Tennessee Department of Transportation
Regional ITS Architectures and Deployment Plans

Johnson City 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
API	Application Program Interface
APTS	Advanced Public Transportation Systems
ASTM	American Society for Testing and Materials
ATC	Advanced Transportation Controller
ATIS	Advanced Travel Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
CAD	Computer Aided Dispatch
CC	Control Center
CCTV	Closed-circuit television
CORBA	Common Object Request Broker Architecture
CPT	Common Public Transportation
CVISN	Commercial Vehicle Information Systems and Networks
DATEX	Data Exchange
DSRC	Dedicated Short Range Communication
DMS	Dynamic Message Sign
DOT	Department of Transportation
EM	Emergency Management
EMA	Emergency Management Agency
EMC	Emergency Management Center
EMS	Emergency Medical Services
EOC	Emergency Operations Center
ESS	Environmental Sensor Station
ETMCC	External TMC Communication
FC	Fare Collection
FHWA	Federal Highway Administration
FTA	Federal Transit Administration

LIST OF ACRONYMS

FTP	File Transfer Protocol
HAR	Highway Advisory Radio
IEEE	Institute of Electrical and Electronics Engineers
IM	Incident Management
ITE	Institute of Transportation Engineers
IT IS	International Traveler Information Systems
ITS	Intelligent Transportation System
ISO	International Organization for Standardization
ISP	Internet Service Provider
IVR	Interactive Voice Response
LRMS	Location Referencing Message Specification
LRTP	Long Range Transportation Plan
MAC	Medium Access Control
MC	Maintenance and Construction
MOU	Memorandum of Understanding
MS	Message Sets
MTPO	Metropolitan Transportation Planning Organization
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
NTD	National Transit Database
OB	On-Board
OER	Octet Encoding Rules
PI	Passenger Information
PIO	Public Information Office
PSAP	Public Safety Answering Point
RDS	Radio Data System
RPO	Rural Planning Organization
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible and Efficient Transportation Equity Act – A Legacy for Users

LIST OF ACRONYMS

SCH	Scheduling/Runcutting
SDO	Standards Development Organization
SP	Spatial Representation
STMF	Simple Transportation Management Framework
TDOT	Tennessee Department of Transportation
TEA-21	Transportation Equity Act for the 21st Century
TEMA	Tennessee Management Emergency Agency
TFTP	Trivial File Transfer Protocol
THP	Tennessee Highway Patrol
TIP	Transportation Improvement Plan
TM	Transportation Management
TMC	Transportation Management Center
TMDD	Traffic Management Data Directory
TMP	Transportation Management Protocols
TOC	Traffic Operations Center
TSIS	TDOT SmartWay Information System
TSS	Transportation Sensor Systems
USDOT	United States Department of Transportation
VIVDS	Video Image Vehicle Detection Systems

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 May 2006, the Tennessee Department of Transportation (TDOT), in coordination with the Johnson City Metropolitan Transportation Planning Organization (MTPO), began development of the Johnson City Regional ITS Architecture. The Regional ITS Architecture has the same geographic boundaries as the Johnson City MTPO study area and focuses on a 20-year vision of ITS for the Region. In addition, 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 deployment 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 Johnson City 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 Johnson City Regional ITS Architecture, and the key features and stakeholders in the Johnson City Region.

Section 2 – Regional ITS Architecture Development Process

An overview of the key steps involved in developing the ITS architecture for the Johnson City 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 Johnson City 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 were prepared and potential agreements to support the sharing of data and resources were identified.

Section 5 – Maintaining the Regional ITS Architecture

A maintenance plan was developed for the Johnson City Regional ITS Architecture and is included in this section. The plan outlines the procedure for updating the ITS architecture over time.

The Johnson City Regional ITS Architecture also contains four appendices:

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

1.3 The Johnson City Region

1.3.1 Geographic Overview

The Johnson City Region is defined by the boundaries of the Johnson City MTPO study area as shown in **Figure 1**. The Region encompasses Washington and Carter Counties in northeastern Tennessee.

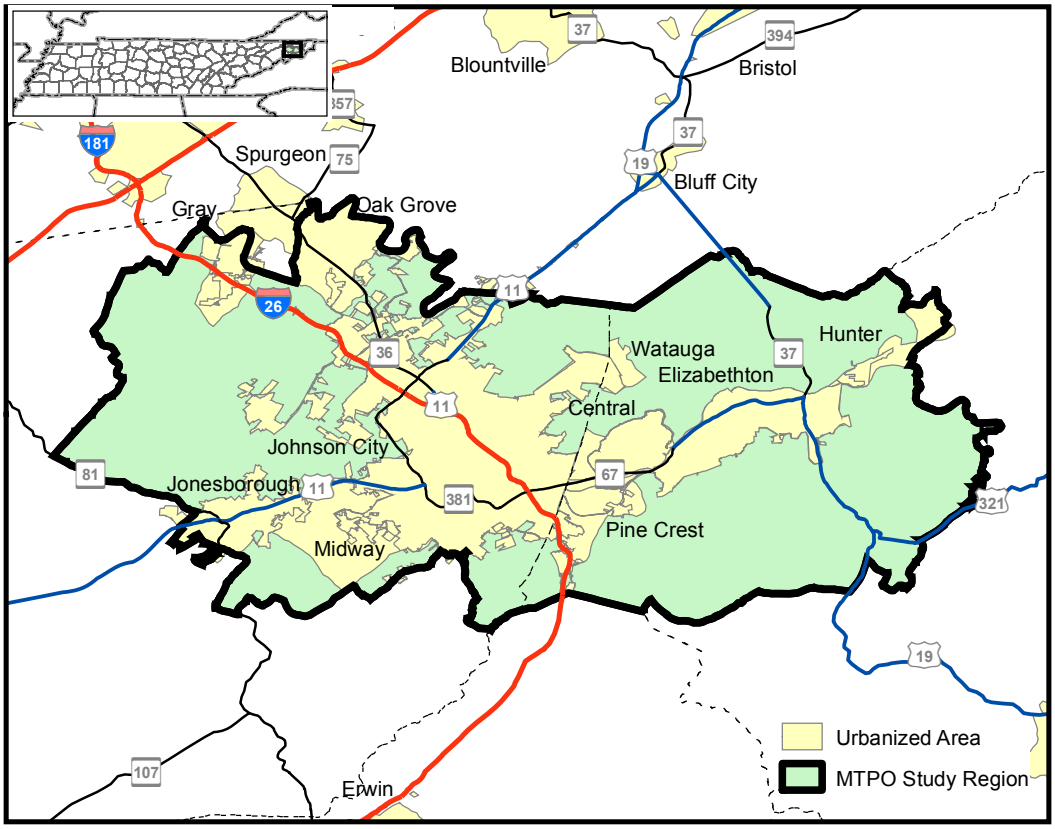

Figure 1 – Johnson City Regional Boundaries

The Johnson City Region is comprised of Johnson City, Elizabethton, Jonesborough and parts of Washington and Carter Counties. When developing the stakeholder group, the project team coordinated with the MTPO to invite the appropriate cities, counties, state and federal agencies, and area transit providers. Johnson City Transit and NET Trans are the transit providers that operate within the Regional boundaries. Johnson City transit provides transit service within the Johnson City urban area. Net Trans primarily operates in the rural areas of the Region, only entering the urban area on trips that originate outside the Johnson City Transit 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 architecture where they interact with agencies in the Johnson City Region. **Table 1** in Section 1.3.4 identifies the stakeholders that participated in the process.

When developing the architecture, a 20-year plan for ITS implementation in the Region was documented. In the ITS Deployment Plan the 20-year timeframe was divided into smaller

time periods to prioritize and sequence the projects. The naming convention used for elements in the Johnson City Regional ITS Architecture is consistent with the naming convention used in the Statewide ITS Architecture. Consistent naming conventions allow users of the various regional ITS architectures and the Statewide ITS Architecture to easily recognize how the architectures interact. As in other regions, statewide commercial vehicle operations were not included in the regional ITS architecture because they are documented in the statewide Commercial Vehicle Information Systems and Networks (CVISN) plan.

1.3.2 Transportation Infrastructure

As illustrated in **Figure 1**, the Region is served by several state and federal highways. The primary roadway facilities include I-26, SR 34 (also designated as US 11 East), SR 36, and SR 67.

I-26 is a divided interstate highway that begins at SR1 (US 11 West) in Kingsport and ends at the coast in Charleston, South Carolina. I-26 connects Kingsport and Johnson City and provides the Johnson City Region with access to I-81. From I-81 travelers can connect to I-40 and drive west across the State of Tennessee to Knoxville, Nashville, and Memphis. SR 34 provides the connection to Bristol, Tennessee near the Virginia state line. Together, Johnson City, Kingsport, and Bristol form the Tri-Cities Area. The roads that connect the Tri-Cities are important to the health of these communities. The Tri-Cities Regional Airport located in Blountville is the commercial airport for the area.

In addition to the roadway network, the area is served by the Tri-Cities Regional Airport. As mentioned in the previous section, Johnson City Transit provides public transportation services in the Johnson City urban area.

1.3.3 Johnson City Region ITS Plans

In 2005, the Johnson City MTPO began the development of a Regional ITS Architecture for the Johnson City Region. In 2006, TDOT contracted with a consultant to develop several regional ITS architectures and deployment plans in the state of Tennessee. The Johnson City Regional ITS Architecture was completed as part of that contract. Version 5.1 of the National ITS Architecture was used in the Architecture development.

The initial deployment of ITS infrastructure in a region is important because as of April 2005, in order for a region to receive funding for ITS projects from the Highway Trust Fund, a region must have an ITS architecture developed. This requirement only applies to regions with existing ITS infrastructure deployed. For regions without any ITS infrastructure deployed, the United States Department of Transportation (USDOT) requires an ITS architecture be completed within four years of their first ITS project entering final design.

The Johnson City Region has several ITS components deployed in the field. Examples of implementations in the Region include closed loop signal systems with video image vehicle detection systems (VIVDS) and computer aided dispatch. As the Johnson City 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.

1.3.4 Stakeholders

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

Table 1 contains a listing of stakeholders in the Johnson City Region who have participated in the project workshops or provided input to the study team with respective needs and issues to be considered as part of the Regional ITS Architecture. Stakeholders who were unable to attend were provided the minutes from the workshops and copies of the reports to assist in their participation.

Table 1 – Johnson City Region Stakeholder Agencies and Contacts

Stakeholder Agency	Address	Contact
City of Elizabethton – Department of Public Works	136 South Sycamore Street Elizabethton, Tennessee 37643	Mike Potter
City of Johnson City Public Works Department – Traffic Division	209 Water Street Johnson City, Tennessee 37601	Anthony Todd
City of Johnson City – Planning Department	P.O. Box 2150 Johnson City, Tennessee 37605-2150	Steve Neilson
Federal Highway Administration – Tennessee Division	640 Grassmere Park Road Suite 112 Nashville, Tennessee 37211-3568	Donald Gedge
First Tennessee Development District	207 West Boone Street, Suite 800 Johnson City, Tennessee 37604	Matt Garland
Johnson City Metropolitan Transportation Planning Organization	137 West Market Street Johnson City, Tennessee 37604	Glenn Berry
Johnson City Metropolitan Transportation Planning Organization	137 West Market Street Johnson City, Tennessee 37604	Jeff Rawles
Johnson City Transit System	137 West Market Street Johnson City, Tennessee 37604	Donna Bridwell
Johnson City Transit System	137 West Market Street Johnson City, Tennessee 37604	Jane Fillers
Tennessee Department of Transportation – HELP	P.O. Box 58 Knoxville, Tennessee 37901-0058	Eddie Newcomb
Tennessee Department of Transportation – Knoxville TMC	P.O. Box 58 Knoxville, Tennessee 37901-0058	John Benditz
Tennessee Department of Transportation – Knoxville TMC	P.O. Box 58 Knoxville, Tennessee 37901-0058	Andy Russell
Tennessee Department of Transportation – Region 1 Traffic	P.O. Box 58 Knoxville, Tennessee 37901	Mark Best
Tennessee Department of Transportation – Long Range Planning Division	505 Deadrick Street Suite 900, James K. Polk Bldg. Nashville, Tennessee 37243-0334	Joe Ed Armstrong, PhD
Tennessee Department of Transportation – Long Range Planning Division	505 Deadrick Street Suite 900, James K. Polk Bldg. Nashville, Tennessee 37243-0334	Teresa Estes
Tennessee Department of Transportation – Long Range Planning Division	505 Deadrick Street Suite 900, James K. Polk Bldg. Nashville, Tennessee 37243-0334	Joe Roach
Tennessee Department of Transportation – Design Division, Signals and Signing	Suite 1000, James K. Polk Bldg. Nashville, Tennessee 37243	Pete Hiett
Washington County – Johnson City Emergency Management Agency	601 East Main Street Johnson City, Tennessee 37601	Nester Levotch

2. REGIONAL ITS ARCHITECTURE DEVELOPMENT PROCESS

Development of the Regional ITS Architecture and Deployment Plan for the Johnson City 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 Johnson City 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.

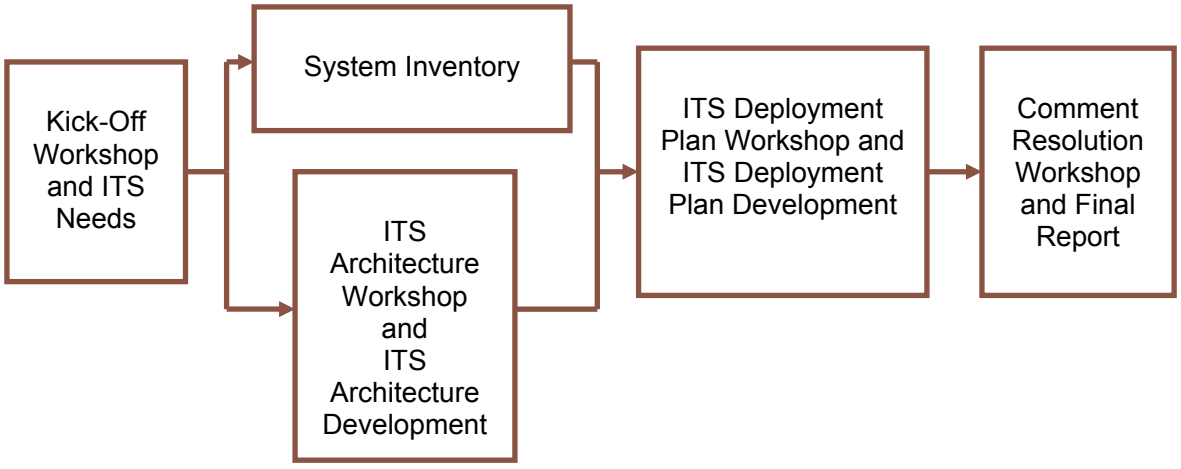

Figure 2 – Johnson City Regional ITS Architecture and Deployment Plan Development Process

A total of four workshops with stakeholders over a period of four months were used to develop the Johnson City 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 the dates for upcoming workshops were chosen.

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 Johnson City Regional ITS Architecture. 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 the elements. The result of the Regional ITS Architecture Workshop was an ITS architecture for the Johnson City 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. The next steps for the Region were discussed and the workshop comments were incorporated into the development of the final Regional ITS Architecture and Regional ITS Deployment Plan.

3. CUSTOMIZATION OF THE NATIONAL ITS ARCHITECTURE FOR THE JOHNSON CITY REGION

3.1 Systems Inventory

An important initial step in the architecture development process is to establish an inventory of existing ITS elements. The Kick-Off Workshop as well as discussions with agency representatives and Johnson City stakeholders provided vital information about existing and planned systems for the development of the Region's 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 Traffic Management Center (TMC) in Knoxville as well as other existing and future TMCs and traffic operations centers (TOCs), detection systems, closed-circuit television (CCTV) cameras, fixed and portable dynamic message signs (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 Commercial Vehicle Information Systems and Networks (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*** – includes technologies such as intersection collision avoidance and automated vehicle operation systems in vehicles. These systems were discussed, but at this time this service group is primarily a private sector initiative.

3.2 Regional Needs

Needs from the Region were identified by Stakeholders at the Kick-Off Workshop held in June of 2006. The needs identified provided guidance for determining which market packages should be included in the architecture. Stakeholders identified ITS needs for the Johnson City Region in the following areas:

- Traffic management;
- Emergency management;
- Maintenance and construction management;
- Transit operations;
- 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 architecture for the Johnson City Region. These ITS systems and components are used to customize the National ITS Architecture and create the architecture for the Johnson City Region.

When developing customized elements, the stakeholder group agreed to create individual traffic, maintenance, and emergency management elements for the City of Johnson City and the City of Elizabethton. The other smaller communities in the Region were documented as part of the municipal elements. This documentation allows the communities to be included in the Regional architecture, and therefore eligible to use federal monies on the potential future ITS deployments.

3.3.1 Subsystems and Terminators

Each identified system or component in the Johnson City 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. The National ITS Architecture groups the subsystems 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 Johnson City Region is shown in **Figure 4**. 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.

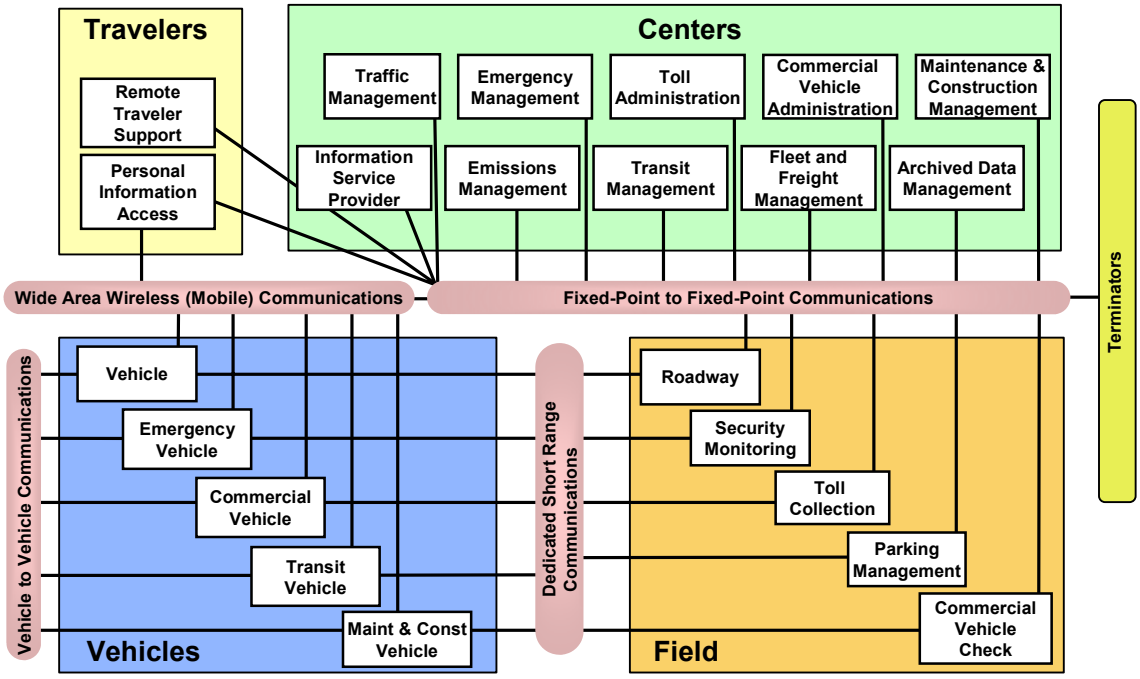

Figure 3 – National ITS Architecture Physical Subsystem Interconnect Diagram

3.3.2 ITS Inventory by Stakeholder

Each stakeholder is associated with one or more systems or elements (subsystems and terminators) that constitute the transportation system in the Johnson City Region. Stakeholders identified in the architecture are listed in **Table 2** along with a description of the stakeholder. For example, rather than individually documenting each of the smaller municipalities in the Region, a single stakeholder was created for municipal/county agencies which represents the cities, towns, and counties not specifically shown in the architecture. **Table 3** sorts the inventory by stakeholder so that each stakeholder can easily identify and review all of the architecture elements associated with the stakeholder's respective agency. The table includes the status of each element. In many cases an element classified as existing might need to be enhanced to attain the service level desired by the Region.

Table 2 – Johnson City Region Stakeholder Descriptions

Stakeholder	Stakeholder Description
Carter County/City of Elizabethton Emergency Management	Emergency management agencies for the City of Elizabethton and Carter County. Includes the Carter County Sheriff's Department, City of Elizabethton Police and Fire Departments as well as emergency medical services.
City of Elizabethton	Municipal government for the City of Elizabethton, Tennessee. Covers all city departments including those that deal with traffic and public safety.
City of Johnson City	Municipal government for the City of Johnson City, Tennessee. Covers all city departments including those that deal with traffic and public safety.
Financial Institution	Handles exchange of money for transit electronic fare collection.
Johnson City Transit	Transit provider that operates both fixed route and paratransit service within the City of Johnson City. Johnson City Transit also operates buses on the East Tennessee State University campus.
Media	Local media outlets. This can include television stations, newspapers, radio stations and their associated websites.
Mountain States Health Alliance	Health care system serving the Johnson City Region. Mountain States Health Alliance operates several hospitals within the Region.
Municipal Government	Municipal government for the City of Jonesborough and other municipalities within the Region that are not identified individually. Covers all city departments including those that deal with traffic and public safety.
NOAA	National Oceanic and Atmospheric Administration, agency that gathers weather information and issues severe weather warnings.
Northeast Tennessee Human Resource Agency	Among other Regional social services, the human resource agency operates NET Trans. NET Trans provides demand response transit in the Region outside the Johnson City Transit service area.
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. In the Johnson City Region this includes North Carolina, Virginia and Kentucky
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.
Regional AMBER Alert Network	Regional AMBER Alert program coordinating emergency management and traffic management agencies for the issemination of Regional AMBER alert information.
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 roadways in the State of Tennessee.
TEMA	Tennessee Emergency Management Agency. The 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 Tennessee.

Table 2 – Johnson City Region Stakeholder Descriptions (continued)

Stakeholder	Stakeholder Description
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.
Washington County/City of Johnson City Emergency Management	Emergency management agencies for the City of Johnson City and Washington County. Includes the Washington County Sheriffs Department, City of Johnson City Police and Fire Departments as well as emergency medical services

Table 3 – Johnson City Region Inventory of ITS Elements

Stakeholder	Element Name	Element Description	Status
Carter County/City of Elizabethton Emergency Management	Carter County 911 Communications District	The City of Elizabethton operates the Carter County 911 Communications District. The 911 PSAP answers and dispatches all 911 calls within the County.	Existing
	Carter County/Elizabethton EMA	Emergency management agency for all of Carter County, including Elizabethton. Responsible for communications with TEMA and coordination of local resources during a disaster or large scale incident.	Existing
	Carter County/Elizabethton Public Safety Vehicles	Carter County Sheriff vehicles, City of Elizabethton Police and Fire Vehicles and EMS vehicles operating within the County and the City.	Existing
City of Elizabethton	City of Elizabethton - City Engineers Office	Responsible for administration of maintenance and construction projects within the City.	Existing
	City of Elizabethton CCTV	Closed-circuit television cameras operated by the City of Elizabethton TOC for traffic condition monitoring and management of incidents.	Planned
	City of Elizabethton DMS	Dynamic message signs for traffic information dissemination operated by the City of Elizabethton TOC.	Planned
	City of Elizabethton Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. This information is used in the operation of the traffic signal system.	Planned
	City of Elizabethton Mayors Office	The office of the Mayor of the City of Elizabethton is responsible for communicating with the media regarding incidents or construction affecting the roadway network. They are also responsible for placing these same types of information on the City of Elizabethton Website.	Existing
	City of Elizabethton Public Works Department	The public works department is responsible for the maintenance of roadways in the City of Elizabethton.	Existing
	City of Elizabethton Public Works Department Vehicles	Vehicles used in maintenance operations including snow removal.	Existing
	City of Elizabethton Speed Monitoring Equipment	Field equipment used for monitoring roadway speeds in the City of Elizabethton.	Planned
	City of Elizabethton TOC	Traffic operations center for the City of Johnson City. Responsible for operating the traffic signal system, CCTV cameras and dynamic message signs.	Planned

Table 3 – Johnson City Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
City of Elizabethton (continued)	City of Elizabethton Traffic Signals	Traffic signal system operated by the City of Elizabethton TOC.	Existing
	City of Elizabethton Website	Website for the City of Elizabethton. This website is existing in a static format. The City envisions that at some point the site will provide real-time information.	Existing
City of Johnson City	City of Johnson City - City Engineers Office	Responsible for administration of maintenance and construction projects within the City.	Existing
	City of Johnson City CCTV	Closed-circuit television cameras operated by the City of Johnson City TOC for traffic condition monitoring and management of incidents.	Planned
	City of Johnson City Community Relations	The office of community relations for the City of Johnson City. The office is responsible for communicating with the media regarding incidents or construction affecting the roadway network. They are also responsible for placing these same types of information on the City of Johnson City Website.	Existing
	City of Johnson City	Dynamic message signs for traffic information dissemination operated by the City of Johnson City TOC.	Planned
	City of Johnson City Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. The data collected from these devices is used to evaluate the performance of the roadway network and for the operation of the traffic signal system.	Existing
	City of Johnson City Public Works Department	The public works department is responsible for the maintenance of roadways in the City of Johnson City.	Existing
	City of Johnson City Public Works Department Vehicles	Vehicles used in maintenance operations including snow removal.	Existing
	City of Johnson City RWIS Sensors	Road weather information systems installed in the field to gather information about the roadways such as temperature and moisture levels.	Planned
	City of Johnson City Speed Monitoring Equipment	Field equipment used for monitoring Johnson City roadway speeds. Speed monitoring equipment is owned by the City of Johnson City Police Department.	Existing
	City of Johnson City Stream Gauges	Field sensors used to measure water levels.	Existing

Table 3 – Johnson City Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
City of Johnson City (continued)	City of Johnson City TOC	Traffic operations center for the City of Johnson City. Responsible for operating the traffic signal system, CCTV cameras and dynamic message signs. Traffic signal system operations are an existing function.	Existing
	City of Johnson City Traffic Signals	Traffic signal system operated by the City of Johnson City TOC.	Existing
	City of Johnson City Website	Website for the City of Johnson City. This website is existing in a static format. The City envisions that at some point the site will provide real-time information.	Existing
	Johnson City Local Access Cable Channel	The local access cable channel for Johnson City, Tennessee.	Planned
	Johnson City MTPO Data Archive	Metropolitan Transportation Planning Organization for Johnson City, Tennessee. The agency is responsible for transportation planning in the Region including development of the Long Range Transportation Plan (LRTP) and Transportation Improvement Plan (TIP) for the Region.	Planned
Financial Institution	Financial Service Provider	Handles exchange of money for transit electronic fare collection.	Planned
Johnson City Transit	Electronic Fare Payment Card	Medium for collection of transit fares electronically.	Planned
	Johnson City Transit Center CCTV Surveillance	Closed-circuit television cameras for surveillance at the Johnson City Transit Center.	Existing
	Johnson City Transit Data Archive	Transit data archive for Johnson City Transit. The archive will be used by FTA, NTD and the TDOT Office of Public Transportation.	Planned
	Johnson City Transit Demand Response Vehicles	Transit vehicles for demand response transit operations.	Existing
	Johnson City Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of fixed route and paratransit vehicles operated by Johnson City Transit.	Existing
	Johnson City Transit Fixed Route Vehicles	Transit vehicles that operate on fixed routes within Johnson City.	Existing
	Johnson City Transit Kiosks	Kiosks for dissemination of transit traveler information. Kiosks can also be used for the purchase and recharging of electronic fare payment cards.	Planned
	Johnson City Transit Website	Website with information about fares and schedules. At this time the website is static.	Existing

Table 3 – Johnson City Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
Media	Local Print and Broadcast Media	Local media that provide traffic or incident information to the public.	Existing
Mountain States Health Alliance	Mountain States Health Alliance - Johnson City Medical Center	Trauma center located in Johnson City.	Existing
	Mountain States Health Alliance - Sycamore Shoals Hospital	Hospital located in the City of Elizabethton. The hospital has a 24 hour emergency department.	Existing
	Wings Dispatch	Dispatch EMS in the City of Johnson City as well as air rescue services.	Existing
Municipal Government	Municipal Maintenance	Department responsible for maintenance of municipal roadway facilities.	Planned
	Municipal Public Safety Dispatch	Responsible for the dispatch of municipal public safety vehicles.	Planned
	Municipal TOC	Municipal Traffic Operations Center responsible for municipal signal system operations.	Planned
	Municipal Traffic Signals	Municipal traffic signal systems.	Planned
NOAA	National Weather Service	Provides official US weather, marine, fire and aviation forecasts, warnings, meteorological products, climate forecasts and information about meteorology.	Planned
Northeast Tennessee Human Resource Agency	NET Trans Dispatch Center	Responsible for the dispatch and scheduling of demand response transit trips in the Region outside of the Johnson City Transit service area.	Existing
Other Agencies	Other Maintenance and Construction Management Agencies	Additional maintenance and construction operations with which information is shared for coordination in an emergency situation.	Planned
	Other Traffic Management Agencies	Additional traffic management agencies with which information is shared for coordination in an emergency situation.	Planned
	Private Transportation Providers	Transportation providers such as taxi companies that pick up at the transit center and long distance bus companies like Greyhound.	Planned
Other States	Kentucky DOT	Kentucky Department of Transportation, responsible for the maintenance and operation of roadways in the State of Kentucky.	Existing
	North Carolina DOT	North Carolina Department of Transportation, responsible for the maintenance and operation of roadways in the State of North Carolina. Included for coordination purposes.	Existing
	Other States Maintenance	Maintenance operations in adjacent states.	Planned

Table 3 – Johnson City Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
Other States (continued)	Virginia DOT	Virginia Department of Transportation, responsible for the maintenance and operation of roadways in the State of Virginia.	Existing
Private Information Provider	Private Sector Traveler Information Services	Subscription based traveler information service.	Planned
Rail Operators	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
Regional AMBER Alert Network	Future Regional AMBER Alert Network	Regional Amber Alert program coordinating emergency management and traffic management for information dissemination.	Planned
	Regional Websites	Websites utilized by members of the Regional Amber Alert Network to disseminate amber alert information.	Planned
System Users	Archived Data User	Those who request information from the data archive systems.	Planned
	Private Traveler Personal Computing Devices	Computing devices that travelers use to access public information.	Planned
	Traveler	Caller seeking information from 511 system.	Existing
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 Transportations regional maintenance offices.	Existing
	TDOT CCTV	Closed-circuit television cameras for traffic surveillance and incident management.	Planned
	TDOT District Maintenance	Each TDOT Region contains several TDOT district maintenance offices. These district offices handle most of the routine roadway maintenance and respond to incidents when their services are requested by local emergency management.	Existing
	TDOT DMS	Dynamic message signs for traffic information dissemination.	Existing
	TDOT Emergency Services Coordinator	Emergency service coordinator from TDOT who serves in the TEMA emergency operations group. During a disaster this coordinator acts as a liaison between TEMA and the various TDOT TMCs and maintenance groups.	Existing
	TDOT Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, RTMS or traditional loops.	Planned

Table 3 – Johnson City Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
TDOT (continued)	TDOT HAR	Highway Advisory Radio for traffic information dissemination.	Existing
	TDOT HELP Vehicles	Roadway service patrol vehicles. Currently operate in Knoxville and are dispatched to the Johnson City Region for special events or large incidents.	Existing
	TDOT Maintenance Headquarters	TDOT statewide maintenance headquarters in Nashville.	Existing
	TDOT Maintenance Vehicles	Tennessee Department of Transportation vehicles used in maintenance operations including snow removal.	Existing
	TDOT Public Information Office	Tennessee Department of Transportation department responsible for the dissemination of traffic information to the media and the public.	Planned
	TDOT Region 1 Construction Office	The Tennessee Department of Transportation office responsible for oversight of construction projects in Region 1.	Existing
	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 PIO.	Planned
	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 of special event.	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 with Region 1.	Existing
	TDOT Region 1 TMC - Knoxville	Traffic 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. The Johnson City Region is located within TDOT Region 1.	Existing
	TDOT Region 2 TMC - Chattanooga	Traffic 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

Table 3 – Johnson City Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
TDOT (continued)	TDOT Region 3 TMC - Nashville	Traffic 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	Traffic 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 road conditions.	Planned
	TDOT Short Range and Project Planning Division Archive	Tennessee Department of Transportation group responsible for traffic data collection and analysis as well as short range planning.	Planned
	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 CCTV, vehicle detection and/or DMS.	Planned
	TDOT SmartWay Information System (TSIS)	TSIS is a statewide roadways conditions database. Currently information can be entered by District and Regional maintenance personnel as well as staff at any of the Traffic Management Centers. TSIS feeds the Statewide 511 system.	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 511 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.	Planned

Table 3 – Johnson City Region Inventory of ITS Elements (continued)

Stakeholder	Element Name	Element Description	Status
THP	THP Dispatch	Tennessee Highway Patrol dispatch center. There are several THP dispatch centers around the State.	Existing
	THP Vehicles	Tennessee Highway Patrol vehicles.	Existing
Tennessee Department of Health and Human Services	Service Agency	Agency responsible for payment of transit fares for medical transportation as part of government subsidized medical care. This includes TennCare, Medicare and VA programs.	Planned
Washington County/City of Johnson City Emergency Management	Washington County/Johnson City 911 Dispatch	The City of Johnson City operates the Washington County/Johnson City 911 Dispatch. The 911 PSAP answers and dispatches all 911 calls within the County.	Existing
	Washington County/Johnson City Public Safety Vehicles	Washington County Sheriff vehicles, City of Johnson City Police and fire Vehicles and EMS vehicles operating within the County and the City.	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 was customized for the Johnson City Region based on the system inventory and information gathered from the stakeholders. **Figure 4** summarizes the existing and planned ITS elements for the Johnson City Region in the context of a physical interconnect. Subsystems and elements specific to the Region are displayed in the boxes surrounding the main interconnect diagram; these elements are color-coded to their associated subsystem.

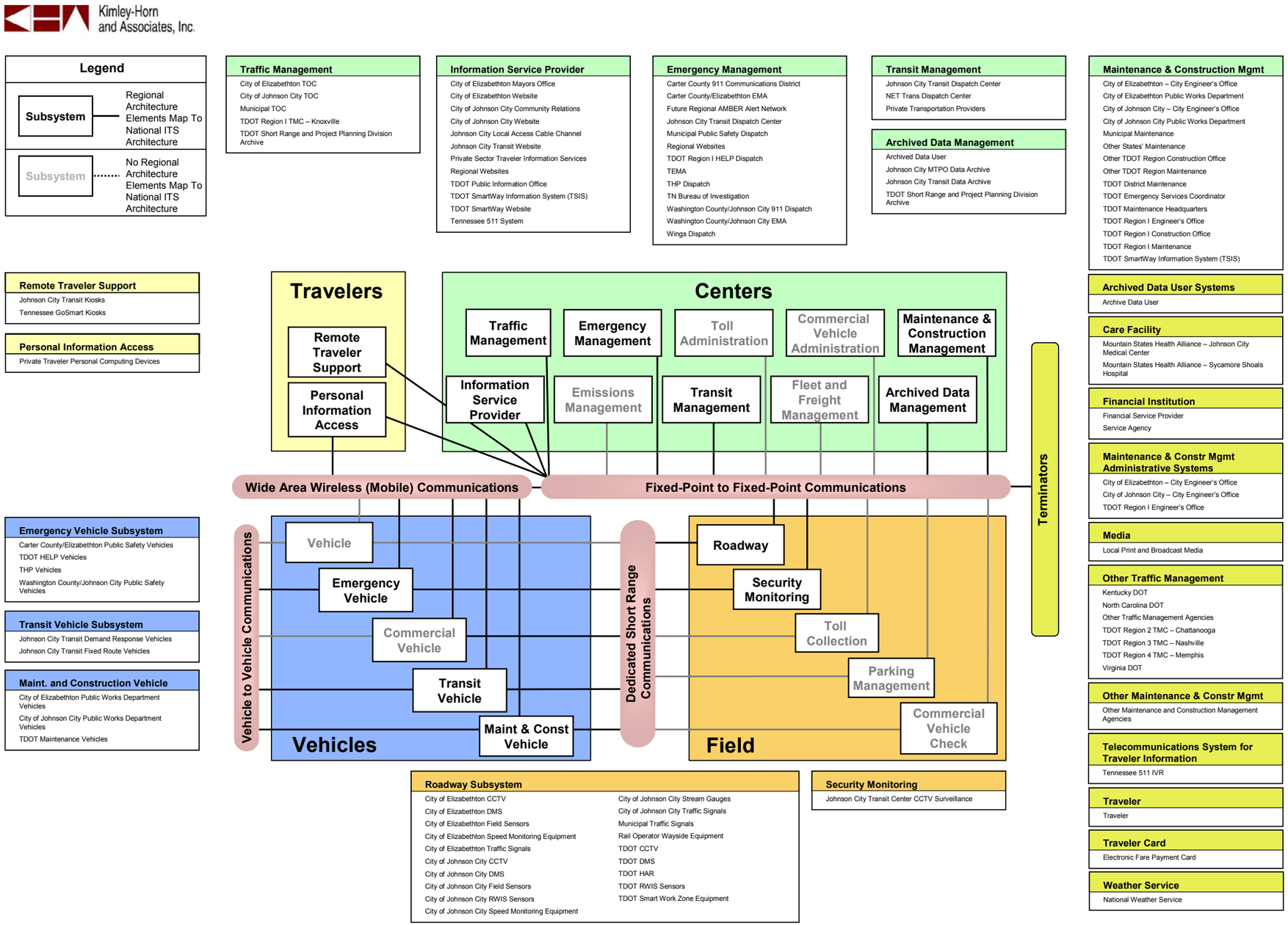

Figure 4 – Johnson City Regional System Interconnect Diagram

3.4 Market Packages

Upon completion of the system inventory, the next step in the development of the architecture was to identify the transportation services important to the Johnson City Region. In the National ITS Architecture, services are referred to as market packages. Market packages can include several stakeholders and elements working 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 85 market packages identified in the National ITS Architecture Version 5.1

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 Johnson City Regional ITS Architecture because private sector automobile and information service providers would implement those market packages.

3.4.1 Selection and Prioritization of Regional Market Packages

In the Johnson City Region, the National ITS Architecture market packages were reviewed and selected by the stakeholders based on the relevance of the service to the Region. Thirty-three market packages were selected for implementation in the Region. They are identified in **Table 4**. 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 applications such as electronic clearance, safety enforcement, and registration. Unless a specific need was identified in the Johnson City 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.

In several cases, there are multiple stakeholders in the Region that provide the same service at different levels. For example, Surface Street Control (ATMS03) on roadways in the Region could be provided by the City of Johnson City or the City of Elizabethton. The market package status is identified as existing or planned for each of the primary stakeholders in the Region. In many cases market packages classified as existing might need to be enhanced to increase the service that the market package provides and establish all of the associated elements.

After selecting the market packages that were applicable for the Region, stakeholders reviewed each market package and the elements for possible inclusion in the Region's customization. This customization is discussed further in the following section.

Table 4 – Johnson City 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 Control ATMS13 Standard Railroad Grade Crossing	ATMS19 Speed Monitoring
Emergency Management		
EM01 Emergency Call-Taking and Dispatch EM02 Emergency Routing EM04 Roadway Service Patrols EM06 Wide-Area Alert EM10 Disaster Traveler Information	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		
APTS1 Transit Vehicle Tracking APTS2 Transit Fixed-Route Operations APTS3 Demand Response Transit Operations APTS5 Transit Security	APTS4 Transit Passenger and Fare Management APTS8 Transit Traveler Information	APTS6 Transit Maintenance APTS7 Multi-modal Coordination
Traveler Information		
ATIS1 Broadcast Traveler Information ATIS2 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 Johnson City Region. Each market package is shown graphically with the market package name, local agencies involved and desired data flows included. Market packages represent a service that will be deployed as an integrated capability.

As explained in Section 3.3, elements were included in the Regional architecture for smaller municipalities within the Region to document the ITS systems municipalities would most likely deploy in the next 20 years. At this time the market packages customized for the municipalities depict a typical implementation of the market package service. **Figure 5** is an example of an ATMS market package for Traffic Incident Management System that was customized for the Region. This market package shows the four subsystems: Traffic Management, Emergency Management, Maintenance and Construction Management and Information Service Provider. Each subsystem shows the associated entities for Traffic Incident Management System in the Region: City of Johnson City TOC, TDOT Region 1 TMC – Knoxville, Washington County/Johnson City EMA, Washington County/ Johnson City 911 Dispatch, City of Johnson City Public Works Department and TDOT SmartWay Information System (TSIS). Data flows between the subsystems indicate what information is being shared. The remainder of the market packages that were customized for the Johnson City Region is shown in **Appendix B**.

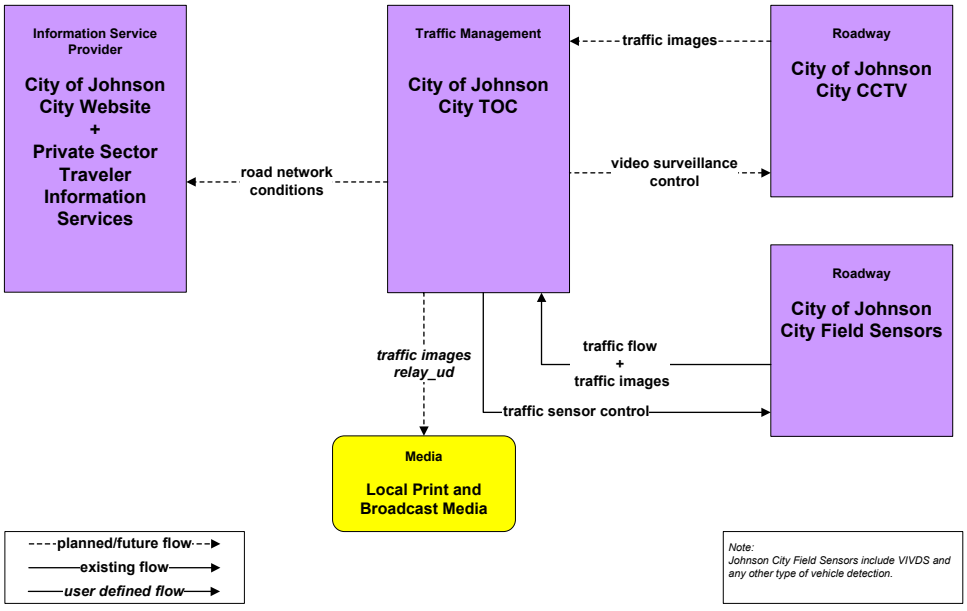

Figure 5 – Example Market Package Diagram: Traffic Incident Management System

3.4.3 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 are included in **Table 5**. The table also identifies which market package documents the ITS need.

Table 5 – Johnson City Region ITS Needs and Corresponding Market Packages

ITS Need	Market Package
Travel and Traffic Management	
Automated vehicle location (AVL) for TDOT HELP vehicles	EM04
Local agencies need to provide information to TDOT for 511	ATMS07 ATMS08
City of Johnson City closed-circuit television (CCTV) cameras	ATMS01
City of Johnson City dynamic message signs (DMS)	ATMS06
City of Elizabethton video detection at signalized intersections	ATMS03
Emergency Management	
Share video feeds from the Johnson City TMC with the Washington County 911 Dispatch	ATMS08
Maintenance and Construction Management	
City of Elizabethton portable DMS	MC08
Johnson City road weather information systems (RWIS)	MC03 MC04
Johnson City stream gauge sensor upgrades	MC03 MC04
Johnson City maintenance fleet AVL to facilitate snow removal	MC01 MC06
Elizabethton maintenance fleet AVL to facilitate snow removal	MC01 MC06
AVL for TDOT snow plows	MC01 MC06
Public Transportation Management	
Johnson City Transit Automated vehicle location (AVL)	APTS1
Johnson City Transit passenger counters	APTS2 APTS3 APTS4
Johnson City Transit demand response scheduling and call back system	APTS3
Johnson City electronic fare payment card	APTS4
Johnson City Transit real-time arrival information for buses operating on the East Tennessee State University campus	APTS8
Archived Data Management	
Coordination with TDOT for traffic count information to support Johnson City Metropolitan Transportation Planning Organization (MTPO)	AD2
Johnson City MTPO planning data archive to store transit and traffic information	AD2
Johnson City Transit computer aided dispatch (CAD)	APTS2 APTS3

3.5 Architecture Interfaces

While the identification of the various systems and stakeholders as part of a regional ITS is important, a primary purpose of the architecture is to identify the connectivity between transportation systems in the Johnson City Region. The system interconnect diagram shown previously in **Figure 4** shows the high-level relationships of the subsystems and terminators in the Johnson City 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 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

There are a large number of different elements identified as part of the Johnson City Regional ITS Architecture. These elements include all of the existing and planned physical components that contribute to the regional ITS such as: traffic management centers, transit vehicles, dispatch systems, emergency management agencies, and media outlets. Interfaces were identified for each element in the Johnson City Regional ITS Architecture and each element was mapped to interface with designated elements. The Turbo Architecture software can generate interconnect diagrams for each element in the Region that show which elements are connected. **Figure 6** is an example of an interconnect diagram from the Turbo database output. This particular interconnect diagram is for the City of Elizabethton Traffic Signals.

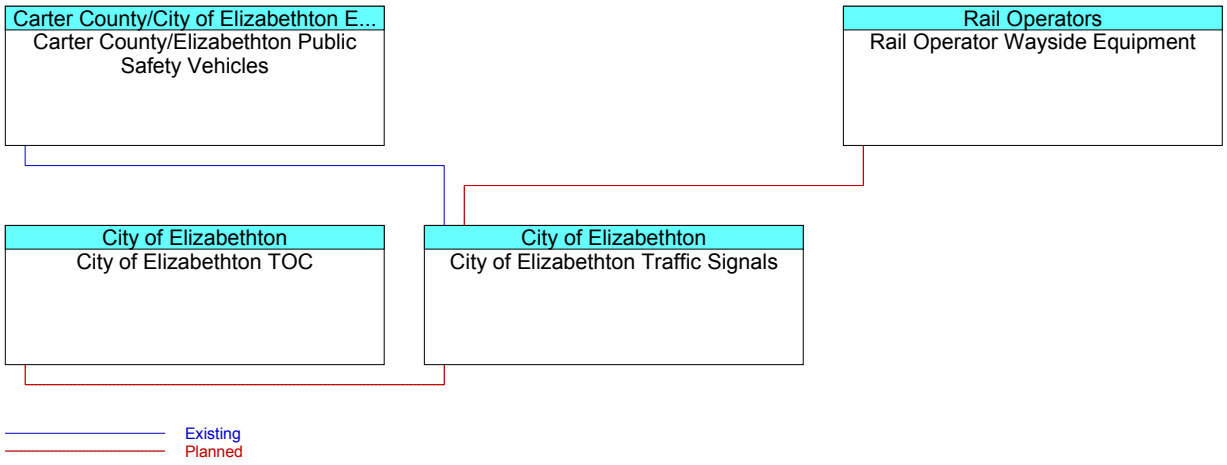

Figure 6 – Example Interconnect Diagram: City of Elizabethton Traffic Signals

3.5.2 Data Flows Between Elements

In the market package diagrams, flows between the subsystems and terminators define the specific information (data) 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/or other key information requirements. Turbo Architecture can be used to output flow

diagrams, filtered by market package, for ease of interpretation. However, custom data flows will not show up in diagrams filtered by market package. This is the same information presented in the market packages found in Appendix B. An example of a flow diagram for Johnson City Transit filtered for APTS2 - Transit Fixed Route Operations is shown in **Figure 7**.

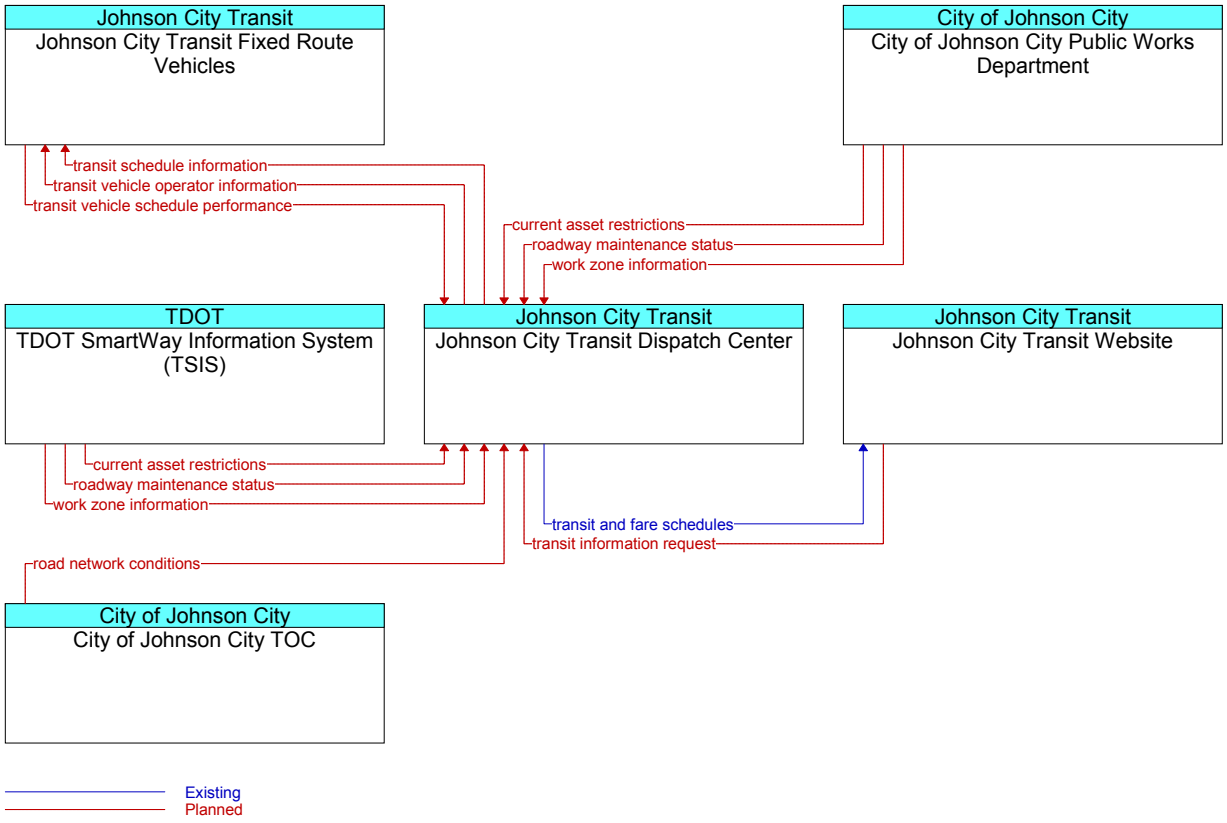

Figure 7 – Example Flow Diagram: APTS2 – Transit Fixed Route Operations

4. APPLICATION OF THE REGIONAL ITS ARCHITECTURE

Once a region has identified the desired components of ITS for its area and established which agencies and systems need to be connected, the structure of the National ITS Architecture assists with the Region's planning and implementation. This section addresses the application of the Regional ITS Architecture in the Johnson City Region. The National ITS Architecture provides recommendations for standards and functional requirements to be considered when implementing ITS elements. In addition, an operational concept was 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 Johnson City Region will likely require interagency agreements. Potential agreements were determined based on the desired data flows identified in the Johnson City Region. The 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 to 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 its Region. In the Johnson City Region, the development of detailed functional requirements such as the "shall" statements included in Process Specifications for a system is recommended at the project level. These detailed "shall" statements identify all functions that a project or system needs to perform.

For the Johnson City Regional ITS Architecture, functional requirements were 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 the operations of the ITS system in the Johnson City Region and the data that needs to be shared among elements.

At a more detailed level, functional requirements for the Johnson City Region are described in terms of functions that each element in the architecture performs or will perform in the future. **Appendix C** 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 Johnson City 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 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 6** identifies each of the ITS standards that could apply to the Johnson City Regional ITS Architecture. These standards are based on the physical subsystem architecture flows previously identified in Section 3.5.2.

Table 6 – Johnson City Region Applicable ITS Standards

SDO	Document ID	Title
AASHTO/ITE/NEMA	NTCIP 1101	Simple Transportation Management Framework (STMF)
	NTCIP 1102	Octet Encoding Rules (OER) Base Protocol
	NTCIP 1103	Transportation Management Protocols (TMP)
	NTCIP 1104	Center-to-Center Naming Convention Specification
	NTCIP 1105	CORBA Security Service Specification
	NTCIP 1106	CORBA Near-Real Time Data Service 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	Environmental Sensor Station (ESS) Interface Standard
	NTCIP 1205	Object Definitions for Closed-Circuit Television (CCTV) Camera Control
	NTCIP 1208	Object Definitions for Closed-Circuit Television (CCTV) Switching
	NTCIP 1209	Data Element Definitions for Transportation Sensor Systems (TSS)
	NTCIP 1210	Field Management Stations – Part 1: Object Definitions for Signal System Masters
	NTCIP 1211	Object Definitions for Signal Control and Prioritization
	NTCIP 1401	TCIP Common Public Transportation (CPT) Objects
	NTCIP 1402	TCIP Incident Management (IM) Objects
	NTCIP 1403	TCIP Passenger Information (PI) Objects
	NTCIP 1404	TCIP Scheduling/Runcutting (SCH) Objects
	NTCIP 1405	TCIP Spatial Representation (SP) Objects
	NTCIP 1406	TCIP On-Board (OB) Objects
	NTCIP 1407	TCIP Control Center (CC) Objects
	NTCIP 1408	TCIP Fare Collection (FC) Business Area Objects
	NTCIP 2101	Point to Multi-Point Protocol Using RS-232 Subnetwork Profile
	NTCIP 2102	Point to Multi-Point Protocol Using FSK Modem Subnetwork Profile
	NTCIP 2103	Point-to-Point Protocol Over RS-232 Subnetwork Profile
	NTCIP 2104	Ethernet Subnetwork Profile
	NTCIP 2201	Transportation Transport Profile
	NTCIP 2202	Internet (TCP/IP and UDP/IP) Transport Profile
	NTCIP 2301	STMF Application Profile
	NTCIP 2302	Trivial File Transfer Protocol (TFTP) Application Profile
	NTCIP 2303	File Transfer Protocol (FTP) Application Profile
	NTCIP 2304	Application Profile for DATEX-ASN (AP-DATEX)
	NTCIP 2305	Application Profile for CORBA (AP-CORBA)
	NTCIP 2306	Application Profile for XML Message Encoding and Transport in ITS C2C Communications
	NTCIP 2501	Information Profile for DATEX
	NTCIP 2502	Information Profile for CORBA

Table 6 – Johnson City Region Applicable ITS Standards (continued)

SDO	Document ID	Title
ASTM	ASTM E2158-01	Standard Specification for Dedicated Short Range Communication (DSRC) Physical Layer using Microwave in the 902-928 MHz Band
	ASTM E2259-xx	Standard Specification for Metadata to Support Archived Data Management Systems
	ASTM E2259-yy	Standard Specification for Archiving ITS Generated Travel Monitoring Data
	ASTM PS 105-99	Standard Provisional Specification for DSRC Data Link Layer
IEEE	IEEE 1512.1-2003	Standard for Traffic Incident Management Message Sets for Use by EMCs
	IEEE 1512.2-2004	Standard for Public Safety Incident Management Message Sets (IMMS) for use by EMCs
	IEEE 1512.3-2002	Standard for Hazardous Material IMMS
	IEEE 1512-2000	Standard for Common IMMS for use by EMCs
	IEEE 1570-2002	Standard for Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection
	IEEE 1609.1	Resource Manager for DSRC 5.9 GHz
	IEEE 1609.2	Application Services (Layers 6,7) for DSRC 5.9 GHz
	IEEE 1609.3	Communications Services (Layers 4,5) for DSRC 5.9 GHz (Future Standard)
	IEEE 1609.4	Medium Access Control (MAC) Extension and the MAC Extension Management Entity for DSRC 5.9 GHz
	IEEE 802.11	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems – 5 GHz Band DSRC MAC and Physical Layer (PHY) Specifications
	IEEE 802.2	Logical Link (Layer 2) for DSRC 5.9 GHz
	IEEE P1512.4	Standard for Common Traffic Incident Management Message Sets for Use in Entities External to Centers
ISO	ISO 21210	Networking Services (Layer 3) for DSRC 5.9 GHz
SAE	ITE TM 1.03	Standard for Functional Level Traffic Management Data Dictionary (TMDD)
	ITE TM 2.01	Message Sets for External TMC Communication (MS/ETMCC)
	SAE J2266	Location Referencing Message Specification (LRMS)
	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 (RDS) Phrase Lists
	SAE J2540-2	ITIS (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 in the operation of a regional ITS. The operational concept documents these roles and responsibilities across a range of transportation services as grouped in the Operational Concepts section of Turbo Architecture. The services covered are:

- ***Arterial Management*** – The development of signal systems that react to changing traffic conditions and provide coordinated intersection timing along a corridor.
- ***Highway Management*** – The development of systems to monitor freeway (or tollway) traffic flow and roadway conditions, and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. Includes systems to provide information to travelers on the roadway.
- ***Incident Management*** – The development 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 winter snow and ice clearance. Includes the managing of construction operations.
- ***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 7 identifies the roles and responsibilities of key stakeholders for a range of transportation services.

Table 7 – Johnson City Region Stakeholder Roles and Responsibilities

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

Table 7 – Johnson City Region Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Incident Management (Traffic) (continued)	City of Johnson City	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate dynamic message signs for the distribution of incident information to travelers on the roadway.
		Responsible for coordination with other traffic operations centers and emergency management agencies for coordinated incident management.
		Coordinate maintenance resources for incident response with the City of Johnson City Public Works Department.
	TDOT	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate dynamic message signs and highway advisory radio for the distribution of incident information to travelers on the roadway.
		Responsible for coordination with other traffic operations centers and emergency management agencies for coordinated incident management.
		Responsible for the development, coordination and execution of special traffic management strategies during evacuation.
Incident Management (Emergency)	Carter County 911 Communications District	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety agencies, the City of Elizabethton TOC, and the TDOT SmartWay Center in Knoxville for incidents on state facilities.
	Municipal Public Safety Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety agencies as well as the TDOT SmartWay Center in Knoxville for incidents on state facilities.
	THP Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety and traffic management agencies as well as the TDOT SmartWay Center in Knoxville for incidents on state facilities.
	Washington County/Johnson City 911 Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety agencies, the City of Johnson City TOC and the TDOT SmartWay Center in Knoxville for incidents on state facilities.
	Wings Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety agencies and the City of Johnson City TOC.

Table 7 – Johnson City Region Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Emergency Management	Carter County 911 Communications District	Responsible for emergency call-taking for Carter County, including the City of Elizabethton, as the 911 Public Safety Answering Point (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.
	Carter County/Elizabethton EMA	Operates the Emergency Operations Center (EOC) for the County and City of Elizabethton 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.
	Municipal Public Safety 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.
	TEMA	Operates the Emergency Operations Center (EOC) for the State of Tennessee in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the State.
		Lead efforts for emergency planning to support large-scale incidents and disasters.
	THP Dispatch	Responsible for 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.

Table 7 – Johnson City Region Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Emergency Management (continued)	THP 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.
	Tennessee Bureau of Investigation	Responsible for the initiation of AMBER alerts.
	Washington County/Johnson City 911 Dispatch	Responsible for emergency call-taking for Washington County and the City of Johnson City as the 911 Public Safety Answering Point (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.
	Washington County/Johnson City EMA	Operates the Emergency Operations Center (EOC) for the County and City of Johnson City in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the County.
		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.
	Wings 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.
Maintenance and Construction Management	City of Elizabethton	Monitors environmental sensors and distributes information about road weather conditions.
		Responsible for the tracking and dispatch of maintenance vehicles for snow removal during a winter weather event.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, highway advisory radio, and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.

Table 7 – Johnson City Region Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Maintenance and Construction Management (continued)	City of Johnson City	Monitors environmental sensors and distributes information about road weather conditions.
		Responsible for the tracking and dispatch of maintenance vehicles for snow removal during a winter weather event.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, highway advisory radio, and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.
	Municipal Maintenance	Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, highway advisory radio, and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.
	TDOT	Monitors environmental sensors and distributes information about road weather conditions.
		Responsible for the tracking and dispatch of maintenance vehicles for snow removal during a winter weather event.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, highway advisory radio, and sharing of information with other groups.
		Disseminates work activity schedules and current asset restrictions to other agencies.
		Operates work zone traffic control equipment including portable surveillance equipment, dynamic message signs, and highway advisory radio transmitters.
Transit Management	Johnson City Transit	Operates demand response and fixed route transit 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.
		Coordinate transit service with other regional transit providers.
		Provide schedule and fare information on transit kiosks.
		Provide transit traveler information to the agency website, local private sector traveler information services, and the Tennessee 511 system.
		Operate on-board systems to provide next stop annunciation.

Table 7 – Johnson City Region Stakeholder Roles and Responsibilities (continued)

Transportation Service	Stakeholder	Roles/Responsibilities
Transit Management (continued)	Johnson City Transit (continued)	Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
Traveler Information	City of Elizabethton	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 Johnson City	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	Responsible for the collection and distribution of traveler information including incident information and maintenance and construction closure information.
		Collection, processing, storage, and broadcast dissemination of traffic, transit, maintenance and construction, event and weather information to travelers via the 511 Traveler Information System.
		Provide transportation information to travelers via traveler information kiosks.
Archived Data Management	Johnson City MTPO	Collect and maintain data from regional traffic and transit management agencies.
	Johnson City Transit	Collect and format transit operations and ridership data to satisfy local, state, and federal government data reporting requirements.

4.4 Potential Agreements

The Regional ITS Architecture for the Johnson City Region has identified many agency interfaces, information exchanges, and integration strategies 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, formal agreements between agencies probably 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 when possible with regards to technology. Technology is likely to change rapidly and changes to technology could require an update of the agreement if the agreement is not technology neutral. Focus of the agreement should be on the responsibilities of the agencies and the high level information that needs to be exchanged. Depending on the type of agreement being used, agencies need to be prepared for the agreement completion process to take several months to years. First, agencies must reach consensus on the content of an agreement and then proceed through the approval process. The approval process for formal agreements varies by agency. The process often is lengthy; agencies should plan ahead to ensure that the agreement does not delay the project.

A first step when implementing an agreement for ITS is to review any existing agreements to determine if amendments or modifications to the existing agreement can include the additional requirements of deploying a system. If there are no existing agreements to modify or use 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 affect for an extended duration or involve any sort of long-term maintenance, then written agreements are strongly recommended. During long-term operations, staff may change and often a verbal agreement between agency representatives is not communicated to 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.
- Interagency and Intergovernmental Agreements: These agreements between public agencies can be used for operation, maintenance, or funding of ITS projects and systems. They can include documentation on the responsibility of each agency, functions each 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.
- Master Agreements: Master agreements include standard contract language for an agency and serve as the main agreement between two entities that 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 8 provides a list of existing and potential agreements for the Johnson City Region based on the interfaces identified in the Regional ITS Architecture. 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 8 – Johnson City Region Potential Agreements

Status	Agreement and Agencies	Agreement Description
Future	**Data Sharing and Usage (Public-Private)** – City of Johnson City, TDOT, media	Agreement would allow private sector media and information service providers to access and broadcast public 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)** – City of Johnson City, City of Elizabethton, TDOT	Agreement would define the parameters, guidelines, and policies for inter-agency ITS data sharing between the public sector agencies. 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	**ITS and Traffic Signal Timing Data Sharing and Usage** – City of Johnson City, City of Elizabethton	Agreement would define the parameters, guidelines, and policies for inter-agency ITS and 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, City of Johnson City, City of Elizabethton, THP, Carter County 911 Communications District, Washington County/Johnson City 911 Dispatch Center	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 CAD systems and include information on lane closures, travel delays, and weather.
Future	**Joint Operations Agreements –** TDOT, City of Johnson City	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 procedure. 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	**Maintenance Agreements** – City of Johnson City, City of Elizabethton, TDOT	Agreement that would allow multiple public agencies to pull their funding together to hire a single maintenance contractor to maintain ITS devices throughout the Region.
Existing	**Operations and Maintenance Agreement** – City of Jonesborough, City of Johnson City	Interlocal agreement for the City of Johnson City to operate and maintain the traffic signals within the City of Jonesborough.

4.5 Phases of Implementation

The Regional ITS Architecture will be implemented over time through a series of projects led by both public sector and private sector agencies. Key foundation systems will need to be implemented in order to support other systems 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 timeframes were identified in the Johnson City Regional ITS Deployment Plan. These projects were 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 Johnson City Region are listed below. Projects associated with these and other market packages identified for the Region were included in the Johnson City Regional ITS Deployment Plan.

- Network Surveillance;
- Surface Street Control;
- Traffic Information Dissemination;
- Regional Traffic Control; and
- 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 Regional ITS Deployment Plan for the Johnson City Region. The plans need to be incorporated into the regional planning process so that the ITS vision for the Region is considered when implementing ITS projects and to ensure that the Region remains eligible for federal funding for implementation of the projects.

As projects transition from the Long Range Transportation Plan to the Transportation Improvement Program (TIP) each project should be evaluated to determine if the project includes any ITS elements. If the project contains an ITS element, then the Regional ITS Architecture needs to be reviewed to ensure that the project is in conformance. The Johnson City MTPO will perform this examination as part of the planning process using the procedure outlined in Section 4.6.1.

4.6.1 Process for Determining Architecture Conformity

The Johnson City Regional ITS Architecture documents the customized market packages that were developed as part of the ITS architecture process. To satisfy federal 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 ITS Architecture or the project to ensure there is conformance.

Identifying 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. 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 deployments and should be included in the ITS architecture.

Identifying the Corresponding Market Packages

If a project was included in the ITS Deployment Plan Tables 8-12, then the applicable market package(s) for that project are identified in a column. 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 without the assistance of an ITS Deployment Plan. In that case, the market packages selected and customized for the Johnson City Region are identified in Table 4 of this document and detailed market package definitions are located in Appendix A.

Identifying the Component within the Market Package

The customized market packages for the Johnson City Region are located in Appendix B. Once the element is located on the market package the evaluator may determine that the element name should be modified. For example, an element called the City of Elizabethton TOC was included in the architecture, but at the time of deployment, the City might decide to call the center by a new name. This name change should be documented using the process outlined in Section 5.2.

Evaluating 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 plan 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.

Documenting 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 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 ITS Architecture developed for the Johnson City Region addresses the Region's vision for ITS implementation at the time the plan was developed. As the Region grows, needs will change and as technology progresses new ITS opportunities will arise. As an example, at the time this architecture was developed the City of Jonesborough did not control its own traffic signals. The City of Johnson City operated and maintained the City of Jonesborough traffic signals through an interlocal agreement. As more development occurs in the Region, Jonesborough may at some point operate its own signal system. Shifts in regional needs and focus as well as changes in the National ITS Architecture will necessitate that the Johnson City Regional ITS Architecture be updated to remain a useful resource for the Region.

5.1 Maintenance Process

The Johnson City MTPO will be responsible for leading the process to update the Johnson City Regional ITS Architecture and Deployment Plan in coordination with the TDOT Long Range Planning Division. **Table 9** summarizes the maintenance process agreed upon by stakeholders in the Region.

Table 9 – Regional ITS Architecture and Deployment Plan Maintenance Summary

Maintenance Details	Regional ITS Architecture		Regional ITS Deployment Plan	
	Minor Update	**Major Update**	**Minor Update**	**Major Update**
Timeframe for Updates	As needed	Every 4 years	Annually	Every 4 years
Scope of Update	Update market packages to satisfy architecture compliance requirements of projects or to document other changes that impact the ITS Architecture	Entire ITS Architecture	Update project status and add or remove projects as needed	Entire ITS Deployment Plan
Lead Agency	Johnson City MTPO		Johnson City MTPO	
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 Johnson City Regional ITS Architecture document, Appendices, and Turbo Architecture database	Updated project tables	Updated Johnson City Regional ITS Deployment Plan document

Additional information on the procedure for submitting minor architecture changes is included in Section 5.2 of this document. A major update will occur every four years in the year preceding the Long Range Transportation Plan (LRTP) update. The next update of the Regional ITS Architecture will take place in 2011. Section 4 of the ITS Deployment Plan contains additional detail on the annual project review process.

5.2 Procedure for Submitting ITS Architecture Changes Between Major Updates

Updates to the Johnson City 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.

For situations where a change is required, an Architecture Maintenance Documentation Form was developed and is included in **Appendix E**. 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 Johnson City MTPO will review and accept the proposed changes and forward the form to the Long Range Planning Division for their records. When a major update is performed all of the documented changes will be incorporated into the architecture.