2022

CHATTANOOGA

REGIONAL INTELLIGENT TRANSPORTATION SYSTEM ARCHITECTURE AND DEPLOYMENT PLAN

Chattanooga-Hamilton County
Regional Planning Agency

Chattanooga
Regional ITS Architecture and Deployment Plan

FINAL REPORT

Completed June 2022

Approved August 2022

A Chattanooga-Hamilton County/North Georgia Transportation Planning Organization Project

Prepared by:

Kimley»Horn

069253701

Placeholder for the Chattanooga-Hamilton County/North Georgia TPO
Resolution Approving the
2022 Regional ITS Architecture and Deployment Plan

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Melissa Furlong
Operations Program Specialist
FHWA Tennessee Division Office
404 BNA Drive, Building 200, Suite 508
Nashville, TN 37217

Subject: Chattanooga Regional ITS Architecture and Deployment Plan 2022 Update

Dear Ms. Furlong,

The subject Regional ITS Architecture has been reviewed by TDOT staff and has been found to be “Ready for Use”.

TDOT requests that your office review the Chattanooga Regional ITS Architecture and concur with our findings by signing below.

Sincerely,

Lee J. Smith
Lee Smith (Jul 23, 2022 15:28 CDT)

Lee Smith
Interim Director of Traffic Operations Division

U.S. Department of Transportation
Federal Highway Administration

Tennessee Division

404 BNA Drive, Suite 508
Nashville, Tennessee 37217
Phone (615) 781-5770

June 28, 2022

In Reply Refer To:
HTS-TN

Mr. Lee Smith
Interim Director of Traffic Operations Division
Tennessee Department of Transportation
James K. Polk Building, Suite 700
Nashville, TN 37243

Subject: Regional ITS Architecture (RITSA) Ready For Use Chattanooga Regional ITS Architecture and Deployment Plan 2022 Update

Dear Mr. Smith:

In response to your June 23, 2022 letter, the Federal Highway Administration (FHWA) has reviewed the final RITSA documents for the subject project in accordance with 23 CFR 940. The RITSA documents are in compliance with the CFR requirements, therefore the request is approved, and the associated documents are considered "ready for use."

If you have questions regarding this approval, please contact me at (615) 781-5769.

Sincerely,

MELISSA FURLONG

Digitally signed by MELISSA FURLONG
Date: 2022.06.28 09:35:10 -05'00'

Melissa Furlong, P.E.
Operations Program Specialist

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AMBER	America's Missing: Broadcast Emergency Response
ATM	Active Traffic Management
ATMS	Advanced Transportation Management System
AVL	Automated Vehicle Location
C2C	Center-to-Center
CARTA	Chattanooga Area Regional Transportation Authority
CHCNGA TPO	Chattanooga-Hamilton County/North Georgia Transportation Planning Organization
CCTV	Closed Circuit Television
CMAQ	Congestion Mitigation and Air Quality Improvement Program
CVO	Commercial Vehicle Operations (National ITS Architecture Service Area)
DM	Data Management (National ITS Architecture Service Area)
DMS	Dynamic Message Sign
DSRC	Dedicated Short Range Communication
EMA	Emergency Management Agency
EMS	Emergency Medical Services
EOC	Emergency Operations Center
FAST Act	Fixing America's Surface Transportation Act
FDS	Fog Detection System
FHWA	Federal Highway Administration
FIPS	Federal Information Processing Standards
FTA	Federal Transit Administration
GDOT	Georgia Department of Transportation
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HELP	Tennessee Freeway Service Patrol
HERO	Highway Emergency Response Operators (Georgia Freeway Service Patrol)
ICM	Integrated Corridor Management
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation Systems
IVR	Interactive Voice Response
MC	Maintenance and Construction (National ITS Architecture Service Area)
MCCD	Motor Carrier Compliance Division
MDT	Mobile Data Terminal
MOA	Memorandum of Agreement

MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NEMA	National Electrical Manufacturers Association
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NOCoE	National Operations Center of Excellence
NTCIP	National Transportation Communications for ITS Protocol
PM	Parking Management (National ITS Architecture Service Area)
PS	Public Safety (National ITS Architecture Service Area)
PSAP	Public Safety Answering Point
PT	Public Transportation (National ITS Architecture Service Area)
RAD-IT	Regional Architecture Development for Intelligent Transportation
RDS	Radar Detection System
RPA	Chattanooga-Hamilton County Regional Planning Agency
RTMS	Remote Traffic Microwave Sensor
RTP	Regional Transportation Plan
RWIS	Road Weather Information System
SDO	Standards Development Organization
SEAR	Systems Engineering Analysis Report
SETHRA	Southeast Tennessee Human Resource Agency
SSEAF	Simple Systems Engineering Analysis Form
STBG	Surface Transportation Block Grant Program
ST	Sustainable Transportation (National ITS Architecture Service Area)
SU	Support (National ITS Architecture Service Area)
SWIFT	Statewide Information for Travelers
TDOT	Tennessee Department of Transportation
TEA-21	Transportation Equity Act for the 21st Century
TEMA	Tennessee Emergency Management Agency
TIP	Transportation Improvement Program
TI	Traveler Information (National ITS Architecture Service Area)
THP	Tennessee Highway Patrol
TIGER	Transportation Investment Generating Economic Recovery
TITAN	Tennessee Integrated Traffic Analysis Network
TM	Traffic Management (National ITS Architecture Service Area)
TMC	Traffic Management Center
TOC	Traffic Operations Center

TPO	Transportation Planning Organization
TraCS	Traffic and Criminal Software
TSMO	Transportation Systems Management and Operations
USDOT	United States Department of Transportation
VS	Vehicle Safety (National ITS Architecture Service Area)
VIVDS	Video Image Vehicle Detection Systems
WAVE	Wireless Access in Vehicular Environments
WX	Weather (National ITS Architecture Service Area)

ACKNOWLEDGEMENTS

Chattanooga Regional ITS Architecture and Deployment Plan

The Chattanooga-Hamilton County Regional Planning Agency on behalf of the Chattanooga-Hamilton County/North Georgia Transportation Planning Organization (TPO) would like to thank all those from the various local governments and many others who helped contribute either by reviewing this document or by giving input.

Chattanooga-Hamilton County/North Georgia Transportation Planning Organization

Todd Leamon, Chairperson

The Chattanooga-Hamilton County/North Georgia TPO Technical Coordinating Committee and TPO Executive Board members represent the counties of Hamilton in Tennessee, Catoosa in Georgia, and portions of Dade and Walker Counties in Georgia, including their respective municipal governments within the Chattanooga-Hamilton County/North Georgia TPO Boundary.

The preparation of this report has been financed in part through grant[s] from the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA), U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code. This report was also supported and funded in part through programs of the Tennessee Department of Transportation (TDOT) and the Georgia Department of Transportation (GDOT). The views and opinions of the authors [or agency] expressed herein do not necessarily state or reflect those of the states or U.S. Department of Transportation.

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No otherwise qualified individual with a disability in the United States shall, solely by reason of her or his disability, be excluded from the participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance (Rehabilitation Act of 1973 29 U.S.C. § 794).

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The Chattanooga-Hamilton County RPA further assures that every effort will be made to ensure non-discrimination in all of its programs and activities, whether or not those programs or activities are federally funded.

EXECUTIVE SUMMARY

According to 23 CFR 940.3, Regional Intelligent Transportation System (ITS) Architecture means a regional framework for ensuring institutional agreement and technical integration for the implementation of ITS projects or groups of projects. The Regional ITS Architecture provides a long-range plan for the deployment, integration, and operation of ITS in the Chattanooga Region. The plan allows stakeholders to determine what they want their transportation system to look like in the long term and provides a framework for dividing the system into smaller pieces that can be implemented over time as funding permits.

*Intelligent Transportation Systems (ITS) are the application of electronic technologies and communications to improve the efficiency and safety of the transportation system. Examples include **traffic detectors**, **cameras**, **dynamic message signs**, and **real-time information** on traffic and transit conditions.*

A regional ITS architecture is necessary to satisfy the ITS conformity requirements first established in 1998 in the Transportation Equity Act for the 21st Century (TEA-21) highway bill and continued in subsequent federal highway bills. The Chattanooga Regional ITS Architecture and Deployment Plan was most recently updated in 2017 and is generally updated every four to five years as part of the broader Regional Transportation Plan (RTP) update process.

Stakeholders and Regional Plans

Kick-off and review workshops were held with stakeholders to update the Chattanooga Regional ITS Architecture and Deployment Plan, and individual interviews were conducted with many of the key stakeholder agencies to gather more information for developing the Regional ITS Architecture. Participating stakeholders included:

- CARTA
- Catoosa County
- Catoosa County Transit
- Chattanooga/Hamilton County/North Georgia TPO
- City of Chattanooga
- City of East Ridge
- FHWA Georgia Division
- FHWA Tennessee Division
- GDOT
- Hamilton County
- Northwest Georgia Regional Commission
- Oak Ridge National Laboratory
- Southeast Tennessee Development District
- TDOT Region 2
- TDOT Traffic Operations Division
- Walker County Transit

*ITS can directly support the five pillars of the vision statement developed for the 2050 Regional Transportation Plan: **Preserving Resources and Assets**, **Protecting Communities**, **Providing Equitable Options**, **Propelling Economic Vitality** and **Pioneering Innovative Technologies**.*

To supplement input from stakeholders, development documents and guiding principles that are part of the Chattanooga-Hamilton County/North Georgia (CHCNGA) 2050 RTP currently under development (2021-2022) were reviewed to determine regional needs that could be addressed through ITS. The investment needs identified through the Regional ITS Architecture development process and the 2050 RTP provided guidance for determining what to include in the architecture.

Developing the Architecture

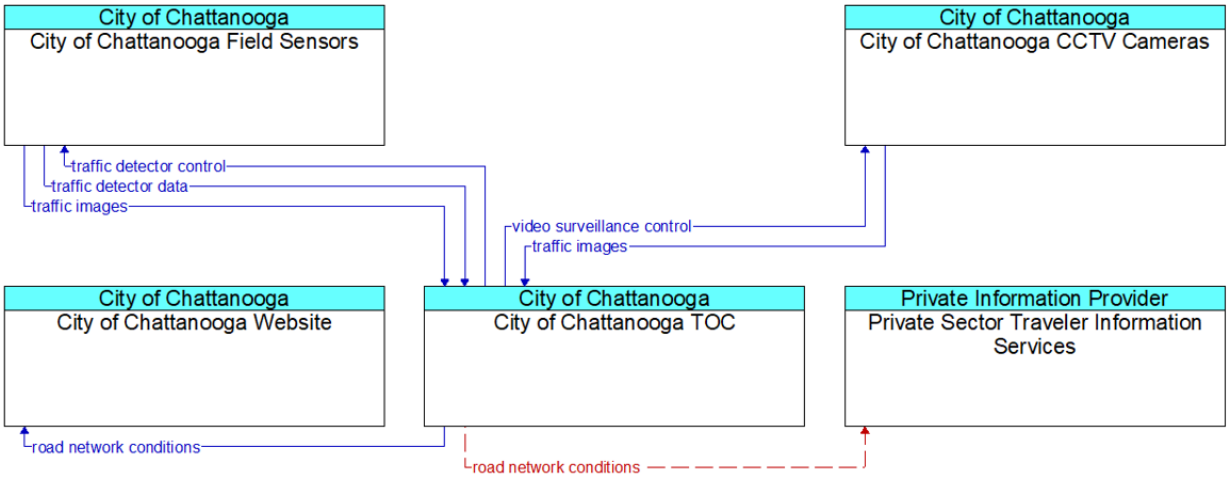
The Chattanooga Regional ITS Architecture was developed in a four-step process. Each step involved stakeholder input from the agencies introduced in the previous section.

Step 1 – Conduct an ITS Inventory Review and Determine Needs

Existing plans were reviewed, and stakeholders were consulted to determine existing and planned ITS elements in the region and any outstanding ITS needs. Needs generally corresponded to either traffic management, public safety, public transportation, or traveler information.

Step 2 – Develop ITS Service Packages

ITS service packages present the services that ITS can provide to address transportation needs in the Region. In the Chattanooga Region, a total of 62 service packages, compared to 54 service packages in the last update, were identified and prioritized as high, medium, or low. Service packages show how that ITS service will be operated and what data flows will be shared between agencies and ITS elements. A sample diagram that shows the information flows to and from the City of Chattanooga's traffic operations center is shown below.



Step 3 – Identify ITS Projects for Deployment

The ITS Deployment Plan section of the Regional ITS Architecture identifies the projects that stakeholders recommended for deployment in the Chattanooga Region. These projects will assist the Region with implementing the ITS services identified in the ITS service packages. Projects are described and a timeframe for implementation (short-term, medium-term, or long-term) is assigned to each one.

Step 4 – Develop a Use and Maintenance Plan for the Architecture

Developing a use and maintenance plan for the architecture helps ensure that requirements are met for the use of federal transportation funding of ITS in the Chattanooga Region. Stakeholders in the Region developed guidelines to address use and maintenance of the plan. Stakeholders in the Chattanooga Region agreed that ITS projects need to be reviewed to determine if the ITS elements in the project are in conformance with the Regional ITS Architecture before being incorporated into the

RTP. Stakeholders also determined that the Architecture should be updated in coordination with updates to the Chattanooga RTP or as large regional ITS projects are deployed.

Key Service Packages

Although 62 service packages are included in the Chattanooga Regional ITS Architecture, 19 are of immediate interest. Each service package in this group was identified by stakeholders as a high priority service package, and each one corresponds to a project in the region's ITS Deployment Plan that is scheduled for implementation within the next five years. These service packages are:

- TM01 – Infrastructure-Based Traffic Surveillance
- TM03 – Traffic Signal Control
- TM04 – Connected Vehicle Traffic Signal System
- TM06 – Traffic Information Dissemination
- TM07 – Regional Traffic Management
- TM08 – Traffic Incident Management System
- TM13 – Standard Railroad Grade Crossing
- TM20 – Variable Speed Limits
- PS08 – Roadway Service Patrols
- PS09 – Transportation Infrastructure Protection
- MC09 – Infrastructure Monitoring
- VS05 – Curve Speed Warning
- VS11 – Oversize Vehicle Warning
- ST05 – Electric Charging Stations Management
- PT03 – Dynamic Transit Operations
- PT04 – Transit Fare Collection Management
- PT07 – Transit Passenger Counting
- PT09 – Transit Signal Priority
- TI01 – Broadcast Traveler Information

ITS Projects Planned for Deployment in the Short-Term

A list of recommended ITS projects for the Chattanooga Region was developed through input from stakeholders. Projects recommended for deployment in the short term are:

TDOT and GDOT Projects

- TDOT/GDOT Coordination
- TDOT/GDOT I-24 Georgia ITS Device Deployment
- TDOT Overheight Vehicle Detection at Bachman Tunnel
- TDOT Region 2 SmartWay Infrastructure Expansion
- TDOT Region 1/Region 2 Fiber Connection
- TDOT Region 2 HELP 'Lite' Service Patrol Expansion
- TDOT Incident Management Drone Acquisition
- TDOT Automated Vehicle Location Implementation
- TDOT HAR Improvements
- TDOT Ramp Metering
- TDOT Region 2 SmartWay Life Cycle Replacement
- TDOT I-24 Ridge Cut (Missionary Ridge) ITS Study
- TDOT I-24/US-27 Interchange ITS Study
- TDOT I-75/I-24 Interchange ITS Study

Transit Projects

- CARTA Video Analytics Passenger Counting
- CARTA Electric Vehicle Inductive Charging Pads
- CARTA SmartCard Implementation

Other Projects

- Hamilton County EMA CCTV Camera Deployment

Municipal/County Projects

- City of Chattanooga ATMS Signal System Software and Signal Upgrades
- City of Chattanooga Adaptive Traffic Signal System Expansion
- City of Chattanooga Smart Corridor Deployment
- City of Chattanooga Transit Signal Priority Deployment
- City of Chattanooga Arterial CCTV Cameras and DMS
- City of Chattanooga Overheight Detection
- City of Chattanooga Curve Speed Warning System
- City of Chattanooga Flood Detection and Warning System
- City of Chattanooga Infrared Bridge Sensors
- City of Chattanooga/Hamilton County Railroad Crossing Blockage Notification
- City of Chattanooga Traffic Signal Railroad Preemption Deployment
- City of Chattanooga Traffic Operations Center Upgrades
- City of Chattanooga Traffic Signal Communication Improvements
- City of Chattanooga School Zone Flasher System Upgrade
- East Ridge Traffic Signal Communication Upgrades and Signal Timing
- Signal Mountain Road Closure Notification

1 INTRODUCTION

The Chattanooga Regional Intelligent Transportation System (ITS) Architecture provides a long-range plan for the deployment, integration, and operation of ITS in the Chattanooga Region. The Regional ITS Architecture allows stakeholders to plan for what they want their system to look like in the long term and then break the system into smaller pieces that can be implemented over time as funding permits. Development of a Regional ITS Architecture encourages interoperability and resource sharing among agencies and allows for cohesive long-range planning among regional stakeholders. Completion and update of the plan is also required by the Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) to use federal transportation funds for ITS projects in the Region.

1.1 Project Overview

ITS can be defined as the application of electronic technologies and communications to improve the operation of the transportation system. Examples of ITS technologies and systems include traffic detectors, closed-circuit television (CCTV) cameras, dynamic message signs (DMS), and real-time information on traffic and transit conditions. ITS often includes interrelated systems from multiple agencies and jurisdictions that work together to deliver transportation services. To support planning and integration of these systems, regional ITS architectures are developed. A regional ITS architecture is a framework for institutional agreement and technical integration in a region. An architecture defines the links between the pieces of the system and the information that is exchanged on each connection. An architecture is important because it allows integration options to be considered prior to investment in the design and development of elements of a system. An architecture defines functions but not specific technologies, which allow the architecture to remain effective over time. Architectures define what must be done, but not how it will be done from a technology standpoint.

The Chattanooga Regional ITS Architecture was first developed by the Tennessee Department of Transportation (TDOT) in 2003. In June 2010, the Chattanooga-Hamilton County/North Georgia Transportation Planning Organization (TPO), in coordination with TDOT, updated the Chattanooga Regional ITS Architecture. The maintenance plan that was developed in the 2010 Chattanooga Regional ITS Architecture and Deployment Plan set a goal to update the plan every four years. To meet that goal, the Chattanooga-Hamilton County/North Georgia TPO completed a second update of the plan in 2014 and a third update in 2017. The current update was completed in early 2022. The time horizon for this update to the Regional ITS Architecture is 2045. This time horizon aligns with the time horizon for the most recently published version of Chattanooga's RTP.

The Regional ITS Architecture consists of several key components:

- **ITS Needs:** The needs describe the transportation related needs in the Region that could possibly be addressed by ITS.
- **ITS Inventory:** The inventory describes all the ITS related elements that either exist or are planned for the Region.
- **ITS Service Packages:** The ITS service packages describe the services that stakeholders in the region want ITS to provide. ITS service package diagrams have been developed to illustrate how each service will be deployed and operated by each agency in the Region that expressed interest in a particular service.

- **Use and Maintenance Plan:** The use and maintenance plan describes how to use the Regional ITS Architecture for ITS planning and design efforts, such as the development of a Systems Engineering Analysis. It also describes how the Regional ITS Architecture should be maintained in the future.

A regional ITS architecture is necessary to satisfy the ITS conformity requirements first established in the Transportation Equity Act for the 21st Century (TEA-21) highway bill. 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 to be eligible for funding from FHWA or FTA. To show this conformance, it is important that any region deploying ITS have an updated regional ITS architecture in place. The ITS conformity requirements are continued in the most recent highway bill, Fixing America's Surface Transportation (FAST) Act, which was signed into law on December 4, 2015.

The Stakeholders developed the Regional ITS Architecture based on a vision of how they wanted to implement and operate ITS through the year 2045 in the Chattanooga Region. In addition, the Regional ITS Architecture includes an ITS Deployment Plan. The ITS Deployment Plan identifies projects that have been recommended by the stakeholders as priority projects for their agency that will help achieve the vision of the Regional ITS Architecture.

The Chattanooga Regional ITS Architecture and the ITS Deployment Plan were both developed with significant input from local, state, and federal officials. Two virtual stakeholder workshops were held with all stakeholders and individual interviews were conducted with many of the stakeholders outside the workshops to solicit input and ensure that the plans reflected the unique needs of the Region. A virtual public involvement event was also held to share details of the Regional ITS Architecture with members of the public. Copies of the draft reports were provided to all stakeholders. The Regional ITS Architecture and Deployment Plan reflects an accurate snapshot of existing ITS deployments and future ITS plans in the Region. Needs and priorities of the Region will change over time, and to remain effective this plan should be periodically reviewed and updated.

1.2 Chattanooga Region

The Chattanooga Region is comprised of Hamilton County in Tennessee, Catoosa County in Georgia, and the northern portions of Dade and Walker Counties in Georgia. These boundaries correspond with the boundaries of the Chattanooga-Hamilton County/North Georgia TPO (CHCNGA TPO), which are shown in **Figure 1**. Several projects are also considered to be within the Chattanooga Region, including the fog detection system that has been deployed by TDOT on I-75 in Bradley County as well as proposed expansions of the TDOT HELP program along I-24 and I-75 in counties adjacent to Hamilton County. Although this system is outside the CHCNGA TPO boundaries, it is operated by the TDOT SmartWay Traffic Management Center (TMC) in Chattanooga and the Chattanooga-Hamilton County/North Georgia TPO and the Cleveland Urban Area MPO have an MOA that states that the I-75 fog detection system will be included in the Chattanooga Regional ITS Architecture.

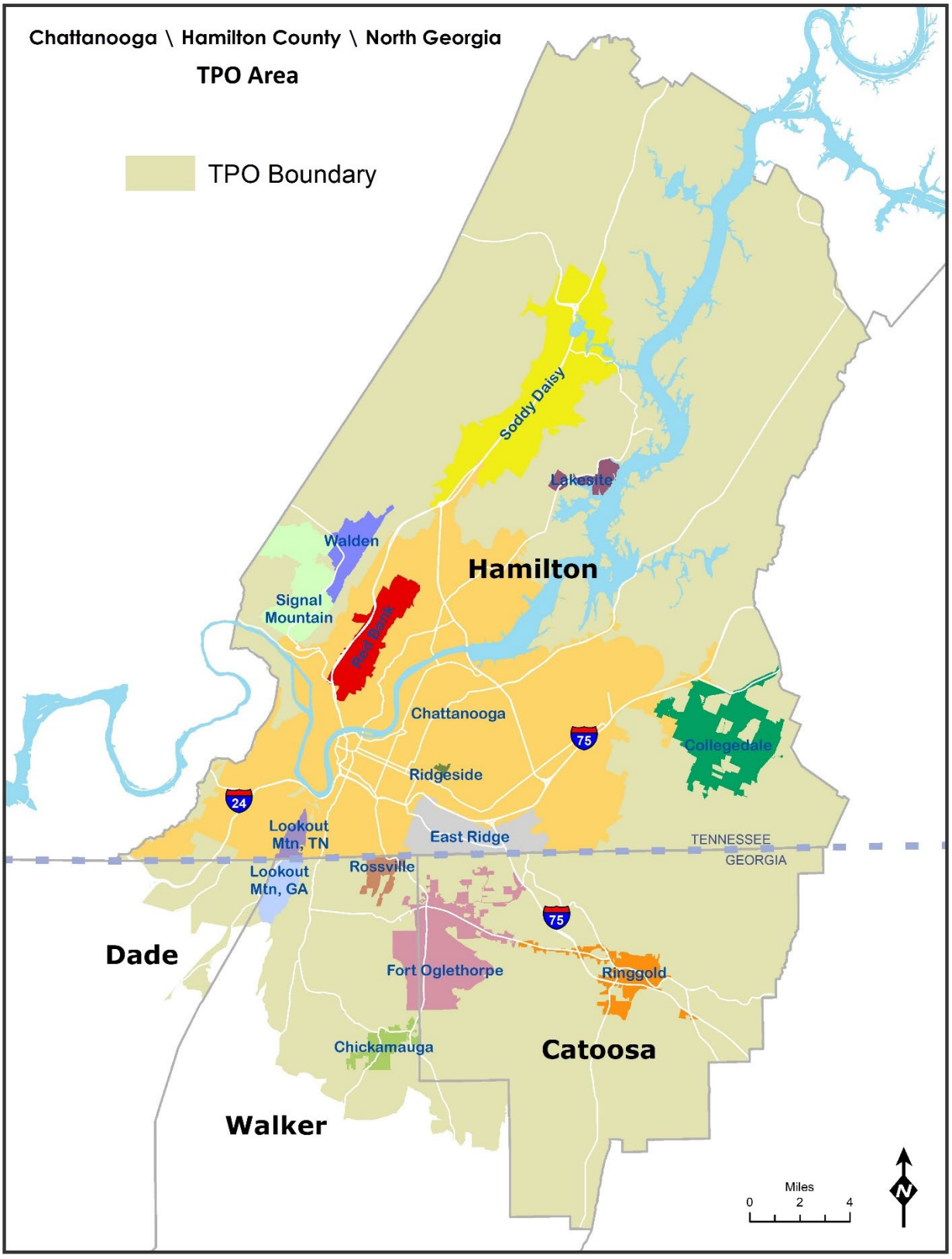


Figure 1 – CHCNGA TPO Regional Boundaries

1.2.1 Transportation Infrastructure

The Chattanooga Region is served by several significant State and Federal highways. The primary access-controlled facilities include I-75, I-24, I-59, US 27, and SR 153. I-75 and I-24 are the principal highway corridors for the Chattanooga Region. I-75 is one of the principal north-south corridors that is critical to movement of goods and people through East Tennessee as well as the United States. I-24 is the principal east-west corridor linking the Chattanooga Region to Central Tennessee. Although I-59 is in Georgia, it is still a key north-south corridor to and from the Chattanooga Region.

US 27 and SR 153 predominately facilitate Chattanooga commuter traffic linking the Chattanooga urban area to communities to the north. Chattanooga generally lacks any high-volume circumferential routes to provide alternatives for any of these principal corridors.

Fixed route and paratransit services are provided in Hamilton County by the Chattanooga Area Regional Transportation Authority (CARTA). Demand response service in the Chattanooga Region is provided by several different agencies depending on the County. Within Tennessee, the Southeast Tennessee Human Resource Agency provides demand response in Hamilton County. In Georgia, demand response service is provided by Catoosa Trans-Aid in Catoosa County, Dade County Transit in Dade County, and Walker County Transit in Walker County. Commuter rail and light rail service does not exist within the Region.

The Chattanooga Region has undertaken several deployments of ITS programs throughout the Region. These programs have come from multiple agencies and cover multiple transportation modes as well. Some multi-agency participation has been present on some of these ITS initiatives. The following are some of the larger ITS initiatives underway or existing within the Chattanooga Region:

- **TDOT SmartWay Program** – TDOT's SmartWay platform is predominately a freeway traffic management platform comprised of closed-circuit television (CCTV) cameras, dynamic message signs (DMS), and radar detection systems (RDS). The system is managed from the TDOT SmartWay TMC located off I-75 in the eastern portion of Chattanooga in the Enterprise South Industrial Park. The TDOT SmartWay TMC operates 24-hours a day, 7 days a week.
- **TDOT HELP** – The TDOT HELP program has been in operation in the Chattanooga Region since 2000. The HELP program trucks patrol freeways including I-75, I-24, US 27, and SR 153 and assist motorists with minor repairs such as flat tire changes, refueling, and push services to move disabled vehicles out of the through lanes. HELP operators also assist with traffic control and detours during major incidents.
- **TDOT I-75 Fog Detection System (FDS)** – TDOT constructed another ITS system just north of Chattanooga consisting of the same elements as their SmartWay freeway management system but with the addition of a fog detection system (FDS). The I-75 FDS covers roughly 20 miles of I-75 in Bradley and McMinn Counties. The system was originally operated by the Tennessee Highway Patrol, but it is now operated by the TDOT Region 2 SmartWay TMC in Chattanooga. Although the FDS is in the geographic region of the Cleveland Urban Area Metropolitan Planning Organization (MPO), there is an agreement between the Chattanooga-Hamilton County/North Georgia TPO and the Cleveland Urban Area MPO that the FDS will be included in the Chattanooga Regional ITS Architecture.

- **Center-to Center (C2C) Communication** – The TDOT SmartWay communication backbone has facilitated C2C communication links between the TDOT SmartWay TMC, the City of Chattanooga TMC, the THP District 2 Headquarters, and the Chattanooga E-911 Emergency Management Center. C2C communications also exists between the TDOT Region 2 SmartWay TMC in Chattanooga and the other TDOT SmartWay TMCs around the state.
- **GDOT** – GDOT has implemented CCTV cameras on I-75 and I-59, including a CCTV camera at the interchange of I-59 and I-24. Public agencies can get access to view GDOT CCTV cameras through an agreement with GDOT. GDOT also has a road weather detection station (RWIS) deployed on I-75 north of Ringgold. HERO freeway service patrol trucks are planned for patrol on I-59 and I-75 in North Georgia. These trucks will be operated through a contract between GDOT and a private vendor.
- **City of Chattanooga Traffic Management Center and Advanced Traffic Management System** – The City of Chattanooga has implemented an Advanced Traffic Management System (ATMS) supporting real time monitoring and control of over 100 traffic signals within Chattanooga as well as in the cities of East Ridge and Red Bank. The ATMS provides the City of Chattanooga TMC the capability to implement traffic signal plans in response to changing traffic patterns as well as the capability to monitor traffic conditions and equipment status. This capability includes downtown traffic signals as well as various closed loop traffic signal systems outside of the downtown area.
- **CARTA ITS –** CARTA has an extensive ITS program that includes several different programs that are either fully implemented or in the process of being implemented. CARTA's bus fleet includes automated vehicle location (AVL), mobile data terminals (MDTs), automated passenger counters, electronic fare payment, and on-board security cameras and alarms. Next bus arrival signs have been implemented at transit stops and real-time information on bus location is available on CARTA's website. Transit trip planning services are available through Google Maps and Bing.

Outside of the Chattanooga Region there have also been ITS deployments that can impact the Region. TDOT has deployed CCTV cameras and DMS on I-24 and I-75, and Georgia has deployed additional CCTV cameras on I-75. This ITS infrastructure can improve operations on freeways that provide access for travelers traveling to or from the Chattanooga Region. TDOT has also deployed a run-away truck ramp detection system and curve warning signs in the Monteagle mountain area, as well as infrared cameras that can monitor traffic during fog conditions on the mountain. These deployments and increased focus on operations, while not in the Chattanooga Region, provide direct benefits to those traveling to or from the Region.

The Infrastructure Investment and Jobs Act, passed by Congress and signed by the President in 2021, provided additional funding that can support ITS and other advanced technology solutions aimed as improving safety, reducing congestion, and improving reliability. The act also included funding to support electric vehicle deployments, including charging infrastructure, throughout the US. Key funding that may support continued deployment of ITS and electric vehicles is listed below.

- Intelligent Transportation Systems - Funding at $250,000,000
- Advanced Transportation Technologies and Innovative Mobility – Funding at $900,000,000
- Congestion Relief Program – Funding at $239,505,000
- National Electric Vehicle Charging Formula Program – Funding at $5 Billion

2 REGIONAL ITS ARCHITECTURE UPDATE PROCESS

The update of the Regional ITS Architecture and Deployment Plan for the Chattanooga Region relied heavily on stakeholder input to ensure that the architecture reflected local needs. Two workshops were held along with a series of stakeholder interviews to gather input, and draft documents were made available to stakeholders for review and comment.

2.1 Stakeholder Engagement

The process followed for the Chattanooga 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.

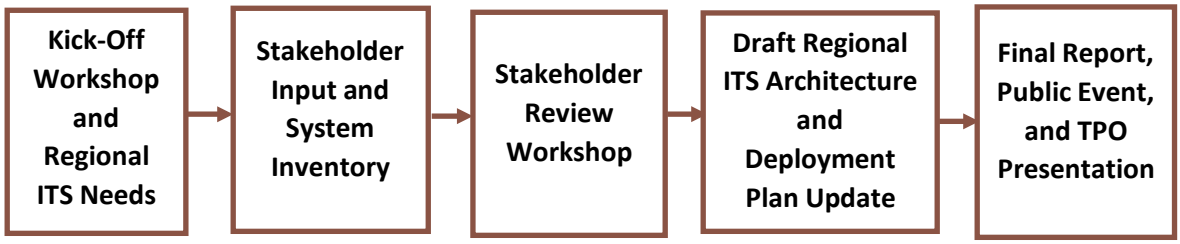


Figure 2 – Chattanooga Regional ITS Architecture and Deployment Plan Development Process

Two workshops with stakeholders were held to update the Chattanooga Regional ITS Architecture and Deployment Plan. These workshops included:

- Kick-Off Workshop
- Stakeholder Review Workshop

In addition, interviews were conducted with many of the key stakeholder agencies outside of the workshops to gather additional information for developing the Regional ITS Architecture. Key components of the process are described below:

Kick-Off Workshop: A stakeholder group was identified that included representatives from regional transportation, public works, public safety, and emergency management agencies in addition to towing companies. The group was invited to the project Kick-Off Workshop where an overview of the project was provided, the regional boundaries were defined, existing and planned ITS deployments in the Region were discussed, and ITS needs for the Region were identified.

Stakeholder Input and System Inventory: Stakeholder input was gathered through the two stakeholder workshops as well as a series of interviews that were conducted with stakeholder agencies. The interviews were used to complete the system inventory for the region, define how ITS services are currently being operated, define how ITS services could be operated in the future, and identify potential ITS projects for the Region.

Stakeholder Review Workshop: A second stakeholder workshop was conducted to review the draft list of projects as well as identify priorities for ITS service packages and confirm the list of potential ITS

projects for the Chattanooga Region. Use and maintenance of the Regional ITS Architecture was also discussed.

Develop Draft Regional ITS Architecture and Deployment Plan Update: Following the stakeholder input, a draft report was developed which identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the ITS system, identifies projects for deployment, and establishes a maintenance plan. Additionally, a website was created to allow stakeholders access to an interactive version of the ITS architecture and documents such as reports, meeting minutes, presentations, and the RAD-IT Architecture database.

Final Report, Public Event, and TPO Presentation: The final Regional ITS Architecture and Deployment Plan was developed, which included an executive summary, project report, RAD-IT Architecture database, and project website with an interactive version of the Regional ITS Architecture. Details of the project were shared with members of the public at a virtual event, and an overview presentation on the Regional ITS Architecture was also given to the Chattanooga-Hamilton County/North Georgia TPO Executive Board and Technical Coordinating Committee.

A corresponding website was also developed for the Chattanooga Regional ITS Architecture which contains electronic versions of all documents, meeting minutes, and an interactive version of the RAD-IT Architecture database. The website is located at the following address:

https://chcrpa.org/intelligent-transportation-system/

2.1.1 Regional ITS Stakeholders

When developing the stakeholder group, the project team coordinated with the Chattanooga-Hamilton County/North Georgia TPO to invite the appropriate city, county, regional, state, and federal agencies, including all members of the TPO. Since ITS often transcends traditional transportation infrastructure, it is important to involve a wide range of local, state, and federal stakeholders in the ITS architecture development and visioning process. Input from these stakeholders is a critical part of defining the interfaces, integration needs, and overall vision for ITS in a region. In the Chattanooga Region, stakeholders that participated included not just representatives from transportation and public transit agencies, but also stakeholders that represented public safety and health.

Appendix A contains a listing of all stakeholders that participated in the update of the Chattanooga Regional ITS Architecture and Deployment Plan. Stakeholder participation included attendance at a project workshop, participation in a stakeholder agency interview, or participation through providing input or comments on one or more deliverables. **Appendix A** also include a list of all stakeholders that were invited to participate even if they were not able to attend any of the stakeholder outreach activities. All stakeholders that were invited to attend were provided minutes of the workshops, copies of presentations used in the workshop, and notified when copies of reports were available for review on the project website to encourage their participation as much as possible.

2.2 RAD-IT Architecture Software

RAD-IT Architecture Version 9.0 was used to develop the Chattanooga Regional ITS Architecture. RAD-IT Architecture is a software application that was developed by the United States Department of Transportation (USDOT) to be used as a tool for documenting and maintaining ITS architectures. Version 9.0 of RAD-IT Architecture was released in May 2021 and was developed to support Version

9.0 of the National ITS Architecture. Use of the RAD-IT Architecture software in development of the regional ITS architectures is recommended by both the FHWA and FTA.

In the Chattanooga Region, the RAD-IT Architecture database was customized based on the National ITS Architecture service packages whose definitions are provided in **Appendix B** of this report. The ITS service packages provide a graphical representation of the services stakeholders in the Region would like ITS to provide. In each service package, the elements, such as a TMC or a CCTV camera, and the data that is shared between them are shown. RAD-IT Architecture allows the Region to document all the elements and information flows that exist or are planned in the Region. RAD-IT Architecture also allows the user to quickly access any standards that are associated with the information flows as well as generate reports and diagrams to assist in reviewing the data. Some examples of the useful reports and diagrams that may be generated using the RAD-IT Architecture software are included in **Table 1**.

RAD-IT Architecture saves data in Microsoft Access compatible data files. RAD-IT Architecture files can be accessed using Microsoft Access, although use of Access will not provide nearly the same number of capabilities as accessing the files using the RAD-IT Architecture software. The USDOT provides the RAD-IT Architecture free of charge to those that wish to download the software. It is available on the National ITS Architecture website located at http://www.arc-it.net. At the time this report was written RAD-IT Architecture Version 9.0 was the most recent version available.

Table 1 – RAD-IT Architecture Report and Diagrams

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

3 REGIONAL ITS NEEDS

Regional needs that could be addressed by ITS were identified by stakeholders in the Chattanooga Regional ITS Architecture workshops held in June and October 2021 and interviews conducted in summer and fall of 2021. In addition, the vision, goals, and performance measures from the Chattanooga-Hamilton County/North Georgia 2050 RTP were reviewed to determine other regional needs that could possibly be addressed in some way through ITS. TDOT's Statewide ITS Architecture and Statewide Traffic Operations Program Plan were also reviewed to identify relevant regional ITS needs.

3.1 Needs Identified in Related Planning Efforts

ITS needs have been identified for the study area both in CHCNGA regional planning efforts and in statewide transportation planning efforts led by TDOT. These needs are identified through a review of the guiding principles of each document.

3.1.1 Regional Transportation Planning Efforts

The Chattanooga-Hamilton County/North Georgia 2050 RTP includes the following vision: **To Preserve, Protect, Provide, Propel, and Pioneer transportation in the Chattanooga-Hamilton County/North Georgia region.** ITS can assist the region in all facets of this vision, as shown below.

Preserve: The 2050 RTP seeks to "Preserve sensitive natural resources and maintain existing transportation assets to reflect a state of repair that is reliable and resilient." ITS can be used to monitor transportation infrastructure assets and impacts to natural resources, including air quality. Decision makers can be notified through ITS if assets are impacted or in need of maintenance. The **Preserve** component of the vision corresponds most closely with the System Maintenance and Environmental Sustainability performance measurement categories from the 2050 RTP.

Protect: The 2050 RTP seeks to "Protect communities by making the safe movement of people and goods a top priority." ITS can be used to monitor operations on transit vehicles, improve incident detection time, and provide advanced warning of incidents or other potential safety issues that might impact travelers. The **Protect** component of the vision corresponds most closely with the Safety & Security performance measurement category from the 2050 RTP.

Provide: The 2050 RTP seeks to "Provide equitable options, access, and freedom of mobility to everyone." ITS can be used to provide information of available options (such as transit and carpool programs) to travelers and can be used to unify different programs that allow for integrated authentication and payment for transportation services. The **Provide** component of the vision corresponds most closely with the System Reliability performance measurement category from the 2050 RTP.

Propel: The 2050 RTP seeks to "Propel the region's economic vitality and growth through an efficient, connected, and sustainable intermodal transportation network." ITS in transit operations can improve the multimodal connections between transit vehicles and other options for mobility. ITS can also encourage sustainable travel by providing infrastructure for electric vehicle charging. Finally, ITS can maintain transportation network efficiency by adjusting operations along freeway access points and at signalized arterial intersections in response to changing traffic conditions. The **Propel** component of

the vision corresponds most closely with the Congestion Reduction, Freight Movement, and Economic Vitality performance measurement categories from the 2050 RTP.

Pioneer: The 2050 RTP seeks to "Pioneer innovative technologies that put the transportation system ahead of the curve in an ever-changing world." ITS solutions include many of these innovative technologies and applications, including those related to connected and autonomous vehicles, big data analytics, and mobility-on-demand transportation services. The **Pioneer** category could correspond with all performance measurement categories from the 2050 RTP, depending upon the innovative technologies in question.

The 2050 RTP includes three goals that were developed from the vision statement. ITS can support each of the goals, as shown below:

Goal 1: Create and maintain an equitable transportation system built on a foundation of safe, walkable communities while also providing biking and public transit connections. ITS can support transportation safety for all modes through tools that detect and alert other travelers to the presence of vulnerable system users. Similar tools can also provide the traveler information and payment and authentication technology necessary to allow for travelers to seamlessly use multiple modes to complete their trips.

Goal 2: Build a reliable, robust public transit network, while minimizing congestion, striving to reduce drive-alone trips in areas not served by public transit, and safely and efficiently connecting communities to opportunities across all modes. ITS can improve the operation of regional transit systems by prioritizing transit throughput along city arterials and enhancing the quality of transit data being shared with dispatchers and the traveling public to reduce the likelihood of missed connections.

Goal 3: Increase economic vitality by investing in technology and intermodal connections that enhance the reliability, efficiency, and safety on regional infrastructure that moves people and goods to, through, and from the region. ITS can provide tools that improve system reliability, efficiency, and safety. Surveillance and detection technology can be used by agency staff to detect unexpected changes in traffic operations due to events such as traffic incidents and severe weather and to dispatch the appropriate resources to restore normal operations quickly and safely.

3.1.2 Statewide Transportation Planning Efforts

TDOT maintains the Statewide ITS Architecture, and regional ITS architectures developed in the state of Tennessee should show conformity with the TDOT Statewide ITS Architecture. The Statewide ITS Architecture was most recently updated in 2019.

The 2019 TDOT Statewide ITS Architecture shares its operational goals with those that were developed as part of the 2017 TDOT Traffic Operations Program Plan. One goal focuses on system operation, while the other focuses on system preservation. Both goals can be accomplished through the implementation of ITS, as described below.

Goal 1: System Operation - Operate and manage Tennessee's transportation system to provide a high level of safety and service for our customers and workers. TDOT currently leverages ITS technologies to operate the state's transportation system. The agency has expanded the SmartWay Program in the project study area by deploying additional fiber optic cable, CCTV units, and DMS devices along area freeways. The TDOT Region 2 SmartWay TMC in Chattanooga also now operates 24-

hours a day, providing the agency with round-the-clock traffic management capacity. TDOT plans to expand ITS deployments including field infrastructure and the agency's HELP service patrol vehicles along freeway segments that currently lack coverage.

Goal 2: System Preservation - Manage the state transportation system to protect the long-term investments of our infrastructure assets. TDOT also uses ITS technologies to assist with infrastructure preservation and asset management. The agency's maintenance vehicles are equipped with cameras and sensors that can transmit road condition information and video images back to SmartWay TMC personnel. HELP vehicles also provide motorist assistance services and firsthand account of roadway conditions that can assist TDOT with the agency's roadway capacity preservation objectives.

3.2 Comprehensive Regional ITS Needs List

The investment needs identified through the Regional ITS Architecture development process as well as the 2050 RTP provided guidance for determining which service packages should be included in the architecture. Stakeholders identified ITS needs for the Chattanooga Region in the following National ITS Architecture service areas:

- Commercial Vehicle Operations;
- Data Management;
- Maintenance and construction;
- Parking Management;
- Public Safety;
- Public Transportation;
- Sustainable Travel;
- Traffic Management;
- Traveler Information;
- Vehicle Safety; and
- Weather.

Table 2 lists each of the needs documented as part of the Regional ITS Architecture in relation to both the ITS service areas that apply as well as the relevant goals from CHCNGA TPO and TDOT. In Section 5.1.4 the list of regional needs is presented along with the ITS service packages that have been recommended for the Region to consider implementing or expanding (if the service package currently exists.)

Table 2 – Regional Planning Goals, Objectives, ITS Needs, and Service Areas

Regional Goal	ITS Needs [1]	Relevant ITS Service Areas
2050 RTP Goal 1 - Create and maintain an equitable transportation system built on a foundation of safe, walkable communities while also providing biking and public transit connections.	14. Deploy an integrated payment system that allows users to pay for regional mobility and parking services via a single platform 15. Improve vehicle tracking and location reporting capabilities for maintenance and transit vehicles 17. Monitor passenger boarding, alighting, and travel trends to improve service	Parking Management Public Transportation Maintenance and Construction
2050 RTP Goal 2 - Build a reliable, robust public transit network, while minimizing congestion, striving to reduce drive-alone trips in areas not served by public transit, and safely and efficiently connecting communities to opportunities across all modes.	1. Expand deployments of surveillance and traveler information infrastructure, as well as accompanying communications infrastructure, along the region's freeway network 7. Monitor railroad crossing locations and convey warning and blockage information to drivers and transportation staff 16. Implement transit priority strategies that allow for improved transit system performance 18. Invest in transit-focused capital improvements that make services more operationally efficient and more environmentally sustainable	Public Transportation Sustainable Travel Traffic Management Traveler Information
2050 RTP Goal 3 - Increase economic vitality by investing in technology and intermodal connections that enhance the reliability, efficiency, and safety on regional infrastructure that moves people and goods to, through, and from the region.	3. Develop alternate routing plans, signal timing plans, and DMS messages that can be implemented during incidents, special events, or construction detours 8. Deploy bridge and tunnel infrastructure monitoring systems and warning systems to divert vehicles that may cause damage to infrastructure 9. Deploy dynamically activated warning systems in flood-prone areas, school zones, sharp curves, and other operationally critical locations 10. Improve coordination of traffic signal system timing between the City of Chattanooga and adjacent cities 11. Expand traffic signal system communications and system detection capabilities 12. Expand adaptive traffic signal system coverage and capabilities 19. Provide emergency responders with access to existing ITS resources to aid in emergency and disaster response and recovery 20. Improve third-party navigation services to provide routing information specific to vehicle type, avoiding situations such as over-height trucks being routed to low clearance tunnels they cannot traverse.	Commercial Vehicle Operations Public Safety Traffic Management Traveler Information Vehicle Safety Weather
TDOT Goal 1 - Operate and manage Tennessee's transportation system to provide a high level of safety and service for our customers and workers.	2. Identify and deploy systems that improve traffic operations along freeway main lanes and ramps, and at interchanges 4. Deploy systems that will alert and divert wrong-way drivers 5. Expand the region's safety service patrol to provide motorist assistance along freeways	Public Safety Traffic Management
TDOT Goal 2 - Manage the state transportation system to protect the long-term investments of our infrastructure assets.	6. Improve coordination between TDOT and Georgia agencies including GDOT 13. Allow for collection, storage, and analysis of regional transportation data to improve decision-making and ease of reporting	Data Management Traffic Management

[1]From Table 8 – Chattanooga Regional ITS Needs and Corresponding ITS Service Packages

4 REGIONAL ITS INVENTORY

The inventory and needs documented at the Chattanooga Regional ITS Architecture and Deployment Plan Kick-Off Workshop, in addition to the individual stakeholder interviews, provide the initial input needed to identify relevant ITS systems and components. These ITS systems and components are used to customize the National ITS Architecture and create the Regional ITS Architecture for the Chattanooga Region.

4.1 Stakeholders

Each element included in the Chattanooga Regional ITS Architecture and Deployment Plan is associated with a stakeholder agency. A list of stakeholder agencies identified in the Chattanooga Regional ITS Architecture and Deployment Plan can be found in **Table 3**, along with a description of each stakeholder. Most stakeholder agencies are called out by name with exception of smaller municipalities.

Table 3 – Chattanooga Regional Stakeholder Descriptions

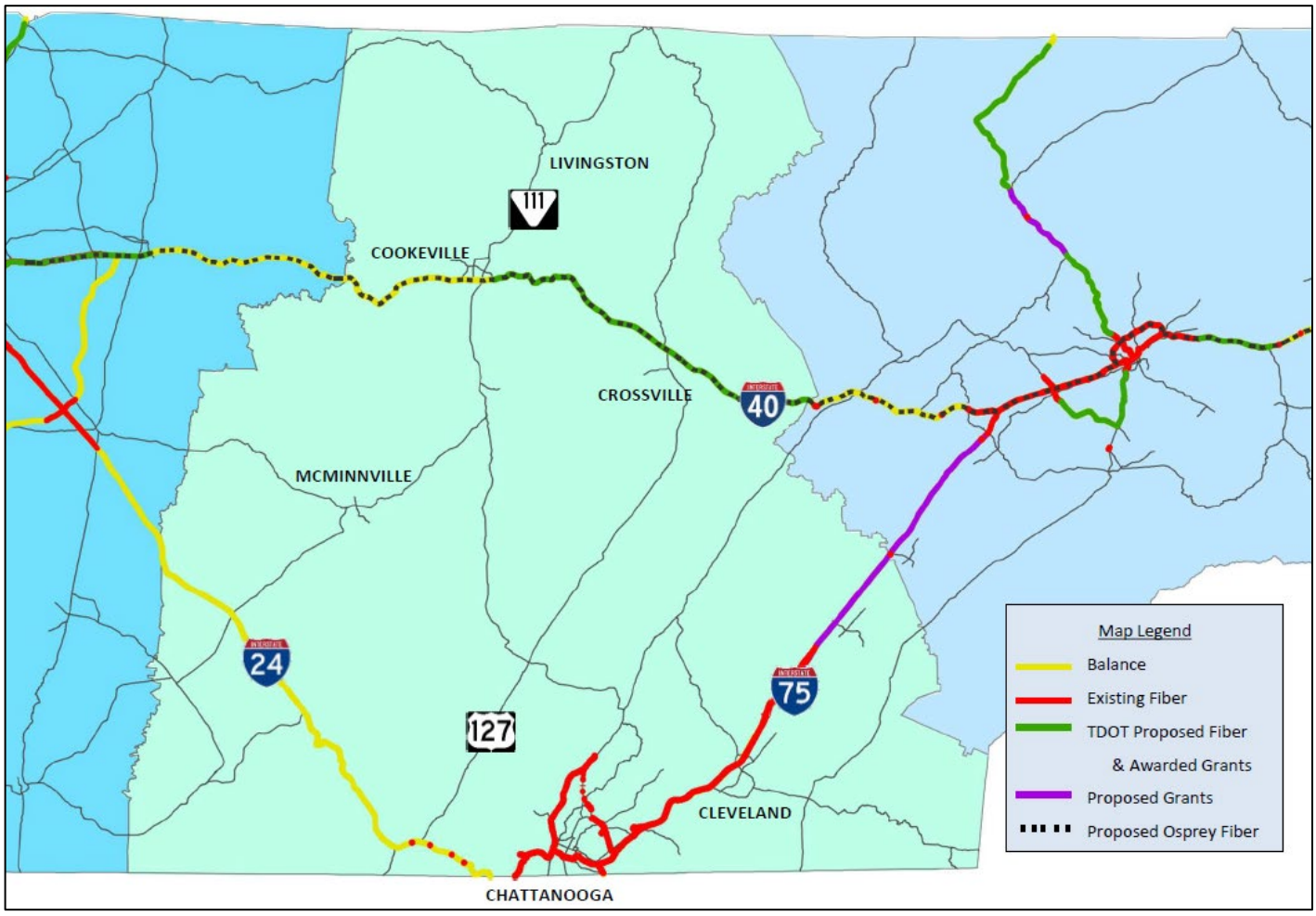
Stakeholder	Stakeholder Description
CARTA	Chattanooga Area Regional Transportation Authority. Responsible for fixed route transit service in Hamilton County, paratransit service, and a downtown shuttle and parking system.
Catoosa County	County government for Catoosa County. Includes all county departments including the Sheriff's Office and Highway Department as well as the Catoosa County Emergency Management Agency.
Catoosa County Trans-Aid	Catoosa County demand response rural transportation provider.
Chattanooga-Hamilton County Air Pollution Control Bureau	The Air Pollution Control Bureau administers local air pollution control laws and monitors air quality in Hamilton County.
Chattanooga-Hamilton County/North Georgia TPO	Transportation Planning Organization for the Chattanooga-Hamilton County/North Georgia Regional Planning Agency.
City of Chattanooga	Municipal government for the City of Chattanooga. Covers all city departments including those that deal with traffic and public safety.
City of East Ridge	Municipal government for the City of East Ridge. Covers all city departments including those that deal with traffic and public safety.
City of Red Bank	Municipal government for the City of Red Bank. Covers all city departments including those that deal with traffic and public safety.
City of Soddy-Daisy	Municipal government for the City of Soddy-Daisy. Covers all city departments including those that deal with traffic and public safety.
Commercial Vehicle Operators	Operators of commercial vehicles.
Dade County	County government for Dade County. Includes all county departments including the Sheriff's Office and Highway Department as well as the Dade County Emergency Management Agency.
Dade County Transit	Dade County demand response rural transportation provider.
Financial Institution	Institution that handles exchange of money for transit electronic fare collection.

Stakeholder	Stakeholder Description
GDOT	Georgia Department of Transportation. Responsible for the construction, maintenance, and operation of state roadways in Georgia.
GEMA	Georgia Emergency Management Agency. Responsible for emergency operations during a disaster or large-scale incident.
Georgia DPS	Georgia Department of Public Safety. Responsible for statewide enforcement of traffic safety laws as well as commercial vehicle regulations.
Hamilton County	County government for Hamilton County. Includes all county departments including the Sheriff's Office and Highway Department as well as the Hamilton County Emergency Management Agency.
Media	Local media outlets including television stations, newspapers, radio stations and their associated websites.
Municipal/County Government	Government for various municipalities and counties within the Region that are not specifically called out. Covers all departments including those that deal with traffic and public safety.
NOAA	The National Oceanic and Atmospheric Administration gathers weather information and issues severe weather warnings.
Oak Ridge National Laboratory	The U.S. Department of Energy's multiprogram science and energy laboratory.
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.
Private Information Provider	Private sector business responsible for the gathering and distribution of traveler information. This service is typically provided on a subscription basis.
Public/Private Vehicles	Vehicles that traverse a specific region.
Rail Operators	Companies that operate rail systems including the dispatch and control of trains and the maintenance and operations of railroad tracks.
System Users	All the users of the transportation system.
TDOT	Tennessee Department of Transportation. Responsible for the construction, maintenance, and operation of state roadways in Tennessee.
TEMA	Tennessee Emergency Management Agency. 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.
Tennessee Department of Health and Human Services	State department that manages funding for medical transportation services.
THP	Tennessee Highway Patrol. Responsible for statewide enforcement of traffic safety laws as well as commercial vehicle regulations.
Walker County	County government for Walker County. Includes all county departments including the Sheriff's Office and Highway Department as well as the Walker County Emergency Management Agency.
Walker County Transit	Walker County demand response rural transportation provider.

4.2 Existing Regional Communication Systems

Both TDOT and the City of Chattanooga maintain communications infrastructure in the Chattanooga Region to support ITS assets. Fiber optic cable is the primary communications link used, with occasional use of cellular modem communication also present in the Region. The TDOT Region 2 fiber network is centered around the TDOT TMC in Chattanooga, with existing fiber located along I-24, I-75, Tennessee Highway 29 (commonly known as US-27), and Tennessee Highway 153. A proposed grant, if successful, would extend the existing fiber optic backbone along I-75 north from Cleveland to connect with existing fiber along I-40. A map of existing and proposed TDOT fiber in TDOT Region 2 is shown in **Figure 3**. The red dots along I-24 west of Chattanooga represent proposed TDOT fiber in the TDOT Region 2 SmartWay Infrastructure Expansion project. This project is described in more detail in Table 27 of Section 6.2 – ITS Project Recommendations.

The City of Chattanooga leases fiber optic communications capacity from a private vendor with a network already in place locally. The City can lease additional capacity as new signals and ITS infrastructure elements are deployed, but neither the City of Chattanooga nor TDOT currently have additional fiber capacity that they maintain that could be used by other agencies.



Source: TDOT Region 2

Figure 3 – TDOT Region 2 Fiber Expansion Program Map

4.3 Existing Regional Transportation Data Availability

Several agencies across the Chattanooga Region collect transportation data. Some data is required for reporting purposes to state or federal government agencies, while other data is collected and shared with the public. **Table 4** lists transportation data that is currently collected and publicly shared by each agency and includes resources for accessing this data online.

Table 4 – Summary of Regional Transportation Data Availability

Stakeholder	Website	Available Transportation Data
CHCNGA-TPO	https://chcrpa.org/reports-and-data/data/	Links to other data sources, including: - Transportation-Focused Census Data - Housing and Transportation Affordability Index - Other sources already included in this table
City of Chattanooga	https://www.chattadata.org/browse	- Car Parking Locations - Bike Parking Locations - CARTA Bus Routes - CARTA Bus Stops - Traffic Flow Visualizations (including Hourly, Weekly, and Monthly summaries) - Traffic Jam Locations - Bikeshare Trip Data
GDOT	http://www.dot.ga.gov/DS/Data	- Traffic Count Data - Roadway Functional Classification
	https://gdot.numetric.net/crash-data#/	- Crash Data, including Maps and Dashboards
	https://511ga.org/	- Real-Time Traffic Incident Reports - Construction and Special Event Road Impacts - Real-Time Traffic and Waze Reports - Real-Time Road Weather Alerts - GDOT CCTV Locations and Current Images - GDOT DMS Locations and Current Messages
TDOT	https://e-trims.tdot.tn.gov/	- Roadway Description Data - Roadway Functional Classification - Traffic Counts - Roadway GIS Data
	https://tdot.public.ms2soft.com/tcds/	- Traffic Count Data (Interactive Map)
	https://smartway.tn.gov/traffic	- Real-Time Traffic Incident Reports - Construction and Special Event Road Impacts - Real-Time Traffic and Waze Reports - Real-Time Road Weather Alerts - TDOT CCTV Locations and Current Images - TDOT DMS Locations and Current Messages
	https://www.tn.gov/safety/stats/crashdata.html	- Crash Data, including Maps and Dashboards - Traffic Enforcement Data

4.4 ITS Elements

The ITS component inventory is documented in the Regional ITS Architecture as elements. **Table 5** sorts the inventory by stakeholder so that each stakeholder can easily identify and review all the architecture elements associated with their agency. The table also specifies whether the element is planned or it already exists. In many cases, an element classified as existing might still need to be enhanced to attain the service level desired by the Region.

The naming convention used for elements in the Chattanooga Regional ITS Architecture is consistent with the naming convention used in the Statewide ITS Architecture. This consistency provides seamless connections between the Regional and Statewide ITS Architecture.

Table 5 – Chattanooga Regional Inventory of ITS Elements

Stakeholder	Element Name	Element Description	Element Status
CARTA	CARTA Bus Stop DMS	Chattanooga Area Regional Transportation Authority (CARTA) real-time next bus arrival information boards at select bus stops.	Existing
	CARTA Care-A-Van Dispatch Center	Chattanooga Area Regional Transportation Authority paratransit service dispatch center for Care-A-Van.	Existing
	CARTA Data Archive	Chattanooga Area Regional Transportation Authority data archive for transit data	Existing
	CARTA Fixed Route Dispatch Center	Chattanooga Area Regional Transportation Authority fixed route dispatch center.	Existing
	CARTA Fixed-Route Vehicles	Chattanooga Area Regional Transit Authority fixed route vehicles. Includes neighborhood routes, downtown shuttles, express buses, and any other fixed route service.	Existing
	CARTA Maintenance Facility CCTV Camera Surveillance	Chattanooga Area Regional Transportation Authority closed circuit television camera surveillance at CARTA maintenance facilities.	Existing
	CARTA Paratransit Vehicles	Chattanooga Area Regional Transportation Authority paratransit vehicles dispatched through the Care-A-Van Dispatch Center.	Existing
	CARTA Routing Application	Chattanooga Area Regional Transportation Authority online routing application to assist travelers in developing a customized transit plan for an upcoming trip. Currently existing with Bing Maps and under Development with Google Maps.	Existing
	CARTA Transit Kiosks	Chattanooga Area Regional Transportation Authority kiosks for dissemination of transit traveler information. Kiosks can also be used for the purchase and recharging of electronic fare payment cards.	Planned

Stakeholder	Element Name	Element Description	Element Status
CARTA (continued)	CARTA Transit Stop CCTV Camera Surveillance	Chattanooga Area Regional Transportation Authority closed circuit television camera surveillance at transit transfer centers or other transit facilities.	Existing
	CARTA Vehicle Electric Charging Stations	Electric vehicle supply equipment that is used to charge CARTA electric buses and other vehicles	Planned
	CARTA Vehicle Onboard Video Sensors	Video-based sensors on CARTA transit vehicles that allow for passenger counting and related transit user analytics.	Planned
	CARTA Website	Chattanooga Area Regional Transportation Authority website. Transit users can track the location of buses.	Existing
	Chattanooga Parking Authority DMS	Dynamic message signs for traffic information dissemination.	Planned
	Chattanooga Parking Authority Facility Management	Managing authority for surface parking, parking lots, and parking garages owned and operated by CARTA.	Existing
	Chattanooga Parking Authority Smart Meters	Parking meters used within the Chattanooga Parking Authority/CARTA parking system.	Existing
	Electronic Fare Payment Card	Medium for collection of transit fares electronically.	Existing
	Regional Transit Coordination Center	Joint effort of regional demand response transit agencies to provide a single point of contact for demand response transit patrons to streamline the reservation process.	Planned
Catoosa County	Catoosa County 911 Dispatch	Catoosa County 911 Public Safety Answering Point (PSAP). Responsible for answering all 911 calls made within the County and dispatching emergency responders.	Existing
	Catoosa County EMA	Catoosa County Emergency Management Agency. Responsible for disaster planning for the County and operating the emergency operations center (EOC).	Existing
Catoosa County Trans-Aid	Catoosa Trans-Aid Data Archive	Data archive for Catoosa Trans-Aid data.	Planned
	Catoosa Trans-Aid Dispatch Center	Dispatch center for Catoosa County Trans-Aid vehicles.	Existing
	Catoosa Trans-Aid Vehicles	Vehicles used by Catoosa County Trans-Aid to provide demand response transit service in Catoosa County. The fleet is equipped with AOA approved wheelchair lifts.	Existing
	Catoosa Trans-Aid Website	Website with information about fares and schedules.	Planned

Stakeholder	Element Name	Element Description	Element Status
Chattanooga-Hamilton County Air Pollution Control Bureau	Chattanooga-Hamilton County Air Pollution Control Bureau	Air Pollution Control Bureau for Chattanooga-Hamilton County. Responsible for administering local air pollution control laws and monitoring air quality in Hamilton County.	Existing
	Chattanooga-Hamilton County Air Pollution Control Bureau Website	Air Pollution Control Bureau website that displays daily air quality measurements and forecasts.	Existing
	Chattanooga-Hamilton County Air Quality Sensors	Air quality sensors that monitor ozone and particulate matter levels.	Existing
Chattanooga-Hamilton County/North Georgia TPO	CHCNGA TPO Data Archive	Data archive for the transportation related data in Chattanooga-Hamilton County/North Georgia Transportation Planning Organization.	Existing
City of Chattanooga	City of Chattanooga CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Existing
	City of Chattanooga City Engineers Office	City Engineer's Office responsible for the administration of maintenance and construction projects within the City.	Existing
	City of Chattanooga Connected Vehicle Roadside Equipment	City of Chattanooga devices that are used to send messages to, and receive messages from, nearby vehicles using wireless communications technologies.	Planned
	City of Chattanooga Curve Speed Warning System	Curve warning sign with flashers that are dynamically activated when a nearby speed sensor detects a vehicle travelling at an excessive speed.	Planned
	City of Chattanooga DMS	Dynamic message signs for traffic information dissemination.	Planned
	City of Chattanooga Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as video image vehicle detection systems (VIVDS), remote traffic microwave sensors (RTMS), or traditional loops.	Existing
	City of Chattanooga Fire Dispatch	Emergency dispatch functions for the Fire Department.	Existing
	City of Chattanooga Fire Vehicles	City of Chattanooga Fire Department vehicles.	Existing
	City of Chattanooga Infrastructure Monitoring Sensors	Equipment that monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure using both fixed and vehicle-based infrastructure monitoring sensors. Sensors collect information such as vibration, stress, temperature, and continuity.	Planned

Stakeholder	Element Name	Element Description	Element Status
City of Chattanooga (continued)	City of Chattanooga ITS Data Warehouse	Data archive for the transportation related data in the City of Chattanooga.	Planned
	City of Chattanooga Overheight Vehicle Detection	City of Chattanooga sensors that detect overheight vehicles approaching a tunnel or bridge overpass with a low clearance.	Planned
	City of Chattanooga Police Department	Police department for the City of Chattanooga. Non-emergency functions include the collection of crash data and enforcement of speed limits and commercial vehicles.	Existing
	City of Chattanooga Police Dispatch	Emergency dispatch functions for the Police Department.	Existing
	City of Chattanooga Police Vehicles	City of Chattanooga Police Department vehicles.	Existing
	City of Chattanooga Portable DMS	Portable dynamic message signs used for traffic information dissemination during maintenance and construction activities, special events, or incidents.	Existing
	City of Chattanooga Public Works Department	Division of the Public Works Department responsible for providing daily logistical planning, resource and personnel management services, and oversight of the implementation of various services that include street construction and maintenance, emergency response, and street cleaning.	Existing
	City of Chattanooga Public Works Department Vehicles	Vehicles used for street construction, street maintenance, and emergency maintenance response.	Existing
	City of Chattanooga Rail Notification System	Roadway equipment used to alert motorists that a crossing is currently blocked by a train.	Existing
	City of Chattanooga Rectangular Rapid Flash Beacons	Rectangular Rapid Flash Beacons activated by pedestrians attempting to cross at a mid-block crossing.	Existing
	City of Chattanooga Road Closure Gates	City of Chattanooga roadway equipment that is used to close roads during inclement weather conditions.	Planned
	City of Chattanooga Road Closure Notification System	Existing email and fax distribution system for disseminating road closure notification information to the media and emergency dispatch.	Existing
	City of Chattanooga RWIS	Road weather information system sensors to monitor weather conditions at the roadway.	Planned
	City of Chattanooga School Zone Flashers	Flashing beacons posted atop school zone speed limit signs.	Existing

Stakeholder	Element Name	Element Description	Element Status
City of Chattanooga (continued)	City of Chattanooga Speed Monitoring Equipment	Equipment used to monitor vehicle speeds for use in targeting locations for police enforcement.	Existing
	City of Chattanooga TOC	Traffic operations center for the City of Chattanooga. Responsible for the operation of the traffic signal system, closed circuit television (CCTV) cameras, dynamic message signs (DMS), and any other ITS infrastructure deployed by the City of Chattanooga.	Existing
	City of Chattanooga Traffic Signals	Traffic signal system operated by the City of Chattanooga.	Existing
	City of Chattanooga Tunnel Bike Warning Beacons	Beacons activated by cyclists passing through a tunnel.	Existing
	City of Chattanooga Website	Website for the City of Chattanooga. Includes information on City departments and in the future, it is envisioned that the website may have real-time information about roadway conditions, including traffic images.	Existing
City of East Ridge	City of East Ridge CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Planned
	City of East Ridge Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as video image vehicle detection systems (VIVDS), remote traffic microwave sensors (RTMS), or traditional loops.	Existing
	City of East Ridge Public Safety Vehicles	Vehicles used by public safety in the City of East Ridge.	Existing
	City of East Ridge TOC	Traffic operations center for the City of East Ridge. Responsible for the operation of the traffic signal system, closed circuit television (CCTV) cameras, and any other ITS infrastructure deployed by the City of East Ridge.	Planned
	City of East Ridge Traffic Signals	Traffic signal system operated by the City of East Ridge.	Existing
	City of East Ridge Website	Website for the City of East Ridge. Includes information on City departments and in the future, it is envisioned that the website will have real-time information about roadway conditions.	Existing
City of Red Bank	City of Red Bank CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Planned

Stakeholder	Element Name	Element Description	Element Status
City of Red Bank (continued)	City of Red Bank Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as video image vehicle detection systems (VIVDS), remote traffic microwave sensors (RTMS), or traditional loops.	Existing
	City of Red Bank Public Safety Vehicles	Vehicles used by public safety in the City of Red Bank.	Existing
	City of Red Bank TOC	Traffic operations center for the City of Red Bank. Responsible for the operation of the traffic signal system, closed circuit television (CCTV) cameras, and any other ITS infrastructure deployed by the City of Red Bank.	Planned
	City of Red Bank Traffic Signals	Traffic signal system operated by the City of Red Bank.	Existing
	City of Red Bank Website	Website for the City of Red Bank. Includes information on City departments and in the future, it is envisioned that the website will have real-time information about roadway conditions.	Existing
City of Soddy-Daisy	City of Soddy-Daisy 911 Dispatch	911 Public Safety Answering Point (PSAP) responsible for answering all 911 calls made within the City and dispatching emergency responders.	Existing
	City of Soddy-Daisy CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Planned
	City of Soddy-Daisy Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as video image vehicle detection systems (VIVDS), remote traffic microwave sensors (RTMS), or traditional loops.	Planned
	City of Soddy-Daisy Public Safety Vehicles	Vehicles used by public safety in the City of Soddy-Daisy.	Existing
	City of Soddy-Daisy TOC	Traffic operations center for the City of Soddy-Daisy. Responsible for the operation of the traffic signal system, closed circuit television (CCTV) cameras, and any other ITS infrastructure deployed by the City of Soddy-Daisy.	Planned
	City of Soddy-Daisy Traffic Signals	Traffic signal system operated by the City of Soddy-Daisy.	Existing
	City of Soddy-Daisy Website	Website for the City of Soddy-Daisy. Includes information on City departments and in the future, it is envisioned that the website will have real-time information about roadway conditions.	Existing
Commercial Vehicle Operators	Commercial Vehicles	Privately owned commercial vehicles traveling within the Region.	Existing

Stakeholder	Element Name	Element Description	Element Status
Commercial Vehicle Operators (continued)	Freight Equipment	A freight container or trailer being transported through the region by a commercial vehicle.	Existing
	Private Commercial Vehicle Dispatch Centers	Dispatch Centers of private trucking companies who manage a commercial vehicle fleet whose trucks may pass through the Region.	Existing
Dade County	Dade County 911 Dispatch	911 Public Safety Answering Point (PSAP) responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Dade County EMA	Emergency management agency for Dade County. Responsible for disaster planning for the County and operating the emergency operations center (EOC).	Existing
Dade County Transit	Dade County Transit Data Archive	Data archive for Dade County Transit data.	Planned
	Dade County Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling, and dispatching of demand response vehicles operated by Dade County Transit.	Existing
	Dade County Transit Vehicles	Demand response transit vehicles operated by Dade County Transit.	Existing
	Dade County Transit Website	Website with information about fares and schedules.	Existing
Financial Institution	Financial Service Provider	Service provider that handles exchange of money for transit electronic payment collection.	Existing
GDOT	GDOT Atlanta TMC	GDOT traffic management center that serves as the Statewide Traffic Management Center. The TMC, part of the GDOT Office of Traffic Operations, has communication with all the TCCs around the State.	Existing
	GDOT CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Existing
	GDOT District 6 Construction and Maintenance	GDOT entity responsible for the oversight of construction and maintenance in District 6.	Existing
	GDOT District 6 Dalton Area Office	GDOT Office that serves Catoosa, Dade, Murray, Walker, and Whitfield Counties.	Existing
	GDOT District 6 Dalton/Whitfield County	GDOT District 6 office located in Dalton/Whitfield County.	Existing

Stakeholder	Element Name	Element Description	Element Status
GDOT (continued)	GDOT District 6 Engineers Office	GDOT Office responsible for administration of maintenance and construction projects within the District as well as communicating work zone information to the public through the Public Information Office.	Existing
	GDOT DMS	GDOT dynamic message signs used for traffic information dissemination. DMS is currently located on southbound I-75.	Existing
	GDOT Emergency Services Coordinator	GDOT coordinator responsible for managing the GDOT response in a large-scale incident or disaster in which the Georgia Emergency Management Agency (GEMA) activates the state emergency operations center (EOC).	Existing
	GDOT Field Sensors	GDOT roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, RTMS, or traditional loops.	Existing
	GDOT HERO Dispatch	GDOT roadway service patrol dispatch.	Existing
	GDOT HERO Vehicles	Roadway service patrol vehicles that operate regionally on Interstates in northern Georgia.	Existing
	GDOT Maintenance Vehicles	GDOT vehicles used in maintenance operations.	Existing
	GDOT Public Information Office	GDOT Office responsible for the dissemination of traffic information to the media and the public.	Existing
	GDOT Smart Work Zone Equipment	GDOT portable ITS equipment that can be used in work zones to manage traffic and provide traveler information more efficiently. Includes portable closed-circuit television (CCTV) cameras, vehicle detection, and dynamic message signs (DMS).	Existing
	GDOT Statewide Construction and Maintenance System	Currently the Transportation Incident Report (TIR) application is used.	Existing
	GDOT Traffic Signals	GDOT traffic signal system operated on state highways.	Existing
	Georgia 511 System	Statewide 511 traveler information system central server.	Existing
	Georgia NaviGAtor System	System to consolidate real-time traffic, incident, and construction road closure information. The information is used by agencies around the state and provides the data available on the NaviGAtor website and through 511.	Existing
	Other GDOT District Construction and Maintenance	Other GDOT District Construction and Maintenance Offices.	Existing

Stakeholder	Element Name	Element Description	Element Status
GEMA	GEMA	Georgia Emergency Management Agency. Responsible for managing emergency operations during a disaster or large-scale incident.	Existing
Georgia DPS	GSP Troop A Dispatch	Georgian State Patrol Troop A dispatch area that includes the northern Georgina counties included in the Chattanooga Regional ITS Architecture.	Existing
	GSP Vehicles	Georgia State Patrol vehicles.	Existing
	MCCD CVO Enforcement	Motor Carrier Compliance Division commercial vehicle operations inspection and enforcement.	Existing
	MCCD Truck Weigh and Inspection Station	Commercial vehicle inspection station with the capability to weigh commercial vehicles and evaluate their credentials.	Existing
	MCCD Weigh-in-Motion	Motor Carrier Compliance Division facilities with the capability to weigh commercial vehicles while they are traveling at highway speeds.	Existing
Hamilton County	Hamilton County E911	911 Public Safety Answering Point (PSAP) responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Hamilton County EMA	Hamilton County Emergency Management Agency. Responsible for disaster planning for the County and operating the emergency operations center (EOC).	Existing
	Hamilton County EMS	Hamilton County Emergency Medical Services. Calls are forwarded from Hamilton County E911.	Existing
	Hamilton County Sheriff Vehicles	Hamilton County Sheriff's Office vehicles.	Existing
	Hamilton County Sheriff's Office	Law enforcement agency for Hamilton County. The emergency dispatch functions for the Sheriff's Office are included in the Hamilton County E911. Non-emergency functions include the collection of crash data.	Existing
Media	Local Print and Broadcast Media	Local media that provide traffic or incident information to the public.	Existing
Municipal/County Government	Municipal/County CCTV Cameras	Municipal/County closed circuit television cameras for traffic surveillance and incident management.	Planned
	Municipal/County Data Archive	Data archive for the transportation related data in a region.	Planned
	Municipal/County Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as video image vehicle detection systems (VIVDS), remote traffic microwave sensors (RTMS), or traditional loops.	Planned

Stakeholder	Element Name	Element Description	Element Status
Municipal/County Government (continued)	Municipal Police Department/County Sheriff	Municipal police departments and county sheriffs within the Region responsible for law enforcement. The emergency dispatch functions for the police departments are included in the Hamilton County E911. Non-emergency functions include the collection of crash data.	Existing
	Municipal/County Rail Notification System	Municipal/County roadway equipment used to alert motorists that a crossing is currently blocked by a train.	Planned
	Municipal/County TOC	Traffic operations centers responsible for the operation of municipal or county signal systems and any other ITS infrastructure.	Planned
	Municipal/County Traffic Signals	Municipal/County traffic signal systems within the Chattanooga Region.	Existing
	Municipal/County Engineers Office	Municipal/County Engineer's office is responsible for administration of maintenance and construction projects within the Region as well as communicating work zone information to the public through the Public Information Office.	Existing
	Municipal/County Maintenance	Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way.	Existing
	Municipal/County Maintenance Vehicles	Municipal/County vehicles used in maintenance and construction operations.	Existing
	Municipal/County Portable DMS	Portable dynamic message signs used for traffic information dissemination during maintenance and construction activities, special events, or incidents.	Planned
	Municipal/County Public Safety Vehicles	Municipal/County law enforcement, fire, and emergency medical services (EMS) vehicles.	Existing
	Municipal/County RWIS	Road weather information system sensors to monitor weather conditions at the roadway.	Planned
	Municipal/County Website	Municipal or county website that includes information on agency departments. In the future it is envisioned that the website would have real-time information about roadway conditions.	Existing
NOAA	National Weather Service	Provides official US weather, marine, fire, and aviation forecasts, warnings, meteorological products, climate forecasts, and information about meteorology.	Existing
Oak Ridge National Laboratory	Oak Ridge National Laboratory	Oak Ridge National Laboratory is the largest US Department of Energy science and energy laboratory. The laboratory manages air quality sensors that monitor ozone and particulate matter levels.	Existing

Stakeholder	Element Name	Element Description	Element Status
Oak Ridge National Laboratory (continued)	Oak Ridge National Laboratory Emissions Sensors	Air quality sensors that monitor ozone and particulate matter levels. Deployed in Chattanooga as part of the Smart Corridors program.	Planned
Other Agencies	Other Maintenance and Construction Management Agencies	Additional maintenance and construction operations agencies with which information is shared for coordination in an emergency.	Existing
	Other Private Parking Facilities	Other privately owned public parking facilities that typically charge a fee for parking.	Existing
	Other Traffic Management Agencies	Additional traffic management agencies with which information is shared for coordination in an emergency.	Existing
Private Information Provider	Location Data Source	A provider of accurate geographic position information, such as GPS.	Planned
	Map Update Provider	A provider of map information which supports ITS services used by travelers.	Planned
	Private Sector Mobility Services	Private companies that provide rideshare and other mobility services.	Existing
	Private Sector Traveler Information Services	Traveler information service operated by a private entity.	Existing
	Social Networking Services	Subscription based services operated by private providers that provide an option for real-time traveler information dissemination. Examples of such services include Facebook or Twitter.	Existing
Public/Private Vehicles	Public/Private Vehicles	Vehicles that traverse a specific region.	Existing
	Vehicle OBE	Vehicle On-Board Equipment (OBE) provides the vehicle-based sensory, processing, storage, and communications functions that support efficient, safe, and convenient travel.	Existing
Rail Operators	Rail Operations Centers	Centers responsible for the operations and tracking of trains.	Existing
	Rail Operator Wayside Equipment	Equipment located along the tracks including railroad crossing gates, bells, and lights as well as the interface to the traffic signal controller indicating the presence of a train.	Existing
System Users	Archive Data User	Users that request information from the data archive systems.	Existing
	Cyclists	Individuals using a non-motorized pedal cycle, such as a bicycle.	Existing
	Pedestrians	Individuals afoot or using a motorized or non-motorized wheelchair.	Existing
	Personal Computing Devices	Computing devices that travelers use to access public information.	Existing

Stakeholder	Element Name	Element Description	Element Status
System Users (continued)	Private Vehicle	Private vehicles used by travelers.	Existing
	Traveler	User of the transportation system.	Existing
	Vehicle Operator	Operators of commercial vehicles.	Existing
TDOT	Municipal/State ActiveITS Platform	Active Traffic Management System available to TDOT and municipalities within Tennessee for the processing and broadcasting of ITS information and the surveillance and control of ITS infrastructure.	Existing
	Other TDOT Region Construction Office	Other TDOT regional construction offices besides the Region 2 Construction Office.	Existing
	Other TDOT Region District Operations	Other TDOT regional maintenance offices.	Existing
	TDOT CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Existing
	TDOT Changeable Speed Limit Signs	TDOT roadway equipment that is used to lower speed limits on the affected roadway segment.	Existing
	TDOT Community Relations Divisions	TDOT Office responsible for the dissemination of traffic information to the media and the public.	Existing
	TDOT Connected Vehicle Roadside Equipment	TDOT devices that are used to send messages to, and receive messages from, nearby vehicles using wireless communications technologies.	Planned
	TDOT DMS	TDOT dynamic message signs for traffic information dissemination.	Existing
	TDOT Emergency Services Coordinator	Coordinator responsible for managing the Tennessee Department of Transportation response in a large-scale incident or disaster in which the Tennessee Emergency Management Agency (TEMA) activates the state emergency operations center (EOC).	Existing
	TDOT Field Sensors	TDOT roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as video image vehicle detection systems (VIVDS), remote traffic microwave sensors (RTMS), or traditional loops.	Existing
	TDOT Fog Sensors	TDOT roadway equipment used to detect the presence of fog and activate the rest of the fog management system.	Existing
	TDOT Fog Zone Speed Detection	TDOT roadway equipment that is part of the fog management system used to detect vehicle speeds.	Existing
	TDOT HAR	Highway advisory radio for traffic information dissemination.	Existing

Stakeholder	Element Name	Element Description	Element Status
TDOT (continued)	TDOT HELP Vehicles	Roadway service patrol vehicles that operate in the Region for large incidents and events.	Existing
	TDOT Lane Control Signals	Overhead lane control signals along facilities maintained by TDOT.	Planned
	TDOT Maintenance Headquarters	The Tennessee Department of Transportation maintenance headquarters.	Existing
	TDOT Maintenance Vehicles	TDOT vehicles used in maintenance operations.	Existing
	TDOT On-Ramp Closure Gates	TDOT roadway equipment that is part of the fog management system used to close freeway on-ramps during a fog event.	Existing
	TDOT Overheight Vehicle Detection	TDOT sensors that detect overheight vehicles approaching a tunnel or bridge overpass with a low clearance.	Planned
	TDOT Protect the Queue Vehicles	Vehicles deployed as a part of the TDOT Protect the Queue safety program on freeways throughout the Region.	Existing
	TDOT Ramp Metering Equipment	Roadway equipment used in the operation of a ramp metering system. Includes the signals and any other ITS equipment.	Planned
	TDOT Region 1 TMC – Knoxville	Transportation management center for Region 1, located in Knoxville. Responsible for the operation of the ITS equipment located in Region 1. This includes the freeway management system in Knoxville as well as rural ITS deployments.	Existing
	TDOT Region 2 District Operations	Office that handles most of the routine roadway maintenance and responds to incidents when services are requested by local emergency management.	Existing
	TDOT Region 2 Engineers Office	TDOT Office is responsible for administration of maintenance and construction projects within the Region as well as communicating work zone information to the public through the Public Information Office.	Existing
	TDOT Region 2 HELP Dispatch	TDOT roadway service patrol dispatch. Currently service is limited to the Chattanooga area except in the case of a large-scale incident.	Existing
	TDOT Region 2 TMC - Chattanooga	TDOT transportation management center for Region 2, located in Chattanooga. Responsible for the operation of the ITS equipment located in Region 2. This includes the freeway management system in Chattanooga as well as rural ITS deployments.	Existing

Stakeholder	Element Name	Element Description	Element Status
TDOT (continued)	TDOT Region 3 TMC - Nashville	Transportation management center for Region 3, located in Nashville. Responsible for the operation of the ITS equipment located in Region 3. This includes the freeway management system in Nashville as well as rural ITS deployments.	Existing
	TDOT Region 4 TMC - Memphis	Transportation management center for Region 4, located in Memphis. Responsible for the operation of the ITS equipment located in Region 4. This includes the freeway management system in Memphis as well as rural ITS deployments.	Existing
	TDOT RWIS Sensors	Road weather information system sensors to monitor weather conditions at the roadway.	Existing
	TDOT Smart Work Zone Equipment	Portable ITS equipment that can be used in work zones to manage traffic and provide traveler information more efficiently. Includes portable closed-circuit television (CCTV) cameras, vehicle detection, and dynamic message signs (DMS).	Planned
	TDOT SmartWay Website	TDOT SmartWay website providing road network conditions including incident and construction information and camera views. Much of the data for the website comes from TSIS.	Existing
	TDOT Statewide Information for Travelers (SWIFT)	TDOT Statewide Information for Travelers (SWIFT) is a statewide roadway conditions database. Currently information can be entered by District and Regional maintenance personnel as well as staff at any of the traffic management centers (TMCs) and the Tennessee Highway Patrol (THP). SWIFT feeds the Statewide 511 system and SmartWay website.	Existing
	TDOT Strategic Transportation Investments Division Archive	TDOT data archive for the Project Planning Division. The Division is responsible for traffic data collection and analysis and includes the Short-Range Planning Office.	Existing
	TDOT Unmanned Aerial Vehicle CCTV Cameras	Closed circuit television cameras housed in unmanned aerial vehicles for on-scene traffic surveillance and incident management.	Planned
	TDOT Wrong Way Vehicle Detection and Warning System	Sensors and sign flashers that detect vehicles travelling in the wrong direction and flash a warning to those errant vehicles.	Planned
	Tennessee 511 IVR	Tennessee 511 Interactive Voice Response. TDOT contracts the IVR operation to a vendor. The IVR accepts callers' requests and provides responses to specific traveler information needs. This is the customer interface component of the 511 phone system.	Existing
	Tennessee 511 System	511 traveler information system central server.	Existing

Stakeholder	Element Name	Element Description	Element Status
TEMA	TEMA	Tennessee Emergency Management Agency responsible for managing emergency operations during a disaster or large-scale incident.	Existing
Tennessee Bureau of Investigation	Tennessee Bureau of Investigation	Responsible for issuing statewide America's Missing: Broadcast Emergency Response (AMBER) Alerts in Tennessee.	Existing
Tennessee Department of Health and Human Services	Health and Human Services	Agency responsible for providing health related services including the subsidization of transportation to obtain medical services.	Existing
THP	THP CVO Enforcement	Tennessee Highway Patrol commercial vehicle operations inspection and enforcement.	Existing
	THP Dispatch	Tennessee Highway Patrol dispatch center. There are several THP dispatch centers around the state of Tennessee.	Existing
	THP District 2 Office	Tennessee Highway Patrol District 2 Office. The District 2 Office can directly control the fog zone management system.	Existing
	THP Truck Weigh and Inspection Station	Commercial vehicle inspection station with the capability to weigh commercial vehicles and evaluate their credentials.	Existing
	THP Vehicles	Tennessee Highway Patrol vehicles.	Existing
	THP Weigh-in-Motion	Tennessee Highway Patrol facilities with the capability to weigh commercial vehicles while they are traveling at highway speeds.	Existing
	TITAN Database	Tennessee Integrated Traffic Analysis Network database. The Tennessee Department of Safety crash record database maintained by THP for the collection of crash record information. TITAN interfaces with the TraCS (Traffic and Criminal Software) system.	Existing
Walker County	Walker County 911 Dispatch	Walker County 911 Public Safety Answering Point (PSAP). Responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Walker County EMA	Walker County Emergency Management Agency. Responsible for disaster planning for the County and operating the emergency operations center (EOC).	Existing
Walker County Transit	Walker County Transit Data Archive	Data archive for Walker County Transit data.	Planned

Stakeholder	Element Name	Element Description	Element Status
Walker County Transit (continued)	Walker County Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling, and dispatching of demand response vehicles operated by Walker County Transit.	Existing
	Walker County Transit Vehicles	Vehicles used by Walker County Transit to provide demand response transit service in Walker County. Vehicles are equipped with ADA approved wheelchair lifts.	Existing
	Walker County Transit Website	Website with information about fares and schedules.	Existing

5 REGIONAL ITS ARCHITECTURE

Upon completion of the system inventory, the next step in the development of the Regional ITS Architecture was to identify the ITS services that are important to the Chattanooga Region. The National ITS Architecture identifies the following twelve groups of ITS service areas:

- **Commercial Vehicle Operations:** Includes THP weigh-in-motion and inspection capabilities.
- **Data Management:** Includes electronic data management and archiving systems.
- **Maintenance and Construction:** Includes work zone management, roadway maintenance, and construction information systems.
- **Parking Management:** Includes parking space management and electronic reservation and payment management for municipal parking garages in the region.
- **Public Safety:** 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.
- **Public Transportation:** Includes transit and paratransit AVL, transit travel information systems, electronic fare collection, and transit security.
- **Support:** These service packages are not included in the Regional ITS Architecture because they represent basic project-level definitions and information flows that for the purposes of this report have already been captured in service packages from other service areas.
- **Sustainable Travel:** Includes systems that monitor emissions and adjusted traffic signal timings to reduce emissions generated by vehicles.
- **Traffic Management:** Includes the TDOT SmartWay TMC in Chattanooga as well as other existing and future TMCs and traffic operations centers (TOCs), detection systems, CCTV cameras, fixed and portable dynamic message signs (DMS), and other related technologies.
- **Traveler Information:** Includes broadcast traveler information, traveler information kiosks, public and private information sources available through the Internet, and highway advisory radio (HAR).
- **Vehicle Safety:** Includes connected vehicle infrastructure and on-board equipment that provides safety-related warnings and guidance.
- **Weather:** Includes road weather detection and warning systems.

Existing, planned, and future systems in the Region were considered in each of the service areas except for the Support service area due to the rationale noted above. Direction related to use and maintenance of the Regional ITS Architecture is included in Section 9.

5.1 ITS Service Packages

In the National ITS Architecture, services that are provided by ITS are referred to as ITS service packages. ITS service packages can include several stakeholders and elements that work together to provide a service in the Region. Examples of ITS service packages from the National ITS Architecture include Infrastructure-Based Traffic Surveillance, Traffic Information Dissemination, and Transit Vehicle Tracking. There are currently 150 ITS service packages identified in the National ITS Architecture

Version 9.0, which was the most recent version available of the National ITS Architecture at the time of the 2022 Chattanooga Regional ITS Architecture and Deployment Plan update began.

5.1.1 Overview of ITS Service Package Structure

An ITS service package is made up of elements and information flows. Each identified system or component in the Chattanooga regional ITS inventory, which is documented in the previous section, was mapped to a subsystem or terminator in the National ITS Architecture. Subsystems and terminators represent the various functional categories that define the role of an element in ITS and the regional architecture. The elements are connected by information flows that document the existing and planned flow of information. **Figure 4** depicts a sample service package with each of the components identified. Additional explanation of the terminology used can be found in the text that follows and in **Table 6**.

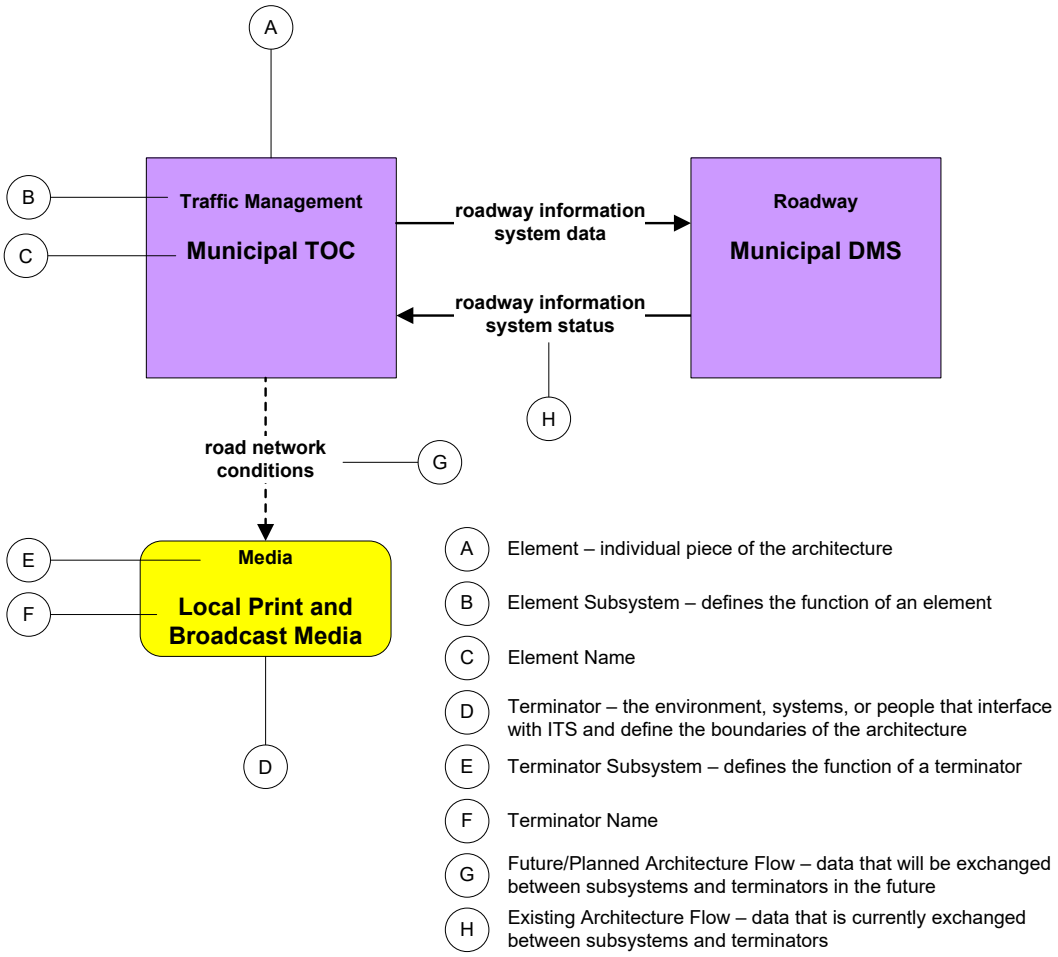


Figure 4 – Overview of ITS Service Package Structure

Elements represent the ITS inventory for the Region. Both existing and planned elements have been included in the inventory and incorporated into the architecture through the development of the service package diagrams.

Subsystems are the highest-level building blocks of the physical architecture, and the National ITS Architecture groups them into four major classes: Centers, Field, Vehicles, and Travelers. Each of these major classes includes various subsystems that represent a set of transportation functions (or processes). Each set of functions is grouped under one agency, jurisdiction, or location, and correspond to physical elements such as: traffic operations centers, traffic signals, or vehicles. Each element is assigned to one or more subsystems.

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, weather services, and information service providers.

Architecture Flows (or Information Flows) provide a standardized method for documenting the types of information that transfer between elements. A flow can be shown as either existing or future/planned. Existing flows indicate a connection that has already been established to share at least a portion of the desired information, but showing a flow as existing is not meant to imply that the function is complete. For example, the traffic information coordination flow between traffic management agencies includes the sharing of video images, incident information and other relevant data. The flow could be shown as existing to capture the sharing of video images while incident information is still a desired expansion of functionality. Many of the information flows have associated technical specifications, known as standards, which define the format of the data being shared.

Table 6 – Summary of ITS Architecture Terminology

Term	Definition	Notes	Examples
Element	Component of the ITS inventory for the Region	Assigned to a subsystem (see below)	Municipal TOC, Municipal DMS, RWIS Sensor
Subsystem	Building blocks of the physical ITS architecture that represent a set of transportation functions	Grouped into four major classes: Centers, Field, Vehicles, and Travelers	Traffic Management, Roadway, Information Service Provider
Terminator	Other people, systems, facilities, or conditions outside of the ITS system that need to interface with ITS architecture	Define the boundaries of an ITS architecture	Broadcast Media, National Weather Service, Traffic Operations Personnel
Information flow	The transfer of information between elements	Connect elements to one another and to terminators	Road network conditions, Incident response status, Work zone information

5.1.2 Selection and Prioritization of Regional ITS Service Packages

In the Chattanooga Region, the National ITS Architecture service packages were reviewed by the stakeholders and selected based on the relevance of the functionality that the ITS service package could provide to the Region. Stakeholders selected 62 ITS service packages for implementation in the Region. They are identified in **Table 7**. Stakeholders prioritized the selected service packages during the workshop, and the table organizes the service packages into service areas and priority groupings.

It should be noted that ITS related commercial vehicle operations applications such as electronic clearance, safety enforcement, and registration should be conducted on a statewide level and outlined

in the Tennessee Statewide ITS Architecture. Unless a specific need was identified in the Chattanooga Region that could be addressed locally, the commercial vehicle operations service packages were not selected.

After selecting the ITS service packages that were applicable for the Region, stakeholders reviewed each service package and the elements that could be included to customize each one according to the Region's needs. This customization is discussed further in the next section.

Table 7 – Chattanooga Regional ITS Service Package Prioritization by Functional Area

High Priority ITS Service Packages	Medium Priority ITS Service Packages	Low Priority ITS Service Packages
Commercial Vehicle Operations		
	CVO01 Carrier Operations and Fleet Management CVO02 Freight Administration CVO03 Electronic Clearance	
Data Management		
	DM01 ITS Data Warehouse	
Maintenance and Construction		
MC06 Work Zone Management MC08 Maintenance and Construction Activity Coordination MC09 Infrastructure Monitoring	MC01 Maintenance and Construction Vehicle and Equipment Tracking	
Parking Management		
PM01 Parking Space Management PM03 Parking Electronic Payment		PM04 Regional Parking Management
Public Safety		
PS01 Emergency Call-Taking and Dispatch PS02 Emergency Response PS03 Emergency Vehicle Preemption PS08 Roadway Service Patrols PS09 Transportation Infrastructure Protection	PS10 Wide-Area Alert PS12 Disaster Response and Recovery PS13 Evacuation and Reentry Management PS14 Disaster Traveler Information	
Public Transportation		
PT01 Transit Vehicle Tracking PT02 Transit Fixed-Route Operations PT03 Dynamic Transit Operations PT04 Transit Fare Collection Management PT05 Transit Security PT07 Transit Passenger Counting PT08 Transit Traveler Information PT09 Transit Signal Priority	PT06 Transit Fleet Management PT14 Multi-modal Coordination PT17 Transit Connection Protection PT18 Integrated Multimodal Electronic Payment	
Sustainable Travel		
ST05 Electric Charging Stations Management		ST01 Emissions Monitoring

High Priority ITS Service Packages	Medium Priority ITS Service Packages	Low Priority ITS Service Packages
Traffic Management		
TM01 Infrastructure-Based Traffic Surveillance TM02 Vehicle-Based Traffic Surveillance TM03 Traffic Signal Control TM04 Connected Vehicle Traffic Signal System TM06 Traffic Information Dissemination TM07 Regional Traffic Management TM08 Traffic Incident Management System TM09 Integrated Decision Support and Demand Management TM13 Standard Railroad Grade Crossing TM20 Variable Speed Limits TM25 Wrong Way Vehicle Detection and Warning	TM05 Traffic Metering TM12 Dynamic Roadway Warning TM17 Speed Warning and Enforcement	TM15 Railroad Operations Coordination TM19 Roadway Closure Management TM22 Dynamic Lane Management and Shoulder Use
Traveler Information		
TI01 Broadcast Traveler Information TI02 Personalized Traveler Information	TI03 Dynamic Route Guidance TI04 Infrastructure-Provided Trip Planning and Route Guidance TI07 In-Vehicle Signage	
Vehicle Safety		
VS05 Curve Speed Warning VS11 Oversize Vehicle Warning	VS09 Reduced Speed Zone Warning / Lane Closure VS12 Pedestrian and Cyclist Safety	
Weather		
WX01 Weather Data Collection	WX02 Weather Information Processing and Distribution	

5.1.3 Customization of Regional ITS Service Packages

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

Figure 5 is an example of a Traffic Management (TM) service package for traffic surveillance that has been customized for the Region. This instance focuses on the activities of the City of Chattanooga. The ITS service package shows the collection of traffic images from the city's CCTV cameras and other data from the city's field sensors at traffic signal locations. The City of Chattanooga includes road network conditions, such as road closures due to construction or other issues, on the City of the

Chattanooga website. There are plans to add CCTV camera feeds and also share this data with private sector information providers someday. The remainder of the ITS service packages that were customized for the Chattanooga Region are included in the Interactive ITS Architecture that is located on the project website. Some of the flows and elements included in each service package had changed since the 2017 edition of the Chattanooga Regional ITS Architecture.

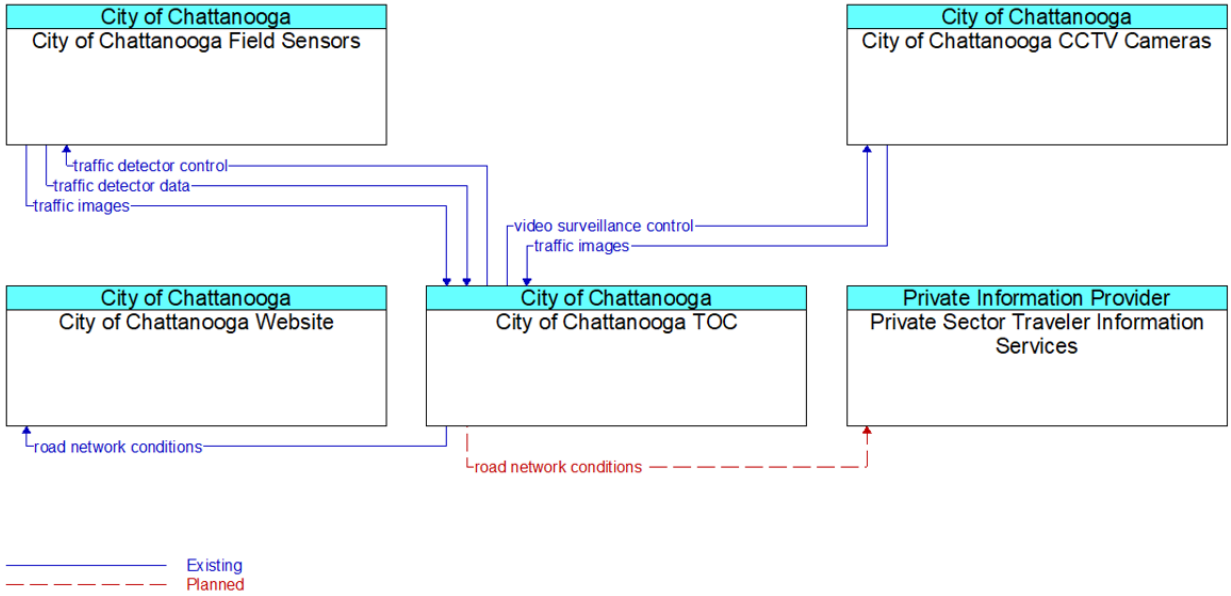


Figure 5 – Example ITS Service Package Diagram

The remainder of the ITS service package diagrams that were customized for the Chattanooga Regional ITS Architecture are provided in the Interactive Architecture available through the online RAD-IT database at:

https://chcrpa.org/intelligent-transportation-system/

To access the ITS service package diagrams, from the website select the "Chattanooga Interactive ITS Architecture", then select the "Services" page from the left sidebar, then click the desired Service Package Name. The link below the "Diagram" heading will lead to the service package diagram.

5.1.4 Regional Needs and Corresponding ITS Service Packages

Stakeholders at the Chattanooga Regional ITS Architecture workshops provided valuable input for the service package customization process. The needs identified in the ITS Architecture workshops as well as needs from the Chattanooga-Hamilton County/North Georgia 2050 Long-Range Transportation Plan are identified in **Table 8**. The table also identifies which service package documents the ITS need.

A list of the stakeholder needs from the Chattanooga Regional ITS Architecture, along with their corresponding service packages, can also be found in the Interactive Architecture through the online RAD-IT database located at:

https://chcrpa.org/intelligent-transportation-system/

To access these Stakeholder Needs table, from the website select the "Chattanooga Interactive ITS Architecture", then select the "Needs" page from the left sidebar, then click the desired Service Package Name.

Table 8 – Chattanooga Regional ITS Needs and Corresponding ITS Service Packages

Need Number	Need Description	Corresponding ITS Service Packages
01	Expand deployments of surveillance and traveler information infrastructure, as well as accompanying communications infrastructure, along the region's freeway network	PS14: Disaster Traveler Information TI01: Broadcast Traveler Information TI02: Personalized Traveler Information TM01: Infrastructure-Based Traffic Surveillance TM06: Traffic Information Dissemination TM07: Regional Traffic Management
02	Identify and deploy systems that improve traffic operations along freeway main lanes and ramps, and at interchanges	PS08: Roadway Service Patrols TM01: Infrastructure-Based Traffic Surveillance TM05: Traffic Metering TM06: Traffic Information Dissemination TM07: Regional Traffic Management TM08: Traffic Incident Management System TM20: Variable Speed Limits TM22: Dynamic Lane Management and Shoulder Use TM25: Wrong Way Vehicle Detection and Warning
03	Develop alternate routing plans, signal timing plans, and DMS messages that can be implemented during incidents, special events, or construction detours	MC06: Work Zone Management PS12: Disaster Response and Recovery PS13: Evacuation and Reentry Management TI01: Broadcast Traveler Information TI02: Personalized Traveler Information TI03: Dynamic Route Guidance TI04: Infrastructure-Provided Trip Planning and Route Guidance TI07: In-Vehicle Signage TM06: Traffic Information Dissemination TM19: Roadway Closure Management
04	Deploy systems that will alert and divert wrong-way drivers	TM25: Wrong Way Vehicle Detection and Warning
05	Expand the region's safety service patrol to provide motorist assistance along freeways	PS08: Roadway Service Patrols TM01: Infrastructure-Based Traffic Surveillance
06	Improve coordination between TDOT and Georgia agencies including GDOT	TM07: Regional Traffic Management TM08: Traffic Incident Management System

Need Number	Need Description	Corresponding ITS Service Packages
07	Monitor railroad crossing locations and convey warning and blockage information to drivers and transportation staff	PS02: Emergency Response TM13: Standard Railroad Grade Crossing TM15: Railroad Operations Coordination
08	Deploy bridge and tunnel infrastructure monitoring systems and warning systems to divert vehicles that may cause damage to infrastructure	MC09: Infrastructure Monitoring PS09: Transportation Infrastructure Protection TM12: Dynamic Roadway Warning VS11: Oversize Vehicle Warning
09	Deploy dynamically activated warning systems in flood-prone areas, school zones, sharp curves, and other operationally critical locations	TM05: Traffic Metering TM12: Dynamic Roadway Warning TM13: Standard Railroad Grade Crossing TM17: Speed Warning and Enforcement TM19: Roadway Closure Management TM25: Wrong Way Vehicle Detection and Warning VS05: Curve Speed Warning VS09: Reduced Speed Zone Warning / Lane Closure VS11: Oversize Vehicle Warning: City of Chattanooga VS12: Pedestrian and Cyclist Safety WX01: Weather Data Collection WX02: Weather Information Processing and Distribution
10	Improve coordination of traffic signal system timing between the City of Chattanooga and adjacent cities	TM03: Traffic Signal Control TM04: Connected Vehicle Traffic Signal System TM07: Regional Traffic Management
11	Expand traffic signal system communications and system detection capabilities	ST01: Emissions Monitoring TM01: Infrastructure-Based Traffic Surveillance TM03: Traffic Signal Control TM04: Connected Vehicle Traffic Signal System
12	Expand adaptive traffic signal system coverage and capabilities	TM01: Infrastructure-Based Traffic Surveillance TM02: Vehicle-Based Traffic Surveillance TM03: Traffic Signal Control TM04: Connected Vehicle Traffic Signal System
13	Allow for collection, storage, and analysis of regional transportation data to improve decision-making and ease of reporting	DM01: ITS Data Warehouse TM07: Regional Traffic Management
14	Deploy an integrated payment system that allows users to pay for regional mobility and parking services via a single platform	PM03: Parking Electronic Payment PM04: Regional Parking Management PT04: Transit Fare Collection Management PT18: Integrated Multi-Modal Electronic Payment
15	Improve vehicle tracking and location reporting capabilities for maintenance and transit vehicles	MC01: Maintenance and Construction Vehicle and Equipment Tracking PT01: Transit Vehicle Tracking
16	Implement transit priority strategies that allow for improved transit system performance	PT01: Transit Vehicle Tracking PT02: Transit Fixed-Route Operations PT09: Transit Signal Priority
17	Monitor passenger boarding, alighting, and travel trends to improve service	PT07: Transit Passenger Counting PT08: Transit Traveler Information
18	Invest in transit-focused capital improvements that make services more operationally efficient and more environmentally sustainable	PT06: Transit Fleet Management PT08: Transit Traveler Information ST05: Electric Charging Stations Management TI02: Personalized Traveler Information

Need Number	Need Description	Corresponding ITS Service Packages
19	Provide emergency responders with access to existing ITS resources to aid in emergency and disaster response and recovery	PS02: Emergency Response PS03: Emergency Vehicle Preemption PS08: Roadway Service Patrols TM01: Infrastructure-Based Traffic Surveillance TM06: Traffic Information Dissemination TM07: Regional Traffic Management TM08: Traffic Incident Management System
20	Improve third-party navigation services to provide routing information specific to vehicle type, avoiding situations such as over-height trucks being routed to low clearance tunnels they cannot traverse.	TI02: Personalized Traveler Information TI03: Dynamic Route Guidance

5.2 Architecture Interfaces

While it is important to identify the various systems and stakeholders that are part of a regional ITS, a primary purpose of the ITS architecture is to identify the connectivity between transportation systems in the Chattanooga Region. To show these connections, the high-level relationships of the subsystems and terminators in the Chattanooga Region and the associated local projects and systems are organized into a *system interconnect diagram*. A system interconnect diagram, or "sausage diagram", shows the systems and primary interconnects in the Region. At a more detailed level, service package diagrams show the information flows between the subsystems and terminators that are important to the operation of each service package that has been tailored to the region's needs. How these systems interface with each other is an integral part of the overall ITS architecture.

5.2.1 Top Level Regional System Interconnect Diagram

The National ITS Architecture interconnect diagram has been customized for the Chattanooga Region based on the system inventory and information gathered from stakeholders. **Figure 6** and **Table 9** summarize the existing and planned ITS elements for the Chattanooga Region in the context of a physical interconnect. Subsystems and elements specific to the Region are called out in the table, and these are color-coded according to the subsystem with which they are associated in the preceding figure.

While a regional system interconnect diagram is not available through RAD-IT, a complete list of the elements shown above in **Table 9**, along with element definitions and other information, can be found in the Interactive Architecture through the online RAD-IT database located at:

https://chcrpa.org/intelligent-transportation-system/

To access this information, from the website select the "Chattanooga Interactive ITS Architecture", then select the "Inventory" page from the left sidebar. Select an Element from the table to learn more about it. Users can also sort elements by physical object or by

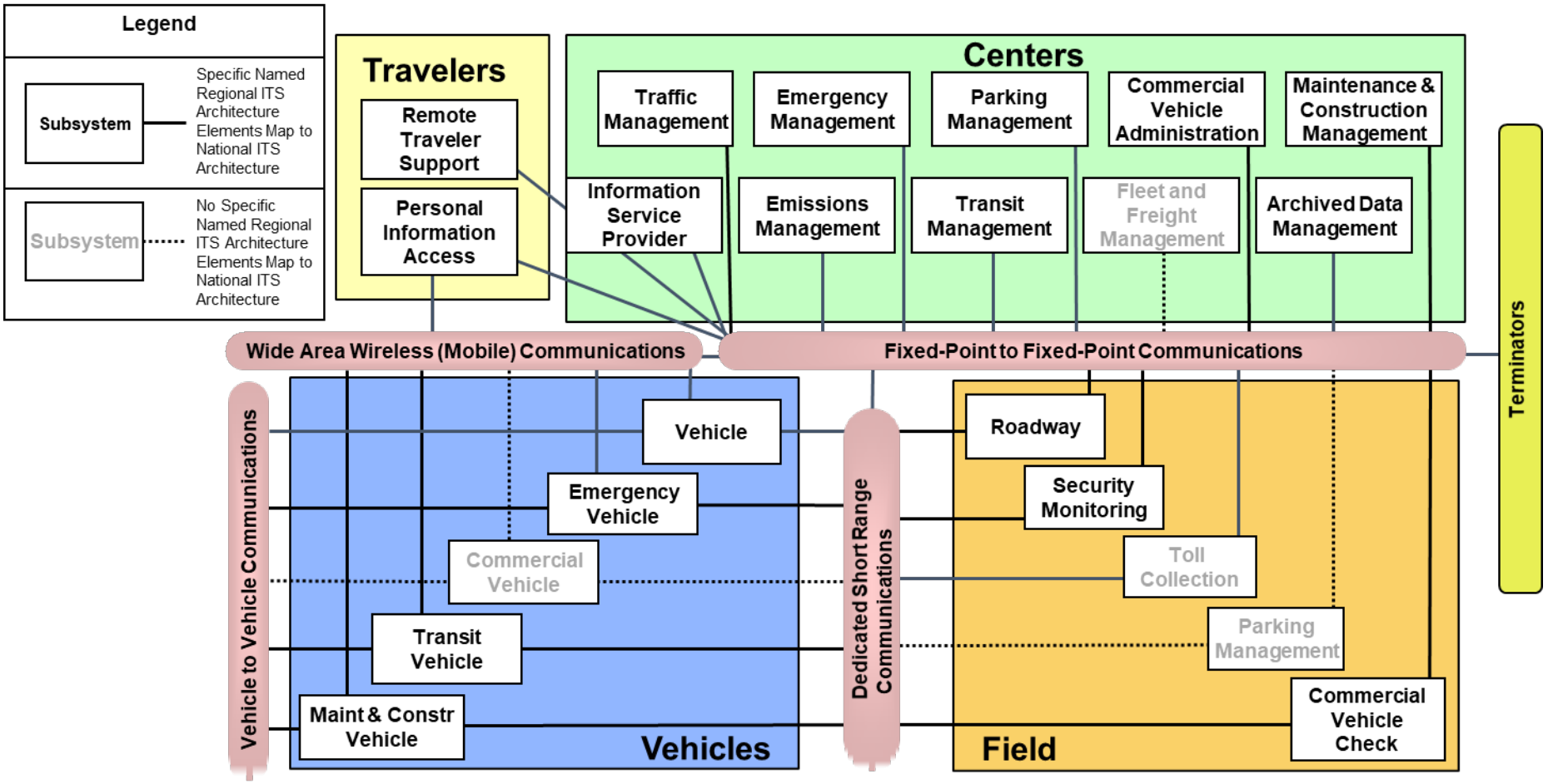


Figure 6 – Chattanooga Regional ITS Subsystem and Element Key

Table 9 – Chattanooga Regional Subsystems and Elements

ITS Architecture System: Travelers		
Subsystem	**Elements**	
Remote Traveler Support	CARTA Bus Stop DMS	CARTA Transit Kiosks
Personal Information Access	Personal Computing Devices	CARTA Routing Application
ITS Architecture System: Centers		
Subsystem	**Elements**	
Archived Data Management	CARTA Data Archive Catoosa Trans-Aid Data Archive CHCNGA TPO Data Archive City of Chattanooga ITS Data Warehouse Dade County Transit Data Archive	SETHRA Data Archive TDOT Project Planning Division Archive TITAN Database Walker County Transit Data Archive Municipal/County Data Archive
Commercial Vehicle Administration	THP Truck Weigh and Inspection Station	MCCD Truck Weigh and Inspection Station
Emergency Management	CARTA Care-A-Van Dispatch Center CARTA Fixed-Route Dispatch Center Catoosa County 911 Dispatch Catoosa County EMA Catoosa Trans-Aid Dispatch Center City of Chattanooga Fire Dispatch City of Chattanooga Police Department City of Chattanooga Police Dispatch City of Soddy-Daisy 911 Dispatch Dade County 911 Dispatch Dade County EMA Dade County Transit Dispatch Center GDOT HERO Dispatch GEMA	GSP Troop A Dispatch Hamilton County E911 Hamilton County EMA Hamilton County Sheriff's Office Municipal Police Department SETHRA Transportation Dispatch Center TDOT Region 2 HELP Dispatch TEMA Tennessee Bureau of Investigation THP Dispatch THP District 2 Office Walker County 911 Dispatch Walker County EMA Walker County Transit Dispatch Center
Emissions Management	Chattanooga-Hamilton County Air Pollution Control Bureau	Oak Ridge National Laboratory
Fleet and Freight Management	Private Commercial Vehicle Dispatch Centers	
Information Service Provider	CARTA Website Catoosa Trans-Aid Website Chattanooga-Hamilton County Air Pollution Control Bureau Website City of Chattanooga Road Closure Notification System City of Chattanooga Website City of East Ridge Website City of Red Bank Website City of Soddy-Daisy Website Dade County Transit Website GDOT Public Information Office GDOT Statewide Construction and Maintenance System	Georgia 511 System Georgia NaviGAtor System Municipal/County Website Municipal/State ActiveITS Platform Private Sector Traveler Information Services SETHRA Website Social Networking Services TDOT Community Relations Divisions TDOT Statewide Information for Travelers (SWIFT) TDOT SmartWay Website Tennessee 511 System Walker County Transit Website

Table 9 – Chattanooga Regional Subsystems and Elements (continued)

Table 9 – Chattanooga Regional Subsystems and Elements

ITS Architecture System: Centers (continued)		
Maintenance & Construction Management	City of Chattanooga City-Wide Services City of Chattanooga TOC GDOT District 6 Construction and Maintenance GDOT Emergency Services Coordinator GDOT Statewide Construction and Maintenance System Municipal/County Maintenance	Other GDOT District Construction and Maintenance Other TDOT Region Construction Office Other TDOT Region District Operations TDOT Region 2 District Operations TDOT Emergency Services Coordinator TDOT Maintenance Headquarters TDOT Statewide Information for Travelers (SWIFT)
Parking Management	Chattanooga Parking Authority Facility Management	
Traffic Management	City of Chattanooga TOC City of East Ridge TOC City of Red Bank TOC City of Soddy-Daisy TOC GDOT Atlanta TMC GDOT District 6 Dalton Area Office GDOT District 6 Dalton/Whitfield County GDOT Emergency Services Coordinator Georgia NaviGAtor System Municipal/County TOC	TDOT Emergency Services Coordinator TDOT Project Planning Division Archive TDOT Region 1 TMC – Knoxville TDOT Region 2 TMC – Chattanooga TDOT Region 3 TMC – Nashville TDOT Region 4 TMC – Memphis TDOT Statewide Information for Travelers (SWIFT) THP District 2 Office
Transit Management	CARTA Care-A-Van Dispatch Center CARTA Fixed Route Dispatch Catoosa Trans-Aid Dispatch Center	Dade County Transit Dispatch Center Regional Transit Coordination Center SETHRA Transportation Dispatch Center Walker County Transit Dispatch Center
ITS Architecture System: Vehicles		
Subsystem	**Elements**	
Commercial Vehicle	Commercial Vehicles	
Emergency Vehicle	City of Chattanooga Fire Vehicles City of Chattanooga Police Vehicles City of East Ridge Public Safety Vehicles City of Red Bank Public Safety Vehicles City of Soddy-Daisy Public Safety Vehicles GDOT HERO Vehicles	GSP Vehicles Hamilton County EMA Hamilton County Sheriff Vehicles Municipal/County Public Safety Vehicles TDOT HELP Vehicles TDOT Protect the Queue Vehicles THP Vehicles
Maintenance and Construction Vehicle	City of Chattanooga City-Wide Services Vehicles GDOT Maintenance Vehicles	Municipal/County Maintenance Vehicles TDOT Maintenance Vehicles
Transit Vehicle	CARTA Fixed-Route Vehicles CARTA Paratransit Vehicles Catoosa Trans-Aid Vehicles	Dade County Transit Vehicles SETHRA Demand Response Vehicles Walker County Transit Vehicles
Vehicle	Chattanooga Parking Authority Smart Meters	Public/Private Vehicle

Table 9 – Chattanooga Regional Subsystems and Elements

ITS Architecture System: Field		
Subsystem	**Elements**	
Commercial Vehicle Check	THP Weigh-in-Motion	MCCD Weigh-in-Motion
Roadway	CARTA Vehicle Electric Charging Stations Chattanooga Parking Authority DMS Chattanooga-Hamilton County Air Quality Sensors City of Chattanooga Connected Vehicle Roadside Equipment City of Chattanooga CCTV Cameras City of Chattanooga Curve Speed Warning System City of Chattanooga DMS City of Chattanooga Field Sensors City of Chattanooga Infrastructure Monitoring Sensors City of Chattanooga Overheight Vehicle Detection City of Chattanooga Portable DMS City of Chattanooga Rail Notification System City of Chattanooga Rectangular Rapid Flash Beacons City of Chattanooga Road Closure Gates City of Chattanooga RWIS City of Chattanooga School Zone Flashers City of Chattanooga Speed Monitoring Equipment City of Chattanooga Traffic Signals City of Chattanooga Tunnel Bike Warning Beacons City of East Ridge CCTV Cameras City of East Ridge Field Sensors City of East Ridge Traffic Signals City of Red Bank CCTV Cameras City of Red Bank Field Sensors City of Red Bank Traffic Signals City of Soddy-Daisy CCTV Cameras City of Soddy-Daisy Field Sensors	City of Soddy-Daisy Traffic Signals GDOT CCTV Cameras GDOT DMS GDOT Field Sensors GDOT Smart Work Zone Equipment GDOT Traffic Signals Municipal/County CCTV Cameras Municipal/County Field Sensors Municipal/County Rail Notification System Municipal/County Traffic Signals Municipal/County Portable DMS Municipal/County RWIS Oak Ridge National Laboratory Emission Sensors TDOT CCTV Cameras TDOT Changeable Speed Limit Signs TDOT Connected Vehicle Roadside Equipment TDOT DMS TDOT Field Sensors TDOT Lane Control Signals TDOT Ramp Metering Equipment TDOT RWIS Sensors TDOT Smart Work Zone Equipment TDOT Fog Sensors TDOT Fog Zone Speed Detection TDOT HAR TDOT On-Ramp Closure Gates TDOT Overheight Vehicle Detection TDOT Unmanned Aerial Vehicle CCTV Cameras TDOT Wrong Way Vehicle Detection and Warning System
Security Monitoring	CARTA Fixed Route Vehicles CARTA Maintenance Facility CCTV Camera Surveillance	CARTA Transit Stop CCTV Camera Surveillance CARTA Vehicle Onboard Video Sensors SETHRA Transit Stop CCTV Camera Surveillance
ITS Architecture System: Terminators		
Subsystem	**Elements**	
Archived Data User Systems	Archive Data User	
Basic Commercial Vehicle	Commercial Vehicles	
Commercial Vehicle Driver	Vehicle Operator	
CVO Inspector	THP CVO Enforcement	MCCD CVO Enforcement

Table 9 – Chattanooga Regional Subsystems and Elements

ITS Architecture System: Terminators (continued)		
Driver	Vehicle Operator	
Enforcement Agency	City of Chattanooga Police Department Hamilton County Sheriff's Office MCCD CVO Enforcement	Municipal Police Department THP CVO Enforcement THP Dispatch
Financial Institution	Financial Service Provider	Health and Human Services
Freight Equipment	Freight Equipment	
Location Data Source	Location Data Source	
Maintenance & Construction Administrative Systems	City of Chattanooga City Engineer's Office GDOT District 6 Engineer's Office	Municipal/County Engineer's Office TDOT Region 2 Engineer's Office
Map Update Provider	Map Update Provider	
Media	Local Print and Broadcast Media	
Other Archives	City of Chattanooga Police Department City of Chattanooga TOC City of East Ridge TOC City of Red Bank TOC City of Soddy-Daisy TOC	Hamilton County Sheriff's Office Municipal Police Department Municipal TOC TDOT Project Planning Division Archive
Other ISP	TDOT SmartWay Website	
Other Maintenance & Construction Management	Other Maintenance and Construction Management Agencies	
Other Parking	Other Private Parking Facilities	
Other Traffic Management	Other Traffic Management Agencies	
Rail Operations	Rail Operations Centers	
Telecommunications System for Traveler Information	Tennessee 511 IVR	
Traveler	Cyclist Pedestrian	Traveler
Traveler Card	Electronic Fare Payment Card	
Wayside Equipment	Rail Operator Wayside Equipment	
Weather Service	National Weather Service	

5.2.2 Element Connections

Elements identified as part of the Chattanooga Regional ITS Architecture include transportation management centers, transit vehicles, dispatch systems, emergency management agencies, media outlets, and others—essentially, all the existing and planned physical components that contribute to the regional ITS. Interfaces have been identified for each element in the Chattanooga Regional ITS Architecture and each element has been mapped to those other elements with which it must interface. The RAD-IT Architecture 9.0 software can generate interconnect diagrams that show which elements are connected to one another for each element in the Region. **Figure 7** is an example of an interconnect diagram from the RAD-IT database output. This interconnect diagram is for the City of Chattanooga Traffic Signals.

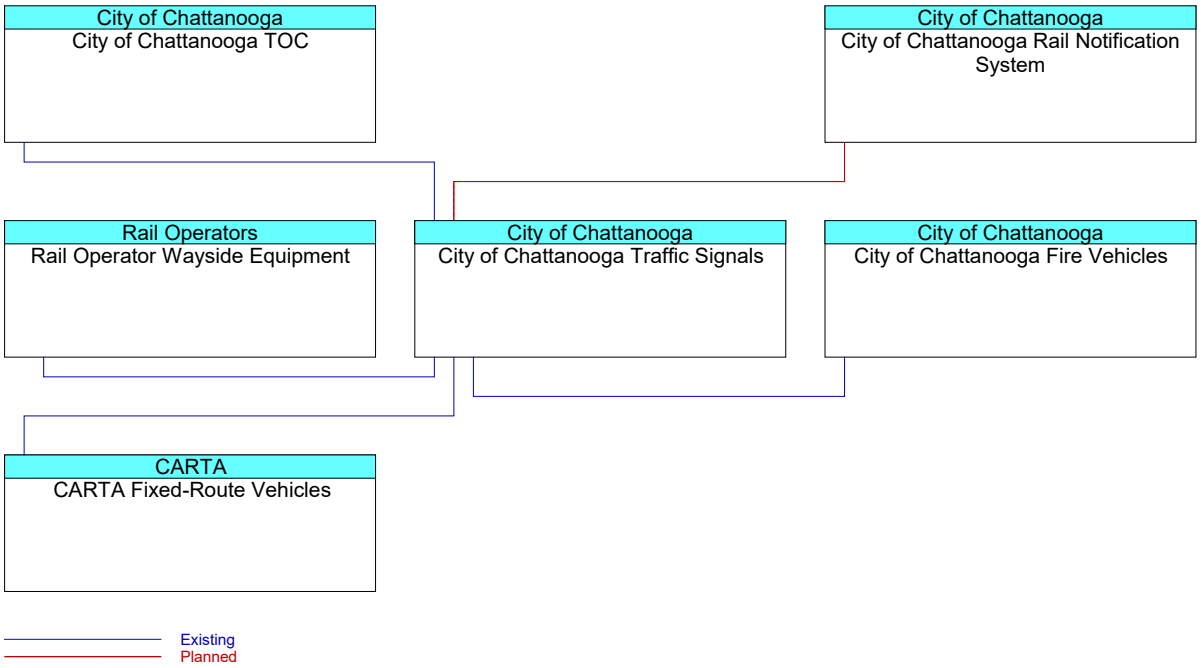


Figure 7 – Example Interconnect Diagram: City of Chattanooga Traffic Signals

5.2.3 Information Flows Between Elements

In the service package diagrams, flows between the subsystems and terminators define the specific information (data) that is exchanged between the elements and the direction of the exchange. The information flows could be requests for information, alerts and messages, status requests, broadcast advisories, event messages, confirmations, electronic credentials, and other key information requirements. RAD-IT Architecture can be used to output flow diagrams and can be filtered by service package for ease of interpretation; however, it is important to remember that custom information flows will not show up in diagrams that are filtered by service package. An example of a flow diagram that has been filtered for the TI01 – Broadcast Traveler Information service package is shown in **Figure 8**.

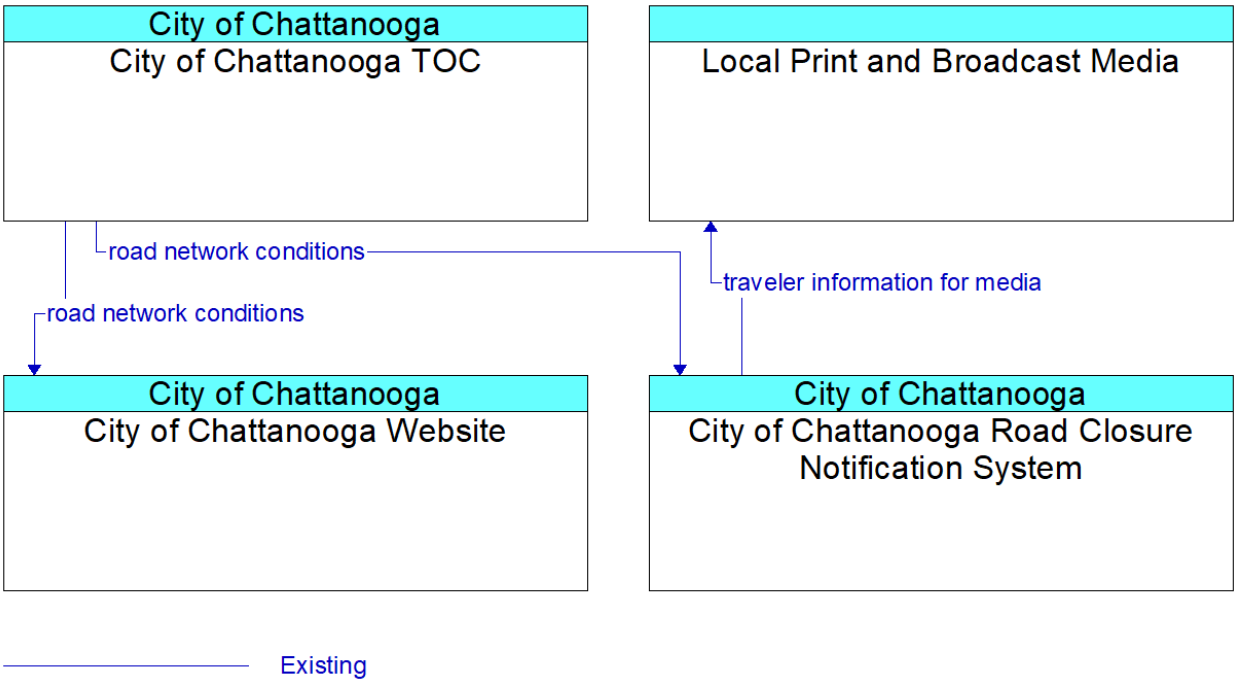


Figure 8 – Example Flow Diagram: ATMS01 – Network Surveillance

Information flows for any element in the Chattanooga Regional ITS Architecture can be found in the Interactive Architecture through the online RAD-IT database located at:

https://chcrpa.org/intelligent-transportation-system/

To access this information, from the website select the "Chattanooga Interactive ITS Architecture", then select the "Interfaces" page from the left sidebar, then click the desired element on the left side of the column to see the context diagram showing all of the other elements that are connected.

5.3 Functional Requirements

Functional requirements are developed for an ITS Architecture based on a region's defined needs. In the National ITS Architecture, functions are defined at several different levels, ranging from general subsystem descriptions, to somewhat more specific equipment package descriptions, to Process Specifications that include substantial detail. Guidance from the USDOT on developing a Regional ITS Architecture recommends that each Region determine to what extent defining functional requirements will be beneficial. In the Chattanooga Region, it is recommended that detailed functional requirements that identify all functions that a project or system needs to perform (process specifications) be developed at the project level. Therefore, the process specification level of detail for ITS architecture elements is not discussed in this report.

Instead, for the Chattanooga Regional ITS Architecture, functional requirements have been identified at two levels. The customized service packages, discussed previously in Section 5.1, describe the services that ITS needs to provide in the Region and the information flows between the elements. These service packages and information flows describe what ITS in the Chattanooga Region must do and the data that needs to be shared among elements.

At a more detailed level, functional requirements for the Chattanooga 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.

5.4 Standards

Standards are an important tool that will allow efficient implementation of the elements in the Chattanooga Regional ITS Architecture over time. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances, vendors change, and as new approaches evolve. The USDOT's ITS Joint Program Office is supporting Standards Development Organizations (SDOs) with an extensive, multi-year program of accelerated, consensus-based standards development to facilitate successful ITS deployment in the United States. **Table 10** identifies each of the ITS standards that could apply to the Chattanooga Regional ITS Architecture. These standards are based on the physical subsystem information flows previously identified in Section 5.2.3 and shown in the Regional ITS Architecture service package diagrams.

While **Table 10** does not match the standards to specific information flows, that information is available through the National ITS Architecture website and RAD-IT Architecture. Since the website is updated more frequently than the software and links directly to additional information about the applicable standard, the website is the preferred method for determining which standards apply to a particular information flow. When a stakeholder agency within the region begins deployment of an ITS project, the agency should ensure that the technology being deployed conforms to standards that are relevant to the applicable project service packages. To locate this information, do the following:

- Go to the Physical Objects page of the National Architecture website at:

  http://www.arc-it.net/html/viewpoints/physical.html;
- From the alphabetical list of flows that appears locate and select the desired flow;
- Information flows are often used between multiple subsystems so scrolling may be required to find the appropriate information associated with the particular use of the flow, in the descriptive information any applicable standards will be identified; and
- For additional information on the applicable standards the standard name is a link that when selected leads to a more detailed description of the standard.

Relevant standards in the Chattanooga Regional ITS Architecture can also be found in the Interactive Architecture through the online RAD-IT database located at:

https://chcrpa.org/intelligent-transportation-system/

To access this information, from the website select the "Chattanooga Interactive ITS Architecture", then select the "Standards" page from the left sidebar, then click the desired Standard title.

Table 10 – Chattanooga Regional ITS Standards

SDO	Document ID	Title
Advanced Traffic Controller Joint Committee	ITE ATC 5201	Advanced Transportation Controller
Advanced Traffic Controller Joint Committee	ITE ATC 5202	Model 2070 Controller Standard
Advanced Traffic Controller Joint Committee	ITE ATC 5301	Intelligent Transportation System Standard Specification for Roadside Cabinets
Advanced Traffic Controller Joint Committee	ITE ATC 5401	Application Programming Interface Standard for the Advanced Transportation Controller
International Organization for Standardization	ISO 21217	Intelligent transport systems -- Communications access for land mobiles (CALM) -- Architecture
National Electrical Manufacturers Association	NEMA TS 5	Portable Traffic Signal Systems (PTSS) Standard
National Electrical Manufacturers Association	NEMA TS 8	Cyber and Physical Security for Intelligent Transportation Systems
National Electrical Manufacturers Association	NEMA TS2	Traffic Controller Assemblies with NTCIP Requirements
National Electrical Manufacturers Association	NEMA TS4	Hardware Standards for Dynamic Message Signs (DMS) With NTCIP Requirements
National Institute for Standards and Technology	NIST FIPS PUB 140-2	Security Requirements for Cryptographic Modules
Society of Automotive Engineers	LTE-V2X WSMP	SAE Traveler Information
Society of Automotive Engineers	WAVE WSMP	SAE Basic Safety Messages

5.5 Operational Concepts

Operational concepts document each stakeholder's current and future roles and responsibilities across a range of transportation services. In the Chattanooga Region, these operational concepts are documented for seven separate areas described in the RAD-IT Architecture, with each area describing an aspect of the operation of an interconnected, regional ITS network. The seven service areas covered are described briefly below:

- **Surface Street Management:** The development and operations of signal systems that react to changing traffic conditions and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions.
- **Freeway Management:** The development and operations of systems to monitor freeway traffic flow and roadway conditions and to provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway.
- **Incident Management:** The development and operations of systems to provide rapid and effective response to traffic incidents. This service area includes systems to detect and verify incidents as well as coordinated agency response to the incidents.
- **Public Safety and Emergency Management:** The development and operations of systems to provide emergency call taking, public safety dispatch, and emergency operations center operations.
- **Transit Management:** The development and operations of systems to manage fleets of transit vehicles and overall transit systems more efficiently.
- **Traveler Information:** The development and operations of systems to provide static and real-time transportation information to travelers.
- **Sustainable Travel:** The development and operations of traffic management systems and fleet management infrastructure that reduces environmental impacts.

These seven service areas are described in greater detail in this section. For each service area, existing relevant ITS applications in the region are described. Current needs and challenges related to the service area are also documented along with future potential ITS applications and opportunities related to the documented needs and challenges. Current and future stakeholders supporting service area deployments are also documented along with each stakeholder's roles and responsibilities for implementing the service in question. The CHCNGA TPO Long-Range Planning noted that they may be able to assist in coordinating the planned roles and responsibilities in the future

Several other service areas included in the Regional ITS Architecture – maintenance and construction management, commercial vehicle operations, archived data management, weather, parking management, and vehicle safety – are only tangentially related to the short-term, high-priority projects in this update. These service areas either do not apply to any of the projects included as part of the Regional ITS Deployment Plan, or else they only apply to a single medium- or long-term project whose implementation would not require substantial coordination among the region's stakeholders.

5.5.1 Surface Street Management

Surface street management refers to the operation and maintenance of ITS that facilitates the movement of traffic on arterial roadway networks. Technologies and strategies that improve the effectiveness or level of control over individual traffic signals as well as regional traffic signal systems (including coordinated signal corridors) are common surface street management approaches. Beyond signalized intersection operations, surface street management may also focus on improving operations at locations on an arterial network that are particularly susceptible to certain types of crashes or to weather events such as flooding.

Table 11 lists current surface street management ITS applications in the Chattanooga Region, as well as current needs or challenges related to surface street management. Potential ITS applications that could address the listed surface street management challenges are also included. On the next page, **Table 12** lists key stakeholders and each one's roles and responsibilities within the service area.

Table 11 – Surface Street Management in the Study Area

Surface Street Management in the Study Area	
Current ITS Applications	▪ The City of Chattanooga maintains a TOC. TOC staff can remotely control traffic signal timings and can view and control CCTV cameras deployed at signal locations. ▪ The City of Chattanooga maintains agreements that allow the TOC to control signals in the nearby cities of East Ridge and Red Bank. ▪ The City of Chattanooga has deployed adaptive traffic signal control technology along two arterial corridors that allows for demand-responsive signal operations. ▪ The City of Chattanooga is currently partnering with CARTA to install transit signal priority technology at key intersections that serve fixed-route transit.
Current Needs and Challenges	▪ The City of Chattanooga has identified several locations along local roads that flood consistently during heavy rain events. ▪ Both the City of Chattanooga and TDOT have identified tunnel and bridge locations along arterials within the region that have been struck in the past by overheight vehicles. ▪ The City of Chattanooga has identified locations where vehicles tend to speed both at sharp curves and within school zones.
Future ITS Applications and Opportunities	▪ Expand the City of Chattanooga's Smart Corridor program by deploying additional adaptive traffic signal control technology. ▪ Deploy dynamically controlled detection and warning systems at arterial locations with operational challenges, including in flood-prone locations, at bridge and tunnel locations with high truck volumes, at sharp curve locations with history of excessive vehicle speeds. Include communications infrastructure linking devices back to TOCs or TMCs. ▪ Install communications infrastructure to allow for remote control of the City of Chattanooga school zone flasher system. ▪ Continue to expand transit signal priority technology along CARTA routes.

Table 12 – Surface Street Management Key Stakeholders, Roles, and Responsibilities

Key Stakeholders for Surface Street Management in the Study Area	
Existing Key Stakeholders	▪ TDOT ▪ GDOT ▪ City of Chattanooga ▪ City of Red Bank (Other Municipal) ▪ City of East Ridge (Other Municipal) ▪ City of Soddy-Daisy (Other Municipal)
Planned Key Stakeholders	▪ Other Local Municipalities/Counties

Surface Street Management Service Area Roles and Responsibilities Matrix								
	Regional Stakeholders							
Roles and Responsibilities	TDOT	City of Chattanooga	CARTA	GDOT	Other Municipal / County	Other Transit	Hamilton County 911 / Other Emergency Mgmt	
Operate and maintain traffic signal systems.		E		E	E			
Operate and maintain ITS equipment including CCTV cameras and vehicle detection on roadways to facilitate traffic signal operations.		E		E	E			
Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle preemptions.		E			P			
Provide traffic signal preemption for emergency vehicles.		E			P			
Provide transit signal priority for transit vehicles.		E			P			
Operate and maintain school zone flasher systems.		P			P			
Operate and maintain ITS devices such as flood detection, curve speed warning, and overheight vehicle warning systems to support surface street operations.	E	P						
Provide the services identified above for surface street management in the City of East Ride and City of Red Bank.		E						

Key	
Existing role or responsibility	E
Planned role or responsibility	P

5.5.2 Freeway Management

Freeway management refers to the operation and maintenance of ITS that facilitates the movement of traffic on freeway and controlled access highway networks. Technologies and strategies that improve freeway surveillance capabilities or influence driver behavior through variable signage are common freeway management approaches. Freeway management activities are most often coordinated by staff at a regional TMC.

Table 13 lists current freeway management ITS applications in the Chattanooga Region, as well as current needs or challenges related to freeway management. Potential ITS applications that could address the listed freeway management challenges are also included. On the next page, **Table 14** lists key stakeholders and each one's roles and responsibilities within the freeway management service area.

Table 13 – Freeway Management in the Study Area

Freeway Management in the Study Area	
Current ITS Applications	▪ Both TDOT and GDOT operate TMCs that manage ITS assets deployed along freeways within the Region. Existing freeway ITS is managed by staff in the TDOT Region 2 SmartWay TMC, and staff coordinate with GDOT NaviGAtor TMC staff when needed. ▪ Both TDOT and GDOT also operate freeway service patrols in the Region. These patrol vehicles assist stranded motorists and provide temporary traffic control in support of incident management. ▪ The TDOT Region 2 SmartWay TMC operates CCTV cameras, DMS units and vehicle detection units on freeways throughout the Region.
Current Needs and Challenges	▪ TDOT Region 2 has identified a need for improved collaboration and communications infrastructure linkages to other TDOT Region TMCs and with GDOT. TDOT has also identified a need to improve camera feed sharing capabilities with local partners. ▪ There is a need to deploy ITS infrastructure along the stretch of I-24 in the Region that passes through north Georgia. ▪ There is a need for traffic smoothing and speed harmonization along I-24 east of downtown Chattanooga. ▪ There is a need to identify hotspot locations for wrong-way driving and to alert and divert wrong-way drivers in these locations.
Future ITS Applications and Opportunities	▪ Expand the existing TDOT SmartWay fiber network along freeways to enhance communications linkages with other TDOT regions and GDOT. ▪ Deploy CCTV cameras, DMS units, and a fiber backbone along I-24 in north Georgia and redeploy highway advisory radio technology. ▪ Install ramp metering and main lane variable speed limit DMS units to support speed harmonization efforts along I-24. ▪ Install wrong-way driver detection and warning systems along freeway entrance ramps. ▪ Expand the deployment of the TDOT HELP freeway service patrol so that it covers a larger geographic reach.

Table 14 – Freeway Management Key Stakeholders, Roles, and Responsibilities

Key Stakeholders for Freeway Management in the Study Area	
Existing Key Stakeholders	▪ TDOT ▪ GDOT
Planned Key Stakeholders	▪ None

Freeway Management Service Area Roles and Responsibilities Matrix								
Roles and Responsibilities	**Regional Stakeholders**							
	TDOT	City of Chattanooga	CARTA	GDOT	Other Municipal / County	Other Transit	Hamilton County 911 / Other Emergency Mgmt	
Operate DMS to distribute traffic information and roadway conditions to travelers on the roadway.	**E**			**E**				
Operate HAR to distribute traffic information and roadway conditions to travelers on the roadway.	**P**							
Operate network surveillance equipment including CCTV cameras and vehicle detection on state roadways.	**E**			**E**				
Operate wrong way driver detection and warning systems along freeway ramps.	**P**							
Operate variable speed limit systems to support freeway speed harmonization.	**P**							
Operate ramp metering systems to manage the use of freeways.	**P**							
Dispatch service patrol vehicles along regional freeways.	**E**			**E**				

Key	
Existing role or responsibility	**E**
Planned role or responsibility	**P**

5.5.3 Incident Management

Incident management refers to the coordination of resources and activities to detect, respond to, and clear traffic incidents quickly and safely. Incident management activities are multidisciplinary in nature, often involving representatives from police, fire, medical services, and transportation agencies. Activities are often coordinated from a TMC, and transportation stakeholders often staff service patrols that patrol freeways and assist with incident management and clearance as incidents are detected.

Table 15 lists current incident management ITS applications in the Chattanooga Region, as well as current needs or challenges related to incident management. Potential ITS applications that could address the listed incident management challenges are also included. On the next page, **Table 16** lists key stakeholders and each one's roles and responsibilities within the incident management service area.

Table 15 – Incident Management in the Study Area

Incident Management in the Study Area	
Current ITS Applications	▪ TDOT and GDOT coordinate freeway incident management and response efforts in the region via each agency's regional TMC. TMC staff coordinate with local law enforcement and emergency response agencies to support the incident commander as requested. ▪ TDOT and GDOT also fund and manage their own fleets of freeway service patrol vehicles that support incident management efforts by establishing temporary traffic control at incident scenes. ▪ TDOT uses its freeway CCTV cameras to assist with incident verification and its DMS units to provide travelers with incident information.
Current Needs and Challenges	▪ There is a need for enhanced coordination on major incidents, including ones involving commercial vehicles or fluid spills. ▪ TDOT has identified a need to improve camera feed sharing capabilities with local partners in traffic incident management so that responders can allocate appropriate resources to response efforts. ▪ There is a need to expand incident management capabilities on freeways in rural portions of the Region.
Future ITS Applications and Opportunities	▪ Identify and deploy technology that allows for sharing and viewing camera feeds from multiple agencies from a single software platform. ▪ Expand the deployment of the TDOT HELP freeway service patrol so that it covers a larger geographic reach, including freeway segments in rural areas. ▪ Equip HELP vehicles with CCTV drones that can be deployed and can send live video of incident scenes back to TMC staff and other response partners. ▪ Establish a regional Traffic Incident Management Working Group composed of incident management stakeholders from throughout the Region. The working group should meet regularly to discuss pressing issues related to incident management within the region and to debrief on response efforts from recent incidents.

Table 16 – Incident Management Key Stakeholders, Roles, and Responsibilities

Key Stakeholders for Incident Management in the Study Area	
Existing Key Stakeholders	▪ TDOT ▪ GDOT ▪ City of Chattanooga ▪ Other Municipal Agencies (Police and Fire) ▪ Hamilton County 911
Planned Key Stakeholders	▪ Other Municipal/County Governmental Agencies (Transportation)

Incident Management Service Area Roles and Responsibilities Matrix							
Roles and Responsibilities	**Regional Stakeholders**						
	TDOT	City of Chattanooga	CARTA	GDOT	Other Municipal / County	Other Transit	Hamilton County 911 / Other Emergency Mgmt
Remotely control traffic and video sensors to support incident detection and verification.	E	E		E	E		
Disseminate traffic incident related data to other centers and the media.	E	E		E	E		
Coordinate with other traffic operations centers and emergency management agencies for coordinated incident management.	E	E		E	P		E
Coordinate maintenance resources for incident response.	E	E		E	E		
Dispatch service patrol vehicles to support incident management.	E			E			
Provide services for incident management in the City of East Ridge and City of Red Bank.		E					

Key	
Existing role or responsibility	E
Planned role or responsibility	P

5.5.4 Public Safety and Emergency Management

Public safety and emergency management refers to the deployment of ITS technologies and strategies that support public safety and emergency response, such as fire and EMS vehicle preemption on traffic signal networks. The service area also refers to coordination activities and special protocol enacted during significant emergencies of a regional nature, such as severe weather events or mass casualty events that may necessitate activities.

Table 17 lists current emergency management ITS applications in the Chattanooga Region, as well as current needs or challenges related to emergency management. Potential ITS applications that could address the listed emergency management challenges are also included. On the next page, **Table 18** lists key stakeholders and each one's roles and responsibilities within the emergency management service area.

Table 17 – Public Safety and Emergency Management in the Study Area

Public Safety and Emergency Management in the Study Area	
Current ITS Applications	▪ The City of Chattanooga has deployed public safety vehicle preemption technology at some traffic signal locations. ▪ There is an existing EOC within Hamilton County. The EOC is managed by Hamilton County EMA and is activated during regional emergencies, which are most commonly severe weather events. ▪ During local emergencies, there is existing formal and informal coordination among police, fire, and emergency response partners. For larger emergencies, EOC participation typically includes representatives from TDOT and from the Tennessee Emergency Management Agency. Counterparts from Georgia agencies may also participate if requested.
Current Needs and Challenges	▪ There is a need for improved transportation information sharing with emergency response partners, including sharing of CCTV camera feeds. City and county responders are also interested in increased use of emergency vehicle preemption technology and would like real-time notifications of railroad blockages throughout the city to better plan emergency vehicle routing. ▪ The City of Chattanooga has identified a need to improve detection and response to fires underneath city bridges. ▪ There is a need to maintain evacuation plans for regional emergencies related to security breaches of the Sequoyah Nuclear Power Plant.
Future ITS Applications and Opportunities	▪ Establish a rail blockage notification system and expand emergency vehicle preemption technology deployments at signals in Hamilton County. ▪ Identify and deploy technology that allows responders to view camera feeds from multiple transportation agencies via a single software platform. ▪ Install temperature monitoring and alert equipment at underpasses of City of Chattanooga bridge locations to improve fire detection.

Table 18 – Emergency Management Key Stakeholders, Roles, and Responsibilities

Key Stakeholders for Public Safety and Emergency Management in the Study Area	
Existing Key Stakeholders	▪ TDOT ▪ City of Chattanooga ▪ CARTA ▪ GDOT ▪ City of East Ridge (Other Municipal) ▪ City of Red Bank (Other Municipal) ▪ City of Soddy-Daisy (Other Municipal) ▪ Hamilton County 911 ▪ Tennessee Emergency Management Agency
Planned Key Stakeholders	▪ None

Public Safety and Emergency Management Service Area Roles and Responsibilities Matrix							
Roles and Responsibilities	**Regional Stakeholders**						
	TDOT	City of Chattanooga	CARTA	GDOT	Other Municipal	Other Transit	Hamilton County 911 / Other Emergency Mgmt
Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.		**E**			**E**		**E**
Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.		**E**			**E**		**E**
Participate in regional emergency planning to support large-scale incidents and disasters.	**E**	**E**	**E**	**E**	**E**	**E**	**E**
Lead regional efforts for emergency planning to support large-scale incidents and disasters.							**E**
Operates an emergency operations center in the event of a disaster or other large-scale emergency situation.							**E**
Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies.							**E**
Responsible for coordination with adjacent states as needed to support emergency management.	**E**			**E**			**E**

Key	
Existing role or responsibility	**E**
Planned role or responsibility	**P**

5.5.5 Transit Management

The transit management service area refers to ITS technologies and strategies that support the operation, planning, and management functions of public transit systems. Typical applications include transit vehicle location tracking, schedule adherence, interfaces with traffic signals, passenger counting functions, transit stop and onboard security, and transit traveler information.

Table 19 lists current transit management ITS applications in the Chattanooga Region, as well as current needs or challenges related to transit management. Potential ITS applications that could address the listed transit management challenges are also included. On the next page, Table 20 lists key stakeholders and each one's roles and responsibilities within the transit management service area.

Table 19 – Transit Management in the Study Area

Transit Management in the Study Area	
Current ITS Applications	▪ The City of Chattanooga has deployed some transit signal priority technology along CARTA routes. ▪ CARTA vehicles are enabled with automated vehicle location tracking and onboard CCTV security cameras. ▪ CARTA fixed-route bus stops are equipped with CCTV cameras for security and have a number that riders can text to receive up-to-date bus arrival information. The central transfer center also has bus arrival information posted on changeable message screens. ▪ CARTA maintains a dispatch center that supports vehicle tracking and communication with fixed route bus operators in addition to providing paratransit demand-response service.
Current Needs and Challenges	▪ CARTA would like to increase the detail in passenger trip data that it collects so that the agency can collect origin-destination trip data. ▪ CARTA would like to deploy a regional smartcard-based fare payment system that could be used for transit fares as well as parking facilities and local micromobility options. ▪ CARTA is seeking to improve service through the deployment of bus rapid transit routes whose performance would be enhanced by additional transit signal priority deployments and dedicated lanes.
Future ITS Applications and Opportunities	▪ Deploy video analytics technology that would allow for anonymized data collection regarding individual passenger origin-destination data from existing onboard CCTV camera footage. ▪ Develop and deploy a smartcard-based fare payment system in partnership with micromobility service providers so that the payment system can be used on CARTA buses as well as in regional parking garages and for local micromobility services such as bikeshare. ▪ Continue deployment of transit signal priority technology at signalized intersections along key CARTA routes. ▪ Partner with the City of Chattanooga and TDOT to identify opportunities to reserve lanes or freeway shoulders for CARTA bus use as bus rapid transit routes are identified and deployed.

Table 20 – Transit Management Key Stakeholders, Roles, and Responsibilities

Key Stakeholders for Transit Management in the Study Area	
Existing Key Stakeholders	▪ CARTA ▪ Catoosa Trans-Aid ▪ City of Chattanooga (transit signal priority support) ▪ Dade County Transit ▪ Walker County Transit
Planned Key Stakeholders	▪ None

Transit Management Service Area Roles and Responsibilities Matrix							
Roles and Responsibilities	**Regional Stakeholders**						
	TDOT	City of Chattanooga	CARTA	GDOT	Other Municipal / County	Other Transit	Hamilton County 911 / Other Emergency Mgmt
Operates fixed route and paratransit services from central dispatch facilities responsible for tracking their location and status.			E				
Provide transit passenger electronic fare payment on fixed route transit vehicles.			P				
Provide transit security on transit vehicles and at transit terminals through silent alarms and surveillance systems.			E			E	
Collect and store transit passenger origin-destination data.			E			E	
Coordinate with local agency staff on transit signal priority deployments.		E	E				
Provide transit traveler information to the agency website and local private sector traveler information services.			E			E	
Operate real-time arrival information boards at transit stops and at transfer stations.			E				
Operates demand response and paratransit services from a central dispatch facility responsible for tracking vehicle location and status.						E	

Key	
Existing role or responsibility	E
Planned role or responsibility	P

5.5.6 Traveler Information

Traveler information refers to ITS technologies and strategies that provide travelers with real-time information about travel conditions including delays, incidents, weather, emergencies, and alternate routes. With this information, travelers can make more informed choices about when and how to complete a trip, thereby better balancing traffic demand with available capacity of a transportation network.

Table 21 lists current traveler information ITS applications in the Chattanooga Region, as well as current needs or challenges related to traveler information. Potential ITS applications that could address the listed traveler information challenges are also included. On the next page, **Table 22** lists key stakeholders and each one's roles and responsibilities within the traveler information service area.

Table 21 – Traveler Information in the Study Area

Traveler Information in the Study Area	
Current ITS Applications	▪ Both TDOT and GDOT have DMS units deployed on freeways throughout the region that are controlled by each department's respective TMC. ▪ TDOT and GDOT also both maintain websites and 5-1-1 services that drivers can use to access real-time traveler information, including road closure and incident information.
Current Needs and Challenges	▪ The City of Chattanooga has identified the need to deploy technology that provides traveler information to those driving on major arterials in the Region. ▪ Several agencies have identified a need to broaden traveler information efforts beyond devices and systems that each transportation agency controls.
Future ITS Applications and Opportunities	▪ Upgrade technology used for TDOT's now-defunct highway advisory radio system so that the system can be brought back into service. ▪ Foster relationships with commercial information service providers (such as WAZE, INRIX, Google, and others) to provide real-time traveler information such as planned road closures to users of these applications ▪ Consider advertising campaigns and media partnerships for major planned events that would impact roadway networks for extended periods of time. ▪ Deploy DMS units along key arterial routes and ahead of key traveler decision points on arterials within the City of Chattanooga (and potentially in neighboring cities).

Table 22 – Traveler Information Key Stakeholders, Roles, and Responsibilities

Key Stakeholders for Traveler Information in the Study Area	
Existing Key Stakeholders	▪ TDOT ▪ GDOT ▪ Hamilton County 911 ▪ Tennessee Emergency Management Agency
Planned Key Stakeholders	▪ City of Chattanooga ▪ City of East Ridge (Other Municipal) ▪ City of Red Bank (Other Municipal) ▪ City of Soddy-Daisy (Other Municipal)

Traveler Information Service Area Roles and Responsibilities Matrix								
Roles and Responsibilities	**Regional Stakeholders**							
	TDOT	City of Chattanooga	CARTA	GDOT	Other Municipal / County	Other Transit	Hamilton County 911 / Other Emergency Mgmt
Collect and distribute traveler information including incident information and maintenance and construction closure information.	E	P		E	P		
Collect and distribute emergency information to the traveling public, including evacuation information and wide-area alerts.	E			E			E
Collect, process, store, and broadcast traffic, transit, maintenance and construction, event and weather information, and evacuation information to travelers via traveler websites and 511 systems.	E	P		E	P		
Provide transportation network condition data to private sector information service providers.	P	P		E	P		
Operate HAR for the distribution of traffic information and roadway conditions to travelers on the roadway.	P						
Operate DMS for the distribution of traffic information and roadway conditions to travelers on the roadway.	E	P		E	P		

Key	
Existing role or responsibility	E
Planned role or responsibility	P

5.5.7 Sustainable Travel

Sustainable travel refers to ITS technologies and strategies that reduce the environmental impacts of traffic operations. Typical approaches include technology at traffic signals that reduces vehicle idling times. As electric vehicle technologies are deployed across the country, the sustainable travel service area will also refer to how the infrastructure that supports electric vehicles is managed and maintained throughout the Region.

Table 23 lists current sustainable travel ITS applications in the Chattanooga Region, as well as current needs or challenges related to sustainable travel. Potential ITS applications that could address the listed sustainable travel challenges are also included. On the next page, Table 24 lists key stakeholders and each one's roles and responsibilities within the sustainable travel service area.

Table 23 – Sustainable Travel in the Study Area

Sustainable Travel in the Study Area	
Current ITS Applications	▪ The City of Chattanooga currently operates two 'Smart Corridors' within the city. These arterial corridors have signals equipped with adaptive traffic signal control technology that allows each signal to dynamically adjust timings based upon detected demand. The technology is also used at times to minimize idle time from stopped vehicles to reduce emissions impacts. ▪ CARTA is in the process of converting its transit vehicle fleet to electric buses.
Current Needs and Challenges	▪ The City of Chattanooga has identified a desire to expand the 'Smart Corridor' concept to additional arterial corridors in the city. ▪ As more electric buses are purchased, CARTA has identified the need to provide charging infrastructure at the ends of fixed transit routes to allow for vehicle battery charging in locations other than the CARTA maintenance yards.
Future ITS Applications and Opportunities	▪ Expand Smart Corridor technology deployments to additional corridors within the City of Chattanooga and identify potential corridors for future deployment in other parts of the Region. ▪ Deploy electric vehicle charging infrastructure at the ends of CARTA transit routes. CARTA has indicated a preference of using inductive charging technology that would be embedded into roadway pavement at charging locations.

Table 24 – Sustainable Travel Key Stakeholders, Roles, and Responsibilities

Key Stakeholders for Sustainable Travel in the Study Area	
Existing Key Stakeholders	▪ City of Chattanooga
Planned Key Stakeholders	▪ CARTA

Sustainable Travel Service Area Roles and Responsibilities Matrix							
Roles and Responsibilities	**Regional Stakeholders**						
	TDOT	City of Chattanooga	CARTA	GDOT	Other Municipal / County	Other Transit	Hamilton County 911 / Other Emergency Mgmt
Manage Smart Corridor signal timing and operation.		**E**					
Monitor emissions levels along Smart Corridors.		**E**					
Operate and maintain electric vehicle inductive charging systems.			**P**				

Key	
Existing role or responsibility	**E**
Planned role or responsibility	**P**

5.6 Existing and Potential Agreements

The Regional ITS Architecture for the Chattanooga Region has identified many agency interfaces, information exchanges, and integration strategies that would be needed to provide the ITS services and systems identified by the stakeholders in the Region. Interfaces and information 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 and 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 Regional ITS Architecture, it is likely that formal agreements between agencies will be needed in the future. These agreements, while perhaps not requiring a financial commitment from agencies in the Region, should outline specific roles, responsibilities, data exchanges, levels of authority, and other facets of regional operations. Some agreements may also outline specific funding responsibilities, where appropriate and applicable.

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

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

Common agreement types and potential applications include:

- **Handshake Agreement:** Handshake agreements are sometimes used in the early stage of a project, most commonly between agencies that already have a well-developed relationship. Regardless of the interagency relationship, these agreements should be formalized in writing as the project moves forward.
- **Memorandum of Understanding (MOU):** A MOU demonstrates consensus but is not typically very detailed. MOUs often identify high-level goals and partnerships.
- **Interagency and Intergovernmental Agreements:** These agreements between public agencies can be used for operation, maintenance, or funding projects and systems. They can

include documentation on the responsibility of each agency, functions they will provide, and liability.

- **Funding Agreements:** Funding agreements document the funding arrangements for ITS projects. At a minimum, funding agreements include a detailed scope, services to be performed, and a detailed project budget. Agency funding expectations or funding sources are also typically identified.
- **Master Agreements:** Master agreements include standard contract language for an agency and serve as the main agreement between two entities which guides all business transactions. Use of a master agreement can allow an agency to do business with another agency or private entity without having to go through the often-lengthy development of a formal agreement each time.

Table 25 provides a list of existing and potential agreements for the Chattanooga Region based on the interfaces identified in the Regional ITS Architecture. It is important to note that as ITS services and systems are implemented in the Region, part of the planning and review process for those projects should include a review of potential agreements that would be needed for implementation or operations.

Regional agreements identified in the Chattanooga Regional ITS Architecture can also be found in the Interactive Architecture through the online RAD-IT database located at:

https://chcrpa.org/intelligent-transportation-system/

To access this information, from the website select the "Chattanooga Interactive ITS Architecture", then select the "Agreements" page from the left sidebar, then click the desired Agreement title.

In **Appendix D**, copies of the existing agreements that were available have been included. These agreements include:

- Memorandum of Agreement between the Cleveland Urban Area MPO and the CHCNGA TPO regarding the development and maintenance of the Regional ITS Architecture in each region;
- Agreement developed by TDOT for live CCTV video access for governmental agency users;
- Agreement developed by TDOT for live CCTV video access for private entity users;
- Open Roads Policy Agreement between TDOT, Tennessee Highway Patrol (THP), and local agencies that establish guidelines for removal of vehicles or debris from the state highway system;
- Agreement between the City of Chattanooga and the City of East Ridge for the City of Chattanooga to provide traffic signal maintenance for traffic signals located in the City of East Ridge; and
- Agreement between the City of Chattanooga and the City of Red Bank for the City of Chattanooga to provide traffic signal maintenance for signals located in the City of Red Bank.

Table 25 – Chattanooga Regional Agreements

Status	Agreement and Agencies	Agreement Description
Existing	**ITS Architecture Development and Support (Public-Public)** – CHCNGA TPO, Cleveland Urban Area MPO	Agreement between the Chattanooga-Hamilton County/North Georgia TPO and the Cleveland Urban Area MPO regarding the Regional ITS Architecture in each region. The agreement states that each region will develop a Regional ITS Architecture as well as support the other region's efforts to develop and maintain their own Regional ITS Architecture. It also states that I-75 Fog Detection System will be included in the Chattanooga Regional ITS Architecture given that the command-and-control operations of the system are in Chattanooga.
Existing/ Future	**Data Sharing and Usage (Public-Private)** –TDOT (Existing), City of Chattanooga (Future), Media	Agreement would allow private sector media and information service providers to access and broadcast public sector transportation agency CCTV camera video feeds, real time traffic speed and volume data, and incident data. Agreements should specify the control priority to allow traffic agencies first priority to control cameras during incidents or other events. The ability of the traffic agency to deny access to video and data feeds if a situation warrants such action should also be part of the agreement.
Future	**Data Sharing and Usage (Public-Public)** – TDOT, GDOT, City of Chattanooga, City of East Ridge, City of Red Bank, City of Soddy-Daisy	Agreement would define the parameters, guidelines, and policies for inter-agency ITS data sharing between public sector agencies including CCTV camera feeds. Like 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.
Existing	**Traffic Signal Timing Data Sharing and Usage (Public-Public)** – City of Chattanooga, City of East Ridge, City of Red Bank	Agreement that defines the parameters, guidelines, and policies for inter-agency traffic signal maintenance and timing, including sharing of timing plans and joint operations of signals, between cities and counties.
Future	**Incident Data Sharing, Usage, and Strategy Coordination (Public-Public)** – TDOT, Hamilton County E911, THP	Agreement would define the parameters, guidelines, and policies for inter-agency sharing of incident data between transportation and emergency management agencies in the Region. Incident information could be sent directly to computer-aided dispatch systems and include information on lane closures, travel delays, and weather. Agreement would also establish guidelines for coordinating the development of regional incident management strategies such as special event plans, alternate route designation, and incident information dissemination.
Existing	**Open Roads Policy (Public-Public)** – TDOT, THP (TDOSHS), and Municipalities/Counties	Memorandum of Understanding among TDOT, THP, and local governments that establishes guidelines to accelerate the removal of vehicles or debris on the State Highway System to restore the flow of traffic following an incident.
Future	**I-24 ITS Operations and Maintenance Agreement** – TDOT, GDOT	Agreement would define operations and maintenance responsibilities and capabilities for ITS devices and related communications infrastructure deployed along I-24 and in the vicinity of the I-24 and I-59 interchange in north Georgia.

5.7 Phases of Implementation

The Chattanooga Regional ITS Architecture will be implemented over time through a series of projects. Though TDOT has already made significant ITS deployments in the Region, for other agencies key foundation systems will need to be implemented to support other systems that have been identified in the Regional ITS Architecture. The deployment of all the systems required to achieve the final Regional ITS Architecture build out will occur over many years.

A sequence of projects and their respective time frames have been identified in the Regional ITS Deployment Plan presented in Section 6. These projects have been sequenced over a period that coincides with the upcoming 2050 Regional Transportation Plan with projects identified for deployment in the short-term (0 to 5 years), mid-term (5 to 10 years), and long-term (beyond 10 years.)

Some of the key service packages that will provide the functions for the foundation systems in the Chattanooga Region are listed below. Key service packages are defined as ones that were indicated as having a high implementation priority during stakeholder workshops and are associated with projects that are included in the Chattanooga Regional ITS Deployment Plan in Section 6 as short-term implementation projects.

- TM01 – Infrastructure–Based Traffic Surveillance;
- TM03 – Traffic Signal Control;
- TM04 – Connected Vehicle Traffic Signal System;
- TM06 – Traffic Information Dissemination;
- TM07 – Regional Traffic Management;
- TM08 – Traffic Incident Management System;
- TM13 – Standard Railroad Grade Crossing;
- TM20 – Variable Speed Limits;
- PS08 – Roadway Service Patrols;
- PS09 – Transportation Infrastructure Protection;
- MC09 – Infrastructure Monitoring;
- VS05 – Curve Speed Warning;
- VS11 – Oversize Vehicle Warning;
- ST05 – Electric Charging Stations Management;
- PT03 – Dynamic Transit Operations;
- PT04 – Transit Fare Collection Management;
- PT07 – Transit Passenger Counting;
- PT09 – Transit Signal Priority; and
- TI01 – Broadcast Traveler Information.

6 REGIONAL ITS DEPLOYMENT PLAN

The Regional ITS Deployment Plan serves as a tool for the Chattanooga Region to identify specific projects that should be deployed to achieve the desired functionality identified in the Regional ITS Architecture. The Regional ITS Deployment Plan builds on the Regional ITS Architecture by outlining specific ITS project recommendations and strategies for the Region and identifying deployment timeframes so that the recommended projects and strategies can be implemented over time.

The Regional ITS Deployment Plan also shows the correlation between each project and the Regional ITS Architecture by identifying the ITS service packages that correspond to each project. If projects were identified that did not correspond to an ITS service package that already existed in the Regional ITS Architecture, then the relevant ITS service packages were added while the architecture was still in draft format. Because of these service package additions, the resulting ITS deployment projects are all supported by the Regional ITS Architecture.

The Chattanooga Regional ITS Deployment Plan provides stakeholders with a list of regionally significant ITS projects that are consistent with the Regional ITS Architecture and assists with addressing transportation needs in the Region. It is important to note that the Regional ITS Deployment Plan is not fiscally constrained. The projects in the plan represent those projects that stakeholders would like to implement; however, funding will still be needed for these projects to be implemented.

6.1 Project Development and Selection

An overview of the process used to develop the Regional ITS Deployment Plan is provided in **Figure 9**. This figure demonstrates that a variety of inputs were used to gather information and develop a set of ITS projects for selection by stakeholders, including a review of the regional needs, ITS service package priorities, and regional and local plans.

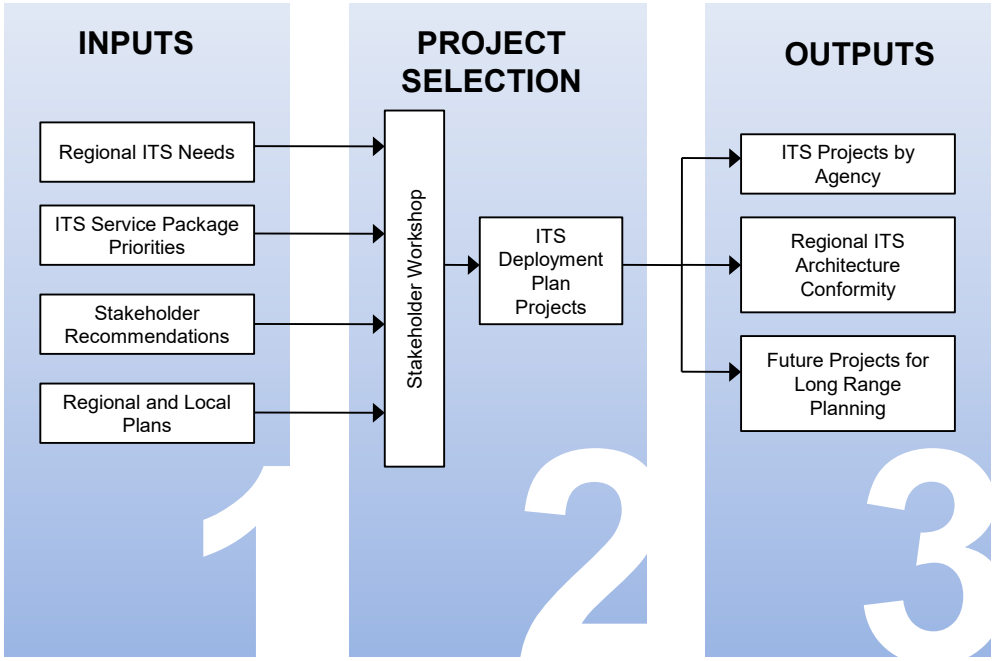


Figure 9 – Project Development and Selection Process

Stakeholder input in Step 1 was gathered through a stakeholder workshop held in August 2021 where regional ITS needs, ITS service package priorities, and planned ITS projects were discussed. A series of interviews were also conducted to discuss this same information in more detail with key agencies in the Region. A review of regional and local plans was also conducted to identify potential project ideas.

The inputs in Step 1 led to the project selection in Step 2. Project selection was completed through both a stakeholder workshop held in October 2021 as well as stakeholder review of the Regional ITS Architecture report.

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

Several projects that were included in the 2017 Regional ITS Deployment Plan have either been implemented or otherwise have been removed and are not included as part of this plan. These projects are listed below in **Table 26**.

Table 26 – Removed Projects from the 2017 Regional ITS Deployment Plan

2017 Project Name	Lead Agency	Justification for Removal from ITS Deployment Plan
TDOT Region 2 SmartWay TMC 24-Hour Operation	TDOT	This project has been implemented. The TDOT Region 2 SmartWay TMC now operates 24 hours a day.
GDOT CCTV Deployment	GDOT	This project has been implemented. GDOT has implemented numerous CCTV cameras along its freeways in the Region.
CARTA Automation of Dial-A-Ride	CARTA	This project has been implemented. CARTA launched its automated Dial-A-Ride system approximately three years after the previous Regional ITS Architecture and Deployment Plan Update.
Regional Transit Coordination	CARTA	This project has been removed since it focused on coordination between CARTA and the Southeast Tennessee Human Resources Agency (SETHRA) which no longer operates transportation services in the Region.
Regional Incident Management Group	Hamilton County 911	This project has been removed since it does not involve the use of any ITS. Stakeholders still noted a need to begin a regional incident management group, however.

6.2 ITS Project Recommendations

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

Input from all stakeholders is required for stakeholders to have ownership of the ITS Deployment Plan and to ensure that the plan has realistically identified projects and timeframes for deployment. Cost is another important factor—cost can vary a great deal for many ITS elements, depending on the level of deployment, maturity of the technology, and type of communications, in addition to other factors.

The projects identified in the ITS Deployment Plan are not fiscally constrained. They represent the needs in the Chattanooga Region, but funding for many of the projects is yet to be determined. During the early years of ITS deployment, the FHWA made several sources available specifically for ITS funding to encourage deployment.

Funding has become much more mainstreamed, with ITS projects often competing against other infrastructure for the same funds. Congestion Mitigation and Air Quality Improvement Program (CMAQ) funds are commonly used for funding ITS and operations type projects, as is the Surface Transportation Block Grant Program (STBG). It should be noted that CMAQ funding is dependent on a region's air quality designation as attainment or non-attainment. Only regions that are designated as non-attainment, or those regions which have previously been designated as non-attainment, are eligible for CMAQ funding.

Funding may also be available through programs at the state or local level, and through grant programs from the USDOT. Recent USDOT grants include Integrated Corridor Management and the Advanced Transportation and Congestion Management Technologies Deployment Initiative. USDOT Transportation Investment Generating Economic Recovery (TIGER) grants have also been used successfully to fund ITS type projects.

Regional projects are identified in **Table 27** through **Table 30**. ITS projects that have a specific physical deployment location are also displayed in **Figure 10.** The tables are divided by primary responsible agency as follows:

- **Table 27 –** State Department of Transportation ITS Projects
- **Table 28 –** Municipal ITS Projects
- **Table 29 –** Transit ITS Projects
- **Table 30 –** Other ITS Projects

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

For each project, the following categories are discussed:

- **Project Name:** Identifies the project name including the agency responsible for implementation where applicable.
- **Lead Agency:** Identifies the agency that would be responsible for project implementation.
- **Project Location:** Identifies the specific geographic location of ITS infrastructure deployments proposed as part of given projects, whenever possible. When locations have not yet been determined, general project location information is provided.
- **Project Description:** Provides a description of the project including notes on timeframes for deployment and costs if applicable. The level of detail in the project descriptions varies depending on the implementing agency and how much detail they wanted to include regarding a project. In some cases, projects had not been discussed beyond a conceptual level and there was limited or no information available on cost and scale of the potential project.
- **Deployment Timeframe:** Provides a recommended timeframe for deployment for each project. Timeframes have been identified as short-term (deployment recommended in less than 4 years), mid-term (deployment recommended in 4-10 years), and long-term (deployment recommended beyond 10 years). Recommendations for deployment timeframes were based on input from each agency and considered the project priority, possibility of funding, and dependency on other project deployments.
- **Partner Stakeholders:** Identifies other stakeholder agencies that the lead agency would likely seek partnership with as a project is developed, implemented, operated, and maintained.
- **Opinion of Probable Cost and Funding Status:** Provides an opinion of probable cost of each project. Because design has not been undertaken for most projects, the opinion of probable cost should not be considered an estimate and should only be used for planning purposes. Costs are presented either as a total project cost (when the project has been defined in detail) or as a unit cost per element (when a project is defined at a conceptual level and a total project cost opinion cannot be provided). In some cases, an estimate of cost is not possible, particularly when the communication systems have not been designed, and design specifications could significantly impact the cost. For each project it is also noted whether funding has been identified or is still needed. Unfunded projects will need to have funding secured prior to implementation.
- **Applicable ITS Service Packages:** Identifies the ITS service packages from the Regional ITS Architecture that each project will assist in implementing. Knowing which ITS service packages each project relates to is an important part of an ITS architecture conformance review. Stakeholder-determined priority levels are provided for each listed service package.

Table 27 – State Department of Transportation ITS Projects

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
TDOT/GDOT Coordination	TDOT & GDOT	Interstate 24 at Interstate 59, Dade County, GA	Improve coordination between TDOT, GDOT, Dade County and the Georgia State Patrol concerning the I-24/I-59 interchange, included exchange of future CCTV camera feeds and improved coordination during incidents.	Short to Mid-Term	Dade County, Georgia State Patrol	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High) TM07 – Regional Traffic Management (High) TM08 – Traffic Incident Management System (High)
TDOT/GDOT I-24 Georgia ITS Device Deployment*	TDOT & GDOT	Interstate 24, Dade County, GA	Deploy fiber optic backbone, CCTV cameras, and DMS units along the segment of I-24 west of Chattanooga that passes through Dade County, GA. Part of this fiber optic backbone segment could be installed as part of the planned widening of I-24 to I-59.	Short-Term	Dade County	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High)
TDOT Overheight Vehicle Detection at Bachman Tunnel*	TDOT	Bachman Tunnel, Ringgold Road (US 41), Hamilton County, TN	Install an overheight vehicle detection and warning system along Ringgold Road (State Route 8) in the vicinity of Bachman Tunnel. System will notify TDOT if an overheight vehicle continues toward tunnel past warning signs and will provide audio warnings and DMS message warnings to drivers in the area. System is currently under contract for design. Information on height restrictions should also be shared with any third party navigation applications that have the capability to account for this information when routing users.	Short-Term	N/A	Cost: TBD	Yes	MC09 – Infrastructure Monitoring (High) TM12 – Dynamic Roadway Warning (Medium) VS11 – Oversize Vehicle Warning (High)
TDOT Region 2 SmartWay Infrastructure Expansion	TDOT	Interstate 24, from GA border to Nickajack Lake, Marion County, TN	Expansion of Region 2 ITS SmartWay fiber optic backbone west of I-24 in Dade County, Georgia to Nickajack Lake, Tennessee. Addition of 6 miles of ITS infrastructure. Includes deployment of CCTV camera sites and regional DMS sites. This project is identified in the TDOT Traffic Operations Program Plan - Three-Year Strategic Deployment Plan.	Short-Term	GDOT	Cost: $5,500,000	Yes	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High) TI01 – Broadcast Traveler Information (High)
TDOT Region 1/Region 2 Fiber Connection	TDOT	Interstate 75, Hamilton County, TN to TDOT Region 1	Complete fiber optic communication connection along I-75 between the TDOT Region 2 TMC and the TDOT Region 1 TMC.	Short-Term	N/A	Cost: TBD	No	TM07 – Regional Traffic Management (High)
TDOT Region 2 HELP 'Lite' Service Patrol Expansion*	TDOT	Interstate 24, Marion County, TN, and Interstate 75, Bradley and McMinn Counties, TN	Deploy TDOT HELP 'Lite' Service Patrol along I-24 in Marion County and along I-75 in Bradley and McMinn Counties to provide basic incident management support outside of CMAQ non-attainment areas.	Short-Term	Tennessee Highway Patrol	Cost: TBD	No	PS08 – Roadway Service Patrols (High)
TDOT Incident Management Drone Acquisition*	TDOT	N/A (Vehicle Technology)	Acquire several drones for use by HELP vehicle operators to provide SmartWay TMC with video coverage of major incidents when they occur.	Short-Term	Tennessee Highway Patrol, Hamilton County EMS	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM08 – Traffic Incident Management System (High)
TDOT Automated Vehicle Location Implementation	TDOT	N/A (Vehicle Technology)	Install automatic vehicle location (AVL) systems on maintenance vehicles, such as snowplows, that require location tracking. All HELP trucks have AVL installed.	Short-Term	N/A	Cost: $3,000/vehicle	No	MC01 – Maintenance and Construction Vehicle and Equipment Tracking (Medium) PS08 – Roadway Service Patrols (High)
TDOT HAR Improvements	TDOT	Various Locations, TN	Improve the TDOT Highway Advisory Radio (HAR) system through addition or relocation of devices, installation of CB Radio Interrupter Systems, and small DMS units at HAR beacon locations to provide supplemental information.	Short to Mid-Term	N/A	Cost: TBD	No	TI01 – Broadcast Traveler Information (High) TM06 – Traffic Information Dissemination (High) PS10 – Wide–Area Alert (Medium)
TDOT Ramp Metering	TDOT	Interstate 24, MM 174-175 and MM 183-184, Hamilton County, TN	Install ramp metering equipment on I-24 from exit 174 to exit 175 and exit 183 to exit 184. Final locations of ramp meters are to be determined.	Short to Mid-Term	City of Chattanooga	Cost: $940,000	No	TM05 – Traffic Metering (Medium)

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
TDOT Region 2 SmartWay Life Cycle Replacement	TDOT	Various Locations, TN	Identify and replace SmartWay infrastructure as needed. Replacements include CCTV cameras, DMS, and buried fiber optic cable. This project is identified as a continuous need in the TDOT Traffic Operations Program Plan - Three-Year Strategic Deployment Plan.	Short to Mid-Term	N/A	Cost: $10,000,000	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High)
TDOT I-24 Ridge Cut (Missionary Ridge) ITS Study	TDOT	Interstate 24, MM 182, Hamilton County, TN	Examine how ITS can be used to improve operations along the I-24 ridge cut in both directions of travel. TDOT will consider the use of variable speed limits and other ITS strategies to improve operations. TDOT will also consider coordination of signals adjacent to I-24 to reduce vehicle queues extending back to the freeway.	Short to Mid-Term	City of Chattanooga	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High) TM05 – Traffic Metering (Medium) TM06 – Traffic Information Dissemination (High) TM08 – Traffic Incident Management Systems (High) TM20 – Variable Speed Limits (High)
TDOT I-24/US-27 Interchange ITS Study	TDOT	Interstate 24, Exit 180B, Hamilton County, TN	Examine how ITS can be used to improve operations at the I-24/US-27 interchange.	Short to Mid-Term	City of Chattanooga	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High) TM08 – Traffic Incident Management System (High)
TDOT I-75/I-24 Interchange ITS Study	TDOT	Interstate 75, Exit 2, Hamilton County, TN	Examine how ITS can be used to improve operations at the I-75/I-24 interchange.	Short to Mid-Term	N/A	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High) TM08 – Traffic Incident Management System (High)
TDOT Variable Speed Limit Implementation	TDOT	Interstate 24 through Chattanooga, TN	Implement variable speed limits along interstates in Tennessee. I-24 through downtown Chattanooga was identified as the most likely location for a pilot deployment.	Mid-Term	N/A	Cost: TBD	No	TM20 – Variable Speed Limits (High)
TDOT Freeway Ramp Wrong-Way Detection*	TDOT	Various Locations, TN	Install Wrong-Way Driver Detection and Warning systems along freeway exit ramps.	Mid-Term	City of Chattanooga	Cost: TBD	No	TM25 – Wrong Way Vehicle Detection and Warning (High)

*Project added in the 2022 update of the Chattanooga Regional ITS Architecture and Deployment Plan.

Table 28 – Municipal ITS Projects

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
City of Chattanooga ATMS Signal System Software and Signal Upgrades	City of Chattanooga	Citywide, Chattanooga, TN	Complete implementation of the City of Chattanooga Regional ATMS signal system software and signal upgrades. Includes traffic signal system upgrades, real-time monitoring capabilities and communications for traffic signal systems in Chattanooga and surrounding municipalities, and improved coordination with 911 and 311 services. The ATMS should also allow for integration with other agencies within the City. Current projects include upgrades to eight signals on Amnicola Highway between Wilcox Blvd. and SR-153. The Amnicola project includes high resolution signal controllers and cabinets, emergency vehicle preemption, video detection, and communications to support Vehicle to Infrastructure (V2I) communications that provide information to vehicles on optimal speeds for progression.	Short-Term	Other Municipalities	Cost: TBD	Yes	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High) TM04 – Connected Vehicle Traffic Signal System (High) PS03 - Emergency Vehicle Preemption (High)
City of Chattanooga Adaptive Traffic Signal System Expansion	City of Chattanooga	Citywide, Chattanooga, TN	Expand the adaptive traffic signal system in Chattanooga and surrounding municipalities. Adaptive type systems are currently deployed on MLK Blvd. and Shallowford Rd. Additional corridors will be added in the future.	Short-Term	Other Municipalities	Cost: $30,000 /intersection	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High)
City of Chattanooga Smart Corridor Deployment*	City of Chattanooga	MLK Boulevard and Shallowford Road, Chattanooga, TN	Deploy and operate Smart Corridor technology along MLK Boulevard and Shallowford Road through partnerships with the University of Tennessee at Chattanooga and Oak Ridge National Laboratories. Smart Corridors can include signal controllers that enable active signal timing modifications, transit signal priority, and sensing devices that include pan-tilt-zoom cameras, LiDAR, and video detection. Note that the CHCNGA TPO has identified a larger Smart Corridor network that includes Smart Freight, Smart Vehicle, and Smart Livability corridors throughout the Region. These corridors are being defined through the development for the 2050 Regional Transportation Plan.	Short-Term	TDOT, CARTA, University of Tennessee at Chattanooga, Oak Ridge National Laboratories	Cost: TBD	Yes	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High) TM04 – Connected Vehicle Traffic Signal System (High) TM13 – Standard Railroad Grade Crossing (High) PT09 – Transit Signal Priority (High)
City of Chattanooga Transit Signal Priority Deployment*	City of Chattanooga	Various Locations, Chattanooga, TN	Implement a transit signal priority system in Chattanooga for CARTA fixed-vehicle buses. The transit signal priority system corridor will include Brainerd Road, Lee Highway, Shallowford Road, and Gunbarrel Road. The system will include early green and green extension strategies at 38 signals, queue jump locations, and exclusive transit lanes. Note that the CHCNGA TPO has identified a larger Smart Corridor network that includes Smart Freight, Smart Vehicle, and Smart Livability corridors throughout the Region. Smart Livability corridors could include transit signal priority.	Short-Term	CARTA, Hamilton County	Cost: $8.8M Opinion of Probable Construction Cost	No	PT09 – Transit Signal Priority (High)
City of Chattanooga Arterial CCTV Cameras and DMS	City of Chattanooga	Citywide, Chattanooga, TN	Install pan/tilt/zoom CCTV cameras with detection capabilities and DMS units along major arterials in Chattanooga and surrounding cities including East Ridge and Red Bank. Additional cameras will also be deployed as part of the transit signal priority project being implemented for CARTA buses.	Short-Term	Other Municipalities	Cost: $20,000/site (CCTV) $75,000/Site (DMS)	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High)

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
City of Chattanooga Overheight Detection	City of Chattanooga	Broad Street near Old Wauhatchie Pike and Wilcox Boulevard at Missionary Ridge, Chattanooga, TN	Implement overheight detection and warning system for underpasses (Broad Street beneath the railroad) and tunnels with low clearance (Wilcox Boulevard Tunnel). The system could include detection to determine whether a vehicle is too tall for an underpass or tunnel and a lighted blank out sign or a static sign with beacons to indicate to the driver if they are over height.	Short-Term	City of Chattanooga	Cost: $20,000 - $30,000/site	No	MC09 – Infrastructure Monitoring (High) TM12 – Dynamic Roadway Warning (Medium) VS11 – Oversize Vehicle Warning (High)
City of Chattanooga Curve Speed Warning System*	City of Chattanooga	Manufacturers Road near Riverside Avenue, Chattanooga, TN	Install curve speed warning system, including sensors and signs, to warn speeding vehicles approaching curve along Manufacturers Road at Chattanooga Bakery.	Short-Term	N/A	Cost: TBD	No	TM12 – Dynamic Roadway Warning (Medium) VS05 – Curve Speed Warning (High)
City of Chattanooga Flood Detection and Warning System	City of Chattanooga	Boy Scout Road, Chattanooga, TN	Implement a system to provide automated flood detection, road closure, and advanced warning on roads with low water crossings that frequently flood, including along Boy Scout Road and other locations as determined by Public Works. The only existing system is located on Davidson Road.	Short-Term	N/A	Cost: $20,000 - $40,000/site	No	TM06 – Traffic Information Dissemination (High) TM19 – Roadway Closure Management (Low) WX01 – Weather Data Collection (High) WX02 – Weather Information Processing and Distribution (Medium)
City of Chattanooga Infrared Bridge Sensors*	City of Chattanooga	Various Locations, Chattanooga, TN	Install infrared sensors beneath bridge decks at city bridge locations to detect fires beneath bridges and alert emergency responders if fire is detected.	Short-Term	Hamilton County EMS, Chattanooga Fire Department	Cost: TBD	No	PS09 – Transportation Infrastructure Protection (High)
City of Chattanooga/Hamilton County Railroad Crossing Blockage Notification*	City of Chattanooga	Various Locations, Chattanooga, TN	Develop railroad crossing blockage detection and notification system to alert city transportation and county emergency response staff when trains are stationary and blocking a railroad crossing. Integrate notification system so that Hamilton County EMS also has access to these alerts. Hamilton County has identified six priority locations for deployment: ▪ 3555 Amnicola Hwy at Judd/ PSC ▪ 1101 Thrasher Pike at Frontage Rd. ▪ 200 Leggett Rd. at Railroad St. ▪ 11966 Back Valley Rd. near Ratledge Rd. ▪ 12161 Back Valley Rd. at Crockett Ln. ▪ 12700 Back Valley Rd. at Coleman Rd. A seventh location was identified by Hamilton County but has since been addressed: ▪ 2152 Hamill Rd. near Crescent Club Dr.	Short-Term	Railroad Operators, Hamilton County EMS, Chattanooga Fire Department	Cost: TBD	No	TM13 – Standard Railroad Grade Crossing (High)

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
City of Chattanooga Traffic Signal Railroad Preemption Deployment*	City of Chattanooga	Various Locations, Chattanooga, TN	Preempt signals by approach of train (to accommodate for railroad crossing) for 13 traffic signals located near at-grade railroad crossings, including adding signal communications if necessary, and variable message signs placed far enough in advance of the crossing for drivers to choose an alternate route if needed. Locations include three at signals that currently have communications: ▪ E. 3rd St. and N Holtzclaw Ave. ▪ McCallie Ave. and Holtzclaw Ave. ▪ Bailey Ave. and S. Holtzclaw Ave. Locations also include ten at signals that need communications: ▪ Rossville Blvd. and Dodds Ave/E. 48th St. ▪ Alton Park Blvd. and W. 33rd St. ▪ Holtzclaw Ave. and Citico Ave. ▪ N. Holtzclaw Ave. and Wilcox Blvd./Sholar Ave. ▪ E. Main St. and S. Holtzclaw Ave. ▪ McFarland Ave. and Maple St. ▪ Dayton Blvd. and Memorial Dr. ▪ Signal Mountain Rd. and Walmart North ▪ Signal Mountain Rd. and Walmart South ▪ Harrison Ln. and Daisy Dallas Rd. The at-grade rail crossing on Hamill Rd will include variable message signs and/or other appropriate installations.	Short-Term	Railroad Operators	Cost: TBD	No	TM03 – Traffic Signal Control (High) TM13 – Standard Railroad Grade Crossing (High) TM15 – Railroad Operations Coordination (Low)
City of Chattanooga Traffic Operations Center Upgrades*	City of Chattanooga	Location TBD, Chattanooga, TN	Update the Traffic Operations Center (TOC) for the City of Chattanooga. The TOC may be a physical location with workstations and video monitoring wall but could also be developed as a virtual TOC with similar capabilities. Provide staff to monitor systems on a regular basis during business hours and possibly expanded coverage after hours.	Short to Mid-Term	Other Municipalities	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High) TM04 – Connected Vehicle Traffic Signal System (High) TM06 – Traffic Information Dissemination (High) TM13 – Standard Railroad Grade Crossing (High) PT09 – Transit Signal Priority (High)
City of Chattanooga Traffic Signal Communication Improvements*	City of Chattanooga	Citywide, Chattanooga, TN	Reconfigure City IP Address scheme and install ethernet field switches to support City of Chattanooga Department of Transportation communication with city traffic signals. Increase communication system resiliency to move towards a fail-safe system.	Short to Mid-Term	N/A	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High)
City of Chattanooga School Zone Flasher System Upgrade*	City of Chattanooga	Citywide, Chattanooga, TN	Update school zone flasher technology and provide communications to flashers to allow for remote control and programming at each location.	Short to Mid-Term	N/A	Cost: TBD	No	TM12 – Dynamic Roadway Warning (Medium) VS09 – Reduced Speed Zone Warning / Lane Closure (Medium)
City of Chattanooga Traffic Data Warehouse Implementation*	City of Chattanooga	N/A (Virtual Technology)	Develop a transportation data warehouse that includes transportation data gathered by ITS devices managed by the City of Chattanooga.	Mid-Term	N/A	Cost: TBD	No	DM01 – ITS Data Warehouse (High)
City of Chattanooga Incident Management Plans	City of Chattanooga	Various Locations, Chattanooga, TN	Develop alternate signal timing plans and implement DMS and blank-out signs to support traffic operations during major incidents, flooding, or rail crossing messages that can be implemented during incidents, special events, or construction detours. Examine alternate routing for major freeway incidents on Ringgold Road, Lee Highway, Brainerd Road, Battlefield Parkway, and other roadways. This effort will be led by the City of Chattanooga in coordination with TDOT, GDOT, the City of East Ridge, and the City of Red Bank.	Long-Term	TDOT, GDOT, City of East Ridge, City of Red Bank	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High) TM06 – Traffic Information Dissemination (High) TM08 – Traffic Incident Management Systems (High)

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
East Ridge Traffic Signal Communication Upgrades and Signal Timing	City of East Ridge	Citywide, East Ridge, TN	Upgrade City of East Ridge signal system including communication system to allow improved signal coordination. Update and install new signal timing plans for signals that require coordination in the City. Although the City of Chattanooga maintains City of East Ridge traffic signals, the City of East Ridge will be responsible for the traffic signal upgrades and developing new signal timing plans.	Short-Term	City of Chattanooga	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM03 – Traffic Signal Control (High)
Signal Mountain Road Closure Notification	City of Signal Mountain	Signal Mountain Road near Suck Creek Road, Hamilton County, TN, and W Road near Mountain Creek Road, Hamilton County, TN	Implement road closure notification signs on routes leading to the top of Signal Mountain. Signs should have the ability to be remotely operated and traffic detection could also be included. The agency responsible for the operation of this system has not been determined. Possible operating agencies include the City of Signal Mountain, City of Chattanooga, or TDOT. Officials currently rely on radio broadcasts to communicate closure information.	Short to Mid-Term	City of Chattanooga, TDOT	Cost: TBD	No	TM01 – Infrastructure–Based Traffic Surveillance (High) TM06 – Traffic Information Dissemination (High)

*Project added in the 2022 update of the Chattanooga Regional ITS Architecture and Deployment Plan.

Table 29 – Transit ITS Projects

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
CARTA Video Analytics Passenger Counting*	CARTA	N/A (Vehicle Technology)	Deploy sensing technology on CARTA buses that uses video analytics to track passenger boardings, alightings, and individual origin-destination transit passenger trip data.	Short-Term	N/A	Cost: TBD	No	PT07 – Transit Passenger Counting (High)
CARTA Electric Vehicle Inductive Charging Pads*	CARTA	Various Locations, Chattanooga, TN	Install in-pavement inductive charging pads along bus routes at locations where buses idle at either end of a given route.	Short-Term	City of Chattanooga, Hamilton County	Cost: TBD	No	ST05 – Electric Charging Stations Management (High)
CARTA SmartCard Implementation	CARTA	NA (Vehicle and Card Technology)	Implement a "Smart Card" fare payment system that allows users to pay for CARTA transit fares, micro transit services, car share services, and parking in municipal parking lots using a single service.	Short to Mid-Term	City of Chattanooga, Private Vendors	Cost: TBD	Yes	PT04 – Transit Fare Collection Management (High) PT18 – Integrated Multi–Modal Electronic Payment (Medium)
CARTA Downtown Multimodal Center and Route Reconfiguration*	CARTA	Chattanooga, TN (Exact Location TBD)	Build a centrally located multimodal transit center that houses micro transit and intercity bus services and reconfigure CARTA routes to connect with the transit center.	Mid-to-Long Term	City of Chattanooga	Cost: TBD	No	PT14 – Multimodal Coordination (Medium)
CARTA Bus Rapid Transit	CARTA	Various Locations, Chattanooga, TN	Implement bus rapid transit service along major transit branch routes in the Region.	Mid to Long-Term	City of Chattanooga, Hamilton County	Cost: TBD	No	PT02 – Transit Fixed–Route Operations (High) PT04 – Transit Fare Collection Management (High)
CARTA Transit Vehicle Freeway Shoulder Riding*	CARTA	Freeways in Hamilton County	Permit CARTA buses to use freeway shoulders along freeway segments that serve CARTA transit routes.	Long-Term	TDOT	Cost: TBD	No	TM22 – Dynamic Lane Management and Shoulder Use (Low)

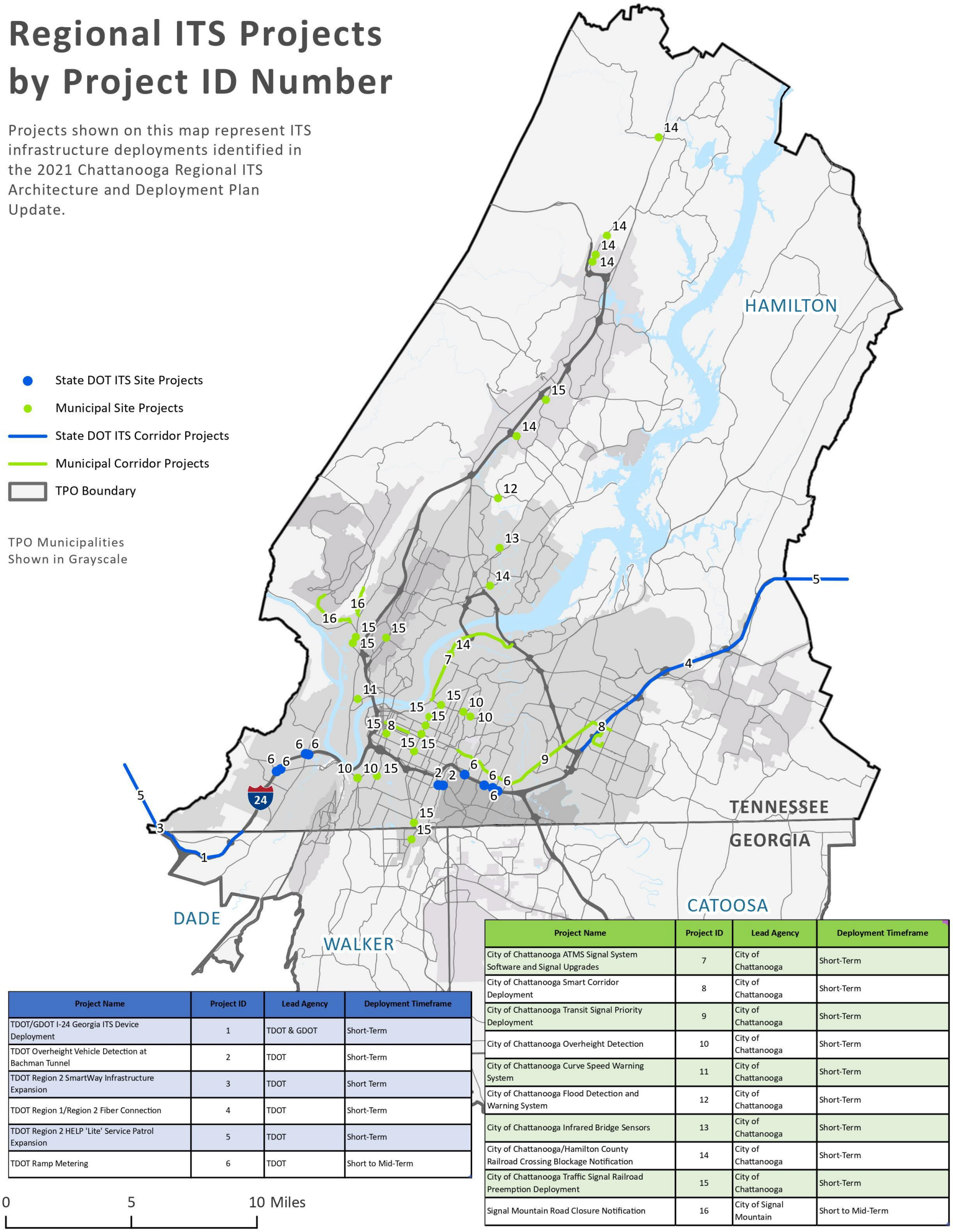
*Project added in the 2022 update of the Chattanooga Regional ITS Architecture and Deployment Plan.

Table 30 – Other ITS Projects

Project Name	Lead Agency	Project Location	Project Description	Deployment Timeframe	Partner Stakeholders	Opinion of Probable Cost	Funding Status	Applicable ITS Service Packages (and Implementation Priority)
Hamilton County EMA CCTV Camera Feed Integration	Hamilton County EMA	N/A (Virtual Technology)	Establish access link to City of Chattanooga CCTV camera feeds to provide improved incident management coordination. Link has already been established with TDOT CCTV camera feeds.	Short-Term	City of Chattanooga	Cost: TBD	Yes	PS12 – Disaster Response and Recovery (Medium) PS13 – Evacuation and Reentry Management (Medium) TM01 – Infrastructure–Based Traffic Surveillance (High) TM08 – Traffic Incident Management System (High)
Chattanooga/ Hamilton County/North Georgia TPO Transportation Data Warehouse Implementation	Chattanooga/ Hamilton County/North Georgia TPO	N/A (Virtual Technology)	Develop a transportation data warehouse that includes region-wide transportation data gathered by multiple agencies from the ITS network.	Mid-Term	TDOT, Local Municipalities, Local Public Safety Agencies	Cost: $200,000 - $400,000	No	DM01 – ITS Data Warehouse (Medium)

Regional ITS Projects by Project ID Number

Projects shown on this map represent ITS infrastructure deployments identified in the 2021 Chattanooga Regional ITS Architecture and Deployment Plan Update.



Project Name	Project ID	Lead Agency	Deployment Timeframe
TDOT/GDOT I-24 Georgia ITS Device Deployment	1	TDOT & GDOT	Short-Term
TDOT Overheight Vehicle Detection at Bachman Tunnel	2	TDOT	Short-Term
TDOT Region 2 SmartWay Infrastructure Expansion	3	TDOT	Short Term
TDOT Region 1/Region 2 Fiber Connection	4	TDOT	Short-Term
TDOT Region 2 HELP 'Lite' Service Patrol Expansion	5	TDOT	Short-Term
TDOT Ramp Metering	6	TDOT	Short to Mid-Term

Project Name	Project ID	Lead Agency	Deployment Timeframe
City of Chattanooga ATMS Signal System Software and Signal Upgrades	7	City of Chattanooga	Short-Term
City of Chattanooga Smart Corridor Deployment	8	City of Chattanooga	Short-Term
City of Chattanooga Transit Signal Priority Deployment	9	City of Chattanooga	Short-Term
City of Chattanooga Overheight Detection	10	City of Chattanooga	Short-Term
City of Chattanooga Curve Speed Warning System	11	City of Chattanooga	Short-Term
City of Chattanooga Flood Detection and Warning System	12	City of Chattanooga	Short-Term
City of Chattanooga Infrared Bridge Sensors	13	City of Chattanooga	Short-Term
City of Chattanooga/Hamilton County Railroad Crossing Blockage Notification	14	City of Chattanooga	Short-Term
City of Chattanooga Traffic Signal Railroad Preemption Deployment	15	City of Chattanooga	Short-Term
Signal Mountain Road Closure Notification	16	City of Signal Mountain	Short to Mid-Term

Figure 10 – Map of Projects in the Regional ITS Deployment Plan

7 EMERGING ITS APPLICATIONS AND CONSIDERATIONS

Section 7 outlines several emerging ITS technologies and trends. Most of these technologies are not currently deployed in the Chattanooga Region, but they may be implemented in the future to address transportation system needs. Applications introduced include:

- Autonomous and Connected Vehicles;
- Active Traffic Management;
- Mobility-on-Demand; and
- Integrated Corridor Management.

This section also includes a discussion on general considerations for these and other emerging ITS applications, including network security and data privacy.

7.1 Autonomous and Connected Vehicles

Autonomous and connected vehicles are defined below:

- **Autonomous Vehicles:** Vehicles that can perform driving functions without the intervention of a human operator. Levels of automation are defined in the industry on a scale of vehicle functionality ranging from full driver control (Level 0) to fully automated driving by the vehicle (Level 5).
- **Connected Vehicles:** Vehicles equipped with advanced technology for communication with other vehicles and roadside infrastructure. Connected vehicle applications include vehicle-to-vehicle communications, vehicle-to-infrastructure communications, and vehicle-to-everything communications.

The rise of autonomous and connected vehicle technologies has a wide range of potential impacts on transportation planning, transportation engineering, and transportation operations. Federal and state governments are working to prepare for how connected and autonomous vehicle technologies will impact safety, mobility, economics, driving law, and community planning. As part of the Chattanooga Regional ITS Architecture update, four new service packages were introduced in anticipation of these technologies: three in the vehicle safety service area, and one for connected vehicle interactions with traffic signal systems in the Chattanooga Region.

Both autonomous and connected vehicles are in operation today with various levels of capability. Automobiles that include intelligent cruise control, automatic braking systems, and driver alert systems all demonstrate some level of autonomy. Fully autonomous driving modes are now available on some vehicle models, but driving law requires that these vehicles still have drivers at the wheel actively monitoring road conditions. While these vehicles have an enormous potential to improve safety and efficiency of the transportation network, it is expected that the full roll-out of this technology will take decades and that transportation agencies will still need to plan for and design systems for a variety of vehicle types where most vehicles on the road are still manually controlled.

It is worth considering that impact that autonomous and connected vehicles may have on ITS infrastructure. At some point in the future, messages may be able to be transmitted directly to and from vehicle on-board systems which could reduce the need for many types of roadside infrastructure.

For example, DMS and HAR could be eliminated if drivers, or the vehicles themselves, can be alerted to road hazards, incidents, or weather events. The development and proliferation of autonomous and connected vehicle technologies will continue to be a factor during future updates of the Regional ITS Architecture.

In Chattanooga, the City of Chattanooga Smart Corridors are currently piloting connected vehicle technology to provide connected vehicles with information including ideal speeds on a corridor to take advantage of traffic signal progression. This technology provides multiple benefits including reducing emissions and improving travel times.

7.2 Active Traffic Management

Active Traffic Management (ATM) strategies are deployed to increase effective capacity of existing facilities during peak hour traffic. Common ATM strategies for freeways include:

- **Variable Speed Limits:** Variable speed limits change based on road, traffic, and weather conditions. They are used to promote safety and improve traffic flow in congested urban areas. Speed limits are displayed to travelers on dynamic signs and are connected back to a TMC that controls the displayed speed limits.
- **Ramp Metering:** Ramp metering on freeway on-ramps is used to smooth traffic flows by controlling the frequency at which vehicles enter the flow of traffic. Ramp metering reduces travel delay, environmental impacts, and collisions by breaking up platoons of vehicles entering the freeway, thereby enabling smoother merging maneuvers.
- **Lane Control System:** A lane control system uses overhead gantries with lane control indicators over each travel lane (and sometimes over full width paved road shoulders) to control traffic. Depending on circumstances, they may show lane restriction symbols or other information to manage traffic. These gantries can accommodate other devices such as CCTV cameras, DMS, variable speed limit signs, and vehicle detectors.

Chattanooga does not have any of the above identified ATM strategies deployed but has identified all three technologies in the Regional ITS Deployment Plan as potential deployment projects. For arterial ATM applications, the City of Chattanooga currently has an adaptive traffic signal system and is investigating the implementation of the following strategies:

- **Over-height Detection:** Optical or laser sensors can be used to detect over-height vehicles and warn them of approaching bridges, overhead gantries, or overhanging roadside infrastructure using alarm bells, flashing lights, or variable message signs. These systems promote the safety of motorists and reduce damage to roadway infrastructure. TDOT is also deployment over-height detection systems on arterial state routes.
- **Transit Signal Priority System:** Giving priority to transit vehicles at intersections can increase the person throughput of an intersection, since one transit vehicle typically contains more passengers than a private vehicle would. Signal priority can be passively designed by favoring roads in signal timing plans with heavy transit traffic or actively implemented by detecting transit vehicles as they approach an intersection and adjusting signals accordingly. Often, active signal prioritization only gives priority to buses that are operating behind schedule.

Both technologies are included as part of potential project deployments in the Regional ITS Deployment Plan, with TDOT, the City of Chattanooga, and CARTA each acting as lead stakeholders for various projects that would incorporate these technologies.

7.3 Mobility-on-Demand

Mobility-on-demand (MOD) refers to the ability of travelers to use a variety of transportation modes to make their trips more efficient or complete. Examples of MOD include ride-share services such as Uber and Lyft, bike-share and scooter programs, and on-demand transit services such as paratransit. A cornerstone of MOD is the reliance of real-time information and communication so that travelers are aware of their options for trips and can reserve or request trips from any location. MOD also relies on technology, such as real-time traffic information, to provide travelers with information about what their MOD options are, how long the trip will take, and the cost of the trip.

ITS supports the effective implementation of MOD in a variety of ways. Many of the MOD options rely on being able to accurately predict the time a trip will take based on real-time traffic information. This allows the MOD provider to accurately predict cost for services, such as ride-shares that charge fees determined in part by the time a trip takes, and can help a traveler determine which option is best for them. ITS projects included in Section 6 of this document include projects that support improved real-time information programs such as TDOT SmartWay expansion and expansion of the Smart Corridors on arterials streets. These programs allow agencies to use technology to closely monitor travel times and identify potential interruptions in services, such as traffic incidents or weather events, that could impact travel times. ITS can also support prioritization for MOD services that are moving larger groups of people. Transit priority on arterial routes makes minor adjustments to traffic signal timing along a transit route to help transit vehicles stay on schedule. Being able to accurately predict arrival times of transit allows travelers to make informed decisions on which mode, or which combination of modes, to use for a trip.

ITS can also support real-time decisions that might change a traveler's choice of modes while en-route. For example, a traveler may choose to make a trip using their personal vehicle based on real-time information when they begin their trip. However, if a major incident were to occur while they are en-route, ITS technologies such as DMS or in-vehicles navigation devices, can inform them that conditions have changed. They may find that their best option now is parking further away from their destination and using a transit service or bike-share option to complete their trip. ITS helps provide the traveler with the most up-to-date information possible so that they can make mode of transportation decisions prior to the trip, as well as while en-route.

7.4 Integrated Corridor Management

Integrated Corridor Management (ICM) is the coordination of transportation operations along a corridor to improve travel management. The most common applications of ICM involve the dissemination of traveler information along a multi-modal corridor that may include freeway, arterial, and transit options. During incidents or other non-recurring events that cause congestion, information about various modes and alternate routes can help improve operation of a corridor and reduce driver delay.

ICM generally involves close coordination between state transportation agencies that may manage freeways and major state routes, local traffic agencies that may manage arterials, and transit agencies that may operate bus, rail, streetcar, or other transit services. Within the Regional ITS Architecture, the desired coordination between these agencies is represented in many of the ITS service packages that show a need for communication between such agencies with future flows representing the desired connection.

ICM also relies on a variety of traveler information techniques, including broadcast media, social media, websites, apps, DMS, and any future methods developed to reach travelers and inform them of their options. ICM is currently deployed in Tennessee along I-24 in the City of Murfreesboro to the northwest of Chattanooga. There are no ICM projects identified in the Chattanooga region as part of this Regional ITS Deployment Plan.

7.5 Security Considerations for Existing and Emerging ITS Applications

Cyber security is a key component to the resiliency of the networks that support ITS. For example, it is important for traffic signal systems to remain secure to protect these systems and the travelers that rely on them from bad actors as technology integration and connectivity increases. According to the National Operations Center of Excellence (NOCoE), a cyber transportation systems framework should be flexible and sensitive to changing technology and means of communications to maintain system resilience against cyber threats.

The NOCoE lists several objectives when formulating a cyber security framework. These should include a means of rapid, secure communication of relevant cybersecurity challenges among stakeholders and a communications platform for all stakeholders to formulate cybersecurity guidance. Those objectives should be used to create guidance on how to respond to cybersecurity threats.

NOCoE objectives are expanded upon by the National ITS Architecture where cyber security threats can be addressed by securing ITS via securing physical objects, methods of information transfer, enterprise objects such as key people and organizations, and communication profiles. These efforts are further enhanced in the National ITS Architecture through ITS Security Areas that exist to determine how to recognize, address and rebound from cyber security threats using ITS technology. The ITS Security Areas listed in the National ITS Reference Architecture are:

- Disaster Response and Evacuation
- Freight and Commercial Vehicle Security
- Hazardous Materials (HAZMAT) Security
- ITS Wide Area Alert
- Rail Security
- Transit Security
- Transportation Infrastructure Security
- Traveler Security

All security areas listed are relevant to the Chattanooga Regional ITS Architecture. Examples of ITS technology to enhance cyber security as stated by the National ITS Reference Architecture include a

transit surveillance system which deters cyber security threats and acts as a system for response when cyber events occur. These security areas and related technologies should be considered when creating a cyber security framework.

It is recommended that the Chattanooga Region create a cyber resiliency plan if one is not existing. NOCoE states the following steps on their website regarding creating or reviewing a cyber resiliency plan:

1. Identify where and/or who has your IT and control system plan in response to a cyber event.
2. If necessary, familiarize yourself with the response plan procedures.
3. Review contact information with internal and external partners to make sure it is current and that all partners understand their roles and responsibilities during a response.
4. Verify the location and condition of any backup software, database, and necessary supporting applications and files.
5. Confirm that the response plan has current procedures in place for restoring software and systems to operating conditions."

In addition, the standards listed in **Table 31** from the National ITS Reference Architecture are relevant to a cyber security framework and resiliency plan.

Table 31 – Relevant Cybersecurity ITS Standards

SDO	Document ID	Title
NIST	FIPS 140-2	Security Requirements for Cryptographic Modules
IEEE	IEEE 1609.2	Standard for Wireless Access in Vehicular Environments (WAVE) - Security Services for Applications and Management Messages
	IEEE 1609.2a	Standard for Wireless Access in Vehicular Environments--Security Services for Applications and Management Messages - Amendment 1
IETF	IETF DTLS	The Datagram Transport Layer Security (DTLS) Protocol Version 1.2
	IETF FTP	File Transfer Protocol (FTP)
	IETF FTP Auth	FTP Security Extensions
	IETF SNMPv3	Simple Network Management Protocol (SNMP) Overview, Management Framework, Protocols, Applications, Security Models and Transport
NEMA	NEMA TS 8	Cyber and Physical Security for Intelligent Transportation Systems (ITS)

7.6 Data Privacy Considerations for Existing and Emerging ITS Applications

With the proliferation of ITS devices that exchange information with one another to allow for improved traffic operations, there is an emerging need for the communications equipment that facilitates this exchange of information to keep data private. Closely related to cyber security, the need for data privacy stems from the desire to preserve anonymity of users across the transportation system.

Within the National ITS Architecture, service package SU07 – ITS Communications shows information flows and element types necessary for secure, reliable communications between ITS devices. The National ITS Architecture further describes this service package, noting that "it provides the layered protocols and communications services and includes the physical network plant and network hardware that supports ITS communications. It also encompasses security services that protect communications and preserve privacy, and the management services that support network management."

Unlike most other ITS service packages, the flows on the SU07 – ITS Communications service package are general in nature and represent all applicable specific information flows in other service packages. As a result, the SU07 – ITS Communications service package is not included in regional or project architectures. The service package includes data privacy functional details for general ITS communications equipment, as well as roadside communications equipment to support connected vehicle technologies. Wide area information dissemination systems are also included as a separate element for broadcast of wide area alerts to both drivers and connected vehicles.

An information flow exists for proxied ITS information within this service package, and this flow represents all information that needs to be anonymized to support data privacy efforts. According to the National ITS Architecture, proxied ITS information is "information exchanged by ITS systems or devices where the sender is isolated from the receiver by an intermediary that acts as a proxy for the sender." As ITS projects are designed, data flows that contain personally identifiable information should be processed so that these information elements are scrubbed from the underlying dataset, and the information that is sent should be proxied so that bad actors are unable to directly associate data flows with an originator.

8 ITS ARCHITECTURE AND REGIONAL TRANSPORTATION PLANNING

The Chattanooga Regional ITS Architecture is one of several documents that address transportation plans for the Region. These documents should be compatible with one another and guided by similar overarching goals and objectives related to the regional transportation network. Federal agencies require that ITS projects using federal funding conform to the Regional ITS Architecture, so it is important that ITS elements which are going to be incorporated into other regional plans are incorporated according to the Regional ITS Architecture.

Section 8.1 describes how the Regional ITS Architecture can be used to guide the incorporation of ITS elements into the Regional Transportation Plan and Transportation Improvement Program (TIP). Section 8.2 describes how the Regional ITS Architecture relates to statewide operations planning efforts. Section 8.3 provides insights into how the Regional ITS Architecture can be used to improve or streamline efforts for transportation operations project selection and implementation throughout the Region.

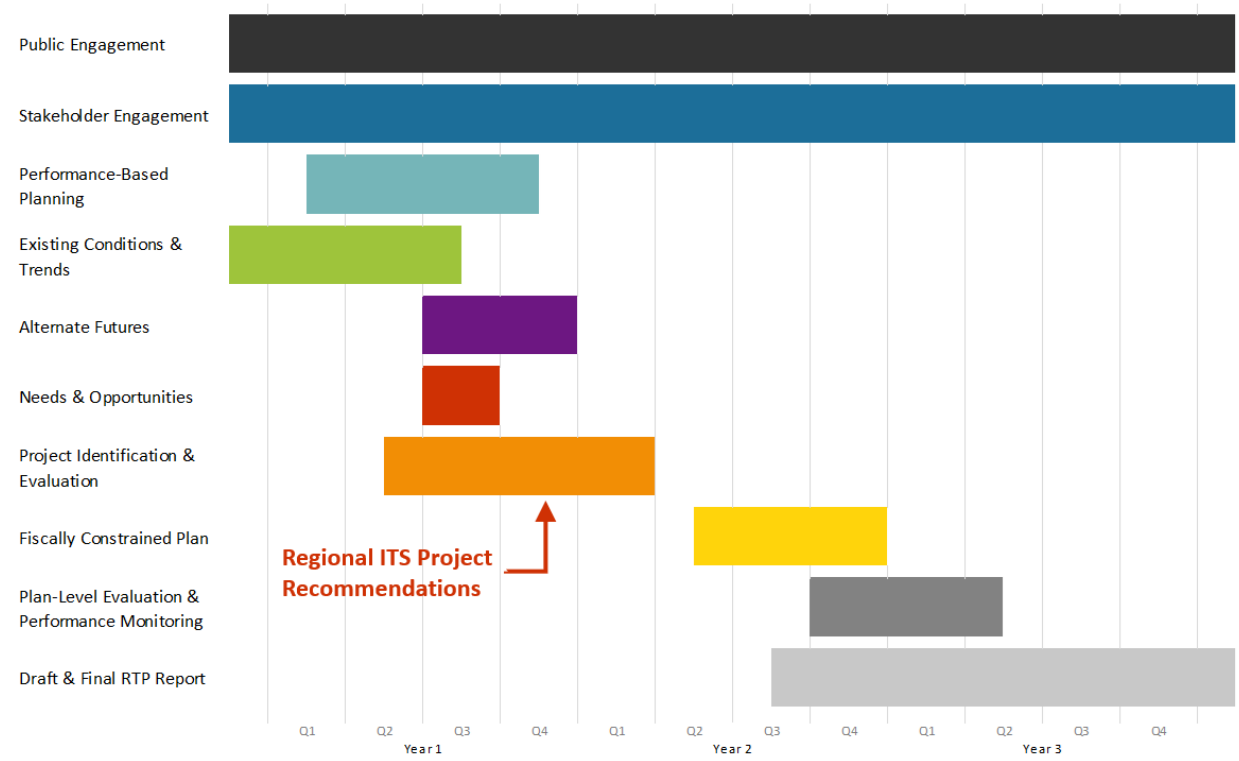
8.1 The Regional ITS Architecture and the General Regional Planning Process

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

Stakeholders in the Chattanooga Region agreed that as projects are submitted for inclusion in the TIP, each project should be evaluated by the submitting agency to determine if the project includes any ITS elements. If the project contains any ITS elements, then the project needs to be reviewed to determine if the ITS elements in the project are in conformance with the Regional ITS Architecture. The submitting agency will perform this examination as part of the planning process using the procedure outlined in Section 9.2. The Chattanooga-Hamilton County/North Georgia TPO will review each project to confirm it does conform to the Regional ITS Architecture.

Figure 11 provides a diagram that details the proposed steps for consideration of the Regional ITS architecture in Chattanooga's regional planning process. As projects transition from the RTP to the 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. Chattanooga-Hamilton County/North Georgia TPO will assist agencies as they perform this examination as part of the project application process using the procedure outlined in Section 9.2.

In this system, the TIP project selection process includes a review of the Regional ITS Architecture to ensure that projects containing ITS elements are in conformity with the regional ITS needs identified by the architecture.



Source: RPA 2050 Regional Transportation Plan Update

Figure 11 – Proposed Regional Planning Process and ITS Architecture Involvement

8.2 The Regional ITS Architecture and Statewide Planning Efforts

In addition to the Chattanooga Regional ITS Architecture, TDOT also has developed and continues to maintain a Statewide ITS Architecture. The TDOT Statewide ITS Architecture was last updated in 2019 and includes both statewide and regional TDOT elements, such as the TDOT Region 2 TMC in Chattanooga as well as the ITS devices the TMC operates. While the statewide architecture shows how TDOT's ITS elements exchange information flows, the Chattanooga Regional ITS architecture also needs to include these TDOT ITS elements to show how they currently or will eventually exchange information with other ITS elements that are maintained by local agencies and other stakeholders within the Chattanooga Region.

TDOT also completed a statewide Traffic Operations Program Plan in 2017. The plan outlines strategies related to Transportation Systems Management and Operations (TSMO) that TDOT may choose to invest in to improve traffic operations statewide. TSMO strategies incorporate the management and use of ITS elements to better address common traffic challenges including traffic incident management, work zone management, and road weather management.

Beyond the use of ITS, the TDOT statewide Traffic Operations Program Plan outlines recommended changes to TDOT business processes, performance measurement strategies, staff organization and workforce plans, and practices for collaboration with local agency partners. For example, one recommendation from the Traffic Operations Program Plan involved increasing staff coverage in the

TDOT Region 2 TMC to allow for 24-hour operations. This recommendation has been implemented since the previous Chattanooga Regional ITS Architecture update was completed. While this staff organization change does not have any impact on the information flows shown in the Chattanooga Regional ITS Architecture, the increase in level of traffic management coverage would still benefit the Region's roadway network by allowing for coordinated traffic management activities and ITS device control to occur even outside of standard business hours or peak travel periods.

8.3 The Regional ITS Architecture and Planning for Operations

Planning for operations is a collaborative process that involves planners and operators working within a region. The goal of planning for operations is to enable improved regional transportation systems management and operations, where improvement is measured by tracking system performance. Rather than reacting and responding to incidents as they occur, the planning for operations approach focuses upon a set of desired system performance outcomes, such as increased travel time reliability or decreased average incident clearance time.

The planning for operations process begins with the development of regional goals and more refined operations objectives. From these goals and objectives, regional needs are identified, and strategies or projects that meet those needs are selected. Quantifiable performance measures that correspond to the selected needs are also identified. The selected management and operations projects are then incorporated into a regional transportation plan and the corresponding transportation funding program. Once the projects are funded and implemented, the transportation system is monitored by tracking the associated performance measures. New operations objectives can then be defined so the implementation process can begin again. **Figure 12** provides a flow chart that outlines this planning for operations process.

Source: Federal Highway Administration

Figure 12 – Proposed Planning for Operations Process

The Regional ITS Architecture contains information that can be very useful to the planning for operations process. Many of the necessary efforts in planning for operations, such as the identification and involvement of regional stakeholders, the identification of appropriate and available performance measures, and the determination of regional needs and gaps in system service coverage, are already present in the Regional ITS Architecture document. Use of the Regional ITS Architecture can expedite the implementation of new transportation operations strategies.

In the initial goal-setting phase of planning for operations, the Regional ITS Architecture is a useful tool for developing a comprehensive list of stakeholders in the Region. Ensuring involvement from all stakeholders will lead to the development of goals and objectives that better reflect the region's transportation priorities. Many of the stakeholders listed in the Regional ITS Architecture also may be experts in a specific operations discipline, and that expertise can lead to the development of better objectives related to planning for operations.

The Regional ITS Architecture contains a list of regional goals and a list of identified needs related to transportation operations, and both lists can provide valuable input to planning for operations. As goals and objectives are developed in the planning for operations process, the Regional ITS Architecture can serve as a gut check to see how well the new goals and objectives conform to both goals in the architecture and goals in other governing policy documents such as the RTP. Furthermore, the needs list that makes up part of the Regional ITS Architecture document can easily be reproduced or adapted to

meet the needs of planning for operations. These needs might include the identification of gaps in an existing ITS system that leave portions of the Region unserved by a certain ITS technology. One planning for operations objective, for example, might be the expansion of coverage for existing ITS systems to currently unserved areas.

Once goals and objectives have been set, the planning for operations process can make use of the ITS service package details and information flow details available in the Regional ITS Architecture. This information can help with the identification of candidate projects and performance measures that correspond to the region's goals. The Regional ITS Architecture contains numerous projects that are candidates for implementation, and the service packages in the document detail for each project which agencies and system components should be incorporated.

The service packages also dictate which information will be sent between the various system components, and this data can help planning for operations in two ways. First, the information flow details can help to define a potential transportation project in greater detail ahead of project development, funding, and implementation. More importantly, the information flow details can inform planning for operations staff as to which performance measure data might be readily available as they track project implementation. Some data might be available for certain parts of the Region, while other data may be available for the entire Region (either from one agency or from multiple agencies with different jurisdictional boundaries). The Regional ITS Architecture can identify which information flows are most used across agencies in a region, which allows for the selection of performance measures that will be able to apply to projects regionwide. For large-scale projects, the Regional ITS Architecture can provide valuable information regarding the organization of many ITS system components and stakeholder agencies. This detailed organizational picture is invaluable when developing a realistic project definition during the scoping process.

Beyond detailing the connections between system components and stakeholders, the Regional ITS Architecture also identifies technologies and elements whose implementation is dependent upon the functionality of other parts of the system. For transportation operations systems that have not yet achieved total implementation, the architecture's identification of dependencies can help in the planning for operations process. For example, through the Regional ITS Architecture, staff can identify critical projects that, once implemented, will allow for the implementation of many other new functions or projects that can build upon the original one. Planning for operations can use this knowledge of dependencies to identify these critical projects, and from it can develop a timeline that prioritizes the implementation of projects with the highest potential impact on operations within a region.

Finally, information from the Regional ITS Architecture can be repurposed as projects are incorporated into a RTP or TIP, are funded, and are implemented within the Region. The level of detail present in the Regional ITS Architecture detailing connections between system elements can help create very specific project descriptions. A higher level of detail can expedite the process for funding and implementing the project, since most of the background information about the project has already been collected and summarized in the architecture documentation.

8.4 The Regional ITS Architecture and the Congestion Management Process

The CHCNGA TPO is responsible for the Congestion Management Process (CMP) within their transportation management area. As part of the CMP, the TPO is required to identify the extent,

duration, and causes of congestion, provide accurate up-to-date information on existing transportation system operations and performance, and to assess alternative strategies for congestion management that meet state and local needs.

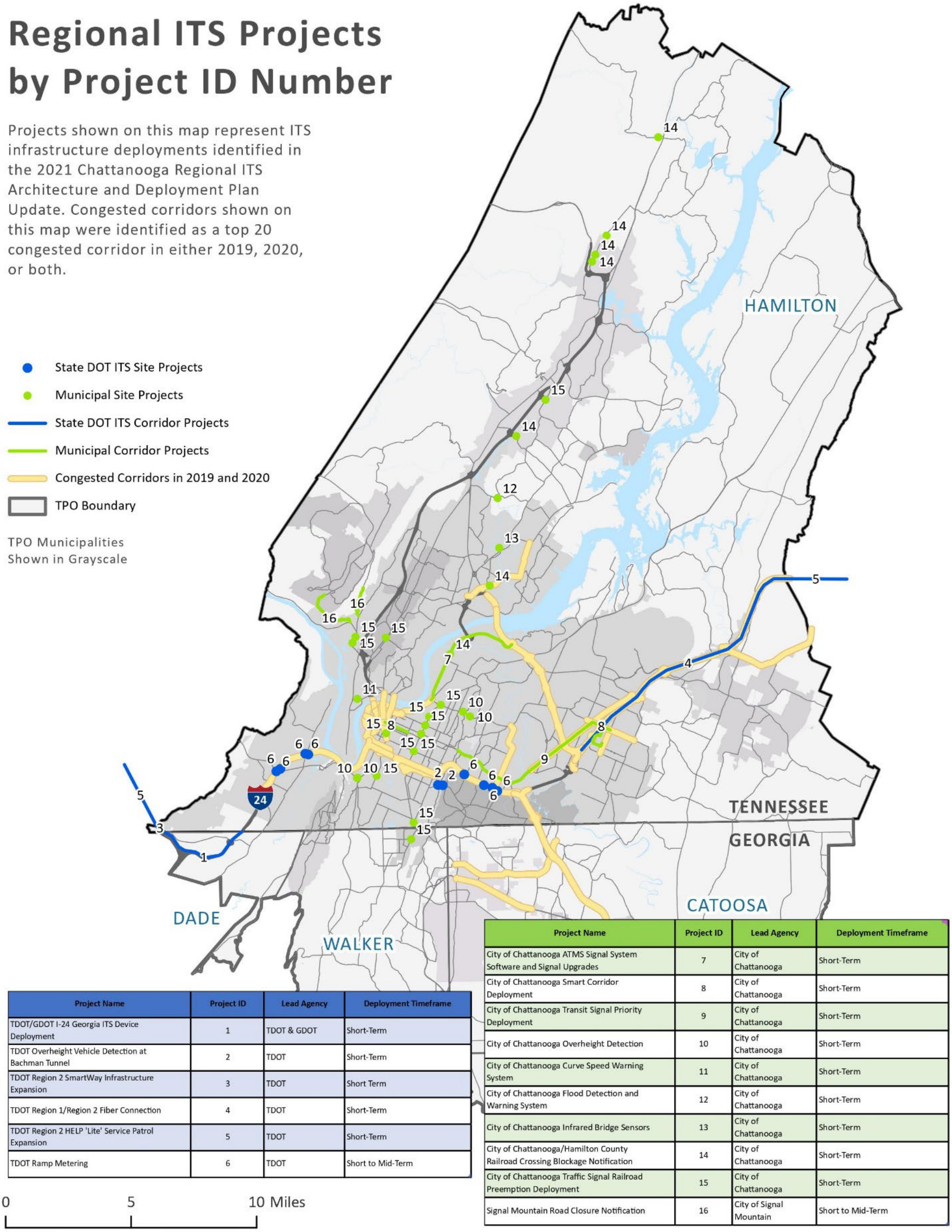
The current CMP Update began at the end of 2020 and will be completed by spring of 2022. The update process includes analyzing 2018, 2019, and 2020 travel data and providing recommendations for potential projects to reduce congestion. The CMP Update results will be used to inform the development of the 2050 Regional Transportation Plan.

Implementing ITS can be an effective strategy in addressing several different types of congestion. Recurrent congestion can be addresses through strategies such as Smart Corridors with improved traffic signal control on arterial streets and ramp metering on freeways. Non-recurrent congestion, including congestion caused by traffic incidents, can be addressed through strategies such as early identification of incidents using CCTV cameras and TDOT's HELP service patrol trucks that can more effectively manage incidents.

In **Figure 13**, the ITS infrastructure project recommendations identified in Section 6 are included with the congested corridors identified in the CMP. Figure 13 shows the 20 most congestion corridors identified in 2019 and 2020. Note that some of these corridors were in the top 20 most congested corridors both years. Projects related to traffic signal timing, ramp metering, incident and road weather management, and railroad crossing blockings can all support efforts to reduce congestion and improve reliability of the transportation system. In addition, there are a number of other ITS projects identified in Section 6 that support efforts to reduce congestion but are not shown in Figure 13 because they do not include the direct deployment of infrastructure or specific locations have not been identified. These projects include improved coordination and data sharing between TDOT and GDOT, increased deployment of CCTV cameras and DMS on arterial streets, and development of incident management plans for rerouting traffic during major traffic incidents.

Regional ITS Projects by Project ID Number

Projects shown on this map represent ITS infrastructure deployments identified in the 2021 Chattanooga Regional ITS Architecture and Deployment Plan Update. Congested corridors shown on this map were identified as a top 20 congested corridor in either 2019, 2020, or both.



Project Name	Project ID	Lead Agency	Deployment Timeframe
TDOT/GDOT I-24 Georgia ITS Device Deployment	1	TDOT & GDOT	Short-Term
TDOT Overheight Vehicle Detection at Bachman Tunnel	2	TDOT	Short-Term
TDOT Region 2 SmartWay Infrastructure Expansion	3	TDOT	Short Term
TDOT Region 1/Region 2 Fiber Connection	4	TDOT	Short-Term
TDOT Region 2 HELP 'Lite' Service Patrol Expansion	5	TDOT	Short-Term
TDOT Ramp Metering	6	TDOT	Short to Mid-Term

Project Name	Project ID	Lead Agency	Deployment Timeframe
City of Chattanooga ATMS Signal System Software and Signal Upgrades	7	City of Chattanooga	Short-Term
City of Chattanooga Smart Corridor Deployment	8	City of Chattanooga	Short-Term
City of Chattanooga Transit Signal Priority Deployment	9	City of Chattanooga	Short-Term
City of Chattanooga Overheight Detection	10	City of Chattanooga	Short-Term
City of Chattanooga Curve Speed Warning System	11	City of Chattanooga	Short-Term
City of Chattanooga Flood Detection and Warning System	12	City of Chattanooga	Short-Term
City of Chattanooga Infrared Bridge Sensors	13	City of Chattanooga	Short-Term
City of Chattanooga/Hamilton County Railroad Crossing Blockage Notification	14	City of Chattanooga	Short-Term
City of Chattanooga Traffic Signal Railroad Preemption Deployment	15	City of Chattanooga	Short-Term
Signal Mountain Road Closure Notification	16	City of Signal Mountain	Short to Mid-Term

Figure 13 – Map of Projects in the Regional ITS Deployment Plan and Congested Corridors

9 USE AND MAINTENANCE PLAN

The Regional ITS Architecture developed for the Chattanooga Region addresses the Region's vision for ITS implementation at the time the plan was developed. Needs will change with the growth of the Region, and as technology progresses new ITS technologies will become available. Shifts in regional needs and focus as well as changes in the National ITS Architecture will necessitate that the Chattanooga Regional ITS Architecture be updated periodically to remain useful to the Region. As projects are developed and deployed, it will be important that projects conform to the Regional ITS Architecture so that they are consistent with both the Region's vision for ITS as well as applicable national standards. In some cases, if projects do not conform it may be necessary to modify the Regional ITS Architecture to reflect changes in the Region's vision for ITS rather than modify the project. In this Section, a process for determining architecture conformity of projects is presented and a plan for how to maintain and update the Regional ITS Architecture is described.

In 2001 the FHWA issued Final Rule 23 CFR 940, which requires that ITS projects using federal funds (or ITS projects that integrate with systems that are deployed with federal funds) conform to a regional ITS architecture and are developed using a systems engineering process. This Section includes a discussion of how the Chattanooga Regional ITS Architecture can be used to support meeting the ITS architecture conformity and systems engineering requirements. A process for maintaining the Regional ITS Architecture, including the Regional ITS Deployment Plan which has been incorporated as Section 6 of the Regional ITS Architecture, is also presented. In Section 9.1 the systems engineering analysis requirements and the guidance provided by TDOT and the FHWA Tennessee Division are discussed. In Section 9.2, the process for determining ITS architecture conformity of an ITS project is presented.

The Regional ITS Architecture is considered a living document. Shifts in regional focus and priorities, changes and new developments in technology, and changes to the National ITS Architecture will necessitate that the Chattanooga Regional ITS Architecture be updated to remain a useful resource for the Region. In the Regional ITS Architecture, a process for maintaining the plan was developed in coordination with stakeholders. The process covers both major updates to the Regional ITS Architecture that will happen approximately every five years (or as needed) as well as minor changes that may be needed between major updates of the documents. These processes have been included in this document in Sections 9.2 and 9.3.

9.1 Systems Engineering Analysis

To assist agencies with meeting the requirements of the FHWA's Final Rule 23 CFR 940, TDOT's Traffic Operations Division developed a guidance document entitled "ITS Project Development Guidelines." The document indicates that unless projects are categorically excluded, a systems engineering analysis must be performed for all ITS projects. Categorically excluded projects are those that do not utilize a centralized control, do not share data with another agency, or are expansions or enhancements to existing systems that do not add any new functionality. For example, installation of an isolated traffic signal or expansion of a freeway management system through the deployment of additional CCTV cameras would be categorically excluded and not require a systems engineering analysis.

The goal of performing a systems engineering analysis is to systematically think through the project deployment process, and show that thorough, upfront planning has been shown to help control costs and ensure schedule adherence. A project's level of risk will determine if a simplified systems

engineering analysis form (SSEAF) is sufficient, or if a more detailed systems engineering analysis report (SEAR) is necessary.

GDOT's process for completing systems engineering analyses for ITS projects adheres to FHWA guidelines. According to the GDOT Plan Development Process, updated in March 2021, all projects within the state that utilize funds from the Highway Trust Fund follow a systems engineering process that is commensurate with the project scope. All projects that move into the design phase must have a project architecture that supports the systems engineering analysis completed for the project.

The TDOT and GDOT requirements indicate that the following considerations should be included in a systems engineering analysis:

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

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

- Portions of the Regional ITS Architecture being implemented;
- Participating agencies and their roles and responsibilities;
- Definition of system requirements (identified in the Chattanooga Regional ITS Architecture RAD-IT Architecture database equipment packages); and
- Applicable ITS standards (identified using ITS service package information flows present in the RAD-IT Architecture Database and their associated national standards).

Many projects are categorically excluded from the systems engineering analysis requirements. Categorically excluded projects are those that do not utilize a centralized control, do not share data with another agency, or are expansions or enhancements to existing systems that do not add any new functionality. For example, installation of an isolated traffic signal or upgrades to an existing signal that does not introduce new functional capabilities would be categorically excluded. Other projects are subject to the systems engineering analysis, either in an abbreviated sense using a form, or in a detailed sense through the preparation of a full report. TDOT and the FHWA Tennessee Division have established a method for determining the necessary documentation for each project, based on the project's risk factors and complexity. This method is shown in the flow chart in **Figure 14** and is described in detail in the *TDOT ITS Development Guidelines* developed by the TDOT Traffic Operations Division (https://tn.gov/tdot/topic/its-project-development).

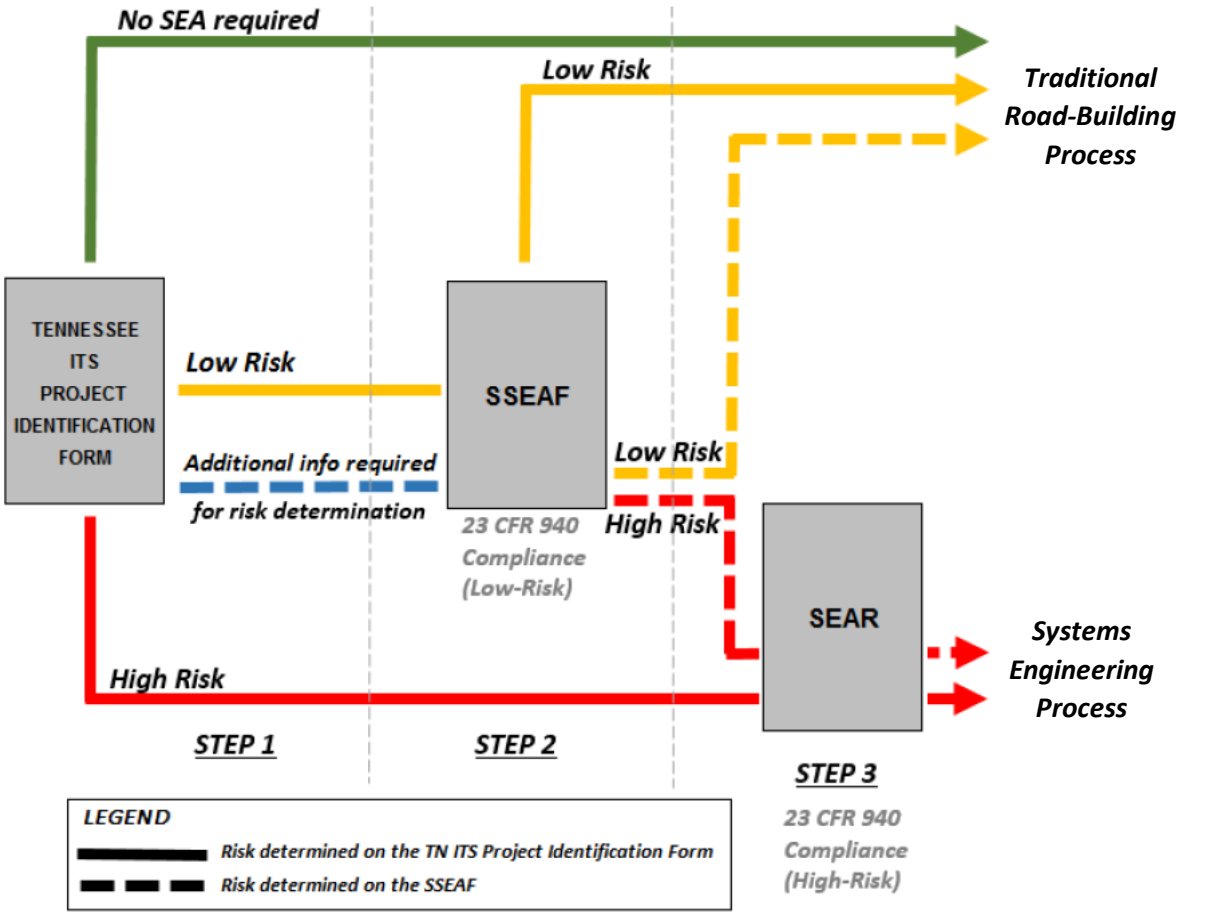


Figure 14 – Systems Engineering Analysis Project Flow Chart

To determine what level of analysis is necessary for a project, a Tennessee ITS Project Identification Form must be completed. This form confirms whether the proposed project should be considered an ITS project and labels the project either "Low Risk" or "High Risk." Many projects that may have some connection to ITS elements or functions, but do not deploy any ITS, may not require a systems engineering analysis because they do not have ITS components and do not add any new functionality to the ITS architecture. The form identifies those projects, which require no further systems engineering analysis and can proceed through the traditional road building project process. In determining risk of projects, the Project Identification Form considers project factors including:

- Number of jurisdictions and modes;
- Extent of software creation;
- Extent of proven hardware and communications technology used;
- Number and complexity of new interfaces to other systems;
- Level of detail in requirements and documentation;
- Level of detail in operating procedures and documentation; and
- Service life of technology applied to equipment and software.

Projects which are identified as “High-Risk” on the Project Identification Form will require a systems engineering analysis report (SEAR). Projects which are identified as “Low Risk” or as requiring more information to determine risk on the Project Identification Form are subject to an abbreviated analysis. In these cases, contracting agencies must fill out a Simplified Systems Engineering Analysis Form (SSEAF). This form is submitted to TDOT, which reviews the form and informs the agency and project sponsor of risk determination. If TDOT determines the project to be “High Risk”, a SEAR is required. If TDOT determines the project to be “Low Risk”, the project can follow the traditional road building project process for other non-ITS projects.

The Vee Diagram, shown in **Figure 15**, is frequently used in systems engineering discussions to demonstrate where the Regional ITS Architecture and systems engineering process fits into the life cycle of an ITS project. The Regional ITS Architecture is shown unattached from the rest of the diagram because it is not specifically project related and an undetermined amount of time can pass between the architecture development and the beginning of project implementation. Moving from left to right along the diagram, the systems engineering process addresses concept exploration, the systems engineering management plan framework, concept of operations, and systems requirements.

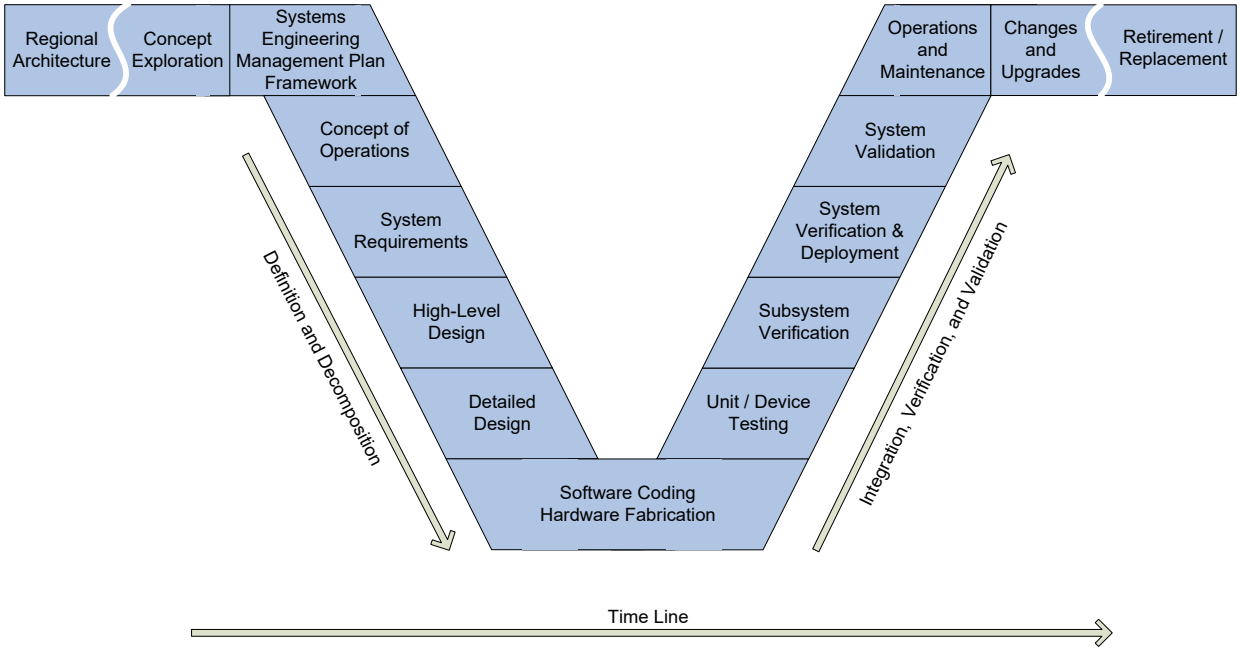


Figure 15 – Systems Engineering Vee Diagram

The Tennessee guidance document contains reference material to aid in the preparation of a systems engineering analysis. During the process, if it is determined that a project is not adequately addressed in the Regional ITS Architecture, the Regional ITS Architecture maintenance process (described in Section 9.3) should be used to document the necessary changes.

9.2 Process for Determining ITS Architecture Conformity

The Chattanooga Regional ITS Architecture documents the customized service packages that were developed as part of the ITS architecture process. To satisfy FHWA and FTA requirements and remain eligible to use Federal funds, a project must be accurately documented. TDOT’s “ITS Project

Development Guidelines" specify that ITS projects need to be reviewed by MPOs to determine if the proposed ITS elements are in conformance with the regional ITS architecture. The steps of determining regional architecture conformity are as follows:

- Step 1 - Identify the ITS components in the project;
- Step 2 - Identify the corresponding service packages(s) from the Regional ITS Architecture;
- Step 3 - Locate the component within the service package;
- Step 4 - 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
- Step 5 - Document any changes necessary to the Regional ITS Architecture or the project to ensure there is conformance.

Step 1 – Identify the ITS Components

ITS components can be fairly apparent in an ITS focused project such as CCTV or DMS deployments but could also be included in other types of projects where they are not as apparent. For example, an arterial widening project could include the installation of signal system interconnect, signal upgrades, and the incorporation of the signals within the project limits into a city's closed loop signal system. These are all ITS functions that involve ITS components, and they should be included in the ITS Architecture. Stakeholders can make use of the TDOT ITS Project Identification Form (introduced in Section 9.1) that was filled out upon project submission to the TIP to help identify ITS components of a given project.

Step 2 – Identify the Corresponding Service Packages

If a project is included in the list of projects identified in the Chattanooga Regional ITS Deployment Plan, then the applicable service package(s) for that project are also identified in the ITS Deployment Plan Section of this report. However, ITS projects are not required to be included in the ITS Deployment Plan to be eligible for federal funding; therefore, ITS service packages might need to be identified for projects that have not been covered in the ITS Deployment Plan. In that case, the ITS service packages selected and customized for the Chattanooga Region should be reviewed to determine if they adequately cover the project. ITS service packages selected for the Chattanooga Region are identified in **Table 7** of this document and detailed service package definitions are in **Appendix B**.

Step 3 – Identify the Component within the Service Package

The customized service packages for the Chattanooga Region can be found in the Interactive ITS Architecture available on-line at the Chattanooga-Hamilton County/North Georgia TPO's website (see note at the end of this section for the website address and instructions to access the service package diagrams.) Once the element is located within the appropriate service package, the evaluator should determine if the element name used in the service package is accurate or if a change to the name is needed. For example, a future element called the City of East Ridge TOC is included in the Chattanooga Regional ITS Architecture. Detailed planning for this center has not begun and the City may select a different name for the TOC once planning and implementation is underway. Such a name change should be documented using the process outlined in Section 9.4.

The ITS service package diagrams that were customized for the Chattanooga Regional ITS Architecture are provided in the Interactive Architecture available through the online RAD-IT database at:

https://chcrpa.org/intelligent-transportation-system/

To access the ITS service package diagrams, from the website select the "Chattanooga Interactive ITS Architecture", then select the "Services" page from the left sidebar, then click the desired Service Package Name. The link below the "Diagram" heading will lead to the service package diagram.

Step 4 – Evaluate the Connections and Flows

The connections and information flows documented in the service package diagrams are selected based on the information available when the Regional ITS Architecture was developed. As the projects are designed, decisions will be made on the system layout that might differ from what is shown in the service package. These changes in the project should be documented in the ITS service packages using the process outlined in Section 9.4.

Step 5 – Document Required Changes

If any changes are needed to accommodate the project under review, Section 9.4 describes how those changes should be documented. Any changes will be incorporated during the next Regional ITS Architecture update. Conformance will be accomplished by documenting how the service package(s) should be modified so that the connections and information flows are consistent with the project.

9.3 Regional ITS Architecture Maintenance Process

The Chattanooga-Hamilton County/North Georgia TPO will be responsible for leading the process to update the Chattanooga Regional ITS Architecture in coordination with the TDOT Traffic Operations Division. **Table 32** summarizes the maintenance process agreed upon by stakeholders in the Region.

Table 32 – Regional ITS Architecture and Deployment Plan Maintenance

Maintenance Details	Full Plan Update Guidance
Timeframe for Updates	Updates will occur on an as needed basis as determined by the TPO and FHWA. Updates will be considered after major ITS deployments in the Region or after major updates to the National ITS Architecture. The Regional ITS Architecture and Deployment Plan will be evaluated to determine if an update is needed prior to the update of the Regional Transportation Plan.
Scope of Update	Entire Regional ITS Architecture and Deployment Plan
Lead Agency	Chattanooga-Hamilton County/North Georgia TPO
Participants	Entire Stakeholder Group
Results	Updated Regional ITS Architecture and Deployment Plan document, Appendices, and RAD-IT Architecture database

Stakeholders agreed that a full update of the Regional ITS Architecture should occur on an as needed basis. The Chattanooga-Hamilton County/North Georgia TPO will work with the FHWA Tennessee Division to determine if there have been enough changes to warrant a full update. Changes that will be considered when evaluating the need to update the Chattanooga Regional ITS Architecture and Deployment Plan include:

- Major ITS deployments in the Region that add new functionality not currently covered in the Chattanooga Regional ITS Architecture and Deployment Plan.
- Major updates to the National ITS Architecture that add new service packages, or substantially change existing service packages, to the extent that the Chattanooga Regional ITS Architecture and Deployment Plan is no longer consistent with the National ITS Architecture.

The Regional ITS Architecture and Deployment Plan can be evaluated to determine if an update is needed at any time, but at a minimum it should be evaluated prior to an update of the Chattanooga Region's RTP. If an update is determined to be needed by the Chattanooga-Hamilton County/North Georgia TPO and the FHWA Tennessee Division, completing it prior to or in conjunction with the RTP update will allow stakeholders to determine the ITS needs and projects that are most important to the Region and document those needs and projects for consideration when developing the RTP.

The Chattanooga-Hamilton County/North Georgia TPO, in coordination with the TDOT Traffic Operations Division and the FHWA Tennessee Division, will be responsible for completing the full updates. During the update process, all stakeholder agencies that participated in the original development of the Regional ITS Architecture and Deployment Plan should be included in addition to any other agencies in the Region that are deploying or may be impacted by ITS projects.

9.4 Procedure for Submitting ITS Architecture Changes Between Major Updates

Updates to the Chattanooga Regional ITS Architecture will occur as described in Section 9.3 to maintain the architecture as a useful planning tool. In between updates, ITS project owners will need to submit documentation to Chattanooga-Hamilton County/North Georgia TPO, the maintainer of the Regional ITS Architecture. Section 9.2 contains step by step guidance for determining whether a project will require review and potential modifications to the Regional ITS Architecture.

For projects where a change is required, one of two forms should be used, depending upon the details of the project. For surface transportation ITS projects in Tennessee that will be funded in whole or in part through federal funding, project owners should complete TDOT's ITS Project Identification Form. This form is included in **Appendix E**. For surface transportation ITS projects in Georgia that will be funded through federal funds, the GDOT Systems Engineering Guidelines should be followed and documentation from that process should be submitted to the Chattanooga-Hamilton County/North Georgia TPO.

The TDOT form is divided into three sections: one to collect general project information, one to conduct a preliminary risk assessment for the project, and one to identify how the project will be funded. TDOT's form requires a signature from both the project owner's representative and an MPO representative (in the Chattanooga Region the MPO is the Chattanooga-Hamilton County/North Georgia TPO), which means that the form can be used to identify any needed updates to the Regional ITS Architecture. TDOT

then evaluates the form and communicates to the project owner whether additional documentation or systems engineering is required.

Since TDOT's existing form applies only to roadway-focused ITS enhancements, other types of ITS projects will need to be documented for the Chattanooga-Hamilton County/North Georgia TPO using a different form. These other types of projects could include transit vehicle or system enhancements that involve ITS, for example.

For these projects, an Architecture Maintenance Documentation Form was developed for use and is included in **Appendix F**. This form should be completed and submitted to the architecture maintenance contact person identified on the form whenever a change to the Regional ITS Architecture is proposed. There are several key questions that need to be answered when completing the Architecture Maintenance Documentation Form including those described below.

Change Information: The type of change that is being requested can include an Administrative Change, Functional Change – Single Agency, Functional Change – Multiple Agency, or a Project Change. A description of each type of change is summarized below.

- **Administrative Change:** Basic changes that do not affect the structure of the ITS service packages in the Regional ITS Architecture. Examples include changes to stakeholder or element names, element status, or information flow status.
- **Functional Change – Single Agency:** Structural changes to the ITS service packages that impact only one agency in the Regional ITS Architecture. Examples include the addition of a new ITS service package or changes to information flow connections of an existing service package. The addition or change will only impact a single agency.
- **Functional Change – Multiple Agencies:** Structural changes to the ITS service packages that have the potential to impact multiple agencies in the Regional ITS Architecture. Examples include the addition of a new ITS service package or changes to information flow connections of an existing ITS service package. The addition or changes will impact multiple agencies and require coordination between the agencies.
- **Project Change:** Addition, modification, or removal of a project in the Regional ITS Deployment Plan Section of the Regional ITS Architecture.

Description of the requested change: A brief description of the type of change being requested should be included.

Service packages being impacted by the change: Each of the ITS service packages that are impacted by the proposed change should be listed on the ITS Architecture Maintenance Documentation Form. If the proposed change involves creating or modifying an ITS service package, then the agency completing the ITS Architecture Maintenance Documentation Form is asked to include a sketch of the new or modified service package.

Impact of proposed change on other stakeholders: If the proposed change is expected to have any impact on other stakeholders in the Region, then those stakeholders should be listed on the ITS Architecture Maintenance Documentation Form. A description of any coordination that has occurred with other stakeholders that may be impacted by the change should be also included. Ideally all stakeholders that may be impacted by the change should be contacted and consensus should be

reached on any new or modified ITS service packages that will be included as part of the Regional ITS Architecture.

When a major update of the Regional ITS Architecture is performed, all the documented changes from any submitted TDOT ITS Project Identification Forms and Architecture Maintenance Documentation Forms should be incorporated.

APPENDICES

APPENDIX A – STAKEHOLDERS

APPENDIX B – ITS SERVICE PACKAGE DEFINITIONS

APPENDIX C – SYSTEM FUNCTIONAL REQUIREMENTS TABLE (FROM RAD-IT)

APPENDIX D – COPIES OF EXISTING REGIONAL ITS AGREEMENTS

APPENDIX E – TDOT ITS PROJECT IDENTIFICATION FORM

APPENDIX F – REGIONAL ITS ARCHITECTURE MAINTENANCE DOCUMENTATION FORM

APPENDIX A – STAKEHOLDERS

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INVITED STAKEHOLDERS

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Note: All members of the Chattanooga-Hamilton County/North Georgia Transportation Planning Organization were also invited.

APPENDIX B – ITS SERVICE PACKAGE DEFINITIONS

Service Package	Service Package Name	Service Package Description
CVO01	Carrier Operations and Fleet Management	This service package manages a fleet of commercial vehicles. The Fleet and Freight Management Center monitors the vehicle fleet and can provide routes using either an in-house capability or an external provider. Routes generated by either approach are constrained by hazardous materials and other restrictions (such as height or weight). A route is electronically sent to the Commercial Vehicle with any appropriate dispatch instructions. The location of the Commercial Vehicle can be monitored by the Fleet and Freight Management Center and routing changes can be made depending on current road network conditions. This service package also supports maintenance of fleet vehicles with on-board monitoring equipment. Records of vehicle mileage, preventative maintenance and repairs are maintained.
CVO02	Freight Administration	This service package tracks the movement of cargo and monitors the cargo condition. Interconnections are provided to intermodal freight shippers and intermodal freight depots for tracking of cargo from origin to destination. In addition to exceptions that are reported, on-going indications of the state of the various freight equipment are reported to the Fleet and Freight Management Center.
CVO03	Electronic Clearance	This service package provides for automated clearance at roadside check facilities. The roadside check facility communicates with the Commercial Vehicle Administration Center to retrieve infrastructure snapshots of critical carrier, vehicle, and driver data to be used to sort passing vehicles. This allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using vehicle to infrastructure (V2I) Communications. Results of roadside clearance activities will be passed on to the Commercial Vehicle Administration Center. The roadside check facility may be equipped with Automated Vehicle Identification (AVI), weighing sensors, communications equipment, and computer workstations. Communications may be implemented using a range of technologies from transponder data readers through connected vehicle short range communications.
DM01	ITS Data Warehouse	This service package provides access to transportation data to support transportation planning, condition and performance monitoring, safety analysis, and research. Configurations range from focused repositories that house data collected and owned by a single agency, district, private sector provider, or research institution to broad repositories that contain multimodal, multidimensional data from varied data sources covering a broader region. Both central repositories and physical distributed ITS data repositories are supported. Requests for data that are satisfied by access to a single repository in the ITS Data Warehouse service package may be parsed by the local repository and dynamically translated to requests to other repositories that relay the data necessary to satisfy the request. The repositories could include a data registry capability that allows registration of data identifiers or data definitions for interoperable use throughout a region.
MC01	Maintenance and Construction Vehicle and Equipment Tracking	This service package tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. Checks can include ensuring the correct roads are being plowed and work activity is being performed at the correct locations.

Service Package	Service Package Name	Service Package Description
MC06	Work Zone Management	This service package manages work zones, controlling traffic in areas of the roadway where maintenance, construction, and utility work activities are underway. Traffic conditions are monitored using CCTV cameras and controlled using dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers. Work zone information is coordinated with other groups (e.g., TIC, traffic management, other maintenance and construction centers). Work zone speeds and delays are provided to the motorist prior to the work zones. This service package provides control of field equipment in all maintenance and construction areas, including fixed, portable, and truck-mounted devices supporting both stationary and mobile work zones.
MC08	Maintenance and Construction Activity Coordination	This service package supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations, or to Transportation Information Centers who can provide the information to travelers. Center to center coordination of work plans supports adjustments to reduce disruption to regional transportation operations.
MC09	Infrastructure Monitoring	This service package monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure (e.g., culverts) using both fixed and vehicle-based infrastructure monitoring sensors. Fixed sensors monitor vibration, stress, temperature, continuity, and other parameters and mobile sensors and data logging devices collect information on current infrastructure condition. This service package also monitors vehicle probes for vertical acceleration data and other probe data that may be used to determine current pavement condition.
PM01	Parking Space Management	This service package monitors and manages parking spaces in lots, garages, and other parking areas and facilities. It assists in the management of parking operations by monitoring parking lot ingress and egress, parking space occupancy and availability. Infrastructure-based detectors and/or connected vehicles may be used to monitor parking occupancy. The service package shares collected parking information with local drivers and information providers for broader distribution.
PM03	Parking Electronic Payment	This service package supports electronic collection of parking fees. This includes all types of parking fee collection including short term and long term parking and pay-for-use loading zones. It collects parking fees from in-vehicle equipment, contact or proximity cards, or any smart payment device. This service package supports both payment via a local point of sale in the parking area or direct payment via wide area wireless communications. User accounts may be established to facilitate secure payment using only a secure ID and enhance services offered to frequent customers.
PM04	Regional Parking Management	This service package supports communication and coordination between equipped parking facilities and also supports regional coordination between parking facilities and traffic and transit management systems. This service package also shares information with transit management centers and transportation information centers to support multimodal travel planning. Information including current parking availability, system status, and operating strategies are shared to enable local parking facility management that supports regional transportation strategies.

Service Package	Service Package Name	Service Package Description
PS01	Emergency Call-Taking and Dispatch	This service package provides basic public safety call-taking and dispatch services. It includes emergency vehicle equipment, equipment used to receive and route emergency calls, and wireless communications that enable safe and rapid deployment of appropriate resources to an emergency. Coordination between Emergency Management Centers supports emergency notification between agencies. Wide area wireless communications between the Emergency Management Center and an Emergency Vehicle supports dispatch and provision of information to responding personnel. This service package also provides information to support dynamic routing of emergency vehicles. Traffic information, road conditions, and weather advisories are provided to enhance emergency vehicle routing. The Emergency Management Center provides routing information based on real-time conditions and has the option to request an ingress/egress route from the Traffic Management Center.
PS02	Emergency Response	This service package supports emergency/ incident response by personnel in the field. It includes emergency vehicle equipment used to provide response status as well as video or images from either the vehicle or from emergency personnel in the field. Wide area wireless communications between the Emergency Management Center, Emergency Personnel and Emergency Vehicles supports a sharing of emergency response information. The service package also includes tactical decision support, resource coordination, and communications integration for Incident Commands that are established by first responders at or near the incident scene to support local management of an incident, including the functions and interfaces commonly supported by a mobile command center.
PS03	Emergency Vehicle Preemption	This service package provides signal preemption for public safety first responder vehicles. Both traditional signal preemption systems and new systems based on connected vehicle technology are covered. In more advanced systems, movement of public safety vehicles through the intersection can be facilitated by clearing queues and holding conflicting phases. In addition, this SP also covers the transition back to normal traffic signal operations after providing emergency vehicle preemption.
PS08	Roadway Service Patrols	This service package supports roadway service patrol vehicles that monitor roads and aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to the traffic stream. If problems are detected, the roadway service patrol vehicles will provide assistance to the motorist (e.g., push a vehicle to the shoulder or median). The service package monitors service patrol vehicle locations and supports vehicle dispatch to identified incident locations. Incident information collected by the service patrol is shared with traffic, maintenance and construction, and traveler information systems.

Service Package	Service Package Name	Service Package Description
PS09	Transportation Infrastructure Protection	This service package includes the monitoring of transportation infrastructure (e.g., bridges, tunnels and management centers) for potential threats using sensors and surveillance equipment and barrier and safeguard systems to control access, preclude an incident, and mitigate the impact of an incident if it occurs. Threats can result from acts of nature (e.g., hurricanes, earthquakes), terrorist attacks or other incidents causing damage to the infrastructure (e.g., stray barge hitting a bridge support). Infrastructure may be monitored with acoustic, environmental threat (such as nuclear, biological, chemical, and explosives), infrastructure condition and integrity, motion and object sensors and video and audio surveillance equipment. Data from such sensors and surveillance equipment may be processed in the field or sent to a center for processing. The data enables operators at the center to detect and verify threats. When a threat is detected, agencies are notified. Detected threats or advisories received from other agencies result in an increased level of system preparedness. In response to threats, barrier and safeguard systems may be activated to deter an incident, control access to an area or mitigate the impact of an incident. Barrier systems include gates, barriers and other automated and remotely controlled systems that manage entry to transportation infrastructure. Safeguard systems include blast shields, exhaust systems and other automated and remotely controlled systems that mitigate impact of an incident.
PS10	Wide-Area Alert	This service package uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather events, civil emergencies, and other situations that pose a threat to life and property. The alert includes information and instructions for transportation system operators and the traveling public, improving public safety and enlisting the public's help in some scenarios. The ITS technologies will supplement and support other emergency and homeland security alert systems such as the Emergency Alert System (EAS). When an emergency situation is reported and verified and the terms and conditions for system activation are satisfied, a designated agency broadcasts emergency information to traffic agencies, transit agencies, information service providers, toll operators, and others that operate ITS systems. The ITS systems, in turn, provide the alert information to transportation system operators and the traveling public using ITS technologies such as dynamic message signs, highway advisory radios, in-vehicle displays, transit displays, 511 traveler information systems, and traveler information websites.

Service Package	Service Package Name	Service Package Description
PS12	Disaster Response and Recovery	This service package enhances the ability of the surface transportation system to respond to and recover from disasters. It addresses the most severe incidents that require an extraordinary response from outside the local community. All types of disasters are addressed including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and national security emergencies such as nuclear, chemical, biological, and radiological weapons attacks).The service package supports coordination of emergency response plans, including general plans developed before a disaster as well as specific tactical plans with short time horizon that are developed as part of a disaster response. The service package provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and maintains situation awareness regarding the disaster itself. In addition, this service package tracks and coordinates the transportation resources - the transportation professionals, equipment, and materials - that constitute a portion of the disaster response. The service package identifies the key points of integration between transportation systems and the public safety, emergency management, public health, and other allied organizations that form the overall disaster response. In this service package, the Emergency Management Center represents the federal, regional, state, and local Emergency Operations Centers and the Incident Commands that are established to respond to the disaster. The interface between the Emergency Management Center and the other centers provides situation awareness and resource coordination among transportation and other allied response agencies. In its role, traffic management implements special traffic control strategies and detours and restrictions to effectively manage traffic in and around the disaster. Maintenance and construction provides damage assessment of road network facilities and manages service restoration. Transit management provides a similar assessment of status for transit facilities and modifies transit operations to meet the special demands of the disaster. As immediate public safety concerns are addressed and disaster response transitions into recovery, this service package supports transition back to normal transportation system operation, recovering resources, managing on-going transportation facility repair, supporting data collection and revised plan coordination, and other recovery activities. This service package builds on the basic traffic incident response service that is provided by TM08, the Traffic Incident Management service package. This service package addresses the additional complexities and coordination requirements that are associated with the most severe incidents that warrant an extraordinary response from outside the local jurisdictions and require special measures such as the activation of one or more emergency operations centers. Many users of ARC-IT will want to consider both TM08 and this service package since every region is concerned with both day-to-day management of traffic-related incidents and occasional management of disasters that require extraordinary response. Disaster Response and Recovery is also supported by PS14, the "Disaster Traveler Information" service package that keeps the public informed during a disaster response. See that service package for more information.

Service Package	Service Package Name	Service Package Description
PS13	Evacuation and Reentry Management	This service package supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. The service package addresses evacuations for all types of disasters, including disasters like hurricanes that are anticipated and occur slowly, allowing a well-planned orderly evacuation, as well as disasters like terrorist acts that occur rapidly, without warning, and allow little or no time for preparation or public warning. This service package supports coordination of evacuation plans among the federal, state, and local transportation, emergency, and law enforcement agencies that may be involved in a large-scale evacuation. All affected jurisdictions (e.g., states and counties) at the evacuation origin, evacuation destination, and along the evacuation route are informed of the plan. Information is shared with traffic management agencies to implement special traffic control strategies and to control evacuation traffic, including traffic on local streets and arterials as well as the major evacuation routes. Reversible lanes, shoulder use, closures, special signal control strategies, and other special strategies may be implemented to maximize capacity along the evacuation routes. Transit resources play an important role in an evacuation, removing many people from an evacuated area while making efficient use of limited capacity. Additional shared transit resources may be added and managed in evacuation scenarios. Resource requirements are forecast based on the evacuation plans, and the necessary resources are located, shared between agencies if necessary, and deployed at the right locations at the appropriate times. Evacuations are also supported by PS14, the "Disaster Traveler Information" service package, which keeps the public informed during evacuations. See that service package for more information.

Service Package	Service Package Name	Service Package Description
PS14	Disaster Traveler Information	This service package uses ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster. This service package collects information from multiple sources including traffic, transit, public safety, emergency management, shelter provider, and travel service provider organizations. The collected information is processed and the public is provided with real-time disaster and evacuation information using ITS traveler information systems. A disaster will stress the surface transportation system since it may damage transportation facilities at the same time that it places unique demands on these facilities to support public evacuation and provide access for emergency responders. Similarly, a disaster may interrupt or degrade the operation of many traveler information systems at the same time that safety-critical information must be provided to the traveling public. This service package keeps the public informed in these scenarios, using all available means to provide information about the disaster area including damage to the transportation system, detours and closures in effect, special traffic restrictions and allowances, special transit schedules, and real-time information on traffic conditions and transit system performance in and around the disaster. This service package also provides emergency information to assist the public with evacuations when necessary. Information on mandatory and voluntary evacuation zones, evacuation times, and instructions are provided. Available evacuation routes and destinations and current and anticipated travel conditions along those routes are provided so evacuees are prepared and know their destination and preferred evacuation route. Information on available transit services and traveler services (shelters, medical services, hotels, restaurants, gas stations, etc.) is also provided. In addition to general evacuation information, this service package provides specific evacuation trip planning information that is tailored for the evacuee based on origin, selected destination, and evacuee-specified evacuation requirements and route parameters. This service package augments the Traveler Information (TI) service packages that provide traveler information on a day-to-day basis for the surface transportation system. This service package provides focus on the special requirements for traveler information dissemination in disaster situations.
PT01	Transit Vehicle Tracking	This service package monitors current transit vehicle location using an Automated Vehicle Location System. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time.
PT02	Transit Fixed-Route Operations	This service package performs automated dispatch and system monitoring for fixed-route and flexible-route transit services. This service performs scheduling activities including the creation of schedules, blocks and runs, as well as operator assignment. This service monitors the transit vehicle trip performance against the schedule and provides information displays at the Transit Management Center.

Service Package	Service Package Name	Service Package Description
PT03	Dynamic Transit Operations	The Dynamic Transit Operations service package allows travelers to request trips and obtain itineraries using a personal device such as a smart phone, tablet, or personal computer. The trips and itineraries cover multiple transportation services (public transportation modes, private transportation services, shared-ride, walking and biking). This service package builds on existing technology systems such as computer-aided dispatch/ automated vehicle location (CAD/AVL) systems and automated scheduling software, providing a coordination function within and between transit providers that would dynamically schedule and dispatch or modify the route of an in-service vehicle by matching compatible trips together. TI06 covers other shared use transportation options.
PT04	Transit Fare Collection Management	This service package manages transit fare collection on-board transit vehicles and at transit stops using electronic means. It allows transit users to use a traveler card or other electronic payment device such as a smart phone. Readers located either in the infrastructure or on-board the transit vehicles enable electronic fare payment. Data is processed, stored, and displayed on the transit vehicle and communicated as needed to the Transit Management Center. This service supports ad-hoc payments to the transport provider (typically through the 'payment' and 'fare' flows), payments using a transport provider's account system using account-based tokens or integrated multi-provider account systems (typically through the 'account', 'secureID' and 'authorization' flows).
PT05	Transit Security	This service package provides for the physical security of transit passengers and transit vehicle operators. On-board equipment performs surveillance and sensor monitoring in order to identify potentially hazardous situations. The surveillance equipment includes video (e.g., CCTV cameras), audio systems and/or event recorder systems. The sensor equipment includes threat sensors (e.g., chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors) and object detection sensors (e.g., metal detectors). Transit user or transit vehicle operator activated alarms are provided on-board. Public areas (e.g., transit stops, park and ride lots, stations) are also monitored with similar surveillance and sensor equipment and provided with transit user activated alarms. In addition this service package provides surveillance and sensor monitoring of non-public areas of transit facilities (e.g., transit yards) and transit infrastructure such as bridges, tunnels, and transit railways or bus rapid transit (BRT) guideways. The surveillance equipment includes video and/or audio systems. The sensor equipment includes threat sensors and object detection sensors as described above as well as, intrusion or motion detection sensors and infrastructure integrity monitoring (e.g., rail track continuity checking or bridge structural integrity monitoring).Most of the surveillance and sensor data that is collected by this service package may be monitored by either the Emergency Management Center or the Transit Management Center, providing two possible approaches to implementing this service package. This service package also supports remote transit vehicle disabling and transit vehicle operator authentication by the Transit Management Center.
PT06	Transit Fleet Management	This service package supports automatic transit maintenance scheduling and monitoring. On-board condition sensors monitor system status and transmit critical status information to the Transit Management Center. The Transit Management Center processes this data and schedules preventative and corrective maintenance. The service package also supports the day to day management of the transit fleet inventory, including the assignment of specific transit vehicles to blocks and the assignment of transit vehicle operators to runs.

Service Package	Service Package Name	Service Package Description
PT07	Transit Passenger Counting	This service package counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center. The collected data can be used to calculate reliable ridership figures and measure passenger load information at particular stops.
PT08	Transit Traveler Information	This service package provides transit users at transit stops and on-board transit vehicles with ready access to transit information. The information services include transit stop annunciation, imminent arrival signs, and real-time transit schedule displays that are of general interest to transit users. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.
PT09	Transit Signal Priority	The Transit Signal Priority service package uses transit vehicle to infrastructure communications to allow a transit vehicle to request priority at one or a series of intersections. The service package provides feedback to the transit driver indicating whether the signal priority has been granted or not. This service package can contribute to improved operating performance of the transit vehicles by reducing the time spent stopped at a red light.
PT14	Multi-modal Coordination	This service package establishes two way communications between multiple transit and traffic agencies to improve service coordination. Multimodal coordination between transit agencies can increase traveler convenience at transit transfer points and clusters (a collection of stops, stations, or terminals where transfers can be made conveniently) and also improve operating efficiency.
PT17	Transit Connection Protection	This service package allows travelers to initiate a request for connection protection anytime during the trip using a personal device or on-board equipment and receive a confirmation indicating whether the request is accepted. Connection protection uses real time data to examine the arrival status of a transit vehicle and to transmit a hold message to a vehicle or other mode of transportation (e.g. rail) in order for the traveler to make a successful transfer from one vehicle to another. Connection protection can be performed within a single agency, across multiple agencies, and across multiple modes. In an intermodal, multimodal or interagency environment, a transfer request brokerage system, represented by the Transit Management System, can be used to determine the feasibility of a connection protection request and support schedule coordination between agencies.
PT18	Integrated Multi-Modal Electronic Payment	The Integrated Multi-Modal Electronic Payment (IMMEP) service package provides electronic payment capability for transit fares, tolls, road use, parking, and other areas requiring electronic payments. IMMEP enables the provision of payment for transportation services using a single account for multiple public transportation providers. The transportation user establishes an account with a financial service provider (modeled as the Payment Administration Center (PAC)), and the PAC communicates with various public transportation providers to coordinate charges. IMMEP also supports the management of transportation user access rights (i.e., this user can use the subway but not the bus). Payment transactions are centralized; the user provides only a secure, registered token (the 'secureID') to the transportation provider's access control equipment. The transportation provider uses that token and context to initiate transactions with the PAC.

Service Package	Service Package Name	Service Package Description
ST01	Emissions Monitoring	This service package monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The collected information is transmitted to the Emissions Management Center for processing. Both area wide air quality monitoring and point emissions monitoring are supported by this service package. For area wide monitoring, this service package measures air quality, identifies sectors that are non-compliant with air quality standards, and collects, stores and reports supporting statistical data. For point emissions monitoring, this service package collects data from on-board diagnostic systems and measures tail pipe emissions to identify vehicles that exceed emissions standards and/or clean vehicles that could be released from standard emissions tests, depending on policy and regulations. Summary emissions information or warnings can also be displayed to drivers. The gathered information can be used to implement environmentally sensitive travel demand management (TDM) programs, policies, and regulations.
ST05	Electric Charging Stations Management	The Electric Charging Station Management service package provides an exchange of information between the electric vehicle and charging station to manage the charging operation. The agency or company operating the charging station can use vehicle information such as the capability of the vehicle (e.g. operational status of the electrical system, how many amps can the vehicle handle, and % charge complete) to determine that the charge is being properly applied and determine an estimated time to complete charging.
TI01	Broadcast Traveler Information	This service package provides a digital broadcast service that disseminates traveler information to all equipped travelers within range. It collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadcasts the information to travelers using technologies such as FM subcarrier, satellite radio, cellular data broadcasts, and Internet streaming technologies. This service package also provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility service packages for connected vehicles. DSRC is used to deliver real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass connected vehicle roadside equipment along their route. This service package provides public information that is available to all equipped vehicles in the vicinity of the roadside equipment.
TI02	Personalized Traveler Information	This service package provides tailored information in response to a traveler request. Both real-time interactive request/response systems and information systems that "push" a tailored stream of information to the traveler based on a submitted profile are supported. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. Although the Internet is the predominate network used for traveler information dissemination, a range of two-way wide-area wireless and fixed-point to fixed-point communications systems may be used to support the required data communications with the traveler. A variety of interactive devices may be used by the traveler to access information prior to a trip or en route including phone via a 511-like portal and web pages via smart phone, tablet, personal computer, and a variety of in-vehicle devices.

Service Package	Service Package Name	Service Package Description
TI03	Dynamic Route Guidance	This service package offers advanced route planning and guidance that is responsive to current conditions. The package augments a user's navigation system equipment with a digital receiver capable of receiving real-time traffic, transit, and road condition information, which is used by the user equipment to provide real-time route guidance that factors in current conditions.
TI04	Infrastructure-Provided Trip Planning and Route Guidance	This service package offers the user trip planning and en route guidance services. It generates a trip plan, including a multimodal route and associated service information (e.g., parking information), based on traveler preferences and constraints. Routes may be based on static information or reflect real time network conditions. Unlike TI03, where the user equipment determines the route, the route determination functions are performed by the center in this service package. The trip plan may be confirmed by the traveler and advanced payment and reservations for transit and alternate mode (e.g., airline, rail, and ferry) trip segments, and ancillary services are accepted and processed. The confirmed trip plan may include specific routing information that can be supplied to the traveler as general directions or as turn-by-turn route guidance depending on the level of user equipment.
TI07	In-Vehicle Signage	This service package augments regulatory, warning, and informational signs and signals by providing information directly to drivers through in-vehicle devices. The information provided would include static sign information (e.g., stop, curve warning, guide signs, service signs, and directional signs) and dynamic information (e.g., current signal states including highway intersection and highway-rail intersection status and local conditions warnings identified by local environmental sensors). This service package also includes the capability for maintenance and construction, emergency, and transit vehicles to transmit sign information to vehicles in the vicinity so that in vehicle signing can be used without fixed infrastructure in areas such as work zones, around incidents, and at bus stops.
TM01	Infrastructure-Based Traffic Surveillance	This service package includes traffic detectors, other surveillance equipment, the supporting field equipment, and Center to Field communications to transmit the collected data back to the Traffic Management Center. The derived data can be used locally such as when traffic detectors are connected directly to a signal control system or remotely (e.g., when a CCTV system sends data back to the Traffic Management Center). The data generated by this service package enables traffic managers to monitor traffic and road conditions, identify and verify incidents, detect faults in indicator operations, and collect census data for traffic strategy development and long range planning. The collected data can also be analyzed and made available to users and the Traveler Information Center physical object.

Service Package	Service Package Name	Service Package Description
TM02	Vehicle-Based Traffic Surveillance	This service package uses probe data information obtained from vehicles in the network to support traffic operations, including incident detection and the implementation of localized operational strategies. Since traffic data is collected from vehicles, travel times and other related traffic performance measures are available. This service package includes the capability to collect data from Connected Vehicles so that "probe" data can be collected from all equipped vehicles, providing access to a large vehicle population as penetration increases. Incident detection enables transportation agencies to determine the location of potential incidents so the agencies can respond more quickly to the incident and mitigate any negative impacts to the transportation network. Vehicle data that can be used to detect potential incidents include changes in vehicle speeds indicating the disruption of traffic flow, when a vehicle's safety systems have been activated or deployed, or sudden vehicle turns or deceleration at a specific location (indicating a potential obstacle in the roadway).
TM03	Traffic Signal Control	This service package provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. A range of traffic signal control systems are represented by this service package ranging from fixed-schedule control systems to fully traffic responsive systems that dynamically adjust control plans and strategies based on current traffic conditions and priority requests. This service package is generally an intra-jurisdictional package. Systems that achieve coordination across jurisdictions by using a common time base or other strategies that do not require real time coordination would also be represented by this package. Coordination of traffic signal systems using real-time communications is covered in the TM07-Regional Traffic Management service package. This service package is consistent with typical traffic signal control systems.
TM04	Connected Vehicle Traffic Signal System	This service package uses both vehicle location and movement information from connected vehicles as well as infrastructure measurement of non-equipped vehicles to improve the operations of traffic signal control systems. The service package utilizes the vehicle information to adjust signal timing for an intersection or group of intersections in order to improve traffic flow, including allowing platoon flow through the intersection. Other service package provide related mobility services such as Transit Signal Priority, Freight Signal Priority, Emergency Vehicle Preemption, and Pedestrian Mobility to maximize overall arterial network performance.
TM05	Traffic Metering	This service package provides central monitoring and control, communications, and field equipment that support metering of traffic. It supports the complete range of metering strategies including ramp, interchange, and mainline metering. This package incorporates the instrumentation included in the TM01 service package (traffic sensors are used to measure traffic flow and queues) to support traffic monitoring so responsive and adaptive metering strategies can be implemented. Also included is configurable field equipment to provide information to drivers approaching a meter, such as advance warning of the meter, its operational status (whether it is currently on or not, how many cars per green are allowed, etc.), lane usage at the meter (including a bypass lane for HOVs) and existing queue at the meter.

Service Package	Service Package Name	Service Package Description
TM06	Traffic Information Dissemination	This service package provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. A wide range of information can be disseminated including traffic and road conditions, closure and detour information, travel restrictions, incident information, and emergency alerts and driver advisories. This package provides information to drivers at specific equipped locations on the road network. Careful placement of the roadway equipment provides the information at points in the network where the drivers have recourse and can tailor their routes to account for the new information. This package also covers the equipment and interfaces that provide traffic information from a traffic management center to the media (for instance via a direct tie-in between a traffic management center and radio or television station computer systems), Transit Management, Emergency Management, and Transportation Information Centers. A link to the Maintenance and Construction Management Center allows real time information on road/bridge closures and restrictions due to maintenance and construction activities to be disseminated.
TM07	Regional Traffic Management	This service package provides for the sharing of information and control among traffic management centers to support regional traffic management strategies. Regional traffic management strategies that are supported include inter-jurisdictional, real-time coordinated traffic signal control systems and coordination between freeway operations and traffic signal control within a corridor. This service package advances the TM03-Traffic Signal Control and TM05-Traffic Metering service packages by adding the communications links and integrated control strategies that enable integrated, interjurisdictional traffic management. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions. This package relies principally on roadside instrumentation supported by the Traffic Signal Control and Traffic Metering service packages and adds hardware, software, and fixed-point communications capabilities to implement traffic management strategies that are coordinated between allied traffic management centers. Several levels of coordination are supported from sharing of information through sharing of device control between traffic management centers.

Service Package	Service Package Name	Service Package Description
TM08	Traffic Incident Management System	This service package manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. The service package includes incident detection capabilities through roadside surveillance devices (e.g. CCTV) and through regional coordination with other traffic management, maintenance and construction management and emergency management centers as well as rail operations and event promoters. Information from these diverse sources is collected and correlated by this service package to detect and verify incidents and implement an appropriate response. This service package supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel to confirmed incidents. The response may include traffic control strategy modifications or resource coordination between centers. Incident response also includes presentation of information to affected travelers using the Traffic Information Dissemination service package and dissemination of incident information to travelers through the Broadcast Traveler Information or Interactive Traveler Information service packages. The roadside equipment used to detect and verify incidents also allows the operator to monitor incident status as the response unfolds. The coordination with emergency management might be through a CAD system or through other communication with emergency personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel. This service package is closely related with the Public Safety service packages, which focus on services that support first responders. In particular, local management of the incident using an incident command system is covered by PS02.
TM09	Integrated Decision Support and Demand Management	This service package recommends courses of action to transportation operators in a corridor, downtown area, or other heavily traveled area. Recommendations are based on an assessment of current and forecast transportation network performance and environmental conditions. Multi-modal transportation operational strategies are created that consider all modes and all roads in the travel area to correct network imbalances and effectively manage available capacity. As part of the operational strategies, this service package may also recommend lane restrictions, transit, parking, and toll strategies to influence traveler route and mode choices to support active demand management programs and policies managing both traffic and the environment. Operational strategies, including demand management recommendations, are coordinated to support operational decisions by each transportation operator that are consistent with the recommended strategy. All recommended operational strategies are based on historical evaluation, real-time assessment, and forecast of the roadway network performance based on predicted travel demand patterns. This service package also collects air quality, parking availability, transit usage, and vehicle occupancy data to support operational strategies that manage and balance capacity and demand.

Service Package	Service Package Name	Service Package Description
TM12	Dynamic Roadway Warning	This service package includes systems that dynamically warn drivers approaching hazards on a roadway. Such hazards include roadway weather conditions, road surface conditions, traffic conditions including queues, obstacles or animals in the roadway and any other transient event that can be sensed. These dynamic roadway warning systems can alert approaching drivers via warning signs, flashing lights, in-vehicle messages, etc. Such systems can increase the safety of a roadway by reducing the occurrence of incidents. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous. Speed warnings that consider the limitations of a given vehicle for the geometry of the roadway (e.g., rollover risk for tall vehicles) are not included in this service package but are covered by the TM17 – Speed Warning and Enforcement service package. Roadway warning systems, especially queue warning systems are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as TM20-Variable Speed Limits and TM22-Dynamic Lane Management and Shoulder Use).
TM13	Standard Railroad Grade Crossing	This service package manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate more advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Both passive (e.g., the crossbuck sign) and active warning systems (e.g., flashing lights and gates) are supported. (Note that passive systems exercise only the single interface between the ITS Roadway Equipment and the Driver in the physical view.) These traditional HRI warning systems may also be augmented with other standard traffic management devices. The warning systems are activated on notification of an approaching train by interfaced wayside equipment. The equipment at the HRI may also be interconnected with adjacent signalized intersections so that local control can be adapted to highway-rail intersection activities. Health monitoring of the HRI equipment and interfaces is performed; detected abnormalities are reported to both highway and railroad officials through wayside interfaces and interfaces to the Traffic Management Center.
TM15	Railroad Operations Coordination	This service package provides an additional level of strategic coordination between freight rail operations and other transportation centers. Rail operations provides train schedules, maintenance schedules, and any other forecast events that will result in highway-rail intersection (HRI) closures. This information is used to develop forecast HRI closure times and durations that may be used in advanced traffic control strategies or to enhance the quality of traveler information.
TM17	Speed Warning and Enforcement	This service package monitors vehicle speeds and supports warning drivers when their speed is excessive. Also the service includes notifications to an enforcement agency to enforce the speed limit of the roadway. Speed monitoring can be made via spot speed or average speed measurements. Roadside equipment can display the speed of passing vehicles and/or suggest a safe driving speed. Environmental conditions and vehicle characteristics may be monitored and factored into the safe speed advisories that are provided to the motorist. For example, warnings can be generated recognizing the limitations of a given vehicle for the geometry of the roadway such as rollover risk for tall vehicles. This service focuses on monitoring of vehicle speeds and enforcement of the speed limit while the variable speed limits service (covered in TM20-Variable Speed Limits service package) focuses on varying the posted speed limits to create more uniform speeds along a roadway, to promote safer driving during adverse conditions (such as fog) and/or to reduce air pollution.

Service Package	Service Package Name	Service Package Description
TM19	Roadway Closure Management	This service package closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, and other scenarios where access to the roadway must be prohibited. The service package includes automatic or remotely controlled gates or barriers that control access to roadway segments including ramps and traffic lanes. Remote control systems allow the gates to be controlled from a central location or from a vehicle at the gate/barrier location, improving system efficiency and reducing personnel exposure to unsafe conditions during severe weather and other situations where roads must be closed. Surveillance systems allow operating personnel to visually verify the safe activation of the closure system and driver information systems (e.g., DMS) provide closure information to motorists in the vicinity of the closure. The equipment managed by this service package includes the control and monitoring systems, the field devices (e.g., gates, warning lights, DMS, CCTV cameras) at the closure location(s), and the information systems that notify other systems of a closure. This service package covers general road closure applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other Traffic Management service packages.
TM20	Variable Speed Limits	This service package sets variable speed limits along a roadway to create more uniform speeds, to promote safer driving during adverse conditions (such as fog), and/or to reduce air pollution. Also known as speed harmonization, this service monitors traffic and environmental conditions along the roadway. Based on the measured data, the system calculates and sets suitable speed limits, usually by lane. Equipment over and along the roadway displays the speed limits and additional information such as basic safety rules and current traffic information. The system can be centrally monitored and controlled by a traffic management center or it can be autonomous. This service establishes variable speed limits and communicates the speed limits to drivers. Speed warnings and enforcement of speeds limits, including variable speed limits, is covered in the TM17-Speed Warning and Enforcement service package. Variable speed limits are an Active Traffic Management (ATM) strategy and are typically used in conjunction with other ATM strategies (such as TM22-Dynamic Lane Management and Shoulder Use and TM23-Dynamic Roadway Warning).
TM22	Dynamic Lane Management and Shoulder Use	This service package provides for active management of travel lanes along a roadway. The package includes the field equipment, physical overhead lane signs and associated control electronics that are used to manage and control specific lanes and/or the shoulders. This equipment can be used to change the lane configuration on the roadway according to traffic demand and lane destination along a typical roadway section or on approach to or access from a border crossing, multimodal crossing or intermodal freight depot. This package can be used to allow temporary or interim use of shoulders as travel lanes. The equipment can be used to electronically reconfigure intersections and interchanges and manage right-of-way dynamically including merges. Also, lanes can be designated for use by special vehicles only, such as buses, high occupancy vehicles (HOVs), vehicles attending a special event, etc. Prohibitions or restrictions of types of vehicles from using particular lanes can be implemented.The lane management system can be centrally monitored and controlled by a traffic management center or it can be autonomous. This service also can include automated enforcement equipment that notifies the enforcement agency of violators of the lane controls.Dynamic lane management and shoulder use is an Active Traffic Management (ATM) strategy and is typically used in conjunction with other ATM strategies (such as TM20-Variable Speed Limits and TM12-Dynamic Roadway Warning).

Service Package	Service Package Name	Service Package Description
TM25	Wrong Way Vehicle Detection and Warning	This service package detects wrong way vehicles on the main roadway and at the exit of divided freeways, tunnels, and bridges. Wrong way vehicle drivers are immediately warned. If the driver continues onto the roadway, warnings are issued to oncoming drivers of the wrong way entry and traffic management and public safety centers are notified.
VS05	Curve Speed Warning	This service package allows connected vehicles to receive information that it is approaching a curve along with the recommended speed for the curve. This capability allows the vehicle to provide a warning to the driver regarding the curve and its recommended speed. In addition, the vehicle can perform additional warning actions if the actual speed through the curve exceeds the recommended speed.
VS09	Reduced Speed Zone Warning / Lane Closure	This service package provides connected vehicles that are approaching a reduced speed zone with information on the zone's posted speed limit and/or if the configuration of the roadway is altered (e.g., lane closures, lane shifts). Reduced speed zones include (but are not be limited to) construction/work zones, school zones, pedestrian crossing areas, and incorporated zones (e.g., rural towns). The connected vehicle uses the revised speed limit along with any applicable changed roadside configuration information to determine whether to provide an alert or warning to the driver. Additionally, to provide warnings to non-equipped vehicles, infrastructure equipment measures the speed of the approaching vehicles and if greater than the reduced speed zone posted speed limit will provide warning signage. It will provide an alert to drivers in advance when aggressive braking is required to reduce to the posted speed limit.
VS11	Oversize Vehicle Warning	This service package uses external measurements taken by the roadside infrastructure, and transmitted to the vehicle, to support in-vehicle determination of whether an alert/warning is necessary. Specifically, the infrastructure data equipment detects and measures the approaching vehicle's height and width. The infrastructure component of the service package transmits the vehicle measurements, along with bridge, overpass, or tunnel geometry, to the oversize vehicle. The vehicle application utilizes this data to determine whether the vehicle can clear the bridge or tunnel. If deemed necessary, the driver is alerted to the impending low height and/or narrow horizontal clearance bridge or tunnel prior to a decision point, enabling the vehicle to reroute and avoid a collision. If the driver ignores the alert and continues along the route, the vehicle will generate a warning indicating an impending collision at a point near the bridge or tunnel approach. To support unequipped vehicles the infrastructure will display warning or reroute information when the measurements indicate that a vehicle does not have adequate height or width clearance. This service package can be expanded to consider weight as well as height and width.

Service Package	Service Package Name	Service Package Description
VS12	Pedestrian and Cyclist Safety	This service package supports the sensing and warning systems used to interact with pedestrians, cyclists, and other non-motorized users that operate on the main vehicle roadways, or on pathways that intersect the main vehicle roadways. These systems allow automated warning or active protection for this class of users. It integrates traffic, pedestrian, and cyclist information from roadside or intersection detectors and new forms of data from wirelessly connected, non-motorized traveler-carried mobile devices to request right-of-way or to inform non-motorized travelers when to cross and how to remain aligned with the crosswalk or pathway based on real-time Signal Phase and Timing (SPaT) and MAP information. In some cases, priority will be given to non-motorized travelers, such as persons with disabilities who need additional crossing time, or in special conditions (e.g., weather) where non-motorized travelers may warrant priority or additional crossing time. This service package will enable a service call to be routed to the traffic controller from a mobile device of a registered person with disabilities after confirming the direction and orientation of the roadway that the individual is intending to cross. It also provides warnings to the non-motorized user of possible infringement of the crossing or pathway by approaching vehicles.
WX01	Weather Data Collection	This service package collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway. It also collects data from vehicles in the road network that can be used to directly measure or infer current environmental conditions. It leverages vehicle on-board systems that measure temperature, sense current weather conditions (rain and sun sensors) and also can monitor aspects of the vehicle operational status (e.g., use of headlights, wipers, and traction control system) to gather information about local environmental conditions. In addition, environmental sensor systems located on Maintenance and Construction Vehicles are also potential data sources. The collected environmental data is used by the Weather Information Processing and Distribution service package to process the information and make decisions on operations. The collected environmental data may be aggregated, combined with data attributes and sent to meteorological systems for data qualification and further data consolidation. The service package may also request and receive qualified data sets from meteorological systems.
WX02	Weather Information Processing and Distribution	This service package processes and distributes the environmental information collected from the Weather Data Collection service package. This service package uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. so operational centers and decision support systems can make decision on corrective actions to take. The continuing updates of road condition information and current temperatures can be used to more effectively deploy road maintenance resources, issue general traveler advisories, issue location specific warnings to drivers using the Traffic Information Dissemination service package, and aid operators in scheduling work activity.

APPENDIX C – SYSTEM FUNCTIONAL REQUIREMENTS TABLE (FROM RAD-IT)

Element Name	Functional Object
CARTA Bus Stop DMS	Transit Stop Information Services
CARTA Care-A-Van Dispatch Center	Emergency Secure Area Alarm Support
	Emergency Secure Area Sensor Management
	Emergency Secure Area Surveillance
	ITS Management Support
	Transit Center Data Collection
	Transit Center Multi-Modal Coordination
	Transit Center Paratransit Operations
	Transit Center Security
	Transit Center Vehicle Assignment
	Transit Center Vehicle Tracking
	Transit Evacuation Support
	Transit Garage Maintenance
CARTA Data Archive	Archive Data Repository
	Archive Government Reporting
CARTA Fixed Route Dispatch Center	Emergency Secure Area Alarm Support
	Emergency Secure Area Sensor Management
	Emergency Secure Area Surveillance
	ITS Management Support
	Transit Center Connection Protection
	Transit Center Data Collection
	Transit Center Fare Management
	Transit Center Fixed-Route Operations
	Transit Center Information Services
	Transit Center Multi-Modal Coordination
	Transit Center Paratransit Operations

Element Name	Functional Object
CARTA Fixed Route Dispatch Center (continued)	Transit Center Passenger Counting
	Transit Center Priority Management
	Transit Center Security
	Transit Center Vehicle Assignment
	Transit Center Vehicle Tracking
	Transit Evacuation Support
	Transit Garage Maintenance
CARTA Fixed-Route Vehicles	Field Secure Area Sensor Monitoring
	Field Secure Area Surveillance
	ITS Management Support
	ITS Security Support
	Transit Vehicle On-Board Fare Management
	Transit Vehicle On-Board Information Services
	Transit Vehicle On-Board Maintenance
	Transit Vehicle On-Board Trip Monitoring
	Transit Vehicle Passenger Counting
	Transit Vehicle Schedule Management
	Transit Vehicle Security
	Transit Vehicle Signal Priority
CARTA Maintenance Facility CCTV Camera Surveillance	Field Secure Area Sensor Monitoring
	Field Secure Area Surveillance
	ITS Management Support
	ITS Security Support
CARTA Paratransit Vehicles	Transit Vehicle On-Board Maintenance
	Transit Vehicle On-Board Paratransit Operations
	Transit Vehicle On-Board Trip Monitoring

Element Name	Functional Object
CARTA Paratransit Vehicles (continued)	Transit Vehicle Schedule Management
	Transit Vehicle Security
CARTA Routing Application	Personal Interactive Traveler Information
CARTA Transit Kiosks	Transit Stop Information Services
	Traveler Fare Management
CARTA Transit Stop CCTV Camera Surveillance	Field Secure Area Sensor Monitoring
	Field Secure Area Surveillance
	ITS Management Support
	ITS Security Support
CARTA Website	TIC Data Collection
	TIC Trip Planning
Catoosa County 911 Dispatch	Emergency Call-Taking
	Emergency Dispatch
	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
	Emergency Routing
Catoosa County EMA	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
Catoosa Trans-Aid Data Archive	Archive Data Repository
	Archive Government Reporting
Catoosa Trans-Aid Dispatch Center	Emergency Secure Area Alarm Support
	Emergency Secure Area Sensor Management
	Emergency Secure Area Surveillance
	ITS Management Support

Element Name	Functional Object
Catoosa Trans-Aid Dispatch Center (continued)	Transit Center Data Collection
	Transit Center Paratransit Operations
	Transit Center Vehicle Tracking
	Transit Evacuation Support
Catoosa Trans-Aid Vehicles	Transit Vehicle On-Board Paratransit Operations
	Transit Vehicle On-Board Trip Monitoring
	Transit Vehicle Security
Catoosa Trans-Aid Website	TIC Traveler Information Broadcast
Chattanooga Parking Authority DMS	Roadway Traffic Information Dissemination
Chattanooga Parking Authority Facility Management	Parking Area Electronic Payment
	Parking Area Management
Chattanooga Parking Authority Smart Meters	Vehicle Basic Toll/Parking Payment
Chattanooga-Hamilton County Air Pollution Control Bureau	Emissions Data Management
Chattanooga-Hamilton County Air Pollution Control Bureau Website	TIC Traveler Information Broadcast
Chattanooga-Hamilton County Air Quality Sensors	Roadway Emissions Monitoring
CHCNGA TPO Information and Research Divsion Data Archive	Archive Data Repository
City of Chattanooga CCTV Cameras	Roadway Basic Surveillance
City of Chattanooga DMS	Roadway Traffic Information Dissemination
City of Chattanooga Field Sensors	Roadway Basic Surveillance
City of Chattanooga Fire Dispatch	Emergency Dispatch
City of Chattanooga Fire Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
City of Chattanooga Infrastructure Monitoring Sensors	Roadway Infrastructure Monitoring
City of Chattanooga Overheight Vehicle Detection	Roadway Basic Surveillance
	Roadway Warning
	TMC Roadway Warning

Element Name	Functional Object
City of Chattanooga Police Department	Emergency Data Collection
City of Chattanooga Police Dispatch	Emergency Dispatch
City of Chattanooga Police Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
City of Chattanooga Portable DMS	Roadway Work Zone Traffic Control
City of Chattanooga Public Works Department	MCM Environmental Information Collection
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Infrastructure Monitoring
	MCM Roadway Maintenance
	MCM Vehicle Tracking
	MCM Work Activity Coordination
	MCM Work Zone Management
City of Chattanooga Public Works Department Vehicles	MCV Vehicle Location Tracking
	MCV Work Zone Support
City of Chattanooga Rail Notification System	Roadway Standard Rail Crossing
City of Chattanooga Rectangular Rapid Flash Beacons	Roadway Mixed Use Crossing Safety
	Roadway Warning
City of Chattanooga Road Closure Gates	ITS Management Support
	ITS Security Support
	Roadway Barrier System Control
	Roadway Basic Surveillance
	Roadway Traffic Information Dissemination
	Roadway Work Zone Traffic Control
City of Chattanooga Road Closure Notification System	TIC Data Collection
	TIC Traveler Information Broadcast

Element Name	Functional Object
City of Chattanooga RWIS	Roadway Environmental Monitoring
City of Chattanooga Speed Monitoring Equipment	Roadway Speed Monitoring and Warning
City of Chattanooga TOC	MCM Infrastructure Monitoring
	TMC Basic Surveillance
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Multi-Modal Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring
	TMC Signal Control
	TMC Speed Warning
	TMC Standard Rail Crossing Management
	TMC Traffic Information Dissemination
	TMC Work Zone Traffic Management
City of Chattanooga Traffic Signals	Roadway Basic Surveillance
	Roadway Signal Control
	Roadway Standard Rail Crossing
City of Chattanooga Tunnel Bike Warning Beacons	Roadway Mixed Use Crossing Safety
	Roadway Warning
City of Chattanooga Website	TIC Data Collection
	TIC Traveler Information Broadcast
City of East Ridge CCTV Cameras	Roadway Basic Surveillance
City of East Ridge Field Sensors	Roadway Basic Surveillance
City of East Ridge Public Safety Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations

Element Name	Functional Object
City of East Ridge TOC	TMC Basic Surveillance
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring
	TMC Signal Control
	TMC Work Zone Traffic Management
City of East Ridge Traffic Signals	Roadway Basic Surveillance
	Roadway Signal Control
City of East Ridge Website	TIC Traveler Information Broadcast
City of Red Bank CCTV Cameras	Roadway Basic Surveillance
City of Red Bank Field Sensors	Roadway Basic Surveillance
City of Red Bank Public Safety Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
City of Red Bank TOC	TMC Basic Surveillance
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring
	TMC Signal Control
	TMC Work Zone Traffic Management
City of Red Bank Traffic Signals	Roadway Basic Surveillance
	Roadway Signal Control
City of Red Bank Website	TIC Traveler Information Broadcast

Element Name	Functional Object
City of Soddy-Daisy 911 Dispatch	Emergency Call-Taking
	Emergency Dispatch
	Emergency Early Warning System
	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
City of Soddy-Daisy CCTV Cameras	Roadway Basic Surveillance
City of Soddy-Daisy Field Sensors	Roadway Basic Surveillance
City of Soddy-Daisy Public Safety Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
City of Soddy-Daisy TOC	TMC Basic Surveillance
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring
	TMC Signal Control
	TMC Work Zone Traffic Management
City of Soddy-Daisy Traffic Signals	Roadway Basic Surveillance
	Roadway Signal Control
City of Soddy-Daisy Website	TIC Traveler Information Broadcast
Dade County 911 Dispatch	Emergency Call-Taking
Dade County 911 Dispatch	Emergency Dispatch
Dade County 911 Dispatch	Emergency Evacuation Support
Dade County 911 Dispatch	Emergency Incident Command
Dade County 911 Dispatch	Emergency Response Management

Element Name	Functional Object
Dade County 911 Dispatch (continued)	Emergency Routing
Dade County EMA	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
Dade County Transit Data Archive	Archive Data Repository
	Archive Government Reporting
Dade County Transit Dispatch Center	Emergency Secure Area Alarm Support
	Emergency Secure Area Sensor Management
	Emergency Secure Area Surveillance
	ITS Management Support
	Transit Center Data Collection
	Transit Center Multi-Modal Coordination
	Transit Center Paratransit Operations
	Transit Center Security
	Transit Center Vehicle Tracking
	Transit Evacuation Support
Dade County Transit Vehicles	Transit Vehicle On-Board Paratransit Operations
	Transit Vehicle On-Board Trip Monitoring
	Transit Vehicle Security
Dade County Transit Website	TIC Traveler Information Broadcast
GDOT Atlanta TMC	TMC Basic Surveillance
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring

Element Name	Functional Object
GDOT Atlanta TMC (continued)	TMC Signal Control
	TMC Traffic Information Dissemination
	TMC Traffic Metering
	TMC Work Zone Traffic Management
GDOT CCTV Cameras	Roadway Basic Surveillance
GDOT District 6 Construction and Maintenance	MCM Incident Management
	MCM Roadway Maintenance
	MCM Vehicle Tracking
	MCM Work Activity Coordination
	MCM Work Zone Management
GDOT District 6 Dalton Area Office	TMC Basic Surveillance
	TMC Roadway Equipment Monitoring
	TMC Signal Control
GDOT District 6 Dalton/Whitfield County	TMC Basic Surveillance
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring
	TMC Signal Control
	TMC Traffic Information Dissemination
	TMC Traffic Metering
	TMC Work Zone Traffic Management
GDOT DMS	Roadway Traffic Information Dissemination
	Roadway Work Zone Traffic Control
GDOT Emergency Services Coordinator	MCM Incident Management
	MCM Roadway Maintenance

Element Name	Functional Object
GDOT Emergency Services Coordinator (continued)	TMC Evacuation Support
	TMC Incident Dispatch Coordination
GDOT Field Sensors	Roadway Basic Surveillance
GDOT HERO Vehicles	EV On-Board En Route Support
	EV On-Board Incident Management Communication
	EV Service Patrol Vehicle Operations
GDOT Maintenance Vehicles	MCV Vehicle Location Tracking
	MCV Work Zone Support
GDOT Public Information Office	TIC Traveler Information Broadcast
GDOT Smart Work Zone Equipment	Roadway Work Zone Traffic Control
GDOT Statewide Construction and Maintenance System	MCM Work Activity Coordination
	MCM Work Zone Management
GDOT Traffic Signals	Roadway Basic Surveillance
	Roadway Signal Control
GEMA	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
Georgia 511 System	TIC Data Collection
	TIC Interactive Traveler Information
	TIC Traveler Telephone Information
Georgia NaviGAtor System	TMC Basic Surveillance
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Roadway Equipment Monitoring
	TMC Traffic Information Dissemination
	TMC Work Zone Traffic Management

Element Name	Functional Object
GreenTrips Website	TIC Data Collection
	TIC Interactive Traveler Information
	TIC Traveler Telephone Information
GSP Troop A Dispatch	Emergency Call-Taking
	Emergency Dispatch
	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
GSP Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
Hamilton County E911	Emergency Call-Taking
	Emergency Dispatch
	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
	Emergency Routing
	Emergency Secure Area Alarm Support
Hamilton County EMA	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
Hamilton County EMS	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
Hamilton County Sheriff Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
Hamilton County Sheriffs Office	Emergency Data Collection
MCCD Truck Weigh and Inspection Station	CVAC Credentials and Taxes Administration

Element Name	Functional Object
MCCD Weigh-in-Motion	CVCE Weigh-In-Motion
Municipal CCTV Cameras	Roadway Basic Surveillance
Municipal Field Sensors	Roadway Basic Surveillance
Municipal Police Department	Emergency Data Collection
Municipal Rail Notification System	Roadway Standard Rail Crossing
Municipal TOC	TMC Basic Surveillance
	TMC Environmental Monitoring
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring
	TMC Signal Control
	TMC Standard Rail Crossing Management
	TMC Traffic Metering
	TMC Work Zone Traffic Management
Municipal Traffic Signals	Roadway Basic Surveillance
	Roadway Signal Control
	Roadway Standard Rail Crossing
Municipal/County Maintenance	MCM Environmental Information Collection
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Roadway Maintenance
	MCM Vehicle Tracking
	MCM Work Activity Coordination
	MCM Work Zone Management

Element Name	Functional Object
Municipal/County Maintenance Vehicles	MCV Vehicle Location Tracking
	MCV Work Zone Support
Municipal/County Portable DMS	Roadway Work Zone Traffic Control
Municipal/County Public Safety Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations
Municipal/County RWIS	Roadway Environmental Monitoring
Municipal/County Website	TIC Data Collection
	TIC Traveler Information Broadcast
Municipal/State ActiveITS Platform	TIC Connected Vehicle Traveler Info Distribution
	TIC Data Collection
	TIC Traveler Information Broadcast
	TIC Trip Planning
Oak Ridge National Laboratory	Emissions Data Management
Oak Ridge National Laboratory Emissions Sensors	Roadway Emissions Monitoring
Other GDOT District Construction and Maintenance	MCM Work Activity Coordination
Other TDOT Region Construction Office	MCM Work Activity Coordination
Other TDOT Region District Operations	MCM Work Activity Coordination
Personal Computing Devices	Personal Interactive Traveler Information
Private Commercial Vehicle Dispatch Centers	Fleet Administration
	Freight Administration and Management
Private Sector Traveler Information Services	TIC Trip Planning
Private Vehicle	Vehicle Basic Toll/Parking Payment
Public/Private Vehicles	Vehicle Emissions Monitoring
Regional Transit Coordination Center	Transit Center Paratransit Operations
Social Networking Services	TIC Traveler Information Broadcast
TDOT CCTV Cameras	Roadway Basic Surveillance

Element Name	Functional Object
TDOT CCTV Cameras (continued)	Roadway Work Zone Traffic Control
TDOT Changeable Speed Limit Signs	Roadway Speed Monitoring and Warning
	Roadway Variable Speed Limits
TDOT Community Relations Divisions	TIC Data Collection
	TIC Traveler Information Broadcast
TDOT DMS	Roadway Traffic Information Dissemination
	Roadway Work Zone Traffic Control
TDOT Emergency Services Coordinator	MCM Incident Management
	MCM Roadway Maintenance
	TMC Evacuation Support
	TMC Incident Dispatch Coordination
TDOT Field Sensors	Roadway Basic Surveillance
TDOT Fog Sensors	Roadway Environmental Monitoring
TDOT Fog Zone Speed Detection	Roadway Basic Surveillance
	Roadway Speed Monitoring and Warning
TDOT HAR	Roadway Traffic Information Dissemination
	Roadway Work Zone Traffic Control
TDOT HELP Vehicles	EV On-Board En Route Support
	EV On-Board Incident Management Communication
	EV Service Patrol Vehicle Operations
TDOT Maintenance Headquarters	MCM Environmental Information Collection
	MCM Environmental Information Processing
TDOT Maintenance Vehicles	MCV Vehicle Location Tracking
	MCV Work Zone Support
TDOT On-Ramp Closure Gates	ITS Management Support
	ITS Security Support

Element Name	Functional Object
TDOT On-Ramp Closure Gates (continued)	Roadway Barrier System Control
TDOT Protect the Queue Vehicles	EV On-Board En Route Support
	EV On-Board Incident Management Communication
	EV Service Patrol Vehicle Operations
TDOT Ramp Metering Equipment	Roadway Basic Surveillance
	Roadway Traffic Information Dissemination
	Roadway Traffic Metering
TDOT Region 1 TMC - Knoxville	TMC Regional Traffic Management
	TMC Signal Control
	TMC Traffic Metering
TDOT Region 2 District Operations	MCM Incident Management
	MCM Roadway Maintenance
TDOT Region 2 TMC - Chattanooga	ITS Management Support
	ITS Security Support
	TMC Barrier System Management
	TMC Basic Surveillance
	TMC Data Collection
	TMC Environmental Monitoring
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination
	TMC Regional Traffic Management
	TMC Roadway Equipment Monitoring
	TMC Signal Control
	TMC Speed Warning
	TMC Traffic Information Dissemination

Element Name	Functional Object
TDOT Region 2 TMC – Chattanooga (continued)	TMC Traffic Metering
	TMC Variable Speed Limits
	TMC Work Zone Traffic Management
TDOT Region 3 TMC - Nashville	TMC Regional Traffic Management
	TMC Signal Control
	TMC Traffic Metering
TDOT Region 4 TMC - Memphis	TMC Regional Traffic Management
	TMC Signal Control
	TMC Traffic Metering
TDOT RWIS Sensors	Roadway Environmental Monitoring
TDOT Smart Work Zone Equipment	Roadway Work Zone Traffic Control
TDOT SmartWay Website	TIC Data Collection
	TIC Emergency Traveler Information
	TIC Interactive Traveler Information
	TIC Traveler Information Broadcast
TDOT Statewide Information for Travelers (SWIFT)	MCM Environmental Information Processing
	MCM Incident Management
	TIC Data Collection
	TIC Emergency Traveler Information
	TIC Interactive Traveler Information
	TIC Operations Data Collection
	TIC Traveler Information Broadcast
TDOT Strategic Transportation Investments Division Archive	Archive Data Repository
	Archive Government Reporting
	TMC Data Collection
TEMA	Emergency Evacuation Support

Element Name	Functional Object
TEMA (continued)	Emergency Incident Command
	Emergency Response Management
Tennessee 511 System	TIC Data Collection
	TIC Emergency Traveler Information
	TIC Interactive Traveler Information
	TIC Traveler Telephone Information
Tennessee Bureau of Investigation	Emergency Incident Command
	Emergency Response Management
THP Dispatch	Emergency Call-Taking
	Emergency Dispatch
	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
THP District 2 Office	Emergency Environmental Monitoring
	Emergency Response Management
	ITS Management Support
	ITS Security Support
	TMC Barrier System Management
	TMC Basic Surveillance
	TMC Environmental Monitoring
	TMC Roadway Equipment Monitoring
	TMC Speed Warning
	TMC Traffic Information Dissemination
THP Truck Weigh and Inspection Station	CVAC Credentials and Taxes Administration
THP Vehicles	EV On-Board En Route Support
	EV Service Patrol Vehicle Operations

Element Name	Functional Object
THP Weigh-in-Motion	CVCE Weigh-In-Motion
TITAN Database	Archive Data Repository
	Archive Government Reporting
Walker County 911 Dispatch	Emergency Call-Taking
	Emergency Dispatch
	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
	Emergency Routing
Walker County EMA	Emergency Evacuation Support
	Emergency Incident Command
	Emergency Response Management
Walker County Transit Data Archive	Archive Data Repository
	Archive Government Reporting
Walker County Transit Dispatch Center	Emergency Secure Area Alarm Support
	Emergency Secure Area Sensor Management
	Emergency Secure Area Surveillance
	ITS Management Support
	Transit Center Data Collection
	Transit Center Multi-Modal Coordination
	Transit Center Paratransit Operations
	Transit Center Security
	Transit Center Vehicle Tracking
	Transit Evacuation Support
Walker County Transit Vehicles	Transit Vehicle On-Board Paratransit Operations
	Transit Vehicle On-Board Trip Monitoring

Element Name	Functional Object
Walker County Transit Vehicles (continued)	Transit Vehicle Security
Walker County Transit Website	TIC Traveler Information Broadcast

APPENDIX D – COPIES OF EXISTING REGIONAL ITS AGREEMENTS

CLEVELAND URBAN AREA MPO AND CHCNGA-TPO MEMORANDUM OF AGREEMENT

TDOT LIVE CCTV VIDEO ACCESS AGREEMENT FOR GOVERNMENTAL USERS

TDOT LIVE CCTV VIDEO ACCESS AGREEMENT FOR PRIVATE ENTITY USERS

TDOT, THP, AND MUNICIPAL GOVERNMENT OPEN ROADS AGREEMENT

CITY OF CHATTANOOGA AND CITY OF EAST RIDGE TRAFFIC SIGNAL MAINTENANCE AGREEMENT

CITY OF CHATTANOOGA AND CITY OF RED BANK TRAFFIC SIGNAL MAINTENANCE AGREEMENT

MEMORANDUM OF AGREEMENT
BETWEEN CLEVELAND URBAN AREA METROPOLITAN PLANNING ORGANIZATION
AND
CHATTANOOGA-HAMILTON COUNTY/NORTH GEORGIA TRANSPORTATION PLANNING ORGANIZATION

This Memorandum of Agreement between the Cleveland Urban Area Metropolitan Planning Organization (MPO) and the Chattanooga-Hamilton County/North Georgia Transportation Planning Organization (TPO) is executed to establish a cooperative relationship on the deployment of mutually benefiting Intelligent Transportation Systems (ITS) which serve motorists and the traveling public within and between each respective planning area.

Both the Cleveland Urban Area MPO and the Chattanooga-Hamilton County/North Georgia TPO are responsible for establishing a continuing, cooperative, and comprehensive multimodal transportation planning process for each of their respective planning areas, that encourages and promotes the safe and efficient development, management, and operation of surface transportation systems to serve the mobility needs of people and freight and foster economic growth and development, while minimizing transportation-related fuel consumption and air pollution.

The Final Rule on ITS Architecture and Standards, published in 23 CFR Part 940, requires that all ITS projects using Federal Funds conform to a regional ITS architecture which adheres to the National ITS Architecture and Standards, and is based on a systems engineering analysis. Development of the regional ITS architecture must be consistent with the statewide and metropolitan transportation planning processes.

The Cleveland Urban Area MPO and the Chattanooga-Hamilton County/North Georgia TPO acknowledge the importance of interstate travel in the region, and the significance of ITS applications along Interstate 75 (I-75), such as the Fog Detection System. Equally, the Cleveland Urban Area MPO and the Chattanooga-Hamilton County/North Georgia TPO recognize that each MPO/TPO planning area has unique local travel demands and travel markets which necessitate separate ITS Architectures for their respective planning areas.

The Cleveland Urban Area MPO and Chattanooga-Hamilton County/North Georgia TPO agree:

1. To develop and maintain separate ITS Architectures for their respective MPO/TPO area;

2. To actively coordinate and cooperate in the development and maintenance of each others' respective Regional ITS Architectures;

3. That the Interstate 75 Fog Detection System will be included in the Chattanooga-Hamilton County/North Georgia TPO Regional ITS Architecture, given that the command and control operations of the system are located in Chattanooga; and

This agreement will remain in effect until terminated by any of the parties. Amendments to this agreement may be made by mutual agreement of both parties and approval by each respective Executive Board.

Adopted this 9th day of July, 2014

Chairman, MPO Executive Board
Cleveland Urban Area
Metropolitan Planning Organization

Adopted this 17th day of JUNE, 2014

Chairman, Executive Board
Chattanooga-Hamilton County/North Georgia
Transportation Planning Organization

Tennessee Department of Transportation

TRAFFIC OPERATIONS PROGRAM POLICY

Effective Date:
Title: Access to Live Video

POLICY

The Tennessee Department of Transportation (TDOT) will make live video of traffic conditions from Closed Circuit Television (CCTV) available to the public. CCTV images will be supplied from the Chattanooga Regional Transportation Management Center (RTMC) at the site of the future TDOT Region 2 Complex. The video images provided will be those selected by the RTMC Operators from the images on the traffic surveillance monitors within the RTMC and that are consistent with the objectives of traffic management.

Live video images will generally be made available upon request to other government and public agencies to better coordinate traffic management strategies on incidents and crashes, and to private news media and other companies for their use in providing traffic information to the public or their customers.

A non-exclusive access agreement is required in order for governmental and private interests to receive direct access to live video. Costs for the access connection will be determined by TDOT and paid for by the USER.

BACKGROUND

In order to gather real-time traffic condition information, TDOT has constructed and operates an RTMC at the site of the future Region 2 Complex on Volkswagen Drive. The RTMC is the central collection point for freeway condition information. The RTMC support systems gather and disseminate traffic information using the latest technologies.

CCTV has proven to be a significant management and delay-reduction tool for the identification and verification of incidents and crashes, thereby enabling a proper and timely response. The sharing of video information enhances the communication of current traffic conditions, thereby aiding travelers in planning their trip times, routes, and travel mode using the latest available information. TDOT will operate and maintain the CCTV system for the purpose of enhancing response to traffic incidents on the Chattanooga regional freeway system. TDOT wishes to share that traffic information with other transportation operating agencies, incident response agencies and the public.

Live CCTV Video Access Agreement Between
Tennessee Department of Transportation
And
Governmental Agency Users

Tennessee Department of Transportation
And
Governmental Agency Users

ACCESS AGREEMENT FOR LIVE VIDEO

This Access Agreement for Live Video (Agreement) is an agreement between the Tennessee Department of Transportation (TDOT) and _____, hereafter referred to as the "USER."

The effective date of this Agreement is _____.

The "Access to Live Video" is that video provided by a Closed Circuit Television (CCTV) system developed for traffic management and provided by the Chattanooga Regional Transportation Management Center (RTMC) which is operated by TDOT. The CCTV images will show live traffic conditions, including crashes, stalled vehicles, road hazards, weather conditions, traffic congestion, and maintenance and repair work locations.

The purpose of providing the USER with Access to Live Video is to disseminate real-time traffic information to motorists and to help improve incident management response times. The following provisions of this Agreement are provided to ensure that the CCTV system is accessed and its information used for this purpose and this purpose alone.

The USER hereby acknowledges that other matters not addressed in this Agreement may arise after the signing of this Agreement. Therefore, TDOT reserves the right to make changes in this Agreement, by adding provisions, deleting provisions, and/or changing existing provisions when in TDOT's opinion circumstances require such changes.

A. GENERAL INFORMATION:

1. TDOT will operate and maintain the CCTV system as a traffic management tool and, consistent with this purpose, TDOT agrees to provide the USER with Access to Live Video. TDOT does not guarantee the continuity of this access, and TDOT does not warrant the quality of any video image or the accuracy of any image or information provided. Any reliance on such images or information is at the risk of the USER.

2. TDOT will not record video images except for staff training purposes, and no videotapes will be made available to the USER under this Agreement.

3. TDOT will maintain exclusive control of the information and images released from the CCTV system to the USER, including but not limited to determining whether and when to provide a CCTV system feed, from what location, and for what duration. No feed will deploy the cameras' zoom capabilities, and no image will focus on vehicle license plates, drivers, or other personal identification of individuals involved in any

traffic-related incident. No image will focus on any property or person outside the TDOT right-of-way. Access via feed will not be provided for events that are not, in the opinion of TDOT personnel, traffic-related. The decision whether to activate, and upon activation to terminate the access, is exclusively at the discretion of TDOT personnel.

4. RTMC personnel will not accept requests that specific CCTV cameras be operated or that cameras be repositioned.

5. Each USER will receive the same video feed from the CCTV system as any other USER participating in this Agreement. This Agreement in no way limits or restricts TDOT from providing video information to any other potential USER.

6. TDOT reserves the right to terminate this video access program or to change the areas, times, or levels of access within the RTMC at any time.

B. USER'S RESPONSIBILITIES:

1. USER, through this Agreement, may be allowed to control the pan, tilt and zoom capabilities of selected CCTV cameras. TDOT will maintain an override capability of these functions.

2. USER agrees not to focus on vehicle license plates, drivers, or other personal identification of individuals involved in any traffic-related incident, nor focus on any property or person outside the TDOT right-of-way. USER further agrees to access the feed only for traffic-related or emergency response activities.

3. USER may install necessary equipment at the RTMC in order to obtain the video feed; the USER is exclusively responsible for any costs related to the purchase and installation of the equipment. TDOT personnel shall determine at what location within the RTMC the equipment is to be placed, and TDOT reserves the right to inspect all installation of equipment. Under no circumstances shall the placement and installation of USER's equipment interfere with RTMC equipment or activities of RTMC personnel. The responsibility for the service, maintenance, and upkeep of the installed equipment is exclusively that of the USER. USER must give RTMC personnel reasonable advance notice of any maintenance/repair visits, and RTMC personnel reserve the right to schedule such visits at a time and in such a manner so as to not interrupt or otherwise obstruct RTMC operations. USER assumes any and all liability for the cost of repair and/or other damages to TDOT's CCTV system caused in any manner by the installation, servicing or maintenance of the USER equipment or by the equipment once installed. USER staff at the RTMC shall be under the general direction of the RTMC Manager for routine conduct, privileges, and protocols within the RTMC.

4. USER shall maintain the security and integrity of the CCTV system by limiting use of the system to trained and authorized individuals, and by insuring that the system is used for the specific purpose stated in this Agreement. No feed shall be purposely

broadcast live or rebroadcast that is zoomed in on an accident where individuals or license numbers are recognizable.

5. USER agrees to move or alter, at its own expense, any of its equipment, hardware, or software, as TDOT deems necessary to accommodate future alterations, improvements, or other changes to the RTMC equipment or facilities.

6. USER accepts all risks inherent with the live video feeds, including, but not limited to, interruptions in the video feed, downtime for maintenance, or unannounced adjustments to the camera displays. TDOT is providing the video feeds as a convenience to the USER and agrees to provide a good faith effort to maintain the video feed from TDOT equipment.

7. USER agrees to provide TDOT with a technical contact person and with a list of all USER'S owned and supplied equipment connected to the RTMC, including the basic operational capabilities of such equipment. USER shall limit calls to the RTMC for monitoring, diagnosing problems or otherwise performing any minor service on USER owned and supplied equipment.

8. USER agrees that video feed will not be used for automated traffic enforcement purposes unless it is specifically allowed by legislation.

C. LIABILILTY AND INDEMNITY PROVISIONS:

1. The USER agrees to be responsible for any and all liability and expense, including defense costs and legal fees, caused by the negligent or wrongful act or omission of the USER, or its agents, officers, and employees, in the use, possession, or dissemination of information made available from the CCTV system to the extent provided by law, including but not limited to, personal injury, bodily injury, death, property damage, and/or injury to privacy or reputation.

2. The liability obligations assumed by the USER pursuant to this Agreement shall survive the termination of this Agreement, as to any and all claims, including without limitation liability for any damages to TDOT property or for personal injury, death, property damage, or injury to personal reputation or privacy occurring as a proximate result of information made available from the CCTV system.

D. TERMINATION:

1. TDOT or USER may terminate this Agreement any time for any reason by providing written notice of termination.

2. Upon termination of this Agreement by either party, the USER shall promptly remove its equipment from the RTMC as directed by TDOT.

State of Tennessee
Department of Transportation

By:_____ Date:_____
John Schroer
Commissioner

Approved as to Form:

By:_____ Date: _____
General Counsel

USER AGENCY:_____

By_____

(Print Name)_____

(Title)_____

Date:_____

Approved by Legal Counsel for USER AGENCY

By_____

(Print Name)_____

(Title)_____

Date:_____

Tennessee Department of Transportation

TRAFFIC OPERATIONS PROGRAM POLICY

Effective Date: July 1st 2012
Title: Access to Live Video

POLICY

The Tennessee Department of Transportation (TDOT) will make live video of traffic conditions from Closed Circuit Television (CCTV) available to the public. CCTV images will be supplied from a Regional Transportation Management Center (RTMC) which are located in each of TDOT's four regions. The video images provided will be those selected by the RTMC Operators from the images on the traffic surveillance monitors within the RTMC and that are consistent with the objectives of traffic management.

Live video images will generally be made available upon request to other government and public agencies to better coordinate traffic management strategies on incidents and crashes, and to private news media and other companies for their use in providing traffic information to the public or their customers.

A non-exclusive access agreement is required in order for governmental and private interests to receive direct access to live video. Costs for access connection are solely the responsibility of the USER and are not set by TDOT.

BACKGROUND

In order to gather real-time traffic condition information, TDOT has constructed and operates an RTMC within each of TDOT's four regions. The RTMC is being developed into the central collection point for freeway condition information. The RTMC support systems gather and disseminate traffic information using the latest technologies.

CCTV has proven to be a significant management and delay-reduction tool for the identification and verification of incidents and crashes, thereby enabling a proper and timely response. The sharing of video information enhances the communication of current traffic conditions, thereby aiding travelers in planning their trip times, routes, and travel mode using the latest available information. TDOT will operate and maintain the CCTV system for the purpose of enhancing traffic incident response on each regional freeway system. TDOT wishes to share that traffic information with other transportation operating agencies, incident response agencies and the public.

Live CCTV Video Access Agreement Between
Tennessee Department of Transportation
And
Private Entity Users

Tennessee Department of Transportation
And
Private Entity Users

ACCESS AGREEMENT FOR LIVE VIDEO

This Access Agreement for Live Video (Agreement) is an agreement between the Tennessee Department of Transportation (TDOT) and _____, hereafter referred to as the "USER."

The effective date of this Agreement is July 1st 2012. This Agreement replaces and supersedes any and all other agreements between the parties with respect to the same subject matter.

The "Access to Live Video" is that video provided by a Closed Circuit Television (CCTV) system developed for traffic management and provided by the Regional Transportation Management Center (RTMC) which is operated by TDOT. The CCTV images will show live traffic conditions including crashes, stalled vehicles, road hazards, weather conditions, traffic congestion, and maintenance and repair work locations.

The purpose of providing the USER with Access to Live Video is to disseminate real-time traffic information to motorists and to help improve incident management response times. The following provisions of this Agreement are intended to ensure that the CCTV system is accessed and its information used for this purpose and this purpose alone.

The USER hereby acknowledges that other matters not addressed in this Agreement may arise after the signing of this Agreement. Therefore, TDOT reserves the right to make changes in this Agreement by adding provisions, deleting provisions, and/or changing existing provisions when in TDOT's opinion circumstances require such changes.

A. GENERAL INFORMATION:

1. TDOT will operate and maintain the CCTV system as a traffic management tool and, consistent with this purpose, TDOT agrees to provide the USER with Access to Live Video. TDOT does not guarantee the continuity of this access, and TDOT does not warrant the quality of any video image or the accuracy of any image or information provided. Any reliance on such images or information is at the risk of the USER.

2. TDOT will not record video images except for staff training purposes, and no video captures will be made available to the USER under this Agreement.

3. TDOT will maintain exclusive control of the information and images released from the CCTV system to the USER, including but not limited to determining whether and when to provide a CCTV system feed, from what location, and for what duration. No feed will deploy the cameras' zoom capabilities, and no image will focus on vehicle license plates, drivers, or other personal identification of individuals involved in any traffic-related incident. No image will focus on any property or person outside the TDOT right-of-way. Access via feed will not be provided for events that are not, in the opinion of TDOT personnel, traffic-related. The decision whether to activate, and upon activation to terminate the access, is exclusively at the discretion of TDOT personnel.

4. RTMC personnel will not accept requests that specific CCTV cameras be operated or that camera's be repositioned.

5. Each USER will receive the same video feed from the CCTV system as any other USER participating in this Agreement. This Agreement in no way limits or restricts TDOT from providing video information to any other potential USER.

6. TDOT reserves the right to terminate this video access program or to change the areas, times, or levels of access within the RTMC at any time.

B. USER'S RESPONSIBILITIES:

1. USER may install necessary equipment at the RTMC in order to obtain the video feed; the USER is exclusively responsible for any costs related to the purchase and installation of the equipment. TDOT personnel shall determine the amount of rack space that will be provided and at what location within the RTMC the equipment will be placed. TDOT reserves the right to inspect all installed equipment and its configuration. Under no circumstances shall the placement and installation of USER's equipment interfere with RTMC equipment or activities of RTMC personnel. The responsibility for the service, maintenance, and upkeep of the installed equipment is exclusively that of the USER. USER must give RTMC personnel reasonable advance notice of any maintenance/repair visits, and RTMC personnel reserves the right to schedule such visits at a time and in such a manner so as to not interrupt or otherwise obstruct RTMC operations. USER assumes any and all liability, to the extent provided by law, for the cost of any repair and/or other damages to TDOT's CCTV system caused in any manner by the installation, servicing or maintenance of the USER's equipment or by the equipment once installed. USER staff at the RTMC shall be under the general direction of the RTMC Manager for routine conduct, privileges, and protocols within the RTMC.

2. USER shall maintain the security and integrity of the CCTV system by limiting use of the system to trained and authorized individuals, and by insuring the system is used for the specific purpose stated in this Agreement. No feed shall be purposely

broadcast live or rebroadcast that is zoomed in on an accident where individuals or license numbers are recognizable.

3. USER agrees to move or alter, at its own expense, any of its equipment, hardware, or software, as TDOT deems necessary to accommodate future alterations, improvements, or other changes to the RTMC equipment or facilities.

4. USER accepts all risks inherent with the live video feeds, including, but not limited to, interruptions in the video feed, downtime for maintenance, or unannounced adjustments to the camera displays. TDOT is providing the video feeds as a convenience to the USER and agrees to provide a good faith effort to maintain the video feed from TDOT equipment. The USER agrees to hold TDOT harmless, including TDOT employees and TDOT-designated agents, from any damages caused to USER by loss of a video signal due to equipment failure or any act or omission on their part.

5. USER agrees to provide TDOT with a technical contact person and with a list of all USER's owned and supplied equipment connected to the RTMC, including the basic operational capabilities of such equipment. USER shall limit calls to the RTMC for monitoring, diagnosing problems or otherwise performing any minor service on USER owned and supplied equipment.

6. USER agrees to acknowledge the video images are provided by the Tennessee Department of Transportation. This must be done by showing either of the two TDOT SmartWay logos provided by TDOT (unaltered) that is readable to the viewer and shown during the entire use of camera images.

C. LIABILITY AND INDEMNITY PROVISIONS:

1. To the extent provided by law, the USER agrees to defend, indemnify, and hold TDOT harmless from and against any and all liability and expense, including defense costs and legal fees, caused by any negligent or wrongful act or omission of the USER, or its agents, officers, and employees, in the use, possession, or dissemination of information made available from the CCTV system to the extent that such expenses or liability may be incurred by TDOT, including but not limited to, personal injury, bodily injury, death, property damage, and/or injury to privacy or reputation.

2. The liability obligations assumed by the USER pursuant to this Agreement shall survive the termination of this Agreement, as to any and all claims including without limitation liability for any damages to TDOT property or for injury, death, property damage, or injury to personal reputation or privacy occurring as a proximate result of information made available from the CCTV system.

D. TERMINATION:

1. TDOT or USER may terminate this Agreement at any time for any reason by providing written notice of termination.

2. Upon termination of this Agreement by either party, the USER shall promptly remove its equipment from the RTMC as directed by TDOT.

State of Tennessee
Department of Transportation

Approved as to Form:

By:_____ _____
JOHN C. SCHROER
Commissioner General Counsel

Date:_____

USER AGENCY_____

By_____

(Print Name)_____

(Title)_____

Date:_____

Approved by Legal Counsel for USER AGENCY

By_____

(Print Name)_____

(Title)_____

Date:_____

State of Tennessee

"OPEN ROADS POLICY"

Quick Clearance for Safety and Mobility

Between the Tennessee Department of Transportation,

Tennessee Department of Safety and Homeland Security, and

Tennessee Counties and Cities

This Memorandum of Understanding (MOU) by and between the Tennessee Department of Transportation (TDOT), the Tennessee Department of Safety and Homeland Security (TDOSHS), County/City Law Enforcement and Fire and Rescue Agencies (City/County Agencies), establishes a policy for the Tennessee Highway Patrol (THP), TDOT, City/County Agencies to expedite the removal of vehicles, cargo, and debris from roadways on the State Highway System (roadways) to restore, in an URGENT MANNER the safe and orderly flow of traffic following a motor vehicle crash or incident on Tennessee's roadways. This MOU is intend to complement the existing Memorandum of Understanding between TDOT and TDOSHS entered into on February 16, 2012, and does not supersede or circumvent any of the components of that document between the two State departments.

Whereas: Public safety is the highest priority and must be maintained especially when injuries or hazardous materials are involved. The quality of life in the State of Tennessee is heavily dependent upon the free movement of people, vehicles, and commerce. THP, TDOT, and City/County Agencies share the responsibility for achieving and maintaining the degree of order necessary to make this free movement possible. THP, TDOT, and City/County Agencies have the responsibility to do whatever is reasonable to reduce the risk to responders, secondary crashes, and delays associated with incidents, crashes, roadway maintenance, construction, and enforcement activities.

The following operating standards are based on the philosophy that the State Highway System will not be closed or restricted any longer than is absolutely necessary.

Be it resolved: Roadways will be cleared of damaged vehicles, spilled cargo, and debris as soon as it is safe to do so. It is understood that damage to vehicles or cargo may occur as a result of clearing the roadway on an urgent basis. While reasonable attempts to avoid such damage shall be taken, the highest priority is restoring traffic to normal conditions. Incident caused congestion has an enormous cost to society. This cost is significantly greater than the salvage value of an already damaged vehicle and its cargo.

Tennessee Highway Patrol Responsibilities

Members of the THP who respond to the scene of traffic incidents will make clearing the travel portion of the roadway a high priority. When an investigation is required, it will be conducted in as expedient a manner as possible considering the severity of the collision. Non-critical portions of the investigation may be delayed until lighter traffic conditions allow completion of those tasks. The THP will only close those lanes absolutely necessary to conduct the investigation safely. THP will coordinate with TDOT representatives to set up appropriate traffic control, establish alternate routes, expedite the safe movement of traffic trapped at the scene, and restore the roadway to normal as soon as possible.

Whenever practical, crashes on access controlled roadways will be removed to off ramps, accident investigation sites or other safe areas for completion of investigations to reduce the delays associated with motorists slowing to "gawk". Tow trucks will be requested a soon as it is evident that they will be needed to clear the roadway. THP will assure that all authorized tow operators have met established competency levels and that the equipment is of appropriate size, capacity and design meeting the standards for the State of Tennessee.

The THP will not unnecessarily cause the delay in reopening all or part of a roadway to allow a company to dispatch their own equipment to off-load cargo or recover a vehicle or load that is impacting traffic during peak traffic hours or creating a hazard to the public. The THP and TDOT will cooperate in planning and implementing clearance operations in the most safe and expeditious manner.

Tennessee Department of Transportation Responsibilities

When requested by the THP or City/County Agencies, TDOT will respond and deploy resources to major traffic incidents 24 hours a day, 7 days per week. Each TDOT District will develop and implement response procedures to meet the goal of providing initial traffic control within **30 minutes** of notification during normal working hours and **60 minutes** after hours and on weekends.

TDOT, in cooperation with the THP, will determine and deploy the necessary heavy equipment and manpower to reopen the roadway if clearance of the travel lanes are being delayed or is determined that the task is beyond the capabilities of the wrecker service on scene. If cargo or non-hazardous spilled loads are involved, TDOT will make every effort to assist in the relocation of the materials in the shortest possible time, using whatever equipment necessary. All such materials or any vehicles relocated by TDOT will be moved as short a distance as possible to eliminate the traffic hazard.

TDOT personnel will document all hours and equipment used for traffic control, roadway clearance, and debris clean up. TDOT will place traffic control devices at the scene should any damaged vehicles or cargo remain adjacent to the travel lanes on the shoulder for removal at a later time.

The THP and TDOT will continually work together to ensure that the needs of motorists on our roadways are being met in the most professional, safe, and efficient manner.

Local Law Enforcement, Fire and Rescue Department Responsibilities

Members of City/County Agencies who respond to the scene of traffic incidents will make clearing the travel portion of the roadway a high priority. When investigating an incident, the investigation will be conducted in as expedient a manner as possible considering the severity of the collision (serious injuries, fatality, or hazardous materials). City/County Agencies will close only those lanes absolutely necessary to safely conduct the fire/rescue operations. City/County Agencies will coordinate with TDOT representatives to set up appropriate traffic control, establish alternate routes, expedite the safe movement of traffic trapped at the scene, and restore the roadway to normal conditions as soon as possible. As soon as TDOT has set up appropriate traffic control for the safety of the responders and travelers, City/County Agencies will move any fire/rescue apparatus or vehicles initially used to shield responders to appropriate areas.

Therefore, it is agreed as follows:

The THP, TDOT, and City/County Agencies, will evaluate and continually update and modify their operating policies, procedures, rules, and standards to assure they are consistent with this **"OPEN ROADS POLICY"** MOU.

The THP, TDOT, and City/County Agencies, will research, evaluate and conduct training in the most advanced technologies, equipment, and approved methods for the documentation and investigation of crash or incident scenes. THP and City/County Agencies will prioritize the investigative tasks and reopen travel lanes upon completion of tasks that must be conducted, without the impediment of traffic flowing.

Roadways will be cleared as soon as possible. It is the goal of THP, TDOT, and City/County Agencies that **all incidents be cleared from the roadway within 90 minutes of the arrival of the first responding officer.** This goal is being made with the understanding that a more complex scenario may require additional time for complete clearance. Incidents that extend beyond the 90 minute goal will be assessed every 30 minutes to determine an expected clearance time and reported to the appropriate communications center.

City/County Agencies will determine the well-being of motorists in the event of a lengthy traffic queue and /or roadway closure and provide assistance to motorists within the stopped traffic queue whenever possible.

City/County Agencies will establish a local Highway Incident Management Committee that will include Local Law Enforcement, Fire and Rescue Departments and all other City/County agencies that respond to roadway incidents for the purpose of optimizing communication, coordination and collaboration at roadway incident scenes. The Committee will meet at least bi-monthly

It is further agreed that:

The THP, TDOT, and City/County Agencies, will actively solicit and enlist other state, county, and local agencies, political subdivisions, industry groups, and professional associations to endorse and become party to this **"OPEN ROADS POLICY"** for the State of Tennessee.

MOU Execution: ***Use of Counterpart Signature Pages***

This MOU, and any amendments hereto may be simultaneously executed in multiple counterparts, each of which so executed shall be deemed to be an original, and such counterparts together shall constitute one and the same instrument. Notwithstanding any other provision herein to the contrary, this MOU shall constitute an agreement amongst the parties that have executed a counterpart and parties listed but not executing shall not be deemed to be parties to the MOU.

In witness whereof, each party hereto has caused this document to be executed in its name and on its behalf by it's duly authorized Chief Executive.

TENNESSEE DEPARTMENT OF TRANSPORTATION

By: _____
Commissioner

Date: 10/12/2012

TENNESSEE DEPARTMENT OF SAFETY AND HOMELAND SECURITY

By: Bill Gibbons
Commissioner

Date: 9/19/12

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AGREEMENT

This Agreement is entered into by and between the City of Chattanooga, Tennessee, and the City of East Ridge, Tennessee.

WITNESSETH

1. The City of Chattanooga, through its Department of Public Works, shall provide signal control equipment maintenance services, as requested by the City of East Ridge, for a the period of one (1) year with an option to renew for four (4) additional one (1) year terms upon mutual agreement of the parties.

2. This Agreement shall be applicable only to electronic signal control devices. The services provided by the City of Chattanooga pursuant hereto shall be subject to the availability of personnel necessary to perform the services required herein. All work will be performed after normal City of Chattanooga working hours. The City of Chattanooga will also provide traffic signal timing and timing implementation through the Chattanooga Regional Public Safety Wireless Network (hereinafter "Wireless Network") at no charge to the City of East Ridge.

3. The City of East Ridge shall make a monthly payment to the City of Chattanooga for the cost of providing routine maintenance services for the wireless network and providing traffic signal control equipment maintenance services on an as-needed basis. The services provided herein and charges imposed herewith are based on the following.

(1). Wireless Network Maintenance.

> The wireless network shall be maintained by the City of Chattanooga Information Services Department at a monthly rate of $19.00 per IP address.

(2) Signal Control Equipment Maintenance

2a. Personnel.

Personnel shall be furnished at the hourly rate of $54.25, which includes fringe benefits and overhead expenses. There shall be a minimum charge of two hours for any repair of equipment.

2b. Direct Cost.

The cost of all materials, supplies, and other expenses directly incurred by the City of Chattanooga for the benefit of the City of East Ridge shall be reimbursed in full. All of these costs shall be itemized and tabulated (including billing from the supplier, if possible) and refunded to the City of Chattanooga immediately. Any single purchase of materials or supplies in excess of $2,500.00 shall be made directly by the City of East Ridge.

2c. Administrative Cost.

There shall be a 25% markup added to each payment pursuant to subsections (a) and (b) by the City of East Ridge to the City of Chattanooga for administrative costs.

(3). Cost Adjustment.

In the event that this Agreement extends beyond the initial term, a mutually agreed upon adjustment may be made to the monthly rate in subsection (1) and the personnel hourly rate in subsection (2a).

4. All technical manuals and schematic wiring diagrams for the equipment to be repaired as part of this Agreement shall be provided by the City of East Ridge at the time of delivery of the equipment to the City of Chattanooga signal shop.

5. Since these services are being provided for the benefit of the citizens of the City of East Ridge at cost, the City of East Ridge shall defend and indemnify the City of Chattanooga, its officers, agents, and employees from any and all liability, loss or

damage that the City of Chattanooga may suffer as a result of claims, demands, costs, or judgments arising out of the wireless network routine maintenance services and the traffic signal control equipment maintenance services provided by the City of Chattanooga pursuant to this Agreement, provided however that the City of East Ridge shall not indemnify the City of Chattanooga for any liability, loss, or damage that is caused by or arises out of the negligence of the City of Chattanooga, its officers, agents, or employees.

6. Notwithstanding the provisions in Section 1, this Agreement may be terminated without cause by either party upon thirty (30) days' written notice to the other party.

IN WITNESS WHEREOF, the parties enter into and execute this Agreement by its duly authorized officials on this 18th day of October, 2011.

ATTEST: CITY OF CHATTANOOGA

By: _____ By: _____
Daisy Madison, Finance Officer
Steve Leach, Administrator of Public Works

ATTEST: CITY OF EAST RIDGE

By: _____ By: _____

City ~~Auditor~~ Manager Mayor

file
JY
JB
TT

AGREEMENT

This Agreement is entered into by and between the City of Chattanooga, Tennessee, and the City of Red Bank, Tennessee.

WITNESSETH

1. The City of Chattanooga, through its Department of Public Works, shall provide signal control equipment maintenance services, as requested by the City of Red Bank, for a the period of one (1) year with an option to renew for four (4) additional one (1) year terms upon mutual agreement of the parties.

2. This Agreement shall be applicable only to electronic signal control devices. The services provided by the City of Chattanooga pursuant hereto shall be subject to the availability of personnel necessary to perform the services required herein. All work will be performed after normal City of Chattanooga working hours. The City of Chattanooga will also provide traffic signal timing and timing implementation through the Chattanooga Regional Public Safety Wireless Network (hereinafter "Wireless Network") at no charge to the City of Red Bank.

3. The City of Red Bank shall make a monthly payment to the City of Chattanooga for the cost of providing routine maintenance services for the wireless network and providing traffic signal control equipment maintenance services on an as-needed basis. The services provided herein and charges imposed herewith are based on the following:

(1). Wireless Network Maintenance.

The wireless network shall be maintained by the City of Chattanooga Information Services Department at a monthly rate of $19.00 per IP address.

(2) Signal Control Equipment Maintenance

2a. Personnel.

Personnel shall be furnished at the hourly rate of $54.25, which includes fringe benefits and overhead expenses. There shall be a minimum charge of two hours for any repair of equipment.

2b. Direct Cost.

The cost of all materials, supplies, and other expenses directly incurred by the City of Chattanooga for the benefit of the City of Red Bank shall be reimbursed in full. All of these costs shall be itemized and tabulated (including billing from the supplier, if possible) and refunded to the City of Chattanooga immediately. Any single purchase of materials or supplies in excess of $2,500.00 shall be made directly by the City of Red Bank.

2c. Administrative Cost.

There shall be a 25% markup added to each payment pursuant to subsections (2a) and (2b) by the City of Red Bank to the City of Chattanooga for administrative costs.

(3) Cost Adjustment.

In the event that this Agreement extends beyond the initial term, a mutually agreed upon adjustment may be made to the monthly rate in subsection (1) and the personnel hourly rate in subsection (2a).

4. All technical manuals and schematic wiring diagrams for the equipment to be repaired as part of this Agreement shall be provided by the City of Red Bank at the time of delivery of the equipment to the City of Chattanooga signal shop.

5. Since these services are being provided for the benefit of the citizens of the City of Red Bank at cost, the City of Red Bank shall defend and indemnify the City of Chattanooga, its officers, agents, and employees from any and all liability, loss or damage that the City of Chattanooga may suffer as a result of claims, demands, costs, or judgments

arising out of the wireless network routine maintenance services and the traffic signal control equipment maintenance services provided by the City of Chattanooga pursuant to this Agreement, provided however that the City of Red Bank shall not indemnify the City of Chattanooga for any liability, loss, or damage that is caused by or arises out of the negligence of the City of Chattanooga, its officers, agents, or employees.

6. Notwithstanding the provisions in Section 1, this Agreement may be terminated without cause by either party upon thirty (30) days' written notice to the other party.

IN WITNESS WHEREOF, the parties enter into and execute this Agreement by its duly authorized officials on this 18th day of October, 2011.

ATTEST:

By: _____
Daisy Madison, Finance Officer

CITY OF CHATTANOOGA

By: _____
Steve Leach, Administrator of Public Works

ATTEST:

By: _____
City Auditor

CITY OF RED BANK

By: _____
Mayor

Approved:
_____
City Attorney
7/15/2011

APPENDIX E – TDOT ITS PROJECT IDENTIFICATION FORM

Tennessee ITS Project Identification Form

INSTRUCTIONS: Refer to Section 4.2 of the TDOT ITS Project Development Guidelines. Attach or make available any documents referenced in this form when submitting.

SECTION 1 – PROJECT INFORMATION

Agency: _____

Agency Information (Address, phone number, e-mail, etc):

_____

Project Name and Location:

_____

☐ New Project
☐ Modification Project
☐ Expansion Project

Nature of Work:

☐ Planning
☐ Design Software / Integration
☐ Operations
☐ Evaluation
☐ Scoping
☐ Construction
☐ Maintenance (Equipment Replacement)
☐ Other: _____

Please provide the following background information. In most cases, 1-3 sentences will be sufficient for each item.

Brief Description of ITS project objectives – (What is the purpose of the project? What needs are being addressed?):

_____

_____

Project Summary – (What solutions will address the needs? What major elements will be installed? What major function(s) will be performed?)

_____

_____

Work to Date: (Any preliminary planning, investigation of options, associated internal or external systems examined?)

_____

SECTION 2 – RISK ASSESSMENT

(For each question, answer Yes, No, Not Sure or N/A for not applicable):

1 – Will the project depend on **only your agency** to implement and operate?

_____

2 - Will the project use only software proven elsewhere, with **no** new software writing?

_____

3 - Will the project use only hardware and communications **proven** elsewhere?

_____

4 - Will the project use only **existing interfaces** (no new interfaces to other systems)?

_____ (If YES include reference)

5 - Will the project use only **existing system requirements** that are well documented?

_____ (If YES include reference)

6 - Will the project use only **existing operating procedures** that are well documented?

_____ (If YES include reference)

7 - Will the project use only technologies with service life **longer** than 2-4 years?

_____

SECTION 3 – FUNDING

Identify all that apply: ☐ Local Agency ☐ State ☐ Federal Funds

TIP/STIP Identification and Description:

_____

_____	_____	_____
Agency Representative	Signature	Date
_____	_____	_____
MPO/RPO Representative	Signature	Date

FOR TDOT USE ONLY:

☐ No additional documentation required ☐ Inconclusive risk level determination (SSEAF is required)

☐ Low Risk (SSEAF is required) ☐ High Risk (SEAR is required)

_____	_____	_____
TDOT Representative	Signature	Date

APPENDIX F – REGIONAL ITS ARCHITECTURE MAINTENANCE DOCUMENTATION FORM

BLANK FORM
EXAMPLE COMPLETED FORM

Chattanooga Regional ITS Architecture

Architecture Maintenance Documentation Form

Please complete the following questionnaire to document changes to the Chattanooga Regional ITS Architecture. Modifications will be made during the next update of the Regional ITS Architecture.

Contact Information

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

Change Information

Please indicate the type of change to the Regional ITS Architecture or Deployment Plan:

- ☐ Administrative Change: Basic changes that do not affect the structure of the ITS service packages in the Regional ITS Architecture.
  Examples include: Changes to stakeholder or element name, element status, or data flow status.
- ☐ Functional Change: Single Agency: Structural changes to the ITS service packages that impact only one agency in the Regional ITS Architecture.
  Examples include: Addition of a new ITS service package or changes to data flow connections of an existing ITS service package. The addition or changes would only impact a single agency.
- ☐ Functional Change: Multiple Agencies: Structural changes to the ITS service packages that have the potential to impact multiple agencies in the Regional ITS Architecture.
  Examples include: Addition of a new ITS service package or changes to data flow connections of an existing ITS service package. The addition or changes would impact multiple agencies and require coordination between the agencies.
- ☐ Project Change: Addition, modification, or removal of a project in the Regional ITS Deployment Plan.
- ☐ Other: _____

Submittal

Please submit ITS Architecture Maintenance Documentation form to:
Chattanooga / Hamilton County / North Georgia Transportation Planning Organization
1250 Market Street
Suite 2000, Development Resource Center
Chattanooga, Tennessee 37402
Phone: 423-643-5900
Fax: 423-757-5532

Form Submittal Date: _____

Chattanooga Regional ITS Architecture

Architecture Maintenance Documentation Form

Question 1 Describe the requested change to the Regional ITS Architecture or Deployment Plan.	
Question 2 Are any of the Regional ITS Architecture service packages impacted by the proposed change?	☐ Yes: Please complete Questions 2A and 2B ☐ No: Please proceed to Question 3 ☐ Unknown: Please coordinate with the Chattanooga RPA to determine impacts of the change to the Regional ITS Architecture
Question 2A List all of the ITS service packages impacted by the proposed change.	
Question 2B Include a copy of the ITS service packages impacted by the proposed change and mark any proposed modifications to the ITS service packages. Add any additional notes on proposed changes in this section.	
Question 3 Does the proposed change impact any stakeholder agencies other than the agency completing this form?	☐ Yes: Please complete Questions 3A and 3B ☐ No: Form is complete ☐ Unknown: Please coordinate with the Chattanooga RPA to determine impacts of change to other agencies in the Regional ITS Architecture
Question 3A Identify the stakeholder agencies impacted by the change and a contact person for each agency.	
Question 3B Describe the coordination that has occurred with the stakeholder agencies and the results of the coordination?	

Chattanooga Regional ITS Architecture

Architecture Maintenance Documentation Form

EXAMPLE COMPLETED FORM

Question 1 Describe the requested change to the Regional ITS Architecture or Deployment Plan.	***City A is planning to deploy CCTV cameras for network surveillance on arterial streets. In the Regional ITS Architecture, the City A Traffic Operations Center (TOC) is shown as the only center controlling the CCTV cameras. The City A TOC is now planning to provide images and control of the CCTV cameras to the City A Police Department for use during incidents.***
Question 2 Are any of the Regional ITS Architecture service packages impacted by the proposed change?	☑ Yes: Please complete Questions 2A and 2B ☐ No: Please proceed to Question 3 ☐ Unknown: Please coordinate with the Chattanooga RPA to determine impacts of the change to the Regional ITS Architecture
Question 2A List all of the ITS service packages impacted by the proposed change.	***TM01 – Infrastructure-Based Traffic Surveillance*** ***TM08 – Traffic Incident Management System***
Question 2B Include a copy of the ITS service packages impacted by the proposed change and mark any proposed modifications to the ITS service packages. Add any additional notes on proposed changes in this section.	***A sketch of the TM08 – Traffic Incident Management System service package diagram for City A is attached. Changes have been marked by hand to indicate the new data connections that will be established to allow the City A TOC to send traffic images to the City A Police Department and for the City A Police Department to control the CCTV cameras. The deployment of the CCTV cameras will also result in several of the data flows in TM01 – Infrastructure-Based Traffic Surveillance being changed from planned to existing. These have also been marked on the service package diagram. (Note: The ITS service package diagrams can be found in the Interactive ITS Architecture under the Services tab)***
Question 3 Does the proposed change impact any stakeholder agencies other than the agency completing this form?	☑ Yes: Please complete Questions 3A and 3B ☐ No: Form is complete ☐ Unknown: Please coordinate with the Chattanooga RPA to determine impacts of change to other agencies in the Regional ITS Architecture
Question 3A Identify the stakeholder agencies impacted by the change and a contact person for each agency.	***The City A TOC and City A Police Department are the two agencies impacted by this change. (Note: Assuming the City A TOC representative is completing this form, the contact person from the City A Police Department working on this project should be listed.)***
Question 3B Describe the coordination that has occurred with the stakeholder agencies and the results of the coordination?	***The City A TOC and City A Police Department have had several meetings in the last year to discuss the operations of the arterial CCTV cameras. An operational agreement for the joint operations of the CCTV cameras is currently being developed.***