal/County
ATMS08	Traffic Incident Management System	TDOT Region 1 TMC – Knoxville
ATMS08	Traffic Incident Management System	VDOT TMC – Salem and Bristol District
ATMS13	Standard Railroad Grade Crossing	Municipal/County
ATMS15	Railroad Operations Coordination	Municipal/County
EM01	Emergency Call Taking and Dispatch	Tennessee Highway Patrol
EM01	Emergency Call Taking and Dispatch	Virginia State Police
EM01	Emergency Call Taking and Dispatch	Sullivan County TN 911 Dispatch
EM04	Roadway Service Patrols	HELP
EM04	Roadway Service Patrols	VDOT Safety Service Patrol
EM06	Wide Area Alert	Tennessee AMBER Alert
EM06	Wide Area Alert	Virginia AMBER Alert
EM08	Disaster Response and Recovery	TEMA
EM08	Disaster Response and Recovery	Virginia Statewide Emergency Operations
EM08	Disaster Response and Recovery	Sullivan County TN EMA
EM09	Evacuation and Reentry Management	TEMA
EM09	Evacuation and Reentry Management	Virginia Statewide EOC
EM09	Evacuation and Reentry Management	Sullivan County TN EMA
EM10	Disaster Traveler Information	Tennessee 511 and TSIS
EM10	Disaster Traveler Information	Virginia 511
MC01	Maintenance and Construction Vehicle and Equipment Tracking	TDOT District Maintenance
MC01	Maintenance and Construction Vehicle and Equipment Tracking	VDOT Bristol District Maintenance
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Municipal/County Maintenance
MC03	Road Weather Data Collection	TDOT RWIS
MC03	Road Weather Data Collection	VDOT RWIS

Table 6 – Bristol and Kingsport Regions Shared Market Packages (continued)

	Market Package	Instance
MC04	Weather Information Processing and Distribution	TDOT Region 1 Maintenance
MC04	Weather Information Processing and Distribution	VDOT Bristol District Maintenance
MC06	Winter Maintenance	TDOT
MC06	Winter Maintenance	VDOT
MC08	Work Zone Management	TDOT District Maintenance
MC08	Work Zone Management	TDOT Region 1 Construction Office
MC08	Work Zone Management	VDOT District Maintenance
MC08	Work Zone Management	Municipal/County
MC10	Maintenance and Construction Activity Coordination	TDOT
MC10	Maintenance and Construction Activity Coordination	VDOT
MC10	Maintenance and Construction Activity Coordination	Municipal/County
ATIS01	Broadcast Traveler Information	TSIS
ATIS01	Broadcast Traveler Information	Virginia Traffic
ATIS02	Interactive Traveler Information	Tennessee GoSmart Kiosks and TDOT SmartWay Website
ATIS02	Interactive Traveler Information	Tennessee 511
ATIS02	Interactive Traveler Information	Virginia 511
AD1	ITS Data Mart	TDOT
AD1	ITS Data Mart	VDOT
AD1	ITS Data Mart	TraCS
AD1	ITS Data Mart	VSP Crash Record Database

There are two distinctions that apply to these market packages because they are included in both Regions. First, there are elements included in them that would not normally be included in the architecture of an adjacent Region. For example, the Kingsport 911 Dispatch would not typically show up in the TDOT Region 1 instance of the ATMS08: Incident Management market package for the Bristol Region, but to maintain consistency between the Regions has been included so that the instance included in each architecture is identical. The second distinction is that if a change needs to be made to one of these market packages, it will need to be made in both the Bristol and Kingsport Regional ITS Architectures to maintain the consistency. The overlap market packages can be found in **Appendix B**.

3.4.4   Regional ITS Needs and Customized Market Packages

Input received from stakeholders at the Kick-Off Workshop provided valuable input for the market package customization process. The specific needs identified at that workshop are included in **Table 7**. The table also identifies which market package documents the particular ITS need. As market packages from the National ITS Architecture were reviewed with stakeholders, a number of them were selected and customized for the Region

to address more general needs that were not specifically identified at the Kick-Off Workshop.

Table 7 – Regional ITS Needs and Corresponding Market Packages

ITS Need	Market Package
Travel and Traffic Management	
Need network surveillance capabilities on I-81 and I-26	ATMS01
Need CCTV cameras and DMS on detour routes	ATMS01
	ATMS06
Need TMC capabilities at the VDOT Bristol District Office	ATMS01
	ATMS06
	ATMS08
Need coordinated and closed loop signal systems for the Cities of Bristol Tennessee and Bristol Virginia	ATMS03
Emergency Management	
Need emergency vehicle traffic signal preemption in the Cities of Bristol Tennessee and Bristol Virginia	EM02
Need VDOT courtesy patrol along I-81	EM04
Need TDOT HELP patrol in the Tri-Cities area	EM04

3.5 Architecture Interfaces

While it is important to identify the various systems and stakeholders as part of a regional ITS, a primary purpose of the ITS architecture is to identify the connectivity between transportation systems in the Bristol Region. The system interconnect diagram shown previously in **Figure 4** showed the high-level relationships of the subsystems and terminators in the Bristol Region and the associated local projects and systems. The customized market packages represent services that can be deployed as an integrated capability and the market package diagrams show the information flows between the subsystems and terminators that are most important to the operation of the market packages. How these systems interface with each other is an integral part of the overall ITS architecture.

3.5.1 Element Connections

A large number of different elements are identified as part of the Bristol Regional ITS Architecture. These elements include TMCs, transit vehicles, dispatch systems, emergency management agencies, media outlets, and others—essentially, all of the existing and planned physical components that contribute to the regional ITS. Interfaces have been identified for each element in the Bristol Regional ITS Architecture and each element has been mapped to those other elements with which it must interface. The Turbo Architecture software can generate interconnect diagrams for each element in the Region that show which elements are connected to one another. **Figure 6** is an example of an interconnect diagram from the Turbo database output. This particular interconnect diagram is for the City of Bristol VA Traffic Signals.
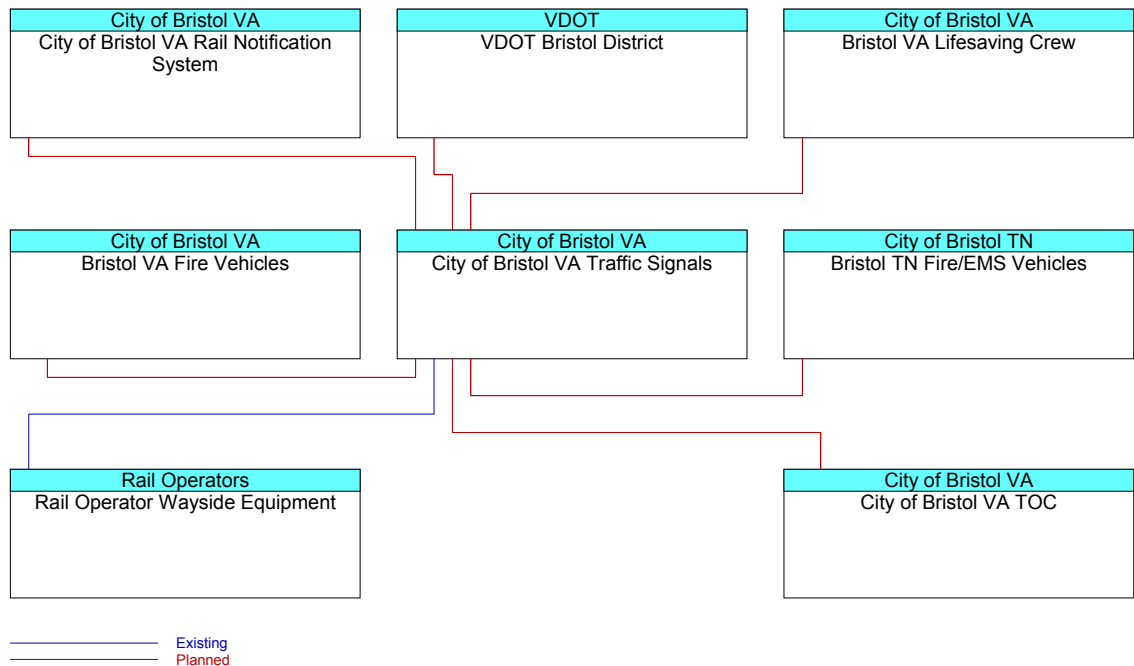
Figure 6 – Example Interconnect Diagram: City of Bristol VA Traffic Signals

3.5.2   Data Flows Between Elements

In the market package diagrams, flows between the subsystems and terminators define the specific information (data) that is exchanged between the elements and the direction of the exchange. The data flows could be requests for information, alerts and messages, status requests, broadcast advisories, event messages, confirmations, electronic credentials, and other key information requirements. Turbo Architecture can be used to output flow diagrams and can be filtered by market package for ease of interpretation; however, it is important to remember that custom data flows will not show up in diagrams that are filtered by market package. An example of a flow diagram for Bristol Tennessee Transit that has been filtered for the APTS2 – Transit Fixed Route Operations market package is shown in **Figure 7**.
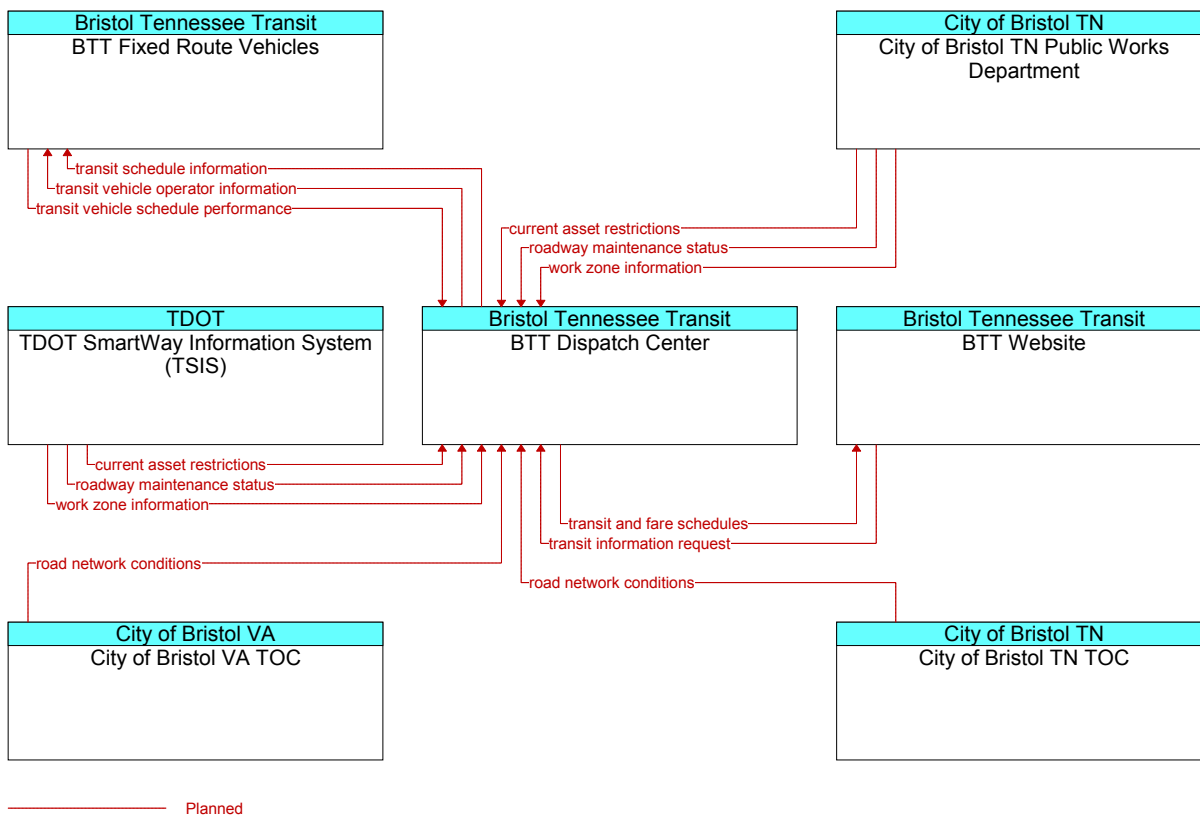
Figure 7 – Example Flow Diagram: APTS02 – Transit Fixed Route Operations

4. APPLICATION OF THE REGIONAL ITS ARCHITECTURE

Once a region has identified the desired components of ITS for their area and established which agencies and systems need to be connected, the structure of the National ITS Architecture assists with the region's ITS planning and implementation. This section addresses the application of the Regional ITS Architecture in the Bristol Region. The National ITS Architecture provides recommendations for standards and functional requirements that should be considered when implementing ITS elements. In addition, an operational concept has been developed for the Region and documents the roles and responsibilities of stakeholders in the operation of the regional ITS. The implementation of ITS in the Bristol Region will likely require interagency agreements. Potential agreements have been identified based on the desired data flows identified in the Bristol Region. The Regional ITS Architecture and ITS Deployment Plan developed as part of this process will be incorporated into the existing planning process for the Region to ensure that the maximum benefit is realized from the development effort.

4.1 Functional Requirements

Functions are a description of what the system has to do. In the National ITS Architecture, functions are defined at several different levels, ranging from general subsystem descriptions through somewhat more specific equipment package descriptions to Process Specifications that include substantial detail. Guidance from the USDOT on developing a Regional ITS Architecture recommends that each Region determine the level of detail of the functional requirements for their Region. In the Bristol Region, it is recommended that the development of detailed functional requirements such as the "shall" statements included in Process Specifications for a system be developed at the project level. These detailed "shall" statements identify all functions that a project or system needs to perform.

For the Bristol Regional ITS Architecture, functional requirements have been identified at two levels. The customized market packages, discussed previously in Section 3.4.2, describe the services that ITS needs to provide in the Region and the architecture flows between the elements. These market packages and data flows describe what ITS in the Bristol Region has to do and the data that needs to be shared among elements.

At a more detailed level, functional requirements for the Bristol Region are described in terms of functions that each element in the architecture performs or will perform in the future. **Appendix D** contains a table that summarizes the functions by element.

4.2 Standards

Standards are an important tool that will allow efficient implementation of the elements in the Bristol Regional ITS Architecture over time. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances, vendors change, and as new approaches evolve. The USDOT's ITS Joint Program Office is supporting Standards Development Organizations (SDOs) with an extensive, multi-year program of accelerated, consensus-based standards development to facilitate successful ITS deployment in the United States. **Table 8** identifies each of the ITS standards that could apply to the Bristol Regional ITS Architecture. These standards are based on the physical subsystem architecture flows previously identified in Section 3.5.2.
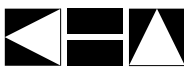
Table 8 – Bristol Region Applicable ITS Standards

SDO	Document ID	Title
AASHTO/ITE/NEMA	NTCIP 1102	Octet Encoding Rules Base Protocol
	NTCIP 1103	Transportation Management Protocols
	NTCIP 1104	Center-to-Center Naming Convention Specification
	NTCIP 1201	Global Object Definitions
	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller Units
	NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)
	NTCIP 1204	Object Definitions for Environmental Sensor Stations
	NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control
	NTCIP 1208	Object Definition for CCTV Camera Switching
	NTCIP 1209	Data Element Definitions for Transportation Sensor Systems
	NTCIP 1210	Field Management Stations – Part 1: Object Definitions for Signal System Masters
	NTCIP 1211	Object Definitions for Signal Control and Prioritization
	NTCIP 2101	Point to Multi-Point Protocol Using RS-232 Subnetwork Profile
	NTCIP 2102	Point to Multi-Point Protocol Using Frequency Shift Keying Modem Subnetwork Profile
	NTCIP 2103	Point-to-Point Protocol Over RS-232 Subnetwork Profile
	NTCIP 2104	Ethernet Subnetwork Profile
	NTCIP 2201	Transportation Transport Profile
	NTCIP 2202	Internet Transmission Control Protocol/Internet Protocol (TCP/IP) and Universal Datagram Protocol/Internet Protocol (UDP/IP) Transport Profile
	NTCIP 2301	Simple Transportation Management Framework Application Profile
	NTCIP 2302	Trivial File Transfer Protocol Application Profile
	NTCIP 2303	File Transfer Protocol Application Profile
	NTCIP 2304	Application Profile for DATEX-ASN (AP-DATEX)
	NTCIP 2306	Application Profile for Extensible Markup Language (XML) Message Encoding and Transport in ITS Center-to-Center Communications
AASHTO/ITE	ITE TMDD 2.1	Traffic Management Data Dictionary and Message Sets for External TMC Communications (TMDD and MS/ETMCC)
APTA	APTA TCIP-S-001 3.0.0	Standard for Transit Communications Interface Profiles
ASTM	ASTM E2213-03	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems – 5 GHz Band Dedicated Short Range Communication Medium Access Control and Physical Layer Specifications
	ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems
	ASTM WK7604	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data

Table 8 – Bristol Region Applicable ITS Standards (continued)

SDO	Document ID	Title
IEEE	IEEE 1512-2006	Standard for Common Incident Management Message Sets for use by Emergency Management Centers
	IEEE 1512.1-2006	Standard for Traffic Incident Management Message Sets for Use by Emergency Management Centers
	IEEE 1512.2-2004	Standard for Public Safety Traffic Management Message Sets for use by Emergency Management Centers
	IEEE 1512.3-2006	Standard for Hazardous Material Incident Management Sets for Use by Emergency Management Centers
	IEEE 1570-2002	Standard for Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection
	IEEE 1609.1 – 2006	Standard for Wireless Access in Vehicular Environments (WAVE) – Resource Manager
	IEEE 1609.2 – 2006	Standard for WAVE – Security Services for Applications and Management Messages
	IEEE 1609.4 – 2006	Standard for WAVE – Multi-Channel Operation
	IEEE P1609.3	Standard for WAVE – Networking Services
	IEEE P802.11p	Standard for Information Technology – Telecommunications and Information Exchange Between Systems – Local and Metropolitan Area Networks – Specific Requirements – Part II: Wireless Local Area Network (LAN) Medium Access Control and Physical Layer Specifications
	IEEE P1512.4	Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers
SAE	SAE J2266	Location Referencing Message Specification
	SAE J2354	Message Set for Advanced Traveler Information System (ATIS)
	SAE J2540	Messages for Handling Strings and Look-Up Tables in ATIS Standards
	SAE J2540/1	Radio Data System Phrase Lists
	SAE J2540/2	International Traveler Information Systems Phrase Lists
	SAE J2540/3	National Names Phrase List

4.3   Operational Concepts

An operational concept documents each stakeholder's current and future roles and responsibilities across a range of transportation services, as grouped in the Operational Concepts section of Turbo Architecture, in the operation of the regional ITS. The services covered are:

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

Table 9 identifies the current and future roles and responsibilities of key stakeholders for a range of transportation services based on the priorities identified in the Regional ITS Architecture.

Table 9 – Bristol Region Stakeholder Roles and Responsibilities

Transportation Service	Stakeholder	Roles/Responsibilities
Surface Street Management	City of Bristol TN	Operate and maintain traffic signal systems within the City.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on roadways within the City to facilitate traffic signal operations.
		Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle signal preemptions.
		Provide traffic signal preemption for emergency vehicles.
		Operate DMS for the distribution of traffic information and roadway conditions to travelers on the roadway.
	City of Bristol VA	Operate and maintain traffic signal systems within the City.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on roadways within the City to facilitate traffic signal operations.
		Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle signal preemptions.
		Provide traffic signal preemption for emergency vehicles.
		Operate DMS for the distribution of traffic information and roadway conditions to travelers on the roadway.
	Municipal/County Government	Operate and maintain traffic signal systems within their jurisdiction.
		Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle signal preemptions.
	Town of Abingdon VA	Operate and maintain traffic signal systems within the Town.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on roadways within the Town to facilitate traffic signal operations.
		Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle signal preemptions.
		Provide traffic signal preemption for emergency vehicles.
	VDOT	Operate and maintain traffic signal systems on state highways.
		Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle preemptions.
		Provide traffic signal preemption for emergency vehicles.

Table 9 – Bristol Region Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Freeway Management	TDOT	Operate DMS and HAR to distribute traffic information and roadway conditions to travelers on the roadway.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on state roadways.
		Operate motorist assistance patrol (HELP) to facilitate special event traffic control and incident management.
	VDOT	Operate DMS and HAR to distribute traffic information and roadway conditions to travelers on the roadway.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on state roadways.
		Operate overheight vehicle detection equipment and DMS to provide active advanced warnings of low overhead structures.
		Operate motorist assistance patrol (SSP) to facilitate special event traffic control and incident management.
Incident Management (Traffic)	City of Bristol TN	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate DMS to distribute incident information to travelers on the roadway.
		Responsible for coordination with other traffic and emergency management agencies for coordinated incident management.
		Coordinate maintenance resources for incident response.
	City of Bristol VA	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate DMS for the distribution of incident information to travelers on the roadway.
		Responsible for coordination with other traffic and emergency management agencies for coordinated incident management.
		Coordinate maintenance resources for incident response.
	TDOT	Remotely control traffic and video sensors from the Smartway TMC to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate DMS and HAR to distribute incident information to travelers on the roadway.

Transportation Service	Stakeholder	Roles/Responsibilities
Incident Management (Traffic) (continued)	TDOT (continued)	Responsible for coordination with other traffic and emergency management agencies for coordinated incident management.
		Responsible for the development, coordination, and execution of special traffic management strategies during an evacuation.
	Town of Abingdon	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Responsible for coordination with other traffic and emergency management agencies for coordinated incident management.
		Coordinate maintenance resources for incident response.
	VDOT	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate DMS and HAR to distribute incident information to travelers on the roadway.
		Responsible for coordination with other traffic and emergency management agencies for coordinated incident management.
		Responsible for the development, coordination, and execution of special traffic management strategies during an evacuation.
Incident Management (Emergency)	Bristol TN 911 Dispatch	Dispatch public safety vehicles to incidents.
		Coordinate incident response with the City of Bristol TN TOC and the TDOT SmartWay Center in Knoxville for incidents on state facilities as well as with other emergency dispatch agencies including the City of Bristol VA, Tennessee Highway Patrol, and Sullivan County TN.
	Bristol VA 911 Dispatch	Dispatch public safety vehicles to incidents.
		Coordinate incident response with the City of Bristol VA TOC, VDOT Bristol District, and VDOT TMC in Salem for incidents on state facilities as well as with other emergency dispatch agencies including the City of Bristol VA, Virginia State Police, and Washington County VA.
	Sullivan County TN 911 Dispatch	Dispatch public safety vehicles to incidents.
		Coordinate incident response with the City of Bristol TN TOC and the TDOT SmartWay Center in Knoxville for incidents on state facilities as well as with other emergency dispatch agencies including the City of Bristol TN and the Tennessee Highway Patrol.
	THP Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety and traffic management agencies as well as the TDOT SmartWay Center in Knoxville for incidents on state facilities.

Transportation Service	Stakeholder	Roles/Responsibilities
Incident Management (Emergency) (continued)	VSP Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety and traffic management agencies, the VDOT Bristol District and VDOT TMC in Salem for incidents on state facilities.
	Washington County VA 911 Dispatch	Dispatch public safety vehicles to incidents.
		Coordinate incident response with emergency dispatch agencies, the City of Bristol VA TOC, VDOT Bristol District, and VDOT TMC in Salem for incidents on state facilities.
Emergency Management	Bristol TN 911 Dispatch	Responsible for emergency call-taking for the City of Bristol TN as the 911 PSAP.
		Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Bristol VA 911 Dispatch	Responsible for emergency call-taking for the City of Bristol VA as the 911 PSAP.
		Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Sullivan County TN 911 Dispatch	Responsible for emergency call-taking for Sullivan County outside the City of Bristol TN and the City of Kingsport TN as the 911 PSAP.
		Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.

Transportation Service	Stakeholder	Roles/Responsibilities
Emergency Management (continued)	Sullivan County TN EMA	Operates the EOC for Sullivan County TN in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the County.
		Lead regional efforts for emergency planning to support large-scale incidents and disasters.
		Lead evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	TEMA	Operates the EOC for the State of Tennessee in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the State.
		Lead statewide efforts for emergency planning to support large-scale incidents and disasters.
		Lead evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Tennessee Bureau of Investigation	Responsible for the initiation of AMBER Alerts.
	THP Dispatch	Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Virginia Statewide EOC	Operates the EOC for the Commonwealth of Virginia in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the State.
		Lead statewide efforts for emergency planning to support large-scale incidents and disasters.
		Lead evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	VSP Dispatch	Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.

Transportation Service	Stakeholder	Roles/Responsibilities
Emergency Management (continued)	VSP Dispatch (continued)	Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	VSP Missing Children Clearinghouse	Responsible for the initiation of AMBER Alerts.
	Washington County VA 911 Dispatch	Responsible for emergency call-taking for Washington County including the Town of Abingdon.
		Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Washington County VA Department of Emergency Services	Operates the EOC for Washington County VA in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the County.
		Lead regional efforts for emergency planning to support large-scale incidents and disasters.
		Lead evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
Maintenance and Construction Management	City of Bristol TN Public Works Department	Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.
	City of Bristol VA Public Works Department	Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.

Transportation Service	Stakeholder	Roles/Responsibilities
Maintenance and Construction Management (continued)	Municipal/County Maintenance	Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.
	TDOT	Monitors environmental sensors and distributes information about road weather conditions.
		Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, HAR, and sharing of information with other groups.
		Responsible for entering and updating work zone information in TSIS.
		Disseminates work activity schedules and current asset restrictions to other agencies.
		Operates work zone traffic control equipment including portable surveillance equipment, DMS, and HAR transmitters.
	VDOT	Monitors environmental sensors and distributes information about road weather conditions.
		Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, HAR, and sharing of information with other groups.
		Responsible for entering and updating work zone information in Virginia Traffic.
		Disseminates work activity schedules and current asset restrictions to other agencies.
		Operates work zone traffic control equipment including portable surveillance equipment, DMS, and HAR transmitters.
Transit Management	Abingdon Public Transit	Operates fixed route and paratransit services from a central dispatch facility responsible for tracking their location and status.
		Provide transit passenger electronic fare payment on fixed route and demand response transit vehicles.
		Provide transit security on transit vehicles and at transit terminals through silent alarms and surveillance systems.
		Provide transit traveler information to the agency website, local private sector traveler information services, and the Virginia 511 system.

Transportation Service	Stakeholder	Roles/Responsibilities
Transit Management (continued)	Abingdon Public Transit (continued)	Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	BTT	Operates fixed route and paratransit services from a central dispatch facility responsible for tracking their location and status.
		Provide transit passenger electronic fare payment on fixed route and demand response transit vehicles.
		Provide transit security on transit vehicles and at transit terminals through silent alarms and surveillance systems.
		Provide transit traveler information to the agency website, local private sector traveler information services, and the Tennessee 511 system.
		Operates on-board systems to provide next stop annunciation.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	BVT	Operates fixed route and paratransit services from a central dispatch facility responsible for tracking their location and status.
		Provide transit passenger electronic fare payment on fixed route and demand response transit vehicles.
		Provide transit security on transit vehicles and at transit terminals through silent alarms and surveillance systems.
		Provide transit traveler information to the agency website, local private sector traveler information services, and the Virginia 511 system.
		Operates on-board systems to provide next stop annunciation.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Washington County VA Public Transit	Operates demand response transit services from a central dispatch facility responsible for tracking vehicle location and status.
		Provide transit passenger electronic fare payment on transit vehicles.
		Provide transit security on transit vehicles and at transit terminals through silent alarms and surveillance systems.
		Provide transit traveler information to the agency website, local private sector traveler information services, and the Virginia 511 system.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.

Table 9 – Bristol Region Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Traveler Information	City of Bristol TN	Responsible for the collection and distribution of traveler information including incident information and maintenance and construction closure information.
		Responsible for the collection and distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.
	City of Bristol VA	Responsible for the collection and distribution of traveler information including incident information and maintenance and construction closure information.
		Responsible for the collection and distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.
	TDOT	Collection, processing, storage, and broadcast dissemination of traffic, transit, maintenance and construction, special event, and weather information to travelers via the Tennessee 511 system.
		Provide transportation information to travelers via traveler information kiosks.
		Provide transportation network condition data to private sector information service providers.
	Town of Abingdon VA	Responsible for the collection and distribution of traveler information including incident information and maintenance and construction closure information.
		Responsible for the collection and distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.
	VDOT	Collection, processing, storage, and broadcast dissemination of traffic, transit, maintenance and construction, special event, and weather information to travelers via the Virginia 511 system.
		Provide transportation network condition data to private sector information service providers.
Archived Data Management	Bristol MPO	Collect and maintain data from regional traffic and transit management agencies.

4.4 Potential Agreements

The Regional ITS Architecture for the Bristol Region has identified many agency interfaces, information exchanges, and integration strategies that would be needed to provide the ITS services and systems identified by the stakeholders in the Region. Interfaces and data flows among public and private entities in the Region will require agreements among agencies that establish parameters for sharing agency information to support traffic management, incident management, provide traveler information, and perform other functions identified in the Regional ITS Architecture.

With the implementation of ITS technologies, integrating systems from one or more agencies, and the anticipated level of information exchange identified in the architecture, it is likely that formal agreements between agencies will be needed in the future. These agreements, while

perhaps not requiring a financial commitment from agencies in the Region, should outline specific roles, responsibilities, data exchanges, levels of authority, and other facets of regional operations. Some agreements will also outline specific funding responsibilities, where appropriate and applicable.

Agreements should avoid being specific with regard to technology when possible. Technology is likely to change and changes to technology could require an update of the agreement if the agreement was not technology-neutral. Focus of the agreement should be on the responsibilities of the agencies and the types of information that need to be exchanged. Depending on the type of agreement being used, agencies should be prepared for the process to complete an agreement to take several months to years. Agencies must first reach consensus on what should be in an agreement and then proceed through the approval process. The approval process for formal agreements varies by agency and can often be quite lengthy, so it is recommended that agencies plan ahead to ensure that the agreement does not delay the project.

When implementing an agreement for ITS, it is recommended that as a first step any existing agreements are reviewed to determine whether they can be amended or modified to include the additional requirements that will come with deploying a system. If there are no existing agreements that can be modified or used for ITS implementation, then a new agreement will need to be developed. The formality and type of agreement used is a key consideration. If the arrangement will be in effect for an extended duration or involve any sort of long term maintenance, then written agreements should be used. Often during long term operations, staff may change and a verbal agreement between agency representatives may be forgotten by new staff.

Common agreement types and potential applications include:

- *Handshake Agreement:* Handshake agreements are often used in the early stage of a project. This type of informal agreement depends very much on relationships between agencies and may not be appropriate for long term operations where staff is likely to change.
- *Memorandum of Understanding (MOU):* A MOU demonstrates general consensus but is not typically very detailed. MOUs often identify high-level goals and partnerships.
- *Interagency and Intergovernmental Agreements:* These agreements between public agencies can be used for operation, maintenance, or funding projects and systems. They can include documentation on the responsibility of each agency, functions they will provide, and liability.
- *Funding Agreements:* Funding agreements document the funding arrangements for ITS projects. At a minimum, funding agreements include a detailed scope, services to be performed, and a detailed project budget. Agency funding expectations or funding sources are also typically identified.
- *Master Agreements:* Master agreements include standard contract language for an agency and serve as the main agreement between two entities which guides all business transactions. Use of a master agreement can allow an agency to do business with another agency or private entity without having to go through the often lengthy development of a formal agreement each time.

Table 10 provides a list of existing and potential agreements for the Bristol Region based on the interfaces identified in the Regional ITS Architecture. It is important to note that as ITS services and systems are implemented in the Region, part of the planning and review process for those projects should include a review of potential agreements that would be needed for implementation or operations.

Table 10 – Bristol Region Existing and Potential Agreements

Status	Agreement and Agencies	Agreement Description
Future	**Data Sharing and Usage (Public-Private)** – (TDOT, VDOT, City of Bristol TN, City of Bristol VA, Town of Abingdon, Media)	Agreement would allow private sector media and information service providers to access and broadcast public sector transportation agency CCTV camera video feeds, real time traffic speed and volume data, and incident data. Agreements should specify the control priority to allow traffic agencies first priority to control cameras during incidents or other events. The ability of the traffic agency to deny access to video and data feeds if a situation warrants such action should also be part of the agreement.
Future	**Data Sharing and Usage (Public-Public)** – (TDOT, VDOT, City of Bristol TN, City of Bristol VA, Town of Abingdon)	Agreement would define the parameters, guidelines, and policies for inter-agency ITS data sharing between the public sector agencies including CCTV camera feeds. Similar to data sharing and usage agreements for public-private agencies, the agency that owns the equipment should have first priority of the equipment and the ability to discontinue data sharing if a situation warrants such action.
Future	**Traffic Signal Timing Data Sharing and Usage** – (City of Bristol TN, City of Bristol VA, VDOT)	Agreement would define the parameters, guidelines, and policies for inter-agency traffic signal timing sharing between cities, counties, and any other agencies that might maintain their traffic signal system.
Future	**Incident Data Sharing and Usage** – (TDOT, VDOT, City of Bristol TN, City of Bristol VA, Bristol TN 911 Dispatch, Bristol VA 911 Dispatch, Sullivan County TN 911 Dispatch, Washington County VA 911 Dispatch, THP, VSP)	Agreement would define the parameters, guidelines, and policies for inter-agency sharing of incident data between transportation and emergency management agencies in the Region. Incident information could be sent directly to computer-aided dispatch systems and include information on lane closures, travel delays, and weather.
Future	**Joint Operations Agreements –** (TDOT, VDOT, City of Bristol TN, City of Bristol VA, Bristol TN 911 Dispatch, Bristol VA 911 Dispatch, Sullivan County TN 911 Dispatch, Washington County VA 911 Dispatch, THP, VSP)	Agreement to operate the system from a shared control facility that could include traffic, transit, and emergency management. Examples could include a regional TMC or a combined TMC and EOC. Agreement will need to identify such issues as sharing of data and control of devices, cost sharing of the facilities, and standard operating procedures. Shared field equipment, such as a CCTV camera that can be accessed by multiple agencies could also be covered under this type of agreement.
Future	**Shared Maintenance Agreements** – (City of Bristol TN, City of Bristol VA, Municipal/County)	Agreement that would allow multiple public agencies to pool their funding together to hire a single maintenance contractor to maintain ITS devices throughout the Region. This type of agreement may reduce the cost of maintenance particularly for agencies with a limited number of ITS devices deployed. By combining all maintenance into a single contract the need for each agency to provide specialized training and equipment to staff is eliminated.

4.5 Phases of Implementation

The Bristol Regional ITS Architecture will be implemented over time through a series of projects. Key foundation systems will need to be implemented in order to support other systems that have been identified in the Regional ITS Architecture. The deployment of all of the systems required to achieve the final Regional ITS Architecture build out will occur over many years.

A sequence of projects and their respective time frames have been identified in the Bristol Regional ITS Deployment Plan. These projects have been sequenced over a 20-year period, with projects identified for deployment in 5-, 10- and 20-year timeframes.

Some of the key market packages that will provide the functions for the foundation systems in the Bristol Region are listed below. Projects associated with these and other market packages identified for the Region have been included in the Bristol Regional ITS Deployment Plan.

- ATMS01 – Network Surveillance;
- ATMS03 – Surface Street Control;
- ATMS06 – Traffic Information Dissemination; and
- APTS01 – Transit Vehicle Tracking.

4.6   Incorporation into the Regional Planning Process

Stakeholders invested a considerable amount of effort in the development of the Regional ITS Architecture and Deployment Plan for the Bristol Region. The Regional ITS Architecture and Deployment Plan needs to be incorporated into the regional planning process so that the ITS vision for the Region is considered when implementing ITS projects in the future, and to ensure that ITS projects in the Region remain eligible for federal funding. The FHWA and FTA require that any project that is implemented with federal funds conform to the Regional ITS Architecture. Many metropolitan planning organizations around the country now require that an agency certify that a project with ITS elements conforms to the Regional ITS Architecture before allowing the project to be included in the Transportation Improvement Program (TIP).

Stakeholders in the Bristol Region agreed that as projects are submitted for inclusion in the TIP each project should be evaluated by the submitting agency to determine if the project includes any ITS elements. If the project contains any ITS elements, then the project needs to be reviewed to determine if the ITS elements in the project are in conformance with the Regional ITS Architecture. The submitting agency will perform this examination as part of the planning process using the procedure outlined in Section 4.6.1 and the Bristol MPO will review each project to confirm it does conform to the Regional ITS Architecture.

4.6.1   Process for Determining Architecture Conformity

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

- Identify the ITS components in the project;
- Identify the corresponding market packages(s) from the Regional ITS Architecture;
- Locate the component within the market package;
- Compare the connections to other agencies or elements documented in the ITS architecture as well as the information flows between them to the connections that will be part of the project; and
- Document any changes necessary to the Regional ITS Architecture or the project to ensure there is conformance.

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

Step 1 – Identify the ITS Components

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

Step 2 – Identify the Corresponding Market Packages

If a project was included in Table 8 through Table 16 of the Bristol Regional ITS Deployment Plan, then the applicable market package(s) for that project are identified in a column of the table. However, ITS projects are not required to be included in the ITS Deployment Plan in order to be eligible for federal funding; therefore, market packages might need to be identified from projects that have not been covered in the ITS Deployment Plan. In that case, the market packages selected and customized for the Bristol Region should be reviewed to determine if they adequately cover the project. Market packages selected for the Bristol Region are identified in **Table 5** of this document and detailed market package definitions are located in **Appendix A**.

Step 3 – Identify the Component within the Market Package

The customized market packages for the Bristol Region are located in **Appendix B and C**. Once the element is located within the appropriate market package the evaluator should determine if the element name used in the market package is accurate or if a change to the name is needed. For example, elements called the City of Bristol TN TOC and the City of Bristol VA TOC were identified in the Regional ITS Architecture as local TOCs. If a project is being deployed that involves one of the TOCs and the owning city has changed the name (or is planning to change the name) of the TOC then this name change should be documented using the process outlined in Section 5.2.

Step 4 – Evaluate the Connections and Flows

The connections and architecture flows documented in the market package diagrams were selected based on the information available at the time the Regional ITS Architecture was developed. As the projects are designed, decisions will be made on the system layout that might differ from what is shown in the market package. These changes in the project should be documented in the ITS market packages using the process outlined in Section 5.2.

Step 5 – Document Required Changes

If any changes are needed to accommodate the project under review, Section 5.2 describes how those changes should be documented. Any changes will be incorporated during the next Regional ITS Architecture update. Conformance will be accomplished by documenting how the market package(s) should be modified so that the connections and data flows are consistent with the project.

5. MAINTAINING THE REGIONAL ITS ARCHITECTURE

The Regional ITS Architecture developed for the Bristol Region addresses the Region's vision for ITS implementation at the time the plan was developed. With the growth of the Region, needs will change and as technology progresses new ITS opportunities will arise. Shifts in Regional needs and focus as well as changes in the National ITS Architecture will necessitate that the Bristol Regional ITS Architecture be updated periodically to remain a useful resource for the Region.

5.1 Maintenance Process

The Bristol MPO will be responsible for leading the process to update the Bristol Regional ITS Architecture and Deployment Plan in coordination with the TDOT Long Range Planning Division. **Table 11** summarizes the maintenance process agreed upon by stakeholders in the Region.

Table 11 – Regional ITS Architecture and Deployment Plan Maintenance Summary

Maintenance Details	Regional ITS Architecture		Regional ITS Deployment Plan	
	Minor Update	**Full Update**	**Minor Update**	**Full Update**
Timeframe for Updates	As needed	Approximately every 5 years (Prior to the LRTP update)	Annually	Approximately every 5 years (Prior to the LRTP update)
Scope of Update	Review and update market packages to satisfy architecture compliance requirements of projects or to document other changes that impact the Regional ITS Architecture	Entire Regional ITS Architecture	Review and update project status and add or remove projects as needed	Entire Regional ITS Deployment Plan
Lead Agency	Bristol MPO		Bristol MPO	
Participants	Stakeholders impacted by market package modifications	Entire stakeholder group	Entire stakeholder group	
Results	Market package or other change(s) documented for next complete update	Updated Regional ITS Architecture document, Appendices, and Turbo Architecture database	Updated project tables	Updated Regional ITS Deployment Plan document

Stakeholders agreed that a full update of the Regional ITS Architecture and Deployment Plan should occur approximately every five years in the year preceding the Long Range Transportation Plan (LRTP) update. By completing a full update in the year prior to the LRTP update, stakeholders will be able to determine the ITS needs and projects that are most important to the Region and document those needs and projects for consideration when developing the LRTP. The Bristol MPO, in coordination with the TDOT Long Range Planning Division, will be

responsible for completing the full updates. During the update process all of the stakeholder agencies that participated in the original development of the Regional ITS Architecture and Deployment Plan should be included as well as any other agencies in the Region that are deploying or may be impacted by ITS projects.

Minor changes to the Regional ITS Architecture should occur as needed between full updates of the plan. In Section 5.2 of this document the procedure for submitting a change to the Regional ITS Architecture is documented. Documentation of changes to the Regional ITS Architecture is particularly important if a project is being deployed and requires a change to the Regional ITS Architecture in order to establish conformity.

Stakeholders recommended that the Bristol MPO lead an annual meeting to review projects in the Regional ITS Deployment Plan to update project status, remove projects that were completed, add project detail when available, and add new projects. Minor changes to the Regional ITS Deployment Plan should be noted by the Bristol MPO. Any corresponding changes to the Regional ITS Architecture will be documented and retained by the Bristol MPO for inclusion during the next complete update.

5.2 Procedure for Submitting ITS Architecture Changes Between Major Updates

Updates to the Bristol Regional ITS Architecture will occur on a regular basis as described in Section 5.1 to maintain the architecture as a useful planning tool. Between major plan updates smaller modifications will likely be required to accommodate ITS projects in the Region. Section 4.6.1 contains step by step guidance for determining whether or not a project requires architecture modifications to the Regional ITS Architecture.

For situations where a change is required, an Architecture Maintenance Documentation Form was developed and is included in **Appendix F**. This form should be completed and submitted to the architecture maintenance contact person whenever a change to the Regional ITS Architecture is proposed. In the process of documenting the change, the stakeholder proposing the change should contact any other agency that will be impacted by the modification to obtain feedback. This communication between agencies will simplify the process of performing a major plan update. The Bristol Area MPO will review and accept the proposed changes and forward the form to the TDOT Long Range Planning Division for their records. When a major update is performed all of the documented changes will be incorporated into the Regional ITS Architecture.

Due to the overlap of the Bristol Regional ITS Architecture with the Kingsport Regional ITS Architecture, any modifications made to any of the market packages in Appendix B should be coordinated with the Kingsport Region as they will also need to make the same change in their Regional ITS Architecture.