Tennessee Statewide Intelligent Transportation Systems Architecture

FINAL
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Sign-off Sheet

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Abbreviations

ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ASC	Actuated Traffic Signal Controller
ATM	Active Traffic Management
ATMS	Advanced Traffic Management System
AVI	Automated Vehicle Identification
BSM(s)	Basic Safety Message(s)
CORBA	Common Object Request Broker Architecture
CVIEW	Commercial Vehicle Information Exchange Window
CVISN	Commercial Vehicle Information Systems Network
CVO	Commercial Vehicle Operations
DMS	Dynamic Message Signs
DSRC	Dedicated Short-Range Communications
EAS	Emergency Alert System
EMA	Emergency Management Agency
EOC	Emergency Operations Center

ETA	Estimated Time of Arrival
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HELP	Heavy Vehicle Electronic License Plate
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
ICM	Integrated Corridor Management
IOO(s)	Infrastructure Owners and Operator(s)
IRP	International Registration Plan
MAAS	Mobility as a Service
MAP	Motorist Assistance Patrol
MPO(s)	Metropolitan Planning Organization(s)
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
PCCTV	Portable CCTV
PCMS	Portable Changeable Message Signs

PRISM	Performance and Registration Information System Management
PVMS	Portable Variable Message Signs
RFID	Radio Frequency Identification
RPO(s)	Rural Planning Organization(s)
RR	Roles and Responsibilities
RSU(s)	Road Side Unit(s)
SAFER	Safety and Fitness Electronic Record
SAV(s)	Shared Automated Vehicle(s)
SmartWay	TDOT SmartWay Information System
SOV(s)	Single Occupant Vehicle(s)
SPaT	Signal Phase and Timing
SWIFT	Statewide Information for Travelers
TDOT	Tennessee Department of Transportation
TEMA	Tennessee Emergency Management Agency
THP	Tennessee Highway Patrol
TI	Traveler Information
TNCs	Transportation Network Companies
TSMO	Transportation Systems Management and Operations

V2I	Vehicle to Infrastructure
VDS	Video Detection Systems
VSL	Variable Speed Limit
WIM	Weigh-in-Motion
XML	Extensive Markup Language

1.0 INTRODUCTION

This document discusses the updates to the Statewide Intelligent Transportation Systems (ITS) Architecture for Tennessee. The previous Statewide ITS Architecture document[1] was developed in October 2006 and intended to provide a "long-range (15-year) vision for Statewide ITS projects and programs, with particular emphasis on ITS projects and integration in the next 5 to 10 years." The update to the Statewide ITS Architecture is very important particularly because of the recent changes to National ITS architecture framework now called Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT).

The ITS architecture will focus on the application of technology to address challenges in transportation such as congestion or mobility, safety and environmental emissions. Technology evolves rapidly and generally provides new capabilities for agencies to collect or share information required for efficient and effective operations, maintenance and management of transportation systems and services. The benefits of ITS to transportation has been well documented in literature and the need for an architecture or a framework to guide the deployment of novel or innovative technologies in transportation is recognized as a requirement to enhance success when complex systems such as ITS are deployed. The Federal Highway Administration (FHWA) recognizes this need and therefore promulgated Final Rule 940 Part 11 which mandates that projects planning to use federal funds in their ITS deployments must have established an ITS Architecture for the geographic area. Paragraph 940.9 (a) states that:

> "A regional ITS architecture shall be developed to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in applicable transportation plans. The National ITS Architecture shall be used as a resource in the development of the regional ITS architecture. The regional ITS architecture shall be on a scale commensurate with the scope of ITS investment in the region.

The purpose of using the ARC-IT framework is to enhance compatibility, functionality, integration, and interoperability that are typically challenges to grapple with when new systems are added to legacy agency systems. In addition to the fact that developing the architecture provides the benefits inherent in the planning process – consensus from a diverse stakeholder group that delivers a useful plan to meet needs and guide implementation – it also has financial implications: FHWA requires that federal funds for ITS are limited to projects or programs that are identified in the ITS architecture; and stakeholders can contribute towards determining and planning for projects that support business needs.

1.1 ITS ARCHITECTURE UPDATE PROCESS

The process adopted for the updates to the Statewide ITS architecture document is as follows:

1. Review the existing Tennessee Statewide ITS Architecture document and the Turbo Architecture (now RAD-IT) database file.

2. Facilitate a stakeholder meeting to solicit information required to develop draft document.

[1] https://www.tn.gov/content/dam/tn/tdot/traffic-operations/its/TN_Statewide_ITS_Architecture.pdf (Accessed 6/20/2018)

3. Architecture document and RAD-IT file updated based on ITS needs and preferences identified for the State of Tennessee and a draft document is developed.

4. Draft document presented with updates to TDOT and stakeholders for review and input.

5. Comments addressed and the Draft Final Statewide ITS Architecture document and RAD-IT files are developed.

6. Draft Final document presented with updates to the broader stakeholder group for review and inputs.

7. Comments addressed and the Statewide ITS Architecture document and RAD-IT files are finalized to reflect consensus among the stakeholders and the documents are published for use.

1.2 GEOGRAPHIC SCOPE

The Tennessee Statewide ITS Architecture covers all modes of transportation in the following geographic scope:

1. All interstates and controlled-access freeways throughout the State of Tennessee including TDOT managed networks such as SR 115 in Knoxville, US 27 in Chattanooga, SR 386 in Nashville, and SR 385 in Memphis.

2. All arterials throughout the State excluding segments of arterials in urbanized areas with existing regional ITS architectures such as US 45 in Jackson, SR 126 in Bristol, and US 79 in Clarksville.

1.3 REGIONAL ITS ARCHITECTURES

Regional ITS Architectures have been developed in eleven metropolitan planning areas throughout Tennessee, each providing transportation management in a limited region (see **Table 1**). The regional ITS architectures are maintained by the respective metropolitan planning organization (MPO). The Statewide ITS architecture shall interface with the regional ITS architectures to facilitate data sharing and a seamless and efficient management of traffic from region to region and intra region.

Table 1: Existing Regional ITS Architectures in Tennessee

Region	Updates	Comments
Bristol	May 2017	
Chattanooga	May 2017	
Clarksville	April 2015	Major update due: April 2019
Cleveland	April 2017	
Jackson	Jun 2015	Major update due: Jun 2019
Johnson City	Jun 2015	Major update due: Jun 2019
Kingsport	May 2017	
Knoxville	Dec 2012	Major update due: Dec 2016 (past due). Update In progress. Looking to obtain a consultant to perform major update.
Lakeway	April 2017	
Memphis	Nov 2014	Major update due: Nov 2018 (past due). Update in progress.
Nashville	Jun 2010	Major update due: Jun 2014 (past due). Update in progress.

1.4 MPO AND RPO

The metropolitan planning organizations (MPOs) are responsible for transportation planning in the urbanized regions of the State of Tennessee with populations greater than 50,000. Tennessee's MPOs are Bristol, Chattanooga, Clarksville, Cleveland, Jackson, Johnson City, Kingsport, Knoxville, Lakeway, Memphis and Nashville. The rural planning organizations (RPOs) are similar to MPOs and serve the rural areas of the State. Tennessee's RPOs are Center Hill, Dale Hollow, East Tennessee North, East Tennessee South, First Tennessee, Middle Tennessee, Northwest, South Central East, South Central West, Southeast, Southwest, and West Tennessee. Both MPOs and RPOs support multimodal transportation planning and make recommendations to TDOT on transportation needs. The ITS needs for the RPOs shall be covered in the Statewide ITS Architecture and shall include the ITS needs for freeways, controlled access facilities and other systems controlled by TDOT both within the MPO and RPO boundaries.

2.0 RELATIONSHIP TO REGIONAL PLANNING

Several statewide planning documents have been developed that consider demographic, employment and economic trends in the State of Tennessee and how they impact mobility and transportation system performance. Tennessee ranks very high on freight movement in the U.S. and as the State experiences steady growth in socio-economic activities, safety, mobility, travel time reliability and environmental preservation become important for everyone. Industry needs timely delivery of materials for manufacturing and products delivered to markets, and the general population desires a safe and uncongested transportation system for access to opportunities and better quality of life.

The following sections highlight the key findings of various studies on the transportation system by TDOT Long Range Planning. The economic and demographic trends identified and the operational objectives of TDOT with regard to mobility and the transportation system give some insights on how intelligent transportations systems can be leveraged. Generally, addressing the challenges of mobility requires a systems approach such as the strategies outlined by FHWA for transportation systems management and operations (TSMO). TDOT has adopted the following guiding principles to underpin development and management of TDOT's transportation system to meet operational objectives[2]:

1. Support the state's economy
2. Preserve and manage the existing system
3. Maximize safety and security
4. Provide for the efficient movement of people and freight
5. Protect natural, cultural and environmental resources
6. Build partnerships for sustainable and livable communities
7. Emphasize Financial Responsibility

The purpose of the Tennessee Statewide ITS Architecture is to provide the framework for planning, defining and integrating technological advancements in transportation to enable TDOT and other stakeholders meet the objectives listed above. Furthermore, this document describes the programs and projects that will enable TDOT and stakeholders to manage the transportation infrastructure, the requirements and standards for interoperability and enterprise data sharing with partner agencies.

2.1 DEMOGRAPHIC AND EMPLOYMENT CHANGES & TRENDS

Population growth trends and where in the state people live and travel to work or engage in other socio-economic activities is very important. The population of Tennessee is projected to grow by more than 2.1 million people by 2040, and during that same period 1.9 million jobs[3] are expected to be created. The distribution of housing and employment

[2] TDOT 25-Year Long Range Transportation Policy Plan, Plan Summary (December 2015)
[3] TDOT 25-Year Long Range Transportation Policy Plan, Demographics & Employment Changes & Trends Policy Paper (December 2015)

will determine how far people travel to work and the modal choice will depend on the options available to them. While most of the population growth will occur in the urban cores, a significant proportion is expected to occur in the suburban and rural areas. There is no doubt that commuters will increase travel demand on primary roadways such as the interstate system, and along with that demand, congestion, safety and environmental challenges will arise. Furthermore, this increased demand will put pressure on not just the primary roadways but also all transportation assets in the network. This growth in demand will increase the cost on TDOT to maintain existing transportation assets, and perhaps source funding to add new capacity. With limited funding availability and the need to do more with less, innovative approaches are required to meet the mobility needs of the population and industry.

2.2 TRAVEL TRENDS & SYSTEM PERFORMANCE

TDOT uses travel trends and system performance measures to determine where investments are required to improve transportation and how effective or efficient transportation policies and programs are. Based on requirements stipulated in MAP 21, federal funding would be tied to states using performance measures to manage transportation systems. The national goal areas identified in MAP 21 include safety, infrastructure condition, congestion reduction, system reliability, freight movement and economic vitality, environmental sustainability, and reduced project delivery delays. States will be required to set targets and meet those goal areas. TDOT recognizes the need to use ITS and a multimodal transportation system to meet these goals. Furthermore, the FAST (Fixing America's Surface Transportation) Act, provided further funding for transportation projects and among other needs it provided a focus on safety on safety and technology.

2.3 FREIGHT LOGISTICS & PLANNING

Freight movement accounts for 40% of Tennessee's GDP and most of the freight movement in the state is by truck. The key drivers for freight movement in Tennessee are agriculture, automotive and advanced manufacturing. Additionally, FedEx operates their major logistic hub in Memphis. Freeway congestion that impacts travel time reliability of freight movement is a concern for many stakeholders. Tennessee is showing a steady growth in its economy, and that means movement of freight will increase and exacerbate congestion in the urbanized areas and in turn slow movement of freight in the state. The stakeholders recommended the deployment of ITS among other strategies to enhance freight movement throughout the state.

2.4 MOBILITY

Mobility is important to connect communities and support socio-economic activities. Tennessee has many ways of meeting the mobility needs or its residents, visitors and businesses. Furthermore, sustainability of mobility options is critical going forward. One of the important goals of TDOT is to reduce the use of single occupant vehicles (SOVs) on the transportation network by using travel demand strategies to shift mode and time of travel. Currently the landscape of how mobility needs are met is changing with the emergence of transportation network companies (TNCs) such as Uber and Lyft and other micro transit companies. Also, on the horizon are automated vehicles and connected vehicles which could prove to be game changers for safety and mobility when they become ubiquitous. Innovative technologies will continue to radically impact transportation depending on the extent to which they are adopted based on political, legal and social constraints. Infrastructure owners and operators (IOOs) such as TDOT will require adaptation of the transportation system in order for the benefits envisioned to be realized.

2.5 TDOT TRAFFIC OPERATIONS PROGRAM PLAN

The TDOT Traffic Operations Program Plan[4] promotes safety, efficiency, reliability and system preservation as the overarching goals for all transportation programs. TSMO has been identified as the key driver to help deliver these overarching goals. There are six cross-cutting TSMO strategies that have been adopted:

1. Optimize existing operations infrastructure capabilities
2. Strategically expand operations infrastructure, partnerships, and capabilities to meet future needs
3. Identify and prepare for the next generation of operational strategies technologies
4. Monitor performance of the transportation system
5. Integrate operations into TDOT culture and process
6. Elevate public awareness of operations

The critical role of technology, partnerships and systems is rather obvious. The Statewide ITS Architecture can help propel TDOT to realize its operational objectives since it impacts almost all the strategies identified.

2.6 PLANNING OBJECTIVES

The planning objectives were adopted from the TDOT TSM&O Goals and Objectives, and the requisite performance measures identified. **Table 2** summarizes the planning objectives for the Statewide ITS Architecture. The performance measures are being tracked by TDOT, which helps with prioritizing projects and planning for future system needs. This, in turn, helps build the ITS Architecture.

Table 2: Planning Objectives and Performance Measures[5]

TDOT Operational Goal	TSM&O Goals	TSM&O Objectives	Performance Measure
System Operation: Operate and manage Tennessee's transportation system to provide a high level of safety and service for our customers and workers	Safety	Reduce the frequency and severity of crashes on the transportation system	Crash Rates: Fatalities & Injuries per 100 million vehicle miles traveled
	Efficiency	Minimize traffic delays from recurring and non-recurring congestion	Crashes per mile per year Incident Vulnerability: Peak Hour Volume/Capacity Ratio, Annual Average Daily Traffic to Capacity Ratio Travel Time, Delay

[4] TDOT Traffic Operations Program Plan, Revised Draft Report (July 2017)
[5] Planning Objectives and Performance Measures were originally developed and stated in the *TDOT Traffic Operations Program Plan Final Draft*, July 2017, Kimley Horn, Table 2, Page 8

TDOT Operational Goal	TSM&O Goals	TSM&O Objectives	Performance Measure
	Reliability	Improve travel time reliability of the transportation system	Planning Time Index, Travel Time Reliability Severe Weather Influence Factor
System Preservation: Manage the state transportation system to protect the long-term investments of our infrastructure assets	Preservation	Maintain functionality of the operations infrastructure and plan for life cycle replacement	Asset Sustainability Index[6]

[6] Asset Sustainability Ratio or Index is the " amount budgeted for an asset category is divided by the amount needed to sustain its condition at the targeted level over the forecast period." See https://www.fhwa.dot.gov/asset/plans/financial/hif15020.pdf (Accessed 12/2/2018)

3.0 ITS STAKEHOLDERS

Stakeholders are key partners that participate in or are impacted by the ITS operations in the Statewide ITS Architecture. **Table 3** provides the names and descriptions of the stakeholders in the Tennessee Statewide ITS Architecture. **Table 4** provides the roles and responsibilities (RR) of each stakeholder. Full participation of stakeholders is important and required for consensus building to develop a relevant and useful ITS infrastructure. An inventory of Service Packages and descriptions for the Statewide ITS Architecture can be found in **Appendix A**. The context flow diagrams and interconnect flow diagrams that shows the interfaces and data exchanges between the physical elements of the Statewide ITS Architecture are provided in **Appendix C**.

Table 3: Statewide ITS Architecture Stakeholders

Stakeholder Name	Stakeholder Description
Airport Operator	Operators of regional airports (including commercial and general aviation) throughout the state. This does not include major commercial airports in the metropolitan areas of Memphis, Nashville, Knoxville or Chattanooga.
Commercial Vehicle Operators	Private operators of commercial vehicles that travel on Tennessee's inter and intrastate transportation network.
County Government	Divisions and departments of county government such as traffic management and emergency management. Specific counties are not identified in the Statewide ITS Architecture; they are represented as general entities. Regional ITS Architectures in Tennessee contain specific interfaces and functions for counties within those regions.
Cumberland Gap Tunnel Authority	Responsible for traffic management and operations at the Cumberland Gap Tunnel. This tunnel carries US25E under Cumberland Gap between Tennessee and Kentucky.
Federal Motor Carrier Safety Administration	The FMCSA is a unit of the USDOT that develops and enforces regulations aimed at safer commercial truck and bus operations. It is the federal agency responsible for the SAFER (Safety and Fitness Electronic Record) system.
FHWA	FHW provides oversight of federal programs and state programs that use federal funds for transportation projects or programs.
Heavy Vehicle Electronic License Plate (HELP), Inc.	HELP is a non-profit partnership between motor carriers and government agencies. HELP's mission is to develop and deploy advanced technology systems that create a cooperative operating and regulatory environment which improves the efficient and safe movement of commercial vehicles and the performance of highway systems.
International Fuel Tax Association	IFTA is an agreement among all states (except Alaska and Hawaii) and Canadian provinces (except Northwestern Territories, Nunavut, and Yukon) to simplify the reporting of fuel used by motor carriers operating in more than one jurisdiction.
International Registration Plan	Commercial Vehicle registration reciprocity agreement among states of the United States and provinces of Canada providing for payment of license fees on the basis of total distance operated in all jurisdictions.
Media	Local media outlets including broadcast television and radio. These are key partners for traveler information, and many have access to TDOT's video feeds from the SmartWay urban area systems.
Municipal Government	Divisions and departments of municipal government such as traffic management and emergency management. Specific municipalities are not identified in the Statewide ITS Architecture; they are represented as general entities. Regional ITS Architectures in Tennessee contain specific interfaces and functions for municipalities within those regions.

ITS STAKEHOLDERS

Stakeholder Name	Stakeholder Description
National Oceanic and Atmospheric Administration	National Oceanic and Atmospheric Administration (NOAA), agency that gathers weather information and issues severe weather warnings. TDOT receives weather information feeds from NOAA/National Weather Service.
Operator	System operator
Other States	Emergency or traffic management agencies in other states. Adjacent states include: Missouri, Kentucky, Virginia, North Carolina, Georgia, Alabama and Mississippi. TDOT's SmartWay TMC connections to neighboring states are detailed in the regional ITS architectures. Neighboring states are included in the statewide ITS architecture as a reference point for functions that include information with these neighboring state DOT traffic and emergency operations centers.
Private Contractor	Construction contractor under contract with TDOT for construction services for highway construction services, including roadway construction, ITS, maintenance and other activities.
Private Corporation	Business for profit, not affiliated with any government agency
Railroad Operators	Companies that operate trains and/or are responsible for the maintenance and operations of railroad tracks.
Regional Amber Alert Network Member Agencies	Agencies that participate in a regional Amber Alert program
Regional Toll Authority	Agency responsible for the operations and maintenance of toll facilities. This is a future entity (tolls systems are not currently implemented in TN).
System Users	Individuals user of ITS elements such as data archives.
Tennessee Department of Safety	The Tennessee Department of Safety is responsible for issues related to safety, law enforcement on highways, issuing driver's licenses, and other aspects of driving in Tennessee. The Tennessee Highway Patrol is a division within the Department of Safety.
Tennessee Department of Transportation	The Tennessee Department of Transportation (TDOT) operates and maintains highways and other key routes throughout the state. TDOT is the lead agency for ITS planning, design, implementation, operations and management on interstate, US and state routes in Tennessee.
Tennessee Emergency Management Agency	The Tennessee Emergency Management Agency (TEMA) develops and maintains emergency response plans. It is the state agency that coordinates and responds to major disasters and emergencies.
Tennessee Highway Patrol	The Tennessee Highway Patrol (THP) s a unit within the Department of Safety. THP is responsible for law enforcement on Tennessee highways, as well as commercial vehicle weigh station monitoring.
TN Bureau of Investigation (TBI)	TBI, is responsible for Amber Alert notification in the state of TN.
TN Department of Health and Human Services	State department that manages funding for medical transportation services.
Transit Agency	Transit agency is responsible for transit operations both fixed route and demand response transit services throughout the state. TDOT's Public Transportation, Rail and Waterways division has spearheaded a uniform set of requirements and procurement process to help implement technologies and systems to enhance transit operations
Traveler	Private travelers using the transportation network
United States Geological Survey (USGS)	The USGS collects stream gauge data from rivers and other estuaries throughout the state.

Table 4: Stakeholder Roles and Responsibilities

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
Arterial Management	Arterial management refers to operational strategies using ITS on arterials for responsive and proactive traffic management to reduce delays at intersections and enhance safety and mobility.	County Government	Arterial maintenance and operations, Traffic signal operation and maintenance	Existing
		Municipal Government	Arterial operations and maintenance, Traffic signal operation and maintenance	Existing
		Tennessee Department of Safety	arterial corridor safety enhancements develop performance measures for corridor assessments	Existing
		Tennessee Department of Transportation	develop traffic signal timing, operations and maintenance, development arterial management strategies, develop arterial performance measures and policies for operations, enhance arterial corridor safety	Existing
		Tennessee Highway Patrol	Incident response	Existing
Commercial Vehicle Operations	Commercial vehicle operations represent movement of freight on the surface transportation system.	Airport Operator	multimodal coordination, freight management, drayage operations	Existing
		Commercial Vehicle Operators	commercial vehicle fleet management, multimodal coordination, vehicle safety , drayage operations, freight travel planning, freight tracking	Existing
		County Government	Vehicle weight enforcement, Truck route planning	Existing
		Cumberland Gap Tunnel Authority	commercial vehicle monitoring	Existing
		Heavy Vehicle Electronic License Plate (HELP), Inc.	develop regulations to support CVO operations , support development of CVO technologies for efficient operations	Existing
		International Fuel Tax Association	commercial vehicle credentials, fuel tax collection and disbursement	Existing
		Municipal Government	Truck route planning	Planned
		Municipal Government	Vehicle weight enforcement	Existing

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
		Railroad Operators	Multimodal coordination, freight tracking, drayage operation, freight travel planning	Existing
		Tennessee Department of Safety	support enforcement of commercial vehicle weight requirements, support commercial vehicle credentialing and inspections	Existing
		Tennessee Department of Transportation	deployment and maintenance of weigh-in-motion systems, commercial vehicle infrastructure management (truck parking), freight advanced traveler information systems	Existing
		Tennessee Department of Transportation	HAZMAT incident response, Develop performance measures	Planned
		Tennessee Emergency Management Agency	HAZMAT management, HAZMAT incident response	Existing
		Tennessee Highway Patrol	Electronic clearance, Safety enforcement, Weight enforcement	Existing
Connected Vehicle Applications	This refers to various concepts of operation for connected vehicles application in the near future and long term. Applications can include queue warning, intersection assist, curve warning, eco-driving, etc.	Commercial Vehicle Operators	connected vehicle OBE, connected vehicle roadside units	Planned
		County Government	deployment of CV infrastructure (RSUs), CV data sharing, CV infrastructure operations	Planned
		Cumberland Gap Tunnel Authority	connected vehicle road side units planning, connected vehicle information planning	Planned
		Heavy Vehicle Electronic License Plate (HELP), Inc.	commercial vehicle security and credentials management, commercial vehicle screening, commercial vehicle safety	Planned
		International Fuel Tax Association	Leverage connected vehicle applications for vehicle mileage and taxation , Commercial vehicle security and credentials management	Planned
		Municipal Government	CV data sharing , deployment of CV infrastructure (RSUs), CV infrastructure operations	Planned
		Private Corporation	CV data use/sharing	Planned

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
		Railroad Operators	Operations data sharing (crossing activations, etc.)	Planned
		Regional Toll Authority	connected vehicle roadway information, connected vehicle tolling, planning and deploying road side units for connected vehicle applications	Planned
		System Users	Leverage connected vehicle applications for enhanced business practices	Planned
		Tennessee Department of Safety	connected vehicle security and privacy for users, develop safety applications for connected vehicles ecosystem	Planned
		Tennessee Department of Transportation	CV infrastructure deployment (RSUs), Broadcast SPaT and MAP messages, Broadcast roadway system status, collect CV data for processing, security and credentials management of vehicles in connected vehicle ecosystem	Planned
		Tennessee Highway Patrol	collect CV data for incident detection	Planned
		Transit Agency	broadcast transit information, respond to transit user requests	Planned
		Traveler	CV data subscription, use broadcast CV information	Planned
Incident and Emergency Management Coordination	This describes the enhanced coordination and real-time communications and information exchange that ITS deployment and integration would facilitate among agencies in Tennessee. In particular, it focuses on coordination and information exchanges among TEMA, TDOT, THP, county and local public safety, transit operators and others.	Commercial Vehicle Operators	freight emergency response coordination	Planned
		Commercial Vehicle Operators	freight hazmat monitoring, freight incident response coordination	Existing
		County Government, Municipal Government	Provide incident management support, Develop incident response plans	Existing
		Cumberland Gap Tunnel Authority	incident detection and response coordination, provide incident information to travelers, provide tunnel system status	Existing
		Media	Disseminate incident information	Existing
		National Oceanic and Atmospheric Administration	Provide extreme weather information to support emergency management	Existing

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
		Other States	Provide transportation system formation, Provide traveler information	Existing
		Railroad Operators	incident response coordination, hazmat monitoring and response coordination	Existing
		Regional Amber Alert Network Member Agencies	Amber alert notification, Amber alert status information	Existing
		Tennessee Department of Safety	incident response coordination	Existing
		Tennessee Department of Transportation	Disseminate traveler information, Provide resources for incident management, Develop incident response plans, Detour route planning	Existing
		Tennessee Emergency Management Agency	Develop incident response plans, HAZMAT incident coordination	Existing
		Tennessee Highway Patrol	Provide incident and emergency support, Secure incident scene, emergency traffic control, Develop incident and emergency response plans, detour route planning and information	Existing
		TN Bureau of Investigation	incident management coordination, security coordination	Existing
		Transit Agency	Provide incident response support, Provide resources for emergency evacuation, Develop incident and emergency response plans	Existing
		Traveler	use incident and emergency response information , use incident and emergency response action plans	Existing
		United States Geological Survey	Provide information for emergency management	Existing
Information Management	ITS operations generate a plethora of data that could be beneficial to several transportation agencies including planning agencies. Archiving transportation data and making it accessible to data users can be mined	Airport Operator, Commercial Vehicle Operators, County Government, Railroad Operators, Tennessee Highway Patrol	Provide operations data for archives, Analyze archive data for planning, policy evaluation, performance measures	Existing
		Cumberland Gap Tunnel Authority, Municipal Government	Analyze archive data for planning, policy evaluation, Archive data products	Existing

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
	for information to improve transportation planning and operations.	Regional Toll Authority	Analyze archive data for planning, policy evaluation, Performance measures development, Archive data products	Planned
		Tennessee Department of Safety	Analyze archive data for planning, policy evaluation, Performance measures	Existing
		Tennessee Department of Transportation	Provide operations data for archives, Analyze archive data for planning, policy evaluation, Safety analysis, performance measures, data security	Existing
		Tennessee Emergency Management Agency	Analyze data for planning, policy evaluation, Provide operations data for archives	Existing
		TN Bureau of Investigation	Provide operations data for archives, data security	Existing
		TN Department of Health and Human Services	Provide operations data for archives, Analyze data for planning and policy decisions	Existing
		Transit Agency	Provide operations data for archives, Archive data products	Existing
		Traveler	utilize information	Existing
		Airport Operator, Media	traveler information	Existing
Freeway Management	Monitoring and management of freeway and interstate system for congestion, incident and any other anomalies that impact freeway performance and deploying strategies for mitigation.	Airport Operator, Media	Traveler information	Existing
		Commercial Vehicle Operators	commercial vehicle tracking and routing, commercial vehicle information, commercial vehicle credentialing	Existing
		County Government, Municipal Government, TN Bureau of Investigation	incident response coordination	Existing
		Cumberland Gap Tunnel Authority	traffic monitoring, tunnel and freeway status information	Existing
		Other States	Freeway management coordination	Existing
		Regional Toll Authority	Toll road status	Existing
		Tennessee Department of Safety	data sharing for freeway management	Existing

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
		Tennessee Department of Transportation	freeway infrastructure construction and maintenance, freeway, freeway infrastructure status, management, roadway monitoring and incident detection, traveler information, incident coordination, freeway incident response, performance measures	Existing
		Tennessee Emergency Management Agency	freeway incident coordination	Existing
		Tennessee Highway Patrol	Incident response and coordination	Existing
		Traveler	Use travel advisories	Existing
Public Transportation	Public transportation falls into two categories. First is the rural public transit which describes the planned and future functions and services that are attributed to demand-response transit operations. The other is public transit in urbanized areas which includes both fixed route operations and demand responsive paratransit services. General activities for transit include enhancements to dispatch capabilities, vehicle tracking, transit traveler information, and the role of transit in emergency and incident management.	Airport Operator	intermodal coordination develop transit facilities	Existing
		County Government	fixed route and demand responsive transit planning , operation of transit systems and maintenance of rolling stock, enable transit oriented development, transit oriented development	Existing
		County Government	transit traveler information	Existing
		Municipal Government	fixed route and demand responsive transit planning, transit-oriented development, transit traveler information, transit operations and maintenance of rolling stock	Existing
		Municipal Government	leverage transportation network companies as needed	Planned
		Private Corporation	supplement public transportation with first mile and last mile solutions, provide public transportation where needed	Planned
		Railroad Operators	provide rail service for public transportation, traveler information for rails services, reservation and payment for service	Existing
		System Users	data mining and added value, public transportation planning and policy	Existing

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
		Tennessee Department of Safety	ensure safety for users of public transportation, assess safety performance and make recommendations for improvements	Existing
		Tennessee Department of Transportation	incident response coordination	Planned
		Tennessee Department of Transportation	Rural transit planning, Rural transit operations and maintenance support, Transit traveler information, Develop performance measures assess system performance, coverage needs, leverage mobility options such as TNCs to supplement public transportation	Existing
		Tennessee Emergency Management Agency	develop transit related emergency response plans, transit evacuation support	Existing
		Tennessee Highway Patrol	Transit security	Existing
		TN Bureau of Investigation	transit security	Planned
		TN Department of Health and Human Services	transit planning support, transit user needs and resources	Existing
		Transit Agency	Transit planning, Transit operations and maintenance	Existing
		Traveler	Transit rider	Existing
Road Weather Management	Road weather management address the impacts of weather on safety and mobility and strategies for mitigation. Accurate and timely assessment, prediction, evaluation and dissemination of road weather information will enable travelers make smart decisions about travel.	Commercial Vehicle Operators	road weather information	Existing
		County Government, Cumberland Gap Tunnel Authority, Municipal Government	road maintenance support	Existing
		Media	road weather information dissemination, road closure information dissemination	Existing
		National Oceanic and Atmospheric Administration	road weather prediction	Existing
		Tennessee Department of Safety	roadway safety assessment, roadway operations coordination	Existing
		Tennessee Department of Transportation	road maintenance, road weather monitoring, road closure, road weather information	Existing
		Tennessee Department of Transportation	traffic control	Planned

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
		Tennessee Emergency Management Agency	weather emergency response support, road weather monitoring	Existing
		Tennessee Highway Patrol	road maintenance support, road weather information, road closure enforcement, traffic monitoring, traffic control	Existing
		Transit Agency	transit status information	Existing
		Traveler	crowdsourced road weather information	Existing
TDOT SmartWay Traffic Management Centers	This describes the expanded functionality of the four SmartWay TMCs in terms of center-to-center connectivity among the TMCs, traveler information, inter-regional, and statewide functions. Detailed urban area TMC functions are included in the regional ITS architectures for Nashville, Memphis, Chattanooga and Knoxville.	Airport Operator	airport status information, traveler information	Existing
		Commercial Vehicle Operators	commercial vehicle information	Existing
		County Government, Cumberland Gap Tunnel Authority, Municipal Government, Other States, Railroad Operators, Regional Amber Alert Network Member Agencies, Tennessee Department of Safety, Tennessee Emergency Management Agency, Tennessee Highway Patrol, TN Bureau of Investigation, Transit Agency	Share data and provide support for traffic operations management	Existing
		Media	Traffic operations information dissemination	Existing
		Regional Toll Authority	regional toll information	Planned
		Tennessee Department of Transportation	collect operations data and management of traffic operations including TMC, share infrastructure operations data with partner agencies for management, deploy and manage systems for data collection, fusion, reporting, and archiving	Existing
		Traveler	crowdsourced system status information	Existing
Traveler Information	Traveler information provides transportation system information to travelers, so they are empowered to travel smarter. Pre-trip and en-route traveler information can help users make decisions about departure	Airport Operator	Disseminate travel information	Existing
		Airport Operator	Provide status information	Planned
		Commercial Vehicle Operators	commercial vehicle information	Existing
		County Government	system status information, traveler information, maintenance and construction information	Existing

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
	time or routes to enhance utility.	Cumberland Gap Tunnel Authority	tunnel status information, system status	Existing
		Media	Disseminate travel advisories	Existing
		Municipal Government	maintenance and construction information, system status information	Existing
		National Oceanic and Atmospheric Administration	Provide weather information and impacts on transportation system	Existing
		Railroad Operators	system status information, traveler information	Existing
		Regional Toll Authority	toll information	Planned
		System Users	status information	Existing
		Tennessee Department of Safety	Provide information for public safety	Existing
		Tennessee Department of Transportation	develop and deploy traveler information system, assess system status and provide status updates	Existing
		Tennessee Emergency Management Agency	traveler information, emergency status updates	Existing
		Tennessee Highway Patrol	Provide incident information	Existing
		TN Bureau of Investigation	system status updates	Existing
		Transit Agency	Provide transit status information	Existing
		Traveler	Use traveler information	Existing

4.0 ITS SYSTEM INVENTORY

4.1 EXISTING ITS ASSETS

TDOT currently operates four TMCs 24 hours per day, 7 days per week in the following locations: Knoxville, Chattanooga, Nashville, and Memphis. The TMCs are responsible for identifying and managing incidents as well as working to prevent secondary crashes. TMC operators are provided a variety of tools to perform their duties including closed circuit television (CCTV) Cameras, dynamic message signs (DMS), radar detection systems (RDS), video detection systems (VDS), highway advisory radio (HAR), height and speed warning systems, a fog warning system, portable variable message signs (PVMS), and portable CCTV (PCCTV) Cameras. The type of and number of devices deployed in each region are shown in **Table 5** below.

Table 5: Existing ITS Devices Deployed by Region[7]

Device	Region 1 Knoxville	Region 2 Chattanooga	Region 3 Nashville	Region 4 Memphis
CCTV Cameras	112	112	201	126
DMS	32	27	76	48
RDS	232	218	431	226
VDS	29	-	-	20
HAR	20	7	14	16
Over Height Warning	3	-	-	5
Overturn Warning	1	-	-	-
Fog Gates	-	6	-	-
Fog Sensors	-	9	-	-
VSL Signs	-	10	-	-
PVMS	5	-	3	-
PCCTV Cameras	5	1	2	-

To help meet their TSMO goals and objectives, TDOT has developed and utilizes a traveler information system called TDOT SmartWay. The traveler information system is populated by the TMC operators via an application called SWIFT (Statewide Information for Travelers) and feeds information such as traffic congestion, lane closures, road closures, traffic incidents, construction activity, road conditions, and rest area locations to the traveling public through the TDOT SmartWay website at https://smartway.tn.gov/traffic. Additionally, users of the website can view the TDOT CCTV cameras and active DMS messages to observe road conditions first-hand prior to starting their journey.

[7] Number of devices as of March 15, 2018.

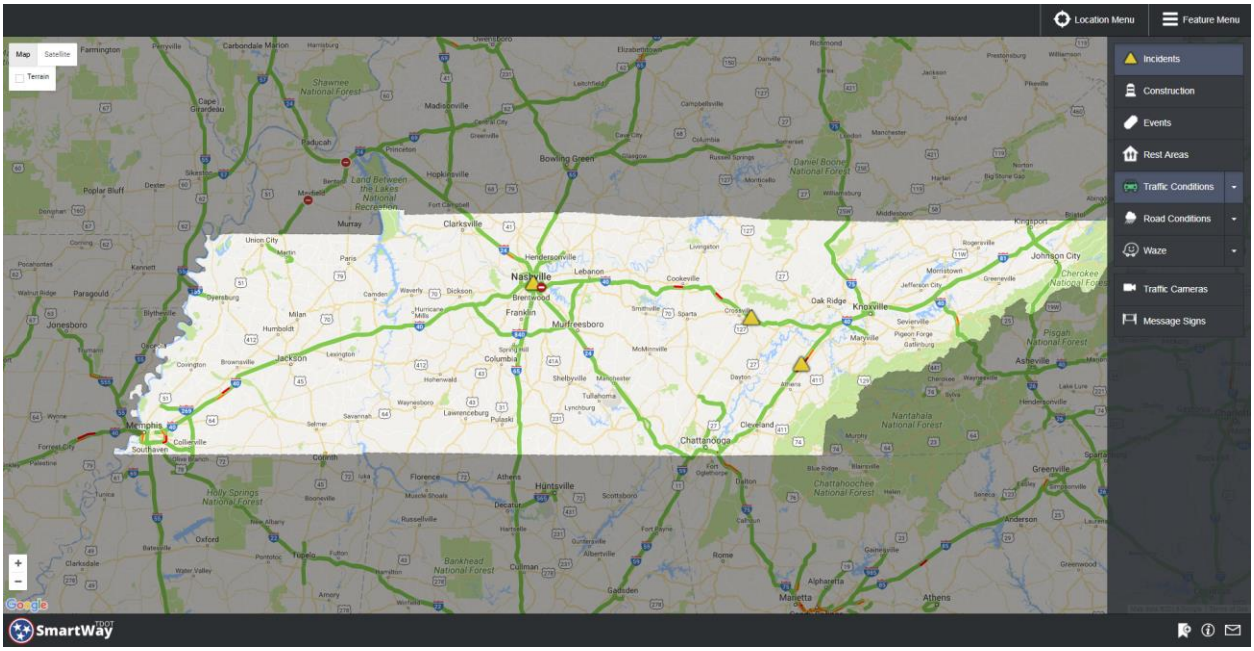


Figure 1: TDOT SmartWay Website

Table 6 shows the inventory of elements in the Statewide ITS Architecture with a brief description of each element and its stakeholder. All elements listed in **Table 6** are within the Transportation Domain.

Table 6: Statewide ITS Architecture Inventory

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
Airport	Regional airport (general and commercial aviation)	Existing	Alternate Mode Transportation Center, Center	Airport Operator
Alabama DOT	Alabama Department of Transportation, responsible for the maintenance and operations of roadways in the State of Alabama. Included in the TN Statewide ITS Architecture for coordination purposes.	Existing	Center, Traffic Management Center	Other States
Archived Data User Systems	Users that request information from the data archive systems.	Existing	Archived Data User System, Center	System Users
Arkansas DOT	Arkansas Department of Transportation, responsible for the maintenance and operations of roadways in the State of Arkansas. Included in the TN Statewide ITS Architecture for coordination purposes.	Existing	Center, Traffic Management Center	Other States
Commercial Vehicle	Commercial Vehicles are typically operated by private companies.	Existing	Basic Commercial Vehicle, Commercial Vehicle OBE, Vehicle OBE	Commercial Vehicle Operators

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
Commercial Vehicle Driver	Driver of commercial vehicle	Existing	Commercial Vehicle Driver	Commercial Vehicle Operators
Contractor Equipment	Portable ITS equipment belonging to a private contractor. In the context of the architecture, this would refer to portable CCTV, DMS, vehicle-mounted systems, or other contractor equipment that could be used at or near a highway construction site.	Existing	Maint and Constr Vehicle OBE	Private Contractor
County EMA	County emergency management agency (EMA). The EMA operates the emergency operations center (EOC).	Existing	Center, Emergency Management Center	County Government
County Field Equipment	Field equipment such as speed monitoring equipment or other ITS devices	Existing	Field, ITS Roadway Equipment	County Government
County Maintenance	Department responsible for maintenance of county roadway facilities. County maintenance departments are represented as general entities within the statewide ITS architecture. Regional ITS architectures provide for more detail about specific county maintenance functions and interfaces.	Existing	Center, Maint and Constr Management Center	County Government
County Public Safety Dispatch	County public safety dispatch, such as sheriff or regional Fire/EMS.	Existing	Center, Emergency Management Center	County Government
County Public Safety Vehicles	County law enforcement/sheriff patrol vehicles	Existing	Emergency Vehicle OBE	County Government
County TOC	County Traffic Operations Center responsible for signal control for county signals	Existing	Center, Traffic Management Center	County Government
County Traffic Signals	County operated signal systems	Existing	Field, ITS Roadway Equipment	County Government
Cumberland Gap TOC	Traffic operations center at the Cumberland Gap Tunnel, located in Middlesboro, KY. This TOC monitors CCTV on the US25E corridor, as well as posts messages on DMS.	Existing	Center, Other Traffic Management Centers	Cumberland Gap Tunnel Authority
CVIEW	Application for exchanging commercial vehicle safety information, Commercial Vehicle Information Exchange Window (CVIEW)	Existing	Center, Commercial Vehicle Administration Center	Federal Motor Carrier Safety Administration
Demand Response Transit Dispatch	Center responsible for the operations of a demand response transit agency and dispatching vehicles. The dispatch center communicates with drivers via radio communications (in most cases).	Existing	Center, Transit Management Center	Transit Agency
Demand Response Transit Vehicles	Transit vehicles for demand response transit operations. These vehicles could included buses, vans and automobiles.	Existing	Transit Vehicle OBE	Transit Agency
Driver	Individual operating a motor vehicle	Existing	Driver	Traveler

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
Electronic Fare Payment Card	Medium for collection of transit fares electronically. Cards typically feature a magnetic strip; on-board fare collection systems then debit the card for the fare amount when swiped.	Existing	Payment Device, Traveler Card	Regional Toll Authority
Financial Institution	Handles exchange of money for electronic payment collection. This element would support transit and potentially toll collection strategies.	Existing	Center, Financial Center	Private Corporation
Freight Equipment	Equipment on hazardous cargo that monitors freight status	Existing	Freight Equipment	Commercial Vehicle Operators
Georgia DOT	Georgia Department of Transportation, responsible for the maintenance and operations of roadways in the State of Georgia. Included in the TN Statewide ITS Architecture for coordination purposes.	Existing	Center, Traffic Management Center	Other States
IFTA	International Fuel Tax Agreement	Existing	Center, Other CV Administration Centers	International Fuel Tax Association
IRP	International Registration Plan allows motor carriers to operate in Canada and contiguous United States to transport international freight and each state entity gets paid for the mileage driven in the state.	Existing	Center, Other CV Administration Centers	International Registration Plan
Kentucky Transportation Cabinet (KYTC)	Kentucky Transportation Cabinet, responsible for the maintenance and operations of roadways in the State of Kentucky. Included in the TN Statewide ITS Architecture for coordination purposes.	Existing	Center, Traffic Management Center	Other States
Local Print and Broadcast Media	Local media outlets including newspapers, television and radio	Existing	Center, Media	Media
Mississippi DOT	Mississippi Department of Transportation, responsible for the maintenance and operations of roadways in the State of Mississippi. Included in the TN Statewide ITS Architecture for coordination purposes.	Existing	Center, Traffic Management Center	Other States
Municipal EMA	Municipal emergency management agency (EMA). The EMA operates the emergency operations center (EOC)	Existing	Center, Emergency Management Center	Municipal Government
Municipal Field Equipment	Field equipment such as detection, speed monitoring equipment or other ITS devices	Existing	Field, ITS Roadway Equipment	Municipal Government
Municipal Maintenance	Department responsible for maintenance of city streets and city-owned infrastructure (such as traffic signals)	Existing	Center, Maint and Constr Management Center	Municipal Government
Municipal Public Safety Dispatch	Dispatch center for municipal law enforcement agency (police). In some areas may also dispatch for Fire/EMS.	Existing	Center, Emergency Management Center	Municipal Government

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
Municipal Public Safety Vehicles	Local law enforcement patrol vehicles. In some areas these could also include fire/EMS vehicles	Existing	Emergency Vehicle OBE	Municipal Government
Municipal TOC	Municipal Traffic Operations center responsible for municipal signal system operations	Existing	Center, Traffic Management Center	Municipal Government
Municipal Traffic Signals	City operated traffic signals and traffic signal systems.	Existing	Field, ITS Roadway Equipment	Municipal Government
National Weather Service	Provides official US weather, marine, fire and aviation forecasts, warnings. The National Weather Service is a division of NOAA. TDOT TMCs receive weather forecast information feeds from NWS.	Existing	Center, Weather Service System	National Oceanic and Atmospheric Administration
North Carolina DOT	North Carolina Department of Transportation, responsible for the maintenance and operations of roadways in the State of North Carolina. Included in the TN Statewide ITS Architecture for coordination purposes.	Existing	Center, Traffic Management Center	Other States
Other Maintenance and Construction Management	Additional maintenance and construction management agencies with whom information is shared for coordination in an emergency situation	Existing	Center, Other Maint and Constr Mgmt Centers	Private Corporation
Other States Maintenance	Maintenance operations of adjacent states. Represented in the Statewide ITS Architecture as a general entity. Detailed interfaces between TDOT entities (particularly regional maintenance or SmartWay TMCs) and maintenance entities in other states are detailed in the Regional ITS Architectures.	Existing	Center, Maint and Constr Management Center	Other States
Other TDOT Region Construction Offices	TDOT Region Construction Offices	Existing	Center, Maint and Constr Management Center	Tennessee Department of Transportation
Other TDOT Region Maintenance	TDOT Region Maintenance	Existing	Center, Maint and Constr Management Center	Tennessee Department of Transportation
Other Traffic Management	Additional traffic management agencies with whom information is shared for coordination in an emergency situation	Existing	Center, Other Traffic Management Centers	Other States
Private Fleet Operations	Fleet and freight management for private carriers	Existing	Center, Fleet and Freight Management Center	Commercial Vehicle Operators
Private Long Distance Bus Company Operations	Private bus carrier	Existing	Center, Transit Management Center	Private Corporation

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
Private Sector Traveler Information Services	Third party distributor of transportation information, usually as a subscription service. This could include in-vehicle systems or wireless. This entity could also include private-sector operated traveler information web sites.	Existing	Center, Transportation Information Center	Private Corporation
Private Traveler Personal Computing Devices	Personal traveler devices for accessing transportation information	Existing	Personal Information Device	Traveler
Private Vehicle	Personal owner operated vehicle	Existing	Vehicle OBE	Traveler
Rail Operations Centers	Centers responsible for the operations and tracking of trains	Existing	Center, Rail Operations Center	Railroad Operators
Regional Amber Alert Network	Regional Amber Alert program coordinating emergency management and traffic management for information dissemination	Existing	Center, Emergency Management Center	Regional Amber Alert Network Member Agencies
Regional Toll Authority	Administration for tolled roadways. At present, there are no toll facilities in Tennessee, but this was identified as a potential future application.	Planned	Center, Payment Administration Center	Regional Toll Authority
Regional Toll Authority Toll Plazas	Toll collection facilities (future)	Planned	Field, ITS Roadway Payment Equipment	Regional Toll Authority
Regional Websites	Websites utilized by members of the Regional AMBER Alert Network to disseminate amber alert information	Existing	Center, Transportation Information Center	Regional Amber Alert Network Member Agencies
Service Agency	Agency responsible for payment of transit fares for medical transportation as part of government subsidized medical care	Existing	Center, Financial Center	TN Department of Health and Human Services
SSRS	Single State Registration System - in which commercial vehicles are required to register their FHWA operating authority and proof of insurance with their base state. The base state is determined by the location of the carrier's principal place of business. If a carrier's principal place of business is maintained outside of a participating state, the carrier must select the state where the largest number of vehicles will be operated during the next registration year.	Existing	Center, Other CV Administration Centers	Tennessee Department of Safety
TDOT Active Lane Management Systems	The active lane management systems refer to the various systems used to manage travel lanes and dynamically change travel lanes to influence drivers choice of lane or facility. These strategies include dynamic junction control, dynamic lane reversal, dynamic lane use control, dynamic merge control, dynamic shoulder lanes and or dynamic speed limits.	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
TDOT Anti-icing Equipment	Roadway equipment that applies a chemical agent to lower the freezing point in an attempt to prevent ice from forming on the roadway	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT CCTV	Closed circuit television cameras for traffic surveillance and incident management. CCTV are existing in both urban and rural areas of the state. TDOT plans to install CCTV along key highways corridors throughout the state.	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT Closure Equipment	Roadway equipment to physically close roadways (such as gate systems)	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT Communications Network	This refers to communication assets used for center-to-center communications or center-to-field communications. They include a mix of fiber optics, licensed wireless, cellular, etc.	Existing	Connected Vehicle Roadside Equipment, Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT	Repository for transportation data for the State of Tennessee	Planned	Archived Data System	TDOT
TDOT DMS	Dynamic message signs for traffic information dissemination. TDOT has DMS in the urban areas, and plans to implement on corridors in the rural areas.	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT DSRC	TDOT DSRC refers to the dedicated short range communications assets which includes road side equipment (RSEs) and the communications infrastructure required to support connected vehicle operations such as queue warning, speed harmonization, in-vehicle signage for traveler information, stop sign gap assist, curve speed warning, and connected vehicle system monitoring and management.	Planned	Connected Vehicle Roadside Equipment, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT Emergency Services Coordinator	Emergency service coordinator from TDOT who serves in the TEMA emergency operations group. During a disaster this coordinator acts as a liaison between TEMA and the various TDOT TMCs and maintenance groups.	Existing	Center, Emergency Management Center, Maint and Constr Management Center	Tennessee Department of Transportation
TDOT Field Sensors	Detectors/sensors that collect speed and volume data on key corridors.	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT HAR	Highway Advisory Radio for traffic information dissemination	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT HELP Dispatch	Roadway service patrol dispatch centers are located in the SmartWay TMCs.	Existing	Center, Emergency Management Center, Traffic Management Center	Tennessee Department of Transportation

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
TDOT HELP Vehicles	Roadway service patrol vehicles. These are existing in the urban areas, and TDOT plans to expand its HELP service to include rural corridors in the state.	Existing	Emergency Vehicle OBE	Tennessee Department of Transportation
TDOT Maintenance Headquarters	TDOT statewide maintenance headquarters in Nashville.	Existing	Center, Maint and Constr Management Center	Tennessee Department of Transportation
TDOT Maintenance Vehicles	TDOT vehicles used in maintenance operations	Existing	Maint and Constr Vehicle OBE	Tennessee Department of Transportation
TDOT Power Network	TDOT Power Network refers to back up power systems such as fuel cells, generators, batteries that power equipment in the event of failure of primary power source from the grid.	Existing	Field, Service Monitor System	Tennessee Department of Transportation
TDOT Probe Data Collector	This includes Blue Toad and Blyncsy devices for probe data collection.	Planned	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT Public Information Office	TDOT department responsible for the dissemination of traffic, road closure, and planned construction activity information to the media and the public	Existing	Center, Transportation Information Center	Tennessee Department of Transportation
TDOT Ramp Meters	This refers to the signalized systems located on on-ramps to controlled access facilities such as the interstate systems which help manage demand on freeways and also break up platoons of vehicles released from adjacent intersections to ensure safe merges and reduce congestion on the freeway.	Planned	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT Region 1 TMC - Knoxville	Traffic Management Center for TDOT Region 1. The center is located in Knoxville and is responsible for operating and managing the SmartWay system in the Knoxville metropolitan area as well as operation of ITS elements in rural areas of the Region. Detailed information flows and connections between the Region 1 TMC and devices and other agencies in Region 1 are detailed in the Knoxville Regional ITS Architecture.	Existing	Center, Emergency Management Center, Traffic Management Center	Tennessee Department of Transportation
TDOT Region 2 TMC - Chattanooga	Traffic Management Center for TDOT Region 2. The center is located in Chattanooga and responsible for operating and managing the SmartWay system in the Chattanooga metropolitan area as well as operation of ITS elements in rural areas of the Region.	Existing	Center, Emergency Management Center, Traffic Management Center	Tennessee Department of Transportation
TDOT Region 3 TMC - Nashville	Traffic Management Center for TDOT Region 3. The center is located in Nashville and is responsible for operating and managing the SmartWay system in the Nashville metropolitan area as well as operation of ITS elements in rural areas of the Region.	Existing	Center, Emergency Management Center, Traffic Management Center	Tennessee Department of Transportation

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
TDOT Region 4 TMC - Memphis	Traffic Management Center for TDOT Region 4. The center is located in Memphis and is responsible for management of traffic in the Memphis metropolitan area as well as operation of ITS elements in rural areas of the Region.	Existing	Center, Emergency Management Center, Traffic Management Center	Tennessee Department of Transportation
TDOT Region Construction Office	Regional TDOT offices responsible for oversight of construction projects	Existing	Center, Maint and Constr Management Center	Tennessee Department of Transportation
TDOT Region Engineers Office	Region engineering office	Existing	Center, Maint and Constr Administrative Systems	Tennessee Department of Transportation
TDOT Region Maintenance	Maintenance headquarters in each TDOT region. Each region contains several maintenance districts.	Existing	Center, Maint and Constr Management Center	Tennessee Department of Transportation
TDOT RWIS Sensors	Road weather information system sensors to provide data about real-time conditions, including temperature, precipitation, humidity and wind. TDOT currently has 37 RWIS stations throughout the state.	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT Security Monitoring Field Equipment	Field equipment for monitoring the security of the transportation infrastructure	Existing	Field, Security Monitoring Equipment	Tennessee Department of Transportation
TDOT Smart Work Zone Equipment	Portable DMS and CCTV cameras as well as work zone safety monitoring equipment	Existing	Connected Vehicle Roadside Equipment, Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT SmartWay	Website providing road network conditions information, including closures, construction activity, weather and major incidents. TSIS provides data for the construction and incident information. A link to SmartWay CCTV camera views is also available	Existing	Center, Transportation Information Center	Tennessee Department of Transportation
TDOT Speed Monitoring Equipment	Field equipment used for monitoring roadway speeds. These can be permanent or portable devices.	Existing	Field, ITS Roadway Equipment	Tennessee Department of Transportation
TDOT Strategic Transportation Investments Division	TDOT group responsible for traffic data collection and analysis as well as short range planning.	Existing	Center	Tennessee Department of Transportation
TEMA	TN Emergency Management Agency. Lead agency for emergency planning and responding to major incidents and disasters in Tennessee.	Existing	Center, Emergency Management Center	Tennessee Emergency Management Agency
Tennessee Pre-Pass	Determines whether or not a registered Pre-Pass commercial vehicle can bypass a weigh station	Existing	Center, Commercial Vehicle Administration Center	Heavy Vehicle Electronic License Plate (HELP), Inc.

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
THP Dispatch	Highway Patrol dispatch center. THP dispatch includes a CAD system.	Existing	Center, Emergency Management Center, Traffic Management Center	Tennessee Highway Patrol
THP Enforcement	Enforcement officers for weigh and inspection station violations. THP is also responsible for law enforcement on state highways.	Existing	Center, Commercial Vehicle Inspector, Enforcement Center	Tennessee Highway Patrol
THP Truck Weigh and Inspection Station	Includes weigh in motion, static scales and inspection pits	Existing	Center, Commercial Vehicle Administration Center, Commercial Vehicle Check Equipment	Tennessee Highway Patrol
THP Vehicles	Tennessee Highway Patrol vehicles	Existing	Emergency Vehicle OBE	Tennessee Highway Patrol
THP Weigh-in-Motion	Weigh-in-Motion scales	Existing	Commercial Vehicle Check Equipment, Field	Tennessee Highway Patrol
TN Bureau of Investigation	Responsible for Amber Alerts in TN	Existing	Center, Emergency Management Center	TN Bureau of Investigation
Transit Agency Archive	Archive for transit data	Existing	Archived Data System, Center, Transit Management Center	Transit Agency
Transit Kiosks	Kiosks for dissemination of transit traveler information	Existing	Traveler Support Equipment	Transit Agency
Transit Vehicle		Existing	Transit Vehicle OBE	Transit Agency
Transit Vehicle Operator	Driver of bus or other transit vehicle	Existing	Transit Vehicle Operator	Operator
Transit Website	Website containing transit traveler information such as fares and schedules	Existing	Center, Transportation Information Center	Transit Agency
USGS Field Equipment	Water level sensors and other weather equipment	Existing	Field, ITS Roadway Equipment	United States Geological Survey
USGS Flood Monitoring System	USGS system for monitoring water levels. Stream gauge data is collected and can be provided to TDOT and other agencies to alert them of high water conditions.	Existing	Center, Emergency Management Center, Maint and Constr Management Center	United States Geological Survey

Element Name	Element Description	Element Status	Associated Physical Objects	Stakeholder
Violation Detection	Roadside equipment to detect trucks that fail to enter the weigh and inspection station as directed	Existing	Commercial Vehicle Check Equipment, Field	Tennessee Highway Patrol
Virginia DOT	Virginia Department of Transportation, responsible for the maintenance and operations of roadways in the State of Virginia. Included in the TN Statewide ITS Architecture for coordination purposes.	Existing	Center, Traffic Management Center	Other States
Wayside Detection Equipment	Train detection equipment.	Existing	Field, Wayside Equipment	Railroad Operators

5.0 ITS NEEDS AND SERVICES

TDOT's mission is to provide a safe and reliable transportation system in Tennessee. With constraints on funding and the ability to expand roadway systems, innovative approaches are required to maximize mobility and safety of the existing transportation system. Furthermore, transportation is undergoing a revolution and mobility as a service (MAAS) with emphasis on shared use rather than personal automobile ownership is gaining ascendancy. While the mobility needs and how they are met depend on many factors beyond the scope of this document such as land use planning and demographic factors, the trends today show that mobility needs will be met using traditional modes of transportation (transit, automobiles, bicycles, etc.) with the addition of novel or nascent technologies like air taxis (velocoptors) and shared automated vehicles. Advancements in technology will serve to integrate these diverse modes and provide seamless trip plan to meet each user's needs. While these innovations are driven by the private sector, the infrastructure owner and operators (IOO), such as TDOT, will be setting policies for access to its infrastructure and ensuring an equitable ecosystem of mobility options to meet all demographic needs. It is challenging to predict with any certainty the pace of evolution and how existing transportation systems will be impacted. This section attempts to address ITS needs looking at both the immediate needs identified based on the outcomes of the stakeholder meetings held in April 2018 and emerging technology that TDOT needs to position itself for leverage. The stakeholder meetings held in April 2018 were for the Statewide ITS Architecture update and the Concept of Operations Workshop for TDOT's Statewide TMC Upgrades provided insight into the stakeholder needs for ITS in Tennessee.

5.1 ARCHIVED DATA MANAGEMENT

Information management systems facilitate collaboration between stakeholders to ensure transportation system data required for planning and operations can be shared. The federal government has instituted the Real-Time System Management Information Program[8] with the goal to monitor traffic and travel conditions and provide a means of sharing the data with state and local governments and the traveling public. The intent is to make traffic data available in formats that can be used by all stakeholders who in turn deliver value-added information. This calls for data exchange protocols that will make this information ubiquitous. Archive data is critical for planning and knowledge development and should be made accessible through a data storage system.

5.2 CENTER-TO-CENTER COMMUNICATIONS

Center-to-center communications is desirable to facilitate data (video, messages, etc.) sharing for operations and management between centers. In the case of TMCs it will help with management of traffic near or crossing regional boundaries such as during Bonnaroo festival which straddles TDOT Regions 2 and 3. It also facilitates management and/or monitoring of any other region's devices during emergency or incident response. For instance, in the event that a specific TMC cannot be staffed, perhaps due to mandatory evacuation because of natural or artificially induced hazards, other centers can remotely operate devices in the affected area and support emergency evacuation. Another identified need is interconnectivity with municipalities to facilitate management of transportation systems.

[8] http://www.ops.fhwa.dot.gov/1201/

5.3 INCIDENT MANAGMENT

While MIST® was previously utilized for incident management, all four TDOT TMCs are in the process of migrating to ActiveITS as the statewide TDOT Advanced Traffic Management System (ATMS) solution. Automatic incident detection with a good map interface is desired to facilitate remote operations for other regions. Maps will make it much easier to share information on location of incidents (department and public) as many times callers don't know exactly where they are.

5.3.1 Vehicle Detection

Vehicle detection systems are desired to monitor traffic congestion. While radar detection systems have been the standard in Tennessee, improvements in video analytics have brought video detection back into interest as well. Furthermore, Bluetooth, Wi-Fi, and other types of probe data detectors that provide origin-destination and travel times are desired.

5.3.2 Oversize Detection

Some bridge structures have sensors for oversize vehicular strikes. Communication from these sensors to the TMC is desired. For example, the existing system in Memphis area can automatically post to the DMS but the TMC is not alerted. However, alerts are provided to the Region 1 TMC in Knoxville when oversize vehicles are detected in that region.

5.3.3 Wrong Way Detection

Often resulting in a fatal incident, wrong way driving occurs quite often in Tennessee (average of about 6 or 7 collisions per year). TDOT desires wrong way detection and is interested in using radar detection systems on off-ramps for wrong way detection. When triggered, the wrong way detection system will actuate scenarios on nearby DMSs and CCTVs along with warning signs along the off-ramp. Video analytics is also being considered with edge analytics being performed to limit bandwidth and server requirements.

5.3.4 Work Zone ITS

Work zones disrupt the normal operation of traffic and pose a safety hazard to travelers and construction crew. Adequate traffic management plans need to be implemented to enhance safety and mobility in and around work zones. ITS devices can play a role in managing traffic at work zones. Current work zone ITS include portable devices to monitor and control traffic such as CCTV cameras, portable changeable message signs (PCMS), variable speed limit (VSL) signs, vehicle detection devices, dynamic merge systems, queue warning systems with data typically shared by cellular communications. Other applications of work zone ITS include automated enforcement (speed management), and performance measurements. The benefits of work zone ITS include enhanced safety and mobility and mitigation of hazards related to the construction. Work zone ITS is desired during freeway rehabilitation and construction with TMC control or oversight of the work zone ITS operations. Currently work zone ITS provides a web interface for the TMC operators to have access to the data from the devices. The desire is to have work zone ITS interface with the TMC operations to enable consistent management of the corridor and or leverage the expertise of experienced TMC operators. Complex work zone ITS may require a system engineering analysis to facilitate integration with a local TMC.

5.3.5 Comprehensive Detour Plan

Comprehensive Detour Plans provide an analysis of critical corridors and detour routes used to mitigate the impacts of incidents and congestion to mobility and the environment. Impacted corridors and counties must be resourced for a more integrated management of incidents.

5.3.6 Automated Incident Detection

Automated Incident Detection is a means of alerting TMC Operators to unusual patterns of traffic and/or objects in the roadway. Automated Incident Detection can be implemented with a variety of hardware solutions such as loop detection, radar vehicle detection, and video analytics. This application can improve incident response times as well as overall TMC operations.

5.3.7 Runaway Ramp Detection

Runaway Ramp Detection is a way of alerting the TMC when a vehicle has driven into a runaway truck ramp. This system also lights up signs along the highway upstream of the ramp that indicate that the runaway truck ramp is occupied to prevent another vehicle from attempting to use the same ramp.

5.4 COMPUTER AIDED DISPATCH INTEGRATION

There have been noted communication issues between some TMC operators having trouble hearing between front rows and back rows within the TMC. Instant messaging between operators could be a means of improving communication which could extend to a notification system with CAD integration that can be tied into THP dispatch. CAD data could also be used to populate location and lane information into the incident management database. Having CAD automatically notify TMC Operators of incidents is desired.

5.5 PARKING MANAGEMENT SYSTEM

There is need to manage parking and sharing information about availability to truck drivers. SmartPark gives qualitative availability of parking (e.g. some availability or full). TDOT would like to share real-time parking availability in the future. A robust system will require several calibration checks required to make sure there is no drift, falsely reporting the availability of parking. Also, there is a need for park and ride in the longer term. There is a study currently ongoing to determine availability of parking and bus operations (headway requirement) for demand in a corridor.

5.6 VIDEO DISTRIBUTION SYSTEM

A video distribution system enables stakeholders for incident and emergency management to assess incident severity and roadway conditions and ensures that the right resources are deployed for incident response and expedite return of the roadway to normal operations. Skyline is currently used for video distribution at TDOT. Transcoding is done in the TMC and hosted on the web and shared with first responders.

5.7 TRAVELER INFORMATION

Traveler information consists of transportation network monitoring and the methods used to obtain and disseminate information to travelers. Traveler information includes traffic conditions such as congestion, incidents, roadway weather conditions, travel time, AMBER alerts, BLUE alerts, transit schedules or status, construction or work zones information.

Traveler information is very important because it empowers users to make smart decisions about travel. Accurate information about network status, congestion, incidents, travel time and modal choices enables travelers to make pre-trip and en-route decisions about the best modal choice, routes, and departure times to meet their mobility needs. Drivers who use alternate routes to avoid congested roadways or locations with incidents help to reduce the duration of congestion and reduce excessive vehicle emissions associated with congestion. From a safety perspective, drivers can avoid hazardous or threatening situations when informed of adverse weather conditions. At the very least, if drivers are informed about incidents and congestion downstream, it removes the uncertainty and the anxiety associated with traveling in congested corridors.

An effective traveler information system depends on accurate real-time information of the transportation network status successfully reaching users. This requires an efficient network surveillance system that monitors for instance vehicle speeds and rapidly detect anomaly in the traffic flow, incidents, and evaluate the impacts and facilitates rapid deployment of mitigation measures. A proactive approach to traffic management includes predictive tools that can help traffic operators estimate traffic conditions in advance and provide traveler information to support smarter travel – this is also referred to as active traffic management. This capability is critical especially during emergencies or evacuations to enable rapid evacuation of people from unsafe zones to areas of refuge. The importance of traveler information during such emergencies cannot be overemphasized, and there are a variety of ways to detect, collect and disseminate traffic data to actively manage the roadway.

5.7.1 Highway Advisory Radio

HAR works in certain regions of the State and not very well in others because of topography or a location is prone to interference and makes it impossible to send clear messages to the public. There is some benefit that HARs can still afford now even though it appears its usefulness will wane in the connected vehicle environment when penetration rates increase and CVs become ubiquitous.

5.7.2 Fog Warning System

The system consists of weather systems, variable speed limit signs and dynamic message signs for traveler information. The fog warning system is operated by the Tennessee Highway Patrol (THP) and depends on human observations. THP controls and manages it with a module in ActiveITS. Even though the TMC has access to the fog warning system it cannot control it. TDOT desires migration of this system from THP control into the TMC operations.

5.7.3 Social Media

The TMC operators desire that the ATMS software interface with social media and use it as an avenue for information dissemination to the public. Currently, TDOT posts messages to Twitter, but it is not an automated process.

5.7.4 Road Weather Information System

The road weather information system (RWIS) integrates with the National Weather Service (NWS) for weather data and shows regions or polygon with weather event. The data collected include wind speed, surface condition, precipitation, visibility, etc. TDOT has about 36 weather stations as part of the ITS inventory in various states of repair that it desires to integrate into SmartWay systems. The lack of a robust and reliable system means that the maintenance crew have to be more proactive and very conservative in response to potential weather-related events. TDOT desires RWIS to address this challenge and be efficient.

5.7.5 Dynamic Message Signs

Dynamic Message Signs (DMSs) are one of the most widely-recognized traveler information assets that TDOT currently operates. TDOT uses DMSs to provide traveler information to alert passing motorists of downstream incidents, alternative route options, travel times, AMBER alerts, Blue Alerts, public service announcements (PSAs), and planned construction. DMSs communicate back and forth to the TMC where operators are responsible for generating relevant messages and scheduling the posting of travel times and PSAs. TDOT desires for the new ATMS to provide recommended messages to post to the DMSs during an incident.

5.7.6 Travel Time Message Signs

Travel Time Message Signs (TTMSs) are static signs with digital inserts that inform motorists of the anticipated travel time from a specific point to another via two or more different routes. There is a desire for these to be implemented in strategic locations where motorists have multiple route choices available to get to a specific destination (i.e. downtown, university, airport). **Figure 2** below shows how these signs would differ from a standard DMS with travel times posted on it.



Figure 2: Example Travel Time Message Sign in Port Allen, LA

5.7.7 In-Vehicle Applications

In-Vehicle Applications are gaining more traction as the world becomes more connected. As technology continues to evolve, there is a desire to utilize connected vehicle technology to deliver traveler information to motorists' dashboards and smartphones. This could be information duplicated from applicable DMSs or vehicle-specific information to inform motorists of downstream travel conditions and incidents.

5.7.8 SmartWay Website

The TDOT SmartWay website provides a public-facing portal that displays real-time road conditions, incidents, construction activity, special event information, traffic conditions, and Waze information to the traveling public. Furthermore, live feeds of the traffic monitoring cameras and dynamic message sign text can be viewed. The SmartWay website is updated and maintained by TDOT.

5.7.9 511

Tennessee 511 is a voice response system that provides road and travel conditions to the traveling public via a phone call to 511 or 877-244-0065. Callers can request information about specific roadways or regions to obtain information pertinent to their travel plans.

5.8 CONNECTED AUTOMATED VEHICLES

5.8.1 Connected Vehicles

Tennessee has a bold plan for deployment of dedicated short-range communications (DSRC) to position itself to rapidly leverage the benefits to traffic operations and safety. Currently plans are under way to deploy DSRC in the I-24 corridor. Additionally, all new traffic signal installations and upgrades going forward will deploy DSRC radios to send basic safety messages (BSMs), signal phase and timing (SPaT) and traveler advisory messages into vehicles. There is a desire also to use this technology for wrong way vehicle detection and warning, reduced speed zones, queue boundaries, airbag deployment notification and activated hazard light with all the information being sent by road side units (RSUs) to a TMC.

While the communications technology for connected vehicle applications is still evolving, it appears the communications technologies could be a mix of DSRC, cellular, satellite or wi-fi. Thus far DSRC has the performance requirements (low latency) to meet the needs for basic safety messages in the connected vehicle ecosystem. It is anticipated that other governmental, non-governmental and commercial entities will use DSRC for business needs and in urbanized areas this could pose a challenge to share spectrum and physical space for stations. There are some DSRC frequencies used by the Department of Defense. TDOT should analyze its spectrum needs for connected vehicle applications and license the frequencies it needs for DSRC especially in urbanized areas. Current licensing regulations puts the responsibility on new licensees to resolve any conflicts with existing licensees in the DSRC spectrum, i.e. any interference issues that must be resolved is the responsibility of the entity installing new stations.

5.8.2 First Mile/Last Mile

Population growth and economic activities will put more demand for trips on the transportation system. Transit systems will play a pivotal role in grappling with congestion as the population continues to grow. However, transit systems are typically not flexible in their routing and therefore many who desire to use transit are either forced to use automobiles or drive to park and ride facilities and change modes. Transit ridership could be significantly improved with flexible and reliable first mile/last mile solutions especially those that can potentially be achieved with automated vehicles or shuttles. Several demonstrations of this concept of shared automated vehicles (SAVs) have been and are currently being performed around the country.

5.9 FREEWAY AND ARTERIAL MANAGEMENT

According to the FHWA *Freeway Management and Operations Handbook*[9], freeway management and operations is the "implementation of policies, strategies and technologies to improve freeway performance." That is to reduce congestion, improve mobility and enhance safety for all users. Congestion results when the demand exceeds the capacity. Congestion can be described as recurrent or non-recurrent congestion. The congestion that occurs during morning and evening rush hour are typical examples of recurrent congestion. Non-recurrent congestion occurs when the capacity of the roadway is reduced temporarily because of an incident or environmental factors. While recurrent congestion often follows a known temporal pattern, non-recurrent congestion is more random in nature.

The TDOT Traffic Operations Program Plan outlines several ways to manage freeways and arterials and classified under three broad themes:

1. Programs: used to identify and add new or improve existing programs, policies and process to support traffic operations including application of innovative and effective technologies.

2. People: training operators and staff for incident management

3. Projects: deploying infrastructure, maintenance and other initiatives

Other future initiatives include leveraging connected and autonomous vehicles (CAVs) for safety and mobility as discussed in **Section 5.8**. Other options include travel demand management, lane controls, ramp meters, high occupancy vehicle (HOV) lanes, and high occupancy toll (HOT) lanes for congestion pricing etc. The mix of strategies depends on the capabilities available based on the infrastructure in place and cooperation between different agencies or stakeholders.

Another emerging area is the use of big data for traffic and incident management. Big data has the potential to provide rich and expansive data and as more and more people use devices connected to the cloud there is a potential to gain real-time and predictive actionable information which can be used to modify traveler behavior with instant results to evaluate management strategies, improve safety and mobility. TDOT can position itself to leverage the benefits of big data by determining data that is useful for its business functions and collecting them in enough detail, sharing data (with necessary and security protocols) and promoting data user communities that can leverage big data tools to develop operations intelligence. While there is a cost associated with data collection, and storage, leveraging scalable cloud

[9] http://ops.fhwa.dot.gov/freewaymgmt/publications/frwy_mgmt_handbook/fmoh_complete_all.pdf (Accessed 7/31/2018)

technologies could afford many benefits at reduced cost. Connected and automated vehicle operations could easily generate terabytes of records from vehicle situational awareness information to incidents.

5.9.1 Ramp Metering

Ramp Metering, or Ramp Signaling as it is also referred to, is a tool to address recurring congestion. The goal of ramp metering is to improve safety and travel times by maximizing throughput of the freeway. This is achieved when ramp meters break up the platoons of vehicles entering the interstate. There are a variety of strategies that can be utilized to operate ramp meters such as time of day demand-responsive operations and adaptive or time of day timing. It is important to perform significant public outreach to educate local commuters how ramp meters work and the benefits that they can provide prior to implementation.

TDOT has identified the I-24 corridor in the Nashville metro area as the first location to deploy ramp meters in Tennessee.

5.9.2 Reversible Lanes

Reversible lanes allow roadway capacity to be maximized on highly directional corridors (such as heavy WB in the morning and heavy EB in the evening). TDOT does not currently operate any reversible lanes; however, there are municipalities within Tennessee that do operate them.

5.10 INTEGRATED CORRIDOR MANAGEMENT

Integrated corridor management (ICM) leverages all available capacity across all modes of travel to move people and goods along a corridor. This requires the use of real-time system information, predictive tools, and decision support systems to balance demand across different transportation assets. ITS enables integrated corridor management when travelers are empowered with information and can take advantage of underused capacity on parallel routes or change modes of travel. ITS can foster more dynamic and fluid travel decisions with high reliability. Messages can be posted on DMS or pushed to smartphone apps for traveler information. Stakeholders within the catchment of the corridor can share information and collaborate operationally to optimize transportation. An integrated approach may require rerouting traffic, changing operational parameters (signal timing, ramp closures, etc.) and or mode shift. ICM facilitates access to excess capacity in a mode or route and can help minimize congestion. This in turn will reduce delays and improve air quality because of fewer emissions. There are several corridors in urbanized areas that lend themselves to ICM techniques to enhance mobility and optimize use of transportation assets. TDOT's first ICM project is located along the I-24 corridor in the Nashville metropolitan area.

5.11 ACTIVE TRAFFIC MANAGEMENT

Active traffic management (ATM) is an integrated set of proactive traffic management strategies used to manage normal and incident congestion on freeways and associated arterials. TDOT intends to leverage active traffic management methods to manage the transportation infrastructure to enhance mobility and safety. The I-24 ICM Project is one such example where ATM strategies will be leveraged.

5.12 PERFORMANCE MEASURES

MAP 21 requires the use of performance measures to enhance transportation systems operation, management and maintenance. Data collected from ITS operations can provide info that can be used in performance monitoring and management and help meet Federal requirements.

5.13 ITS ASSET MANAGEMENT

An ITS Asset Management system can help manage maintenance schedules, track recalled devices, and identify device locations and fiber locates for construction projects. TDOT needs an asset management system to help with their ITS device maintenance and create more efficient overall operations. Furthermore, an ITS asset management system that will support life cycle planning for ITS assets is desired.

5.14 PUBLIC TRANSIT

Public transportation or transit systems serve all demographics in both rural and urban areas by providing mobility and increasing accessibility to opportunities. For children, the elderly, the blind or others with disabilities that preclude them from driving, it becomes the principal means of mobility. When patronized, public transit reduces automobile trips and traffic congestion, makes work accessible to many and fosters livable communities. There are various public transit options available that can be implemented depending on the population density. Potential applications include regional commuter rail, light rail, express bus and paratransit and fixed route transit systems.

ITS technologies can enhance transit operations and user experience by providing real-time transit information and enabling users to request for and pay for transit services electronically and seamlessly change modes. Trip planning software can be used to help travelers plan trips and customize these trips to their needs based on the available transit options. Transit operators can track transit vehicles and provide real time information on the status of transit systems and can take implement real-time measures to enhance service reliability. Computer aided dispatch systems can monitor transit vehicle location and dispatch transit to meet demand and improve headways for schedule adherence. Transit signal priority can be implemented in collaboration with local traffic management agencies to ensure on-time arrival of transit vehicles thereby reducing delay for those who use transit. The reliability of transit arrival times will further encourage transit use and facilitate travel demand management. Paratransit systems can benefit from automatic vehicle location systems since dispatchers can efficiently respond to user calls and provide service in a shorter period of time by dispatching the appropriate vehicle. This can enhance mobility and make paratransit use more efficient. Transit users can also be informed about incidents and any delays in the system and can empower users to choose alternate modes and save money and time.

Current mobility trends show a diverse and evolving ecosystem of modes that include transportation network companies (TNCs), shared bikes or shared scooters, used to address mobility needs. For instance, in fixed route transit operations, TNCs offer flexibility to address first mile and last mile challenges associated with transit operations and ridership. Transit agencies may use TNCs to address paratransit needs. There are several studies currently under way to assess the impacts of these new mobility options on public health, and urban curb spaces. Dockless bikes and scooters are known to adversely impact ADA compliance. Furthermore, issues related to these novel transportation options and curb space management is one that needs to be addressed to ensure a safe and efficient system for all modes of transportation (including bicyclists and pedestrians), freight and courier deliveries, emergency services, electric vehicle

charging, ADA access, parking, parklets and streetscape. Prioritization for transit services especially in urbanized areas may be required by using "regulatory, operations, and technology strategies to optimize curb access and usage"[10].

TDOT is currently undertaking studies to assess the use of transit managed lanes including bus on shoulder concepts, transit signal priority, park-and-ride and some intelligent transportation systems deployment to enhance transit operations. TDOT will assess the benefits of TNCs as an integral part of the mobility options for public transit.

5.15 COMMERCIAL VEHICLE OPERATIONS

The domestic freight ton-miles traveled by trucks in the United States is projected to continue to increase. Commercial vehicles are required to have appropriate credentials, evidence of meeting specified qualifications, to operate on the interstate system, carry hazardous materials, or operate vehicles over standard legal weight or size. ITS technologies facilitate efficient commercial vehicle operations by streamlining the permitting and documentation process and improve the safety and security of motor carriers, the transportation system and the general public. Commercial vehicle operations (CVO) ITS technologies include weigh-in-motion (WIM) sensors, commercial vehicle information systems network (CVISN), and performance and registration information system management (PRISM). CVISN and PRISM are programs managed by the Federal Motor Carrier Safety Administration (FMCSA), and both have the objective of improving motor carrier safety through information exchange. The PRISM and CVISN programs are complementary and both are geared towards improving motor carrier safety. When implemented together the programs work synergistically and use limited resources for targeted enforcement by focusing on high risk carriers and vehicles.

5.15.1 Weigh-in-Motion

Commercial vehicle axle load enforcement is critical to the structural integrity of pavements and bridges and has a direct impact on cost of maintaining these facilities. Overloaded trucks cause accelerated damage to the physical roadway infrastructure, shorten the life of the infrastructure, and increase the life cycle cost. Overloaded trucks also pose a serious safety hazard to all road users since braking and steering are compromised by the excess weight and there is an increased risk for a tire blowout.

Weigh-in-motion (WIM) technology allows the axle loads of heavy vehicles to be weighed at highway speed without stopping. This enforcement approach allows only trucks that have loads approaching a set threshold to be pulled over for axle load inspection while other trucks that are not in violation may continue on their journey. The selective pre-screening approach is effective in reducing delays by targeting enforcement at potential axle load violations.

5.15.2 Virtual Weigh-in-Motion

A virtual weigh station refers to a roadside enforcement facility that is used to screen trucks for weight enforcement by relaying axle and gross vehicular weight information to enforcement agencies that may be located downstream. The information may include photographs of the truck in violation for identification. The main difference between virtual weigh-in-motion and permanent weigh-in-motion stations is that the former does not require continuous staffing and is typically monitored from a remote location. The virtual site may be monitored from a nearby fixed WIM site or from an enforcement agency vehicle located downstream and equipped with a laptop and requisite communication. Virtual WIM

[10] https://www.ite.org/technical-resources/topics/complete-streets/curbside-management-resources/ (Accessed 12/20/2018)

can complement fixed sites when deployed on secondary routes that are used to bypass fixed sites by carriers or drivers that are in violation. Furthermore, in instances where cost and environmental factors will preclude construction of a fixed site, such as urban areas, virtual weigh stations can be a more feasible option.

5.15.3 Hazardous Material

Transportation of Hazardous Materials (HAZMAT) is important because of the potential health impacts from incidents. HAZMAT loads can lead to extensive traffic delays depending on the toxicity of the material and the cleanup required. CVSIN provides an avenue to track HAZMAT movement and flag any deviations from assigned routes.

5.15.4 Incident Management and Alternate Routing

The dispatchers and drivers of commercial vehicles need advance knowledge of route conditions pre-trip and en-route. With many manufacturing plants and other industrial plants eliminating warehousing and relying on just-in-time delivery of goods, travel time reliability is critical. Any change in expected travel time because of incidents or work zones must be communicated to drivers with reliable alternate routing to facilitate on-time delivery of freight. Furthermore, it is desired to add integration of radio frequency identification (RFID) into the TMC AVL monitoring systems to track oversized, over dimensional, and hazardous materials trucks as they traverse the state.

5.16 ATMS SOFTWARE

TDOT desires an updated ATMS software that will facilitate integration of devices and device data and have functionalities that can turn raw data into actionable information to support real-time operations and management of the transportation system. Currently, a suite of different and often incompatible software is used by the TDOT TMCs to manage the transportation system. This means repetitive information input from software to software which is inefficient. An integrated software product with powerful functions that automatically process important tactical information with minimum inputs from the TMC operators will enhance efficiency of the operator and lead to faster response times and incident clearance, subsequently opening up the opportunity for the TMCs to expand into congestion management operations. With those objectives in mind, TDOT has obtained licensure of Southwest Research Institute's ActiveITS ATMS software. The new ATMS software will be rolled out to all four regional TMCs over the course of 2019. The service packages identified in **Appendix A** were based on functions that the stakeholders desired during outreach portions of the TDOT Statewide TMC Upgrades Systems Engineering Analysis. Service packages describe specific services and are used to show systems and devices and their functional objects and information flows that provide desired service.

6.0 FUNCTIONAL REQUIREMENTS

The functional requirements describe the task or activities that must be performed by each system in the Statewide ITS architecture to achieve the required services. The service packages define several specific functional requirements or operational details to implement the ITS services under the Concept of Operations. It is important to note that these functional requirements do not specify technology. **Appendix B** summarizes the functional requirements of the elements in the Statewide ITS Architecture.

7.0 INTERFACES BETWEEN ITS MANAGEMENT SYSTEMS

The Statewide ITS Architecture focuses on operations and management of all ITS systems throughout the State of Tennessee but outside of the MPOs, including all freeways and other TDOT owned assets within the MPO boundaries. There are several regional ITS architectures that have been developed and serve some urbanized areas in the state and have operations centers to manage the ITS systems. The Statewide ITS Architecture will interface with the regional ITS architectures for information sharing and coordination. **Figure 3** summarizes the interconnection between the Statewide Regional ITS Architecture and the regional ITS architectures.

INTERFACES BETWEEN ITS management SYSTEMS

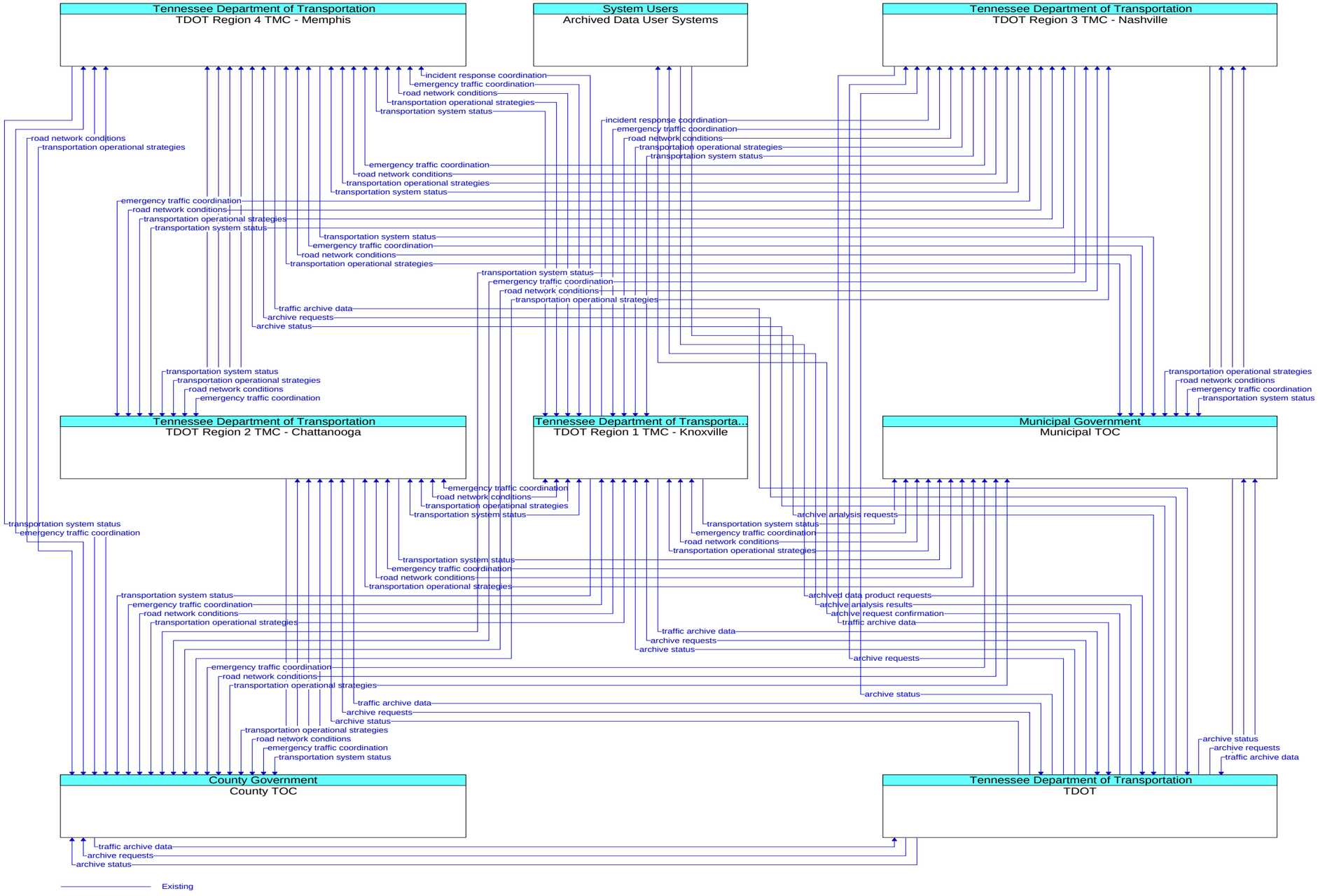


Figure 3: Statewide-Regional Architecture Interconnect

8.0 STANDARDS

Standardizing the flow of information between the systems is essential to interoperability and interchangeability for ITS. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances and new approaches evolve. Establishing standards also allows for expandability thereby reducing risk and cost. Since an agency using standardized interfaces can select among multiple vendors for products and applications, competition is maintained, and prices are lower in the long term. Using the ARC-IT framework and the associated RAD-IT software allows the architecture to be developed with consistent standards that the various stakeholders can use when deploying devices and systems for integration.

Table 7 provide the ITS standards identified for the Tennessee Statewide ITS Architecture.

Table 7: Standards

SDO	Document ID	Standard Title	Standard Type	Source Element	Destination Element	Flow Name
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Airport	Demand Response Transit Dispatch, Private Long Distance Bus Company Operations	multimodal service data
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	County EMA, Municipal EMA	Demand Response Transit Dispatch	emergency transit service request
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Demand Response Transit Dispatch	County EMA, Municipal EMA	emergency transit service response
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Demand Response Transit Dispatch	Demand Response Transit Vehicles	alarm acknowledge, transit vehicle operator information
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Demand Response Transit Dispatch	Private Traveler Personal Computing Devices	personal transit information
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Demand Response Transit Dispatch	Tennessee 511 System	transit and fare schedules
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Demand Response Transit Dispatch	Transit Kiosks	transit fare information, transit traveler information

SDO	Document ID	Standard Title	Standard Type	Source Element	Destination Element	Flow Name
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Demand Response Transit Dispatch, Private Long Distance Bus Company Operations	Airport	transit multimodal information
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Demand Response Transit Vehicles	Demand Response Transit Dispatch	alarm notification, fare collection data, transit vehicle conditions, transit vehicle loading data, transit vehicle location data, transit vehicle schedule performance
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Private Traveler Personal Computing Devices	Demand Response Transit Dispatch	transit information user request
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/Data	Transit Kiosks	Demand Response Transit Dispatch	fare collection data
American Society for Testing and Materials	ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems	Message/Data	TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	TDOT Data Warehouse, TDOT Short Range Planning and Data Office	traffic archive data
American Society for Testing and Materials	ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems	Message/Data	TDOT SmartWay Information System (SmartWay)	TDOT SmartWay Archive	traveler archive data

SDO	Document ID	Standard Title	Standard Type	Source Element	Destination Element	Flow Name
American Society for Testing and Materials	ASTM E2665-08	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data	Message/Data	TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	TDOT Data Warehouse, TDOT Short Range Planning and Data Office	traffic archive data
Consortium of AASHTO, ITE, and NEMA	NTCIP 1201	Global Object Definitions	Message/Data	County Traffic Signals	County TOC	signal fault data
Consortium of AASHTO, ITE, and NEMA	NTCIP 1201	Global Object Definitions	Message/Data	Municipal Traffic Signals	Municipal TOC	signal fault data
Consortium of AASHTO, ITE, and NEMA	NTCIP 1201	Global Object Definitions	Message/Data	TDOT Anti-icing Equipment	TDOT District Maintenance, TDOT Region Maintenance	roadway treatment system status
Consortium of AASHTO, ITE, and NEMA	NTCIP 1201	Global Object Definitions	Message/Data	TDOT District Maintenance, TDOT Region Maintenance	TDOT Anti-icing Equipment	roadway treatment system control
Consortium of AASHTO, ITE, and NEMA	NTCIP 1201	Global Object Definitions	Message/Data	TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	TDOT Security Monitoring Field Equipment	secure area surveillance control
Consortium of AASHTO, ITE, and NEMA	NTCIP 1201	Global Object Definitions	Message/Data	TDOT Security Monitoring Field Equipment	TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	secure area surveillance data

SDO	Document ID	Standard Title	Standard Type	Source Element	Destination Element	Flow Name
Consortium of AASHTO, ITE, and NEMA	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller (ASC) Units	Message/Data	County TOC	County Traffic Signals	signal control commands, signal control device configuration, signal control plans, signal system configuration

9.0 AGREEMENTS

This section identifies the list of agreements between each of the stakeholder organizations participating in the statewide ITS operations in Tennessee. Successful ITS operations involve the full participation of multiple stakeholders and may require technical and or institutional integration or interagency agreements to facilitate smooth operations. **Table 8** has been reproduced from the Regional ITS Architecture Guidance Document[11] and it provides definitions of various types of agreements that are used to facilitate ITS operations. **Appendix D** provides copies of the available ITS agreements that support ITS operations in Tennessee.

Table 8: Types of Agreements

Type of Agreement	Description
Handshake Agreement	• Early agreement between one or more partners • Not recommended for long term operations.
Memorandum of Understanding	• Initial agreement used to provide minimal detail and usually demonstrating a general consensus. • Used to expand a more detailed agreement like an Interagency Agreement which may be broad in scope but contains all of the standard contract clauses required by a specific agency. • May serve as a means to modify a much broader Master Funding Agreement, allowing the master agreement to cover various ITS projects throughout the region and the MOUs to specify the scope and differences between the projects.
Interagency Agreement	• Between public agencies (e.g., transit authorities, cities, counties, etc.) for operations, services or funding • Documents responsibility, functions and liability, at a minimum.
Intergovernmental Agreement	• Between governmental agencies *(e.g., Agreements between universities and State DOT, MPOs and State DOT, etc.)*
Operational Agreement	• Between any agency involved in funding, operating, maintaining or using the right-of-way of another public or private agency. • Identifies respective responsibilities for all activities associated with shared elements being operated and/or maintained.
Funding Agreement	• Documents the funding arrangements for ITS projects *(and other projects)* • Includes at a minimum standard funding clauses, detailed scope, services to be performed, detailed project budgets, etc.
Master Agreements	• Standard contract and/or legal verbiage for a specific agency and serving as a master agreement by which all business is done. These agreements can be found in the legal department of many public agencies. • Allows states, cities, transit agencies, and other public agencies that do business with the same agencies over and over (e.g., cities and counties) to have one *Master Agreement* that uses smaller agreements *(e.g., MOUs, Scope-of-Work and Budget Modifications, Funding Agreements, Project Agreements, etc.*) to modify or expand the boundaries of the larger agreement to include more specific language.

[11] https://ops.fhwa.dot.gov/publications/regitsarchguide/6imp.htm (Accessed 7/31/2018)

10.0 PROJECTS AND SEQUENCING

10.1 POTENTIAL PROJECTS

Based on the concepts described in **Section 5.0**, potential projects that could help meet the needs identified and deliver services required to enhance transportation management have been identified. Furthermore, existing transportation planning and management documents have identified projects that need to be implemented. The projects described in **Table 9** are based on current known gaps and emerging needs in ITS deployments. As funds become available for the deployment of systems to enhance safety and mobility, each project must be evaluated to see if the need is still warranted.

Table 9: Potential Projects

Location	Project Title	Description	Timeframe
Proposed Region 1 ITS Projects	ITS Expansion from MM 109.6 to near SR-61 (Exit 122), 4.41 miles	Includes the deployment of CCTV cameras at critical interchanges. Install communications infrastructure and at least 2 CCTV cameras at each interchange.	Programmed
	ITS Expansion along SR-115 between Cherokee Trails in Knox County and Rivertrace Blvd in Blount County, 5.10 miles	Includes the installation of fiber optic cable, CCTV cameras, DMS, and RDS.	Programmed
	ITS Expansion along SR-115 in Blount County between Rivertrace Blvd and SR-35, 10.50 miles	Includes the installation of fiber optic cable, CCTV cameras, DMS, and RDS.	Programmed
	Install ITS communication and instrumentation at interchange (SR 61/Andersonville Hwy, Exit 122), 0.59 miles	Install communications infrastructure and at least 2 CCTV cameras at each interchange.	Programmed
	ITS Expansion along I-140 between I-40 in Knox County and SR-115 in Blount County, 12.10 miles	Includes the installation of fiber optic cable, CCTV cameras, DMS, and RDS.	Programmed
	Implement a fog and severe weather detection system on I-75 over Jellico Mountain, 24.98 miles	Includes implementing RWIS including a fog and severe weather detection system.	Programmed
	ITS Expansion on I-75 at interchange (SR-63/Howard Baker Rd, Exit 141), 0.23 miles	Includes installation of communications infrastructure and at least 2 CCTV cameras at each interchange.	Programmed
	ITS Expansion at interchange (SR-9/SR-116/US 25W, Exit 134), 0.10 miles	Includes installation of communications infrastructure and at least 2 CCTV cameras at each interchange.	Programmed

Location	Project Title	Description	Timeframe
	ITS Rural Deployment on I-40 to State Line, 21.92 miles	Includes the deployment of CCTV cameras at critical interchanges. Includes installation of communications infrastructure and at least 2 CCTV cameras at each interchange.	Programmed
	From Near Strawberry Plains Pike (Exit 398) Interchange to Near SR-66 (Sevierville, Exit 407) Interchange (IA)	Include the installation of fiber optic cable, 7 CCTV cameras, 3 DMS and 7 RDS.	Programmed
	ITS Expansion along I-81 between I-26 (Exit 57) Interchange and Virginia State Line, 18.75 miles	Includes the deployment of CCTV cameras at critical interchanges. Includes installation of communications infrastructure and at least 2 CCTV cameras at each interchange	Programmed
Proposed Region 2 ITS Projects	(Cumberland Plateau) From Near Spring Street in Cookeville (Exit 290) to Near SR-299 (Exit 338) (IA)	Includes the deployment of fiber optic cable, 9 CCTV cameras, 2 DMS, and 2 RWIS.	Programmed
Proposed Region 3 ITS Projects	From Near I-840 to Near US-70S (Exit 196) and from Near SR-255 (Donelson Pike, Exit 216) to Near US-70 (Exit 239)	Includes the deployment of fiber optic cable, CCTV cameras, DMS, DSRC, signal controller upgrades, ramp metering and RWIS.	Programmed
	I-24 Smart Corridor Project (Between I-440 and SR-231) Phase 1		Programmed
	I-24 Smart Corridor Project (Between I-440 and SR-231) Phase 2		Programmed
	I-24 Smart Corridor Project (Between I-440 and SR-231) Phase 3		Programmed
Proposed Region 4 ITS Projects	ITS expansion along I-40 in the Jackson Area	Includes the deployment of communications infrastructure, 18 CCTV cameras and 4 DMS.	Programmed
	ITS Expansion on SR 385/I-269 from I-40 Southward to the Mississippi State Line	Includes the deployment of fiber optic cable, 14 CCTV cameras, 7 DMS, and 7 HAR.	Programmed
	ITS Expansion from MM 7 to MM 15	Includes the deployment of fiber optic cable, 10 CCTV cameras, 5 DMS, and 3 HAR.	Programmed
Others	Connected Vehicle Road Side Units and Communications	Deploy new RSUs to monitor and control traffic to improve mobility, incident detection and response and regional traffic management.	Illustrative

Location	Project Title	Description	Timeframe
	ITS Communications Upgrades	Deployment of communication assets including fiber optic, ethernet and wireless systems (licensed wireless or cellular) to support ITS field device communications between devices (field-to-field) and to centers (field-to-center) and between stakeholders (center-to-center communications) for coordination.	Illustrative
	Field Device Upgrades	General upgrades of legacy systems to new systems with better functionalities.	Illustrative
	Work Zone ITS	Deployment of portable devices (CCTV cameras, DMS, queue detection system, variable speed limit signs etc.) to help manage work zones and enhance mobility and safety of traveling public and construction crew. The work zone data can be integrated into the TMC operations.	Illustrative
	Comprehensive Detour Plan Analysis	Detour plans to manage incidents along segments of critical highway corridors must be established, and resources allocated in counties that will be affected for re-routing including staffing and training. Signal systems on detour routes must be upgraded with communication.	Illustrative
	Arterial Signal Coordination and Communication	Upgrade signal systems on critical arterial corridors with communication and controllers that will support coordination, emergency timing plans and establish protocol for emergency signal activation. Needed upgrades also include CCTV cameras for intersection monitoring.	Illustrative
	Ramp Metering	Deploy ramp metering on access ramps to freeway facilities to manage travel demand during peak commute hours to enhance freeway performance for travel time reliability and Safety. Coordinate with traffic signal systems on arterials.	Illustrative
	Active Traffic Management (Lane Control Signs)	Provide overhead lane control signs and communication on freeways to help manage incidents that block travel lanes on critical freeway corridors	Illustrative
	Commercial Vehicle Parking	Provide commercial vehicle parking facilities with monitoring for real-time parking management and information dissemination to commercial vehicle drivers	Illustrative
	Incident Management	Upgrade incident management system to provide credible real-time incident response status. Include portable devices for incident monitoring especially in areas outside of urbanized areas.	Illustrative
	Integrated Corridor Management	Establish and deploy integrated corridor management strategies for critical corridors to optimize the use of all transportation assets to reduce congestion and improve safety.	Illustrative
	Data Management System	Establish a data management system to make data readily available and accessible to stakeholders and other private parties that can add value and share with public or Statewide ITS stakeholders for planning and to support transportation operations.	Illustrative
	ITS Asset Management	Deploy management tools and strategies to help maintain and upgrade ITS assets for enhanced functions and service delivery	Illustrative

10.2 TDOT ATMS SOFTWARE

A systems engineering analysis was performed in 2018 to analyze the existing TDOT TMC operations and determine the needed upgrades for TDOT to meet their operational goals and objectives. As part of that effort, TDOT has obtained licensure of Southwest Research Institute's ActiveITS ATMS software to improve the efficiency and capability of their TMC operations. The new ATMS software will be rolled out to all four regional TMCs over the course of 2019 and 2020.

11.0 MAINTENANCE PLAN

This section discusses the proposed Maintenance Plan for the Statewide ITS Architecture. FHWA's Final Rule on ITS Architecture and Standards (23 CFR Part 940) requires development of an architecture maintenance plan. Paragraph 940.9 (f) states that:

> "The agencies and other stakeholders participating in the development of the regional ITS architecture shall develop and implement procedures and responsibilities for maintaining it, as needs evolve within the region."

The Maintenance Plan for the Statewide ITS Architecture is based on the guidelines provided by FHWA's White Paper[12]. This report provides some background on the need for architecture maintenance and addresses key issues under the following headings:

1. Why maintain a Statewide ITS Architecture?
2. Who will maintain the Architecture?
3. When will the Architecture be updated?
4. What will be maintained?
5. How will the Architecture be maintained?

These questions are discussed in detail in the subsequent sections.

11.1 WHY MAINTAIN A STATEWIDE ITS ARCHITECTURE?

As ITS projects are implemented, the Statewide ITS architecture will need to be updated to reflect new ITS priorities and strategies that emerge through the transportation planning process. It will also need to be updated to account for expansion in ITS scope and to allow for the evolution and incorporation of new ideas. Furthermore, the Statewide ITS architecture is a bridge between the Regional ITS architectures and the National ITS architecture. The Statewide ITS architecture help ensure consistency and interoperability to achieve the goals and objectives of the stakeholders. The goal of the maintenance plan is to guide controlled updates to the Statewide ITS architecture baseline so that it continues to accurately reflect the State's existing ITS capabilities and future plans and how they fit into the National and Regional frameworks.

11.2 WHO WILL MAINTAIN THE ARCHITECTURE?

To maintain a consensus ITS architecture, ideally all stakeholders should participate in the process. The primary requirements of the Statewide architecture maintainer are the mission/authority to perform such functions and the necessary skills to perform the same. The mission of the ITS architecture maintainer most closely resembles a Statewide body that, as consistent with its mission, has the authority to initiate, update, and document changes in

[12] http://ops.fhwa.dot.gov/its_arch_imp/guidance.htm

Statewide ITS documents. For the Statewide ITS Architecture, TDOT Traffic Operations will assume the role of the ITS Architecture keeper and maintainer.

Although TDOT Traffic Operations will lead the architecture maintenance activities, like all other Statewide planning activities, ITS architecture maintenance will require close coordination between several stakeholder agencies. TDOT Traffic Operations will need to coordinate with other major stakeholders[13] in the state, including:

1. TDOT Long-Range Planning
2. TDOT TMC Managers
3. TDOT Information Technology (IT)
4. Tennessee Highway Patrol
5. Tennessee Emergency Management Agency (TEMA)
6. Local Law Enforcement

The Statewide ITS planning document covers a planning horizon of five years; however, yearly meetings of the stakeholder group would allow for periodic evaluation of the existing system and addendum updates could be used to accelerate adoptions of innovations and new technology. Therefore, it is proposed that the stakeholder group for the Statewide ITS Architecture meet at least once per year to report/discuss and recommend updates to the existing ITS Architecture. This stakeholder group will also be responsible for reporting all new ITS deployments that can be leveraged for Statewide application. TDOT Traffic Operations will also be responsible for following up with all stakeholders to ensure that any and all ITS deployments are reported and documented in the Statewide plan including updates to the Statewide ITS architectures. Other responsibilities include but are not limited to the following:

1. Verify that the Statewide ITS architecture RAD-IT source file is kept up to date with the Statewide ITS deployment projects
2. Update plans for future deployments by Statewide stakeholders
3. Review changes in State and National ITS Architectures, regulations, and requirements, if any
4. Determine any needs for an update to the Statewide ITS Architecture
5. Communicate identified needs and impacts to all stakeholders of the Statewide ITS architecture and the Regional ITS architecture.

[13] Other stakeholders may be included as necessary based on ITS development and deployment activities, or new stakeholders that are formed and can be useful partners for instance Safety Coalition Groups or similar with a mission to advance roadway safety for all users.

A change in a stakeholder's systems may impact other stakeholders and this has to be communicated and managed effectively to mitigate any negative impacts to ITS operations. A sample Change Request Form (see **Appendix E**) has been provided and can be used as needed.

11.3 WHEN WILL THE ARCHITECTURE BE UPDATED?

The Statewide ITS architecture is not static. It must change as traffic operations plans and strategies change, as ITS projects are implemented, and as the ITS needs and services evolve in the State. The stakeholders may meet and perform architecture updates more frequently to keep with the pace of the State's ITS implementation. Annual or more frequent updates will include integrating completed projects into the Statewide ITS architecture RAD-IT source file. A brief summary of the change will be added as an appendix to the Statewide ITS architecture document.

Regardless of the frequency selected for periodic updates, it is recommended that the stakeholders recognize the potential need for "Exception Maintenance" to occur in the event of major project implementations, major revisions to the Architecture Reference for Cooperative and Intelligent Transportation, or to meet the requirements of future regulations. It is recommended that the Statewide ITS architecture is fully updated every five years. The following list includes many of the events that may cause change to a Statewide ITS architecture:

11.3.1 Changes in Statewide TDOT Traffic Operations Plan

The TDOT Traffic Operations Plan forms the foundation for traffic operations management in the State and provides strategies to guide traffic operations management. ITS implementation or deployments are based on fostering these strategies to meet desired outcomes. Therefore, any change in the TDOT Traffic Operations Plan will require a review of ITS planning and deployment to support the new strategies identified.

11.3.2 Changes in Statewide Needs

Statewide ITS architectures are created to support transportation planning in addressing Statewide needs. Over time these needs can change and the corresponding aspects of the Statewide ITS architecture that addresses these needs may need to be updated. These changes in needs should be expressed in updates to planning documents such as the Statewide Transportation Plan.

11.3.3 Changes in Stakeholders

New stakeholders become active in ITS and the statewide ITS architecture should be updated to reflect their place in the statewide view of ITS elements, interfaces, and information flows. New stakeholders might represent new organizations that were not in place during the original development of the statewide ITS architecture. Conversely, some stakeholders may need to be removed at some point as they are absolved into another entity or are no longer relevant to the activities outlined in the architecture. All stakeholder changes should be accurately maintained in the statewide ITS architecture.

11.3.4 Changes in Scope of Services Considered

The range of services considered by the Statewide ITS architecture could expand. This might happen because the National ITS Architecture has been expanded and updated to include new user services or to better define how existing

elements satisfy the user services. The National ITS Architecture may have expanded to include a user service that is not in the Statewide ITS architecture or was included in only a very cursory manner. Changes in the National ITS Architecture are not of themselves a reason to update a Statewide ITS architecture, but the stakeholders may want to consider any new services in the context of their statewide needs.

11.3.5 Changes in Stakeholder or Element Names

An agency's name or the name used to describe their element(s) undergoes change. Transportation agencies occasionally merge, split, or just rename themselves. In addition, element names may evolve as projects are defined. The statewide ITS architecture should be updated to use the current, correct names for both stakeholders and elements.

11.3.6 Changes in Other Architectures

A Statewide ITS architecture may interface with an adjoining regional or statewide ITS architecture. Changes in the adjoining architecture may necessitate changes in the Statewide ITS Architecture to maintain consistency between the two. Architectures may also overlap (e.g. a Statewide ITS architecture and a regional ITS architecture for a region within the state) and a change in one might necessitate a change in the other.

11.3.7 Changes due to Project Definition or Implementation

There are several changes relating to project definition that will cause the need for updates to the Statewide ITS architecture. When actually defined or implemented, a project may add, subtract or modify elements, interfaces, or information flows from the Statewide ITS architecture. Because the Statewide ITS architecture is meant to describe the current, as well as future, statewide implementation of ITS, it must be updated to correctly reflect how the developed projects are integrated.

11.3.8 Changes due to Project Addition/Deletion

Occasionally a project will be added or deleted through the planning process, or through project delivery, and some aspects of the Statewide ITS architecture that are associated with the project may be expanded, changed, or removed.

11.3.9 Changes in Project Priority

Due to funding constraints, or other considerations, the planned project sequencing may change. Delaying a project may have a ripple effect on other projects that depend on it. Raising the priority for a project's implementation may impact other projects that are related to it.

11.4 WHAT WILL BE MAINTAINED?

Those constituent parts of the Statewide ITS architecture that will be maintained are referred to as the "baseline". This section considers the different "parts" of the Statewide ITS architecture and whether they should be a part of the baseline. Baseline parts are annually updated within the Statewide ITS architecture RAD-IT file and addendum updates prepared for the document. Comprehensive updates can be conducted every five years. The parts discussed are:

- Description of Region

- List of Stakeholders
- Operational Concepts
- List of ITS Elements
- List of Agreements
- Interfaces between Elements
- System Functional Requirements
- Applicable ITS Standards
- Project Sequencing

One of the benefits of a Statewide ITS architecture is to enable the efficient exchange of information between ITS elements in one region with elements outside the region. Efficiency refers to the economical deployment of ITS elements and their interfaces. The result of these ITS deployments should be contributions to the safe and efficient operation of the surface transportation network. Each of the components in the Statewide ITS architecture below has a role in this economy and an appropriate effort should be levied to maintain them.

11.4.1 Description of Region

This description includes the geographic scope, functional scope, and architecture timeframe, and helps frame each of the following parts of a Statewide ITS architecture. Geographic scope defines the ITS elements that are “in” the State, although additional ITS elements outside the State may be needed to be described if they communicate ITS information to elements inside the State. Functional scope defines which services are included in the ITS architecture. Architecture timeframe is the distance (in years) into the future that the Statewide ITS architecture will consider. The description of the region is usually contained in an architecture document but may reside in a database containing aspects of the Statewide ITS architecture and should certainly be a part of the baseline.

11.4.2 List of Stakeholders

Stakeholders are of great importance to the definition of the architecture. Stakeholders may consolidate or separate and such changes should be reflected in the architecture. Furthermore, stakeholders that have not been engaged in the past may be approached through outreach to be sure that the Statewide ITS architecture represents their ITS requirements as well. The stakeholders should be described in architecture documentation (and may also reside in a database representing aspects of the Statewide ITS architecture). Their listing and description should be part of the baseline.

11.4.3 Operational Concepts

It is crucial that the operational concepts represented as roles and responsibilities or as customized service packages in a Statewide ITS architecture accurately represent the consensus vision of how the stakeholders want their ITS to

operate for the benefit of surface transportation users. These should be reviewed and, if necessary, changed to represent both what has been deployed (which may have been shown as “planned” in the earlier version of the statewide ITS architecture) and the current consensus view of the stakeholders. Many of the remaining maintenance efforts will depend on the outcome of the changes made here. The operational concept will reside in the architecture documentation and possibly in a diagramming tool if a customized service package approach is used and should be part of the baseline.

11.4.4 List of ITS Elements

The inventory of ITS elements is a key aspect of the statewide ITS architecture. Changes in stakeholders as well as operational concepts may impact the inventory of ITS elements. Furthermore, recent implementation of ITS elements may change their individual status (e.g. from planned to existing). The list of elements is often contained in architecture documentation and is key information in any architecture database. It is a key aspect of the baseline.

11.4.5 List of Agreements

One of the greatest values of a statewide ITS architecture is to identify where information will cross an agency boundary, which may indicate a need for an agency agreement. An update to the list of agreements can follow the update to the Operational Concept and/or interfaces between elements. The list of agreements will usually be found in the architecture documentation. This listing should be a part of the baseline.

11.4.6 Interfaces between Elements

Interfaces between elements define the “details” of the architecture. They are the detailed description of how the various ITS elements are or will be integrated throughout the timeframe of the architecture. These details are usually held in an architecture database. They are a key aspect of the architecture baseline and one that will likely see the greatest amount of change during the maintenance process.

11.4.7 System Functional Requirements

High-level functions are allocated to ITS elements as part of the Statewide ITS architecture. These can serve as a starting point for the functional definition of projects that map to portions of the Statewide ITS architecture. Usually this information is held in spreadsheets or databases but may be included in the architecture document. They are a part of the baseline.

11.4.8 Applicable ITS Standards

The selection of standards depends on the information exchange requirements. But in addition, the maintenance process should consider how ITS standards may have evolved and matured since the last update and consider how any change in the “standards environment” may impact previous standards choices (especially where competing standards exist). For example, if Extensive Markup Language (XML) based Center-To-Center standards reach a high level of maturity, reliability, and cost-effectiveness, then a statewide standards technology decision may be made to transition from investments in other standards technologies (e.g. Common Object Request Broker Architecture (CORBA) to XML). The description of the standards environment for statewide, as well as the details of which standards apply to the architecture, should be part of the baseline.

11.4.9 Project Sequencing

While project sequencing is partly determined by functional dependencies (e.g. “surveillance” must be a precursor to “traffic management”), the reality is that most project sequences are local policy decisions. Project sequences should be reviewed to make sure that they are in line with current policy decisions. Furthermore, policy makers should be informed of the sequences and their input should be sought to make the project sequences coincide with their expectations. This is crucial to eliminate the possibility of the Statewide ITS architecture becoming irrelevant. The project sequencing should be included in the architecture documentation and may also be held in a spreadsheet or database. These should be part of the architecture baseline.

11.5 HOW WILL THE ARCHITECTURE BE MAINTAINED?

TDOT Traffic Operations will oversee and ensure that the Statewide architecture is maintained. The guidelines contained within FHWA’s Regional ITS Architecture Maintenance White Paper will be helpful in guiding the maintenance effort. In addition to detailing the recommended maintenance process, the White Paper also contains examples of Maintenance Plans developed by a range of agencies and regions throughout the country. **Appendix E** has a sample Change Request Form that can be used to initiate changes in the Tennessee Statewide ITS Architecture. Any stakeholder can use the form to initiate a change in the architecture.

APPENDICES

Appendix A SERVICE PACKAGES

Table 10: Service Packages

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Commercial Vehicle Operations	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.	Existing	Commercial Vehicle, Private Fleet Operations
	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.	Existing	Commercial Vehicle, Commercial Vehicle Driver, Freight Equipment, Private Fleet Operations

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	Commercial Vehicle, Commercial Vehicle Driver, CVIEW, Freight Equipment, IFTA, IRP, Private Fleet Operations, Tennessee Pre-Pass, THP Enforcement, THP Truck Weigh and Inspection Station, THP Weigh-in-Motion, Violation Detection
					Commercial Vehicle, Commercial Vehicle Driver, CVIEW, THP Enforcement, THP Truck Weigh and Inspection Station
	CVO04	CV Administrative Processes	This service package supports program administration and enrollment and provides for electronic application, processing, fee collection, issuance, and distribution of CVO credential and tax filing. Through this process, carriers, drivers, and vehicles may be enrolled in a variety of programs including electronic clearance and wireless inspection programs which allow commercial vehicles to be screened at mainline speeds. Through this enrollment process, current profile databases are maintained in the Commercial Vehicle Administration Center and snapshots of this data are made available to the roadside check facilities.	Existing	CVIEW, IFTA, IRP, Private Fleet Operations, Tennessee Pre-Pass, THP Enforcement, THP Truck Weigh and Inspection Station, THP Weigh-in-Motion

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	CVO07	Roadside CVO Safety	This service package provides for automated roadside safety monitoring and reporting. It automates commercial vehicle safety inspections at roadside check locations. The basic option, directly supported by this service package, facilitates safety inspection of vehicles that have been pulled off the highway, perhaps as a result of the automated screening process provided by the Electronic Clearance (CVO03) service package. In this scenario, only basic identification data and status information is read from the electronic tag on the commercial vehicle. The identification data from the tag enables access to additional safety data maintained in the infrastructure which is used to support the safety inspection, and may also inform the pull-in decision if system timing requirements can be met. More advanced implementations collect additional data from commercial vehicles. This service package focuses on manned inspection locations. See CVO08 for remote monitoring options using smart roadside infrastructure at unmanned, virtual inspection stations.	Existing	Commercial Vehicle, Commercial Vehicle Driver, CVIEW, Private Fleet Operations, THP Enforcement, THP Truck Weigh and Inspection Station, THP Weigh-in-Motion, Violation Detection

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	CVO08	Smart Roadside and Virtual WIM	This service package includes the delivery of capabilities related to wireless roadside inspections and electronic screening/virtual weigh stations. Wireless roadside inspection is defined by a safety screening capability that employs communications technologies to obtain information from a commercial vehicle that will allow safety screening of the vehicle and its driver. This capability provides for the interrogation at mainline speeds of a commercial vehicle when it has entered a control segment or geofenced area. Vehicle identification and driver information are provided to the roadside unit. The information communicated can be used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. A more advanced version of this service package would download safety information measured on the vehicle including driver related information such as the driver log allowing real time evaluation that the vehicle and driver are meeting safety requirements. The electronic screening/virtual weigh stations capability employs communications technologies to obtain information from a commercial vehicle that will allow verification of permits or credentials for the vehicle. The information communicated is used to verify compliance with safety requirements, allowing a decision to be made regarding whether the vehicle should pull in to a roadside check station. This service package can also be used to verify that the commercial vehicle meets vehicle weight (via weigh in motion capability) or dimension requirements.	Existing	Commercial Vehicle, Commercial Vehicle Driver, CVIEW, Freight Equipment, Tennessee Pre-Pass, THP Enforcement, THP Truck Weigh and Inspection Station, THP Weigh-in-Motion

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	CVO12	HAZMAT Management	This service package integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents. HAZMAT tracking is performed by the Fleet and Freight Management Center. The Emergency Management Center is notified by the Commercial Vehicle if an incident occurs and coordinates the response. The response is tailored based on information that is provided as part of the original incident notification or derived from supplemental information provided by the Fleet and Freight Management Center. The latter information can be provided prior to the beginning of the trip or gathered following the incident depending on the selected policy and implementation.	Existing	Commercial Vehicle, County EMA, County Public Safety Dispatch, Freight Equipment, Municipal EMA, Municipal Public Safety Dispatch, TDOT Emergency Services Coordinator, TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch
	CVO13	Roadside HAZMAT Security Detection and Mitigation	This service package provides the capability to detect and classify security sensitive HAZMAT on commercial vehicles using roadside sensing and imaging technology. Credentials information can be accessed to verify if the commercial driver, vehicle and carrier are permitted to transport the identified HAZMAT. If the credentials analysis and sensed HAZMAT information do not agree, the vehicle can be signaled to pull off the highway, and if required, an alarm can be sent to Emergency Management to request they monitor, traffic stop or disable the vehicle.	Existing	Commercial Vehicle, Commercial Vehicle Driver, County EMA, County Public Safety Dispatch, CVIEW, Municipal EMA, Municipal Public Safety Dispatch, TDOT Emergency Services Coordinator, TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	CVO14	CV Driver Security Authentication	This service package provides the ability for Fleet and Freight Management to detect when an unauthorized commercial vehicle driver attempts to drive their vehicle based on stored driver identity information. If an unauthorized driver has been detected, Fleet and Freight Management can activate commands to safely disable the commercial vehicle. Alarms can also be sent to emergency management to inform them of a potential commercial vehicle hijacking or theft and potential hazardous situation. In addition, Emergency Management can request Fleet and Freight Management to disable a specific vehicle in their fleet.	Existing	Commercial Vehicle, Commercial Vehicle Driver, Private Fleet Operations, THP Dispatch
Data Management	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.	Existing	Airport, Archived Data User Systems, County EMA, County Public Safety Dispatch, County TOC, CVIEW, Municipal EMA, Municipal Public Safety Dispatch, Municipal TOC, Other TDOT Region Maintenance, TDOT Data Warehouse, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Truck Weigh and Inspection Station

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	DM02	Performance Monitoring	The Performance Monitoring service package uses information collected from detectors and sensors, connected vehicles, and operational data feeds from centers to support performance monitoring and other uses of historical data including transportation planning, condition monitoring, safety analyses, and research. The information may be probe data information obtained from vehicles in the network to determine network performance measures such as speed and travel times, or it may be information collected from the vehicles and processed by the infrastructure, e.g. environmental data and infrastructure conditions monitoring data. Additional data are collected including accident data, road condition data, road closures and other operational decisions to provide context for measured transportation performance and additional safety and mobility-related measures. More complex performance measures may be derived from the collected data.	Existing	Airport, County EMA, County Maintenance, County Public Safety Dispatch, County TOC, Cumberland Gap TOC, CVIEW, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Truck Weigh and Inspection Station
Maintenance and Construction	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.	Existing	County Maintenance, Municipal Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, TDOT Maintenance Vehicles
	MC02	Maintenance and Construction Vehicle Maintenance	This service package performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities on vehicles and other maintenance and construction equipment. It includes on-board sensors capable of automatically performing diagnostics for maintenance and construction vehicles, and the systems that collect this diagnostic information and use it to schedule and manage vehicle and equipment maintenance.	Existing	County Maintenance, Municipal Maintenance, TDOT Maintenance Vehicles

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	MC03	Roadway Automated Treatment	This service package automatically treats a roadway section based on environmental or atmospheric conditions. Treatments include fog dispersion, anti-icing chemicals, etc. The service package includes the environmental sensors that detect adverse conditions, the automated treatment system itself, and driver information systems (e.g., dynamic message signs) that warn drivers when the treatment system is activated.	Planned	TDOT Anti-icing Equipment, TDOT Closure Equipment, TDOT Field Sensors, TDOT Maintenance Headquarters, TDOT RWIS Sensors, USGS Field Equipment
	MC04	Winter Maintenance	This service package supports winter road maintenance including snow plow operations, roadway treatments (e.g., salt spraying and other anti-icing material applications), and other snow and ice control activities. This package monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.	Existing	County Maintenance, Municipal Maintenance, Municipal TOC, National Weather Service, TDOT Maintenance Headquarters, TDOT Maintenance Vehicles, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	MC05	Roadway Maintenance and Construction	This service package supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Maintenance services include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, CCTV, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.	Existing	Contractor Equipment, County Maintenance, County TOC, Municipal Maintenance, Municipal TOC, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, TDOT Maintenance Vehicles, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT Region Maintenance, TDOT Smart Work Zone Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	Contractor Equipment, County Field Equipment, County TOC, Local Print and Broadcast Media, Municipal Field Equipment, Municipal Maintenance, Municipal TOC, Other Maintenance and Construction Management, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, Private Sector Traveler Information Services, Regional Websites, TDOT Active Lane Management Systems, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT HAR, TDOT HELP Dispatch, TDOT Maintenance Headquarters, TDOT Maintenance Vehicles, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT Region Engineers Office, TDOT Region Maintenance, TDOT Smart Work Zone Equipment, TDOT SmartWay, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	MC07	Work Zone Safety Monitoring	This service package provides warnings to maintenance personnel within a work zone about potential hazards within the work zone. It enables vehicles or the infrastructure to provide warnings to workers in a work zone when a vehicle is moving in a manner that appears to create an unsafe condition (e.g., moving at high speed or entering the work zone).	Existing	County Field Equipment, Municipal Field Equipment, Other TDOT Region Construction Offices, TDOT DSRC, TDOT Field Sensors, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment
	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.	Existing	Alabama DOT, Arkansas DOT, County Maintenance, Georgia DOT, Kentucky DOT, Mississippi DOT, Municipal Maintenance, Municipal TOC, North Carolina DOT, TDOT Maintenance Headquarters, TDOT Public Information Office, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT SmartWay, Virginia DOT
	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.	Existing	County Field Equipment, Municipal Field Equipment, Other TDOT Region Maintenance, TDOT Field Sensors, TDOT Maintenance Headquarters, TDOT Maintenance Vehicles, TDOT Region Maintenance, TDOT RWIS Sensors, USGS Field Equipment, USGS Flood Monitoring System

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Parking Management	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.	Planned	County TOC, Municipal TOC, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Private Vehicle, Regional Websites, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT SmartWay, Transit Website
	PM02	Smart Park and Ride System	This service package provides real-time information on Park and Ride capacity and supports traveler's decision-making on where best to park and make use of transit alternatives. Transit operators are provided arrival information to support efficient pickup and drop offs and drivers switching to transit are offered current transit information.	Planned	Demand Response Transit Dispatch, Driver, Private Long Distance Bus Company Operations, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Private Vehicle, TDOT DSRC, TDOT Public Information Office, TDOT SmartWay, Transit Agency Archive, Transit Website
	PM03	Parking Electronic Payment	This service package supports electronic collection of parking fees. It collects parking fees from in-vehicle equipment, contact or proximity cards, or any smart payment device. User accounts may be established to enhance services offered to frequent customers.	Existing	Driver, Electronic Fare Payment Card, Financial Institution, Private Traveler Personal Computing Devices, Private Vehicle, Regional Toll Authority

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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 systems and information service providers to support multimodal travel planning, including parking reservation capabilities. Information including current parking availability, system status, and operating strategies are shared to enable local parking facility management that supports regional transportation strategies.	Existing	County Field Equipment, County TOC, Demand Response Transit Dispatch, Municipal Field Equipment, Municipal TOC, Private Sector Traveler Information Services, Regional Websites, TDOT DMS, TDOT DSRC, TDOT HAR, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT SmartWay, Transit Website
	PM05	Loading Zone Management	This service package manages the occupancy of spaces in a loading/ unloading zone. It monitors the current status of each loading/unloading zone space under its control and makes this information available to arriving vehicles. The service package also operates a reservation system for loading zones, providing the capability for loading zone users, including commercial vehicle drivers or fleet operators, to reserve and pay for future use of a loading/unloading space. Interfaces to the general Vehicle OBE are included since loading zones may be used by any vehicle, though commercial vehicles are the most frequent users.	Planned	Commercial Vehicle, Driver, Electronic Fare Payment Card, Private Fleet Operations, Private Vehicle, Regional Toll Authority

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Public Safety	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.	Existing	County EMA, County Public Safety Dispatch, County Public Safety Vehicles, Municipal EMA, Municipal Public Safety Dispatch, Municipal Public Safety Vehicles, Regional Amber Alert Network, TDOT HELP Dispatch, TDOT HELP Vehicles, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch, THP Vehicles, TN Bureau of Investigation
	PS02	Routing Support for Emergency Responders	This service package 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.	Existing	County Public Safety Dispatch, County Public Safety Vehicles, County TOC, Municipal EMA, Municipal TOC, TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County TOC, County Traffic Signals, Municipal TOC, Municipal Traffic Signals, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	PS05	Vehicle Emergency Response	The Vehicle Emergency Response service package provides arriving public safety vehicles with information from connected vehicles involved in a crash. Emergency responders need information about the vehicles involved in a crash to respond safely and effectively to the vehicle crash. Information such as HAZMAT data can assist the responders. Information about air bag activations and other measures indicating the severity of the crash can provide useful input to ambulance staff. In addition information about the power system of the vehicle (e.g. hybrid, electric, or internal combustion engine) can affect the response.	Existing	Commercial Vehicle, Commercial Vehicle Driver, County Public Safety Vehicles, Driver, Freight Equipment, Municipal Public Safety Vehicles, Private Vehicle, TDOT HELP Vehicles, THP Vehicles

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	PS06	Incident Scene Pre-Arrival Staging Guidance for Emergency Responders	This service package will provide situational awareness to and coordination among emergency responders - upon dispatch, while en route to establish incident scene work zones, upon initial arrival and staging of assets, and afterward if circumstances require additional dispatch and staging. It collects a variety of data from emergency, traffic, and maintenance centers. It includes a vehicle and equipment staging function that supplies the en-route responders with additional information about the scene of an incident that they can use to determine where to stage personnel and equipment prior to their arrival on-scene. The service package also includes a dynamic routing function which provides emergency responders with real-time navigation instructions to travel from their base to the incident scene, accounting for traffic conditions, road closures, and snowplow reports if needed. In addition it includes an emergency responder status reporting function which continuously monitors the location of the en-route responder vehicles as well as the vehicles already on-scene. The function develops and maintains the current position of the responder's vehicles and provides updates for estimated time of arrival (ETA).	Existing	County EMA, County Maintenance, County Public Safety Dispatch, County Public Safety Vehicles, County TOC, Municipal EMA, Municipal Public Safety Dispatch, Municipal Public Safety Vehicles, Municipal TOC, TDOT Emergency Services Coordinator, TDOT HELP Dispatch, TDOT HELP Vehicles, TDOT Maintenance Headquarters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, TEMA, THP Dispatch, THP Vehicles

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	PS07	Incident Scene Safety Monitoring	This service package employs communications technologies to provide warnings and alerts relating to incident zone operations. One aspect of the service is an in-vehicle messaging system that provides drivers with merging and speed guidance around an incident. Another aspect is providing in-vehicle incident scene alerts to drivers, both for the protection of the drivers as well as incident zone personnel. A third aspect is a warning system for on-scene workers when a vehicle approaching or in the incident zone is being operated outside of safe parameters for the conditions.	Existing	County Field Equipment, County Public Safety Vehicles, County TOC, Municipal Field Equipment, Municipal Public Safety Vehicles, Municipal TOC, Private Vehicle, TDOT DSRC, TDOT Field Sensors, TDOT HELP Dispatch, TDOT HELP Vehicles, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment, THP Dispatch, THP Vehicles
	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.	Existing	TDOT HELP Dispatch, TDOT HELP Vehicles, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County Field Equipment, County Maintenance, County TOC, Municipal Field Equipment, Municipal Maintenance, Municipal TOC, TDOT CCTV, TDOT Maintenance Headquarters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, THP Dispatch, THP Vehicles, TN Bureau of Investigation

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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 web sites.	Existing	Alabama DOT, Arkansas DOT, County EMA, County Field Equipment, County Public Safety Dispatch, County TOC, Georgia DOT, Kentucky DOT, Mississippi DOT, Municipal EMA, Municipal Field Equipment, Municipal TOC, North Carolina DOT, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Regional Amber Alert Network, Regional Websites, TDOT DMS, TDOT DSRC, TDOT HAR, TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT SmartWay, TN Bureau of Investigation, Virginia DOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	PS11	Early Warning System	This service package monitors and detects potential, looming, and actual disasters including natural disasters (hurricanes, earthquakes, floods, winter storms, tsunamis, etc.) and technological and man-made disasters (hazardous materials incidents, nuclear power plant accidents, and acts of terrorism including nuclear, chemical, biological, and radiological weapons attacks). The service package monitors alerting and advisory systems, ITS sensors and surveillance systems, field reports, and emergency call-taking systems to identify emergencies and notifies all responding agencies of detected emergencies.	Existing	Municipal TOC, National Weather Service, TDOT Emergency Services Coordinator, TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Security Monitoring Field Equipment, TEMA, THP Dispatch, TN Bureau of Investigation, USGS Flood Monitoring System
	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	Existing	Alabama DOT, Arkansas DOT, County EMA, County Maintenance, County Public Safety Dispatch, County TOC, Cumberland Gap TOC, Demand Response Transit Dispatch, Georgia DOT, Kentucky DOT, Mississippi DOT, Municipal EMA, Municipal Maintenance, Municipal Public Safety Dispatch, Municipal TOC, North Carolina DOT, Other Maintenance and Construction Management, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, Other Traffic Management, Rail Operations Centers, TDOT Emergency Services Coordinator, TDOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
			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		HELP Dispatch, TDOT Maintenance Headquarters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT Region Maintenance, TEMA, THP Dispatch, TN Bureau of Investigation, USGS Flood Monitoring System, Virginia DOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
			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.		
	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	Existing	Alabama DOT, Arkansas DOT, County EMA, County Maintenance, County Public Safety Dispatch, County TOC, Cumberland Gap TOC, Demand Response Transit Dispatch, Georgia DOT, Kentucky DOT, Mississippi DOT, Municipal EMA, Municipal Maintenance, Municipal Public Safety Dispatch, Municipal TOC, North Carolina DOT, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, Other Traffic Management, Private Long Distance Bus Company Operations, Private Sector Traveler Information Services, Rail Operations Centers, Regional Toll Authority, Regional Websites, TDOT Emergency Services Coordinator, TDOT HELP Dispatch, TDOT Maintenance Headquarters, TDOT Public Information

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
			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.		Office, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT Region Maintenance, TDOT SmartWay, TEMA, THP Dispatch, TN Bureau of Investigation, Transit Website, USGS Flood Monitoring System, Virginia DOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	Alabama DOT, Arkansas DOT, Commercial Vehicle, County EMA, County Public Safety Dispatch, County TOC, Demand Response Transit Dispatch, Driver, Georgia DOT, Kentucky DOT, Local Print and Broadcast Media, Mississippi DOT, Municipal EMA, Municipal Public Safety Dispatch, Municipal TOC, National Weather Service, North Carolina DOT, Private Long Distance Bus Company Operations, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Regional Websites, TDOT Emergency Services Coordinator, TDOT HELP Dispatch, TDOT Public Information Office, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT SmartWay, TEMA, THP Dispatch, TN Bureau of Investigation, Transit Kiosks, Transit Website, USGS Flood Monitoring System, Virginia DOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Public Transportation	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.	Existing	Demand Response Transit Dispatch, Demand Response Transit Vehicles, Transit Vehicle, Transit Website
	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.	Existing	Demand Response Transit Dispatch, Demand Response Transit Vehicles, Transit Vehicle, Transit Vehicle Operator, Transit Website
	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.	Existing	Demand Response Transit Dispatch, Demand Response Transit Vehicles, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Transit Vehicle, Transit Vehicle Operator
	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.	Existing	Demand Response Transit Vehicles, Electronic Fare Payment Card, Financial Institution, Transit Kiosks, Transit Vehicle, Transit Vehicle Operator, Transit Website

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County Public Safety Dispatch, Demand Response Transit Dispatch, Demand Response Transit Vehicles, Municipal EMA, Municipal Public Safety Dispatch, Regional Amber Alert Network, TEMA, THP Dispatch, TN Bureau of Investigation, Transit Vehicle, Transit Vehicle Operator

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	Demand Response Transit Dispatch, Demand Response Transit Vehicles, Private Long Distance Bus Company Operations, Transit Agency Archive, Transit Vehicle, Transit Vehicle Operator
	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.	Existing	Demand Response Transit Dispatch, Demand Response Transit Vehicles, Transit Agency Archive, Transit Vehicle
	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.	Existing	Demand Response Transit Dispatch, Demand Response Transit Vehicles, Local Print and Broadcast Media, Private Long Distance Bus Company Operations, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Regional Websites, TDOT SmartWay, Transit Kiosks, Transit Vehicle, Transit Website

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	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.	Existing	County Field Equipment, County TOC, County Traffic Signals, Demand Response Transit Dispatch, Demand Response Transit Vehicles, Municipal TOC, Municipal Traffic Signals, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, Transit Vehicle, Transit Vehicle Operator
	PT10	Intermittent Bus Lanes	This service package provides dedicated bus lanes during peak demand times to enhance transit operations mobility. An intermittent bus lane is a lane that can change its status from regular lane (accessible for all vehicles) to bus lane, for the time strictly necessary for a bus or set of buses to pass. The status of the IBL is communicated to drivers using roadside message signs and through in-vehicle signage. The creation and removal of dedicated bus lanes is managed through coordination between traffic and transit centers.	Existing	County Field Equipment, County TOC, Demand Response Transit Dispatch, Demand Response Transit Vehicles, Municipal TOC, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, Transit Vehicle, Transit Vehicle Operator
	PT11	Transit Pedestrian Indication	The Transit Pedestrian Indication service package provides vehicle to device communications to inform pedestrians at a station or stop about the presence of a transit vehicle. In addition, this service package would inform the transit vehicle operator about the presence of pedestrians nearby and those waiting for the bus. It would help prevent collisions between transit vehicles and pedestrians.	Planned	Demand Response Transit Vehicles, Private Traveler Personal Computing Devices, Transit Vehicle, Transit Vehicle Operator

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	PT12	Transit Vehicle at Station/Stop Warnings	The Transit Vehicle at Station/Stop Warnings service package inform nearby vehicles of the presence of a transit vehicle at a station or stop. The service package also indicates the intention of the transit vehicle in terms of pulling into or out of a station/stop.	Planned	County Field Equipment, Demand Response Transit Dispatch, Demand Response Transit Vehicles, Driver, Municipal Field Equipment, Private Traveler Personal Computing Devices, Private Vehicle, TDOT DSRC, Transit Vehicle, Transit Vehicle Operator
	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.	Existing	Airport, Demand Response Transit Dispatch, Demand Response Transit Vehicles, Private Long Distance Bus Company Operations, Transit Agency Archive, Transit Vehicle
	PT15	Transit Stop Request	This service package allows a transit passenger to send a stop request to an approaching transit vehicle. The transit vehicle receives the request and notifies the vehicle operator of the stop request.	Existing	Demand Response Transit Dispatch, Demand Response Transit Vehicles, Private Traveler Personal Computing Devices, TDOT DSRC, Transit Agency Archive, Transit Kiosks, Transit Vehicle, Transit Vehicle Operator

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	PT18	Integrated Multi-Modal Electronic Payment	The Integrated Multi-Modal Electronic Payment service package provides electronic payment capability for transit fares, tolls, road use, parking, and other areas requiring electronic payments.	Planned	Commercial Vehicle, Demand Response Transit Dispatch, Demand Response Transit Vehicles, Electronic Fare Payment Card, Financial Institution, Private Long Distance Bus Company Operations, Private Traveler Personal Computing Devices, Private Vehicle, Regional Toll Authority, Transit Agency Archive, Transit Kiosks, Transit Vehicle
Sustainable Travel	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.	Existing	County Field Equipment, Municipal Field Equipment, National Weather Service, TDOT Field Sensors, TDOT RWIS Sensors

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	ST02	Eco-Traffic Signal Timing	The Eco-Traffic Signal Timing service package is similar to current adaptive traffic signal control systems; however, the service package's objective is explicitly to optimize traffic signals for the environment rather than the current adaptive systems' objective, which is to enhance the intersection level of service or throughput, which might improve the intersection's environmental performance. The Eco-Traffic Signal Timing service package processes real-time and historical connected vehicle data at signalized intersections to reduce fuel consumption and overall emissions at the intersection, along a corridor, or for a region. It evaluates traffic and environmental parameters at each intersection in real time and adapts so that the traffic network is optimized using available green time to serve the actual traffic demands while minimizing the environmental impact.	Planned	County Field Equipment, County TOC, County Traffic Signals, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	ST03	Eco-Traffic Metering	The Eco-Traffic Metering service package determines the most environmentally efficient operation of traffic signals at freeway on-ramps to manage the rate of entering automobiles. This service package collects traffic and environmental data from roadside sensors and connected vehicles to allow on-ramp merge operations that minimize overall emissions, including traffic and environmental conditions on the ramp and on the freeway upstream and downstream of the ramp. Using this information, the service package determines a timing plan for the ramp meter based on current and predicted traffic and environmental conditions.	Planned	County Field Equipment, County TOC, County Traffic Signals, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, TDOT CCTV, TDOT DMS, TDOT Field Sensors, TDOT Region 3 TMC - Nashville, TDOT Speed Monitoring Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	ST04	Roadside Lighting	The Roadside Lighting service package is a connected vehicle version of the automated roadside lighting systems that uses the presence of vehicles based on V2I communications as an input to control of roadside lighting systems. The service package can use the presence of vehicles to alter roadside lighting levels, and can use environmental data obtained from the vehicles as an input to support adjustment of the lighting based on adverse weather conditions such as fog, rain, or snow.	Planned	Commercial Vehicle, County Field Equipment, Municipal Field Equipment, Private Vehicle, TDOT Field Sensors, TDOT Probe Data Collector
	ST06	HOV/HOT Lane Management	This service package manages high-occupancy vehicle (HOV) and high-occupancy toll (HOT) lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals. Preferential treatment is given to HOV lanes using special bypasses, reserved lanes, and exclusive rights-of-way that may vary by time of day. Vehicle occupancy can be detected to verify HOV compliance and to notify enforcement agencies of violations. For HOT lane configurations, tolls are collected for vehicles that do not meet the high-occupancy criteria for the lane.	Planned	Commercial Vehicle, County Field Equipment, County TOC, Electronic Fare Payment Card, Financial Institution, Municipal Field Equipment, Municipal TOC, Private Traveler Personal Computing Devices, Private Vehicle, Regional Toll Authority, Regional Toll Authority Toll Plazas, TDOT Closure Equipment, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Speed Monitoring Equipment, THP Enforcement

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	ST07	Eco-Lanes Management	The Eco-Lanes Management service package supports the operations of eco-lanes – dedicated lanes similar to high-occupancy vehicle (HOV) or high-occupancy toll (HOT) lanes, but optimized for the environment. The service package employs communication technology to gather traffic and environmental information from multiple sources including infrastructure, vehicles, and other systems. The service package then processes these data and determines whether an eco-lane should be created or decommissioned along a roadway. These decisions would be in response to real-time traffic and environmental conditions. While the eco-lanes would have the capability to be flexible and more dynamic, it is envisioned that these parameters would change only as needed to ensure that travelers do not become confused by a system that is too dynamic in nature. Travelers would need to assume some level of consistency with their trip and should not be surprised by constant changing of the eco-lane's parameters. The Eco-Lanes Management service package establishes parameters and defines or geo-fences the eco-lanes boundaries. Eco-lanes parameters may include the types of vehicles allowed in the eco-lanes, emissions parameters for entering the eco-lanes, the number of lanes, and the start and end of the eco-lanes. The service package also conveys this information about eco-lanes to traveler information centers so those centers can provide the information to travelers.	Planned	Commercial Vehicle, County Field Equipment, County TOC, Driver, Municipal Field Equipment, Municipal TOC, Private Vehicle, TDOT Active Lane Management Systems, TDOT CCTV, TDOT Closure Equipment, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT HAR, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT SmartWay, TDOT Speed Monitoring Equipment, THP Enforcement

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	ST08	Eco-Approach and Departure at Signalized Intersections	The Eco-Approach and Departure at Signalized Intersections service package uses wireless data communications sent from a connected vehicle roadside equipment (RSE) unit to connected vehicles to encourage "green" approaches to and departures from signalized intersections. The vehicle collects intersection geometry information and signal phase movement information using V2I communications and data from nearby vehicles using V2V communications. Upon receiving this information, the service package performs calculations to provide speed advice to the driver, allowing the driver to adapt the vehicle's speed to pass the next traffic signal on green or to decelerate to a stop in the most eco-friendly manner. The service package also considers a vehicle's acceleration as it departs from a signalized intersection. Finally, the service package may perform engine adjustments that provide increased fuel efficiency.	Planned	Commercial Vehicle, County Field Equipment, County TOC, County Traffic Signals, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, Private Vehicle, TDOT Active Lane Management Systems, TDOT Closure Equipment, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT Probe Data Collector, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	ST09	Connected Eco-Driving	The Connected Eco-Driving service package provides customized real-time driving advice to drivers so that they can adjust their driving behavior to save fuel and reduce emissions. Eco-driving advice includes recommended driving speeds, optimal acceleration, and optimal deceleration profiles based on prevailing traffic conditions, interactions with nearby vehicles, and upcoming road grades. The service package also provides feedback to drivers on their driving behavior to encourage drivers to drive in a more environmentally efficient manner. Finally, the service package may include vehicle-assisted strategies where the vehicle automatically implements the eco-driving strategy (e.g., changes gears, switches power sources, or reduces its speed in an eco-friendly manner).	Planned	Commercial Vehicle, Driver, Private Sector Traveler Information Services, Private Vehicle, TDOT Communications Network, TDOT DSRC, TDOT Smart Work Zone Equipment, TDOT SmartWay

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Support	SU01	Connected Vehicle System Monitoring and Management	This service package provides monitoring, management and control services necessary to other applications and/or devices operating within the Connected Vehicle Environment. This service package maintains and monitors the performance and configuration of the connected vehicle system. This includes tracking and management of the infrastructure configuration as well as detection, isolation, and correction of infrastructure service problems. It also includes monitoring of performance of the infrastructure and mobile equipment, which includes RSEs, OBEs, the back office applications, as well as the communication links that connect the system.	Planned	County TOC, Cumberland Gap TOC, Municipal TOC, Private Fleet Operations, Private Vehicle, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Smart Work Zone Equipment
	SU02	Core Authorization	This service package manages the authorization mechanisms to define roles, responsibilities and permissions for connected vehicle applications . This allows system administrators to establish operational environments where different connected vehicle system users may have different capabilities. For instance, some Mobile elements may be authorized to request signal priority, or some Centers may be permitted to use the geographic broadcast service, while those without those permissions would not.	Planned	Commercial Vehicle, County Field Equipment, County TOC, Cumberland Gap TOC, Municipal Field Equipment, Municipal TOC, Private Fleet Operations, Private Long Distance Bus Company Operations, Private Vehicle, Rail Operations Centers, TDOT Communications Network, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT Region Engineers Office, TDOT Strategic Transportation Investments Division

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	SU03	Data Distribution	This service package manages the distribution of data from data providers to data consumers and protects those data from unauthorized access. It informs data providers of how to provide data, manages data subscriptions, and provides data forwarding capabilities. The service package also maintains a directory of System Users that want data and supports multiple distribution mechanisms including publish-subscribe and directly from data provider to data consumer. It allows data consumers to specify (and change the specification of) data they wish to receive.	Existing	Airport, Archived Data User Systems, Commercial Vehicle, County TOC, Cumberland Gap TOC, CVIEW, Demand Response Transit Dispatch, Financial Institution, IFTA, IRP, Municipal TOC, Private Long Distance Bus Company Operations, Rail Operations Centers, TDOT Communications Network, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Engineers Office, TDOT Smart Work Zone Equipment, TDOT Strategic Transportation Investments Division, TEMA, Tennessee Pre-Pass, THP Enforcement, THP Truck Weigh and Inspection Station, Transit Agency Archive

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	SU04	Map Management	This service package defines interfaces that can be used download or update all types of map data used to support intelligent transportation systems. This map data will be accessed by centers, field, and vehicle physical objects. The service package can also be used to harness the Connected Vehicle Environment to provide rich source data that can be used to verify, refine, and enhance geographic map data.	Planned	Archived Data User Systems, Commercial Vehicle, County TOC, Cumberland Gap TOC, Municipal TOC, Private Fleet Operations, Private Long Distance Bus Company Operations, Private Vehicle, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, THP Enforcement

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	SU05	Location and Time	This service package identifies the external systems and interfaces that provide accurate location and time to intelligent transportation system devices and systems.	Existing	County TOC, Cumberland Gap TOC, Municipal TOC, Rail Operations Centers, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT HAR, TDOT Power Network, TDOT Probe Data Collector, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment, Tennessee Pre-Pass, THP Truck Weigh and Inspection Station, USGS Field Equipment, USGS Flood Monitoring System

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	SU06	Object Registration and Discovery	This service package provides registration and lookup services necessary to allow objects to locate other objects operating within the Connected Vehicle Environment. An object registry is like a phone book for all the connected centers, systems, and equipment in the transportation system (the "objects"). In this service package, each object registers itself with the ORDS and tells the registry where it lives in the communication network (e.g., host, port, node name) and information about the services it provides - information that other objects can use to determine the type of service, the geographic scope of the service, and other information that helps users of the registry to make informed decisions about which object(s) support a needed service or information stream. This is the "Discovery" part of the service. Connected objects can use the registry to find (discover) objects that can be used to get needed information or services.	Planned	County TOC, Cumberland Gap TOC, Municipal TOC, Other Traffic Management, Private Fleet Operations, Private Vehicle, Rail Operations Centers, TDOT Communications Network, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Enforcement, TN Bureau of Investigation

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	SU07	Privacy Protection	This service package provides the privacy protection essential to the operation of connected vehicle applications. Privacy Protection obscures the network identifiers of mobile devices in order to allow communications with credentials management and other centers.	Planned	County TOC, Cumberland Gap TOC, Municipal TOC, Other Traffic Management, Private Fleet Operations, Private Long Distance Bus Company Operations, Private Traveler Personal Computing Devices, Private Vehicle, Rail Operations Centers, Regional Toll Authority, Service Agency, TDOT Communications Network, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Engineers Office, THP Enforcement, THP Truck Weigh and Inspection Station, TN Bureau of Investigation

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	SU08	Security and Credentials Management	This service package is used to ensure trusted communications between mobile devices and other mobile devices or roadside devices and protect data they handle from unauthorized access. The service package grants trust credentials to qualified mobile devices and infrastructure devices in the Connected Vehicle Environment so that those devices may be considered trusted by other devices that receive trust credentials from the SCM service package. The service package allows credentials to be requested and revoked and secures the exchange of trust credentials between parties, so that no other party can intercept and use those credentials illegitimately. The service package provides security to the transmissions between connected devices, ensuring authenticity and integrity of the transmissions. Additional security features include privacy protection, authorization and privilege class definition, as well as non-repudiation of origin.	Planned	County TOC, Cumberland Gap TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	SU09	Center Maintenance	This service package supports maintenance of the computers, networks, video walls, and other information technology assets that are installed in a center to support center operations. Like other support service packages, this SP is drawn at a high level of abstraction so the basic interfaces and functionality associated with maintaining center IT assets can be applied to any center.	Existing	County TOC, Cumberland Gap TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	SU10	Field Equipment Maintenance	This service package supports maintenance of ITS devices that are installed in the field. Like other support service packages, this SP is drawn at a high level of abstraction so the basic interfaces and functionality associated with maintaining field ITS assets can be applied to any field equipment. In particular, this service package supports maintenance of field subsystems like ITS Payment Equipment, Parking Management Systems, and Commercial Vehicle Check Equipment where maintenance is not covered by a more specific Service Package. Two Field subsystems have more specific service packages associated with their maintenance: See MC05 for maintenance of ITS Roadway Equipment and SU01 for more specific interfaces associated with maintaining Connected Vehicle Roadside Equipment.	Existing	County Field Equipment, County Maintenance, County TOC, County Traffic Signals, Cumberland Gap TOC, Municipal Field Equipment, Municipal Maintenance, Municipal TOC, Municipal Traffic Signals, TDOT CCTV, TDOT Closure Equipment, TDOT DMS, TDOT Field Sensors, TDOT HAR, TDOT Maintenance Headquarters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, TDOT Speed Monitoring Equipment, Tennessee Pre-Pass, THP Truck Weigh and Inspection Station, THP Weigh-in-Motion, Wayside Detection Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Traveler Information	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.	Existing	County TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	Demand Response Transit Dispatch, Private Traveler Personal Computing Devices, Transit Kiosks, Transit Website
	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.	Existing	Commercial Vehicle, Demand Response Transit Dispatch, Driver, Private Long Distance Bus Company Operations, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Private Vehicle, TDOT HELP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	Airport, Commercial Vehicle, Demand Response Transit Dispatch, Transit Kiosks, Transit Website
	TI05	Travel Services Information and Reservation	This service package provides travel service information and reservation services to the traveler pre-trip and while en route. This includes information for tourist attractions, lodging, dining, service stations, parking, emergency services, and other services and businesses of interest to the traveler.	Existing	Airport, Commercial Vehicle, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Transit Kiosks, Transit Website

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	TI06	Dynamic Ridesharing and Shared Use Transportation	This service package addresses dynamic ridesharing/ride matching services to travelers and other forms of shared use transportation. Dynamic ridesharing allows travelers to arrange carpool trips through a personal device with a wireless connection to a ride matching system (e.g., a web-based application). It uses inputs from both passengers and drivers pre-trip, during the trip, and post-trip . These inputs are then translated into "optimal" pairings between passengers and drivers to provide both with a convenient route between their two origin and destination locations. After the trip, information is provided back to the service package to improve the user's experience for future trips. The shared use aspect of the service package addresses three types of shared use that may be arranged using an internet connected personal device. In the first type, a traveler arranges for the temporary use of a vehicle. In the second type of shared use, a traveler arranges for a vehicle to pick them up at a specific location and take them to another location. The second type of shared use may be implemented as a ride matching or ridesharing service, including those provided by Uber and Lyft. The third type of shared use is a bikeshare capability.	Planned	Demand Response Transit Dispatch, Driver, Financial Institution, Private Long Distance Bus Company Operations, Private Traveler Personal Computing Devices, Private Vehicle, Service Agency, Transit Kiosks

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Planned	Commercial Vehicle, County Field Equipment, County Public Safety Vehicles, County TOC, County Traffic Signals, Driver, Municipal Field Equipment, Municipal Public Safety Vehicles, Municipal TOC, Municipal Traffic Signals, Private Vehicle, TDOT Active Lane Management Systems, TDOT Anti-icing Equipment, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT HELP Vehicles, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment, THP Vehicles

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Traffic Management	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.	Existing	Alabama DOT, Arkansas DOT, County Field Equipment, County TOC, County Traffic Signals, Georgia DOT, Kentucky DOT, Mississippi DOT, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, North Carolina DOT, TDOT CCTV, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Smart Work Zone Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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).	Existing	County TOC, Municipal TOC, Private Long Distance Bus Company Operations, Private Vehicle, TDOT Communications Network, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Smart Work Zone Equipment
	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.	Existing	County Field Equipment, County TOC, County Traffic Signals, Municipal TOC, Municipal Traffic Signals, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Planned	County Field Equipment, County TOC, County Traffic Signals, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, Private Vehicle, TDOT Active Lane Management Systems, TDOT DSRC, TDOT Field Sensors, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	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.	Planned	County Field Equipment, County TOC, County Traffic Signals, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, TDOT DSRC, TDOT Field Sensors, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	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	Existing	Alabama DOT, Arkansas DOT, County EMA, County Field Equipment, County Maintenance, County Public Safety Dispatch, County TOC,

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
			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.		County Traffic Signals, Demand Response Transit Dispatch, Driver, Georgia DOT, Kentucky DOT, Local Print and Broadcast Media, Mississippi DOT, Municipal EMA, Municipal Field Equipment, Municipal Maintenance, Municipal Public Safety Dispatch, Municipal TOC, Municipal Traffic Signals, North Carolina DOT, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, Private Long Distance Bus Company Operations, Private Sector Traveler Information Services, Regional Amber Alert Network, Regional Websites, TDOT Active Lane Management Systems, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT Emergency Services Coordinator, TDOT Field Sensors, TDOT HAR, TDOT HELP Dispatch, TDOT Maintenance Headquarters, TDOT Probe Data Collector, TDOT Public Information Office, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
					Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT Region Maintenance, TDOT Smart Work Zone Equipment, TDOT SmartWay, TDOT Speed Monitoring Equipment, TEMA, Transit Website, Virginia DOT
	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.	Existing	Alabama DOT, Arkansas DOT, County TOC, Cumberland Gap TOC, Georgia DOT, Kentucky DOT, Mississippi DOT, Municipal TOC, North Carolina DOT, Other Traffic Management, TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch, Virginia DOT
	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	Existing	Alabama DOT, Arkansas DOT, County EMA, County Field Equipment, County Maintenance, County Public Safety Dispatch,

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
			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 field personnel. The coordination can also extend to tow trucks and other allied response agencies and field service personnel.		County Public Safety Vehicles, County TOC, County Traffic Signals, Cumberland Gap TOC, Demand Response Transit Dispatch, Georgia DOT, Kentucky DOT, Local Print and Broadcast Media, Mississippi DOT, Municipal EMA, Municipal Field Equipment, Municipal Maintenance, Municipal Public Safety Dispatch, Municipal Public Safety Vehicles, Municipal TOC, Municipal Traffic Signals, North Carolina DOT, Other Maintenance and Construction Management, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, Other Traffic Management, Private Long Distance Bus Company Operations, Private Sector Traveler Information Services, Rail Operations Centers, Regional Amber Alert Network, Regional Websites, TDOT Active Lane Management Systems, TDOT Anti-icing Equipment, TDOT CCTV, TDOT Closure Equipment, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
					Emergency Services Coordinator, TDOT Field Sensors, TDOT HAR, TDOT HELP Dispatch, TDOT HELP Vehicles, TDOT Maintenance Headquarters, TDOT Probe Data Collector, TDOT Public Information Office, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Construction Office, TDOT Region Maintenance, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, TDOT SmartWay, TDOT Speed Monitoring Equipment, TEMA, THP Dispatch, THP Vehicles, TN Bureau of Investigation, Transit Website, USGS Flood Monitoring System, Virginia DOT

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County EMA, County TOC, Cumberland Gap TOC, Demand Response Transit Dispatch, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	TM10	Electronic Toll Collection	The Electronic Toll Collection service package provides toll operators with the ability to collect tolls electronically and detect and process violations. The fees that are collected may be adjusted to implement demand management strategies. Field-Vehicle Communication between the roadway equipment and the vehicle is required as well as Fixed Point-Fixed Point interfaces between the toll collection equipment and transportation authorities and the financial infrastructure that supports fee collection. Toll violations are identified and electronically posted to vehicle owners. Standards, inter-agency coordination, and financial clearinghouse capabilities enable broad interoperability for these services.	Planned	Commercial Vehicle, Electronic Fare Payment Card, Financial Institution, Private Fleet Operations, Private Vehicle, Regional Toll Authority, Regional Toll Authority Toll Plazas, TDOT Communications Network, THP Enforcement

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	TM11	Road Use Charging	The Road Use Charging service package supports the capability to charge fees to roadway vehicle owners for using specific roadways with potentially differential payment rates based on time-of-day, which specific roadway is used, and class of vehicle (a local policy decision by each roadway owner). These payment schemes could be forms of Vehicle Miles Traveled (VMT) or other schemes that are yet to be defined. Vehicle owners need only register with a single payment entity of their choice (a participating state, municipal, or regional DOT, an authority, or a private entity), and payments are reconciled by the entity receiving payment (and travel history) with all roadway owners that participate in the road use payment scheme, which may also include the Federal government. Vehicle owners would pay nothing for distances traveled where there are no payments required (e.g. in jurisdictions that have not implemented a distance based payment or for roadway operators that collect payment using traditional tolls), although a Federal payment rate might cover some or all roadway operations (a Federal policy decision). Basic operation depends on the vehicle tracking its own location, and periodically reporting its travel history to the registered entity receiving payment using connected vehicle communications.	Planned	Commercial Vehicle, Driver, Electronic Fare Payment Card, Financial Institution, Private Sector Traveler Information Services, Private Traveler Personal Computing Devices, Private Vehicle, Regional Toll Authority, Regional Toll Authority Toll Plazas, TDOT Communications Network, TDOT DSRC, TDOT Public Information Office, THP Enforcement, Transit Kiosks

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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).	Existing	County Field Equipment, County TOC, County Traffic Signals, Driver, Municipal TOC, Municipal Traffic Signals, TDOT Anti-icing Equipment, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County Field Equipment, County TOC, County Traffic Signals, Driver, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, Rail Operations Centers, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	TM14	Advanced Railroad Grade Crossing	This service package manages highway traffic at highway-rail intersections (HRIs) where operational requirements demand advanced features (e.g., where rail operational speeds are greater than 80 miles per hour). This service package includes all capabilities from the Standard Railroad Grade Crossing service package and augments these with additional safety features to mitigate the risks associated with higher rail speeds and leverage Connected Vehicle technologies. The active warning systems supported by this service package include positive barrier systems that preclude entrance into the intersection when the barriers are activated. Like the Standard package, the HRI equipment is activated on notification by wayside interface equipment which detects, or communicates with the approaching train. In this service package, the wayside equipment provides additional information about the arriving train so that the train's direction of travel, estimated time of arrival, and estimated duration of closure may be derived. This service package will alert and/or warn drivers who are approaching an at-grade railroad crossing if they are on a crash-imminent trajectory to collide with a crossing or approaching train. This enhanced information may be conveyed to the driver prior to, or in context with, warning system activation. This service package also includes additional detection capabilities that enable it to detect an entrapped or otherwise immobilized vehicle within the HRI and provide an immediate notification to highway and railroad officials.	Existing	County Field Equipment, County TOC, County Traffic Signals, Driver, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, Rail Operations Centers, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County TOC, County Traffic Signals, Municipal TOC, Municipal Traffic Signals, Rail Operations Centers, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	TM16	Reversible Lane Management	This service package provides for the management of reversible lane facilities. In addition to standard surveillance capabilities, this service package includes sensory functions that detect wrong-way vehicles and other special surveillance capabilities that mitigate safety hazards associated with reversible lanes. The package includes the field equipment, physical lane access controls, and associated control electronics that manage and control these special lanes. This service package also includes the equipment used to electronically reconfigure intersections and manage right-of-way to address dynamic demand changes and special events.	Existing	County Field Equipment, County TOC, Municipal Field Equipment, Municipal TOC, TDOT CCTV, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County Field Equipment, Municipal Field Equipment, TDOT DMS, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment, THP Enforcement

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	TDOT Closure Equipment, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, THP Dispatch, USGS Flood Monitoring System, County EMA, County Field Equipment, County Maintenance, County TOC, Municipal Field Equipment, Municipal TOC, TDOT Anti-icing Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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).	Existing	County Field Equipment, County TOC, Municipal Field Equipment, Municipal TOC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	TM21	Speed Harmonization	This service package determines speed recommendations based on traffic conditions and weather information and uses connected vehicle technologies to assist in harmonizing speeds to these recommendations. The speed recommendations can be regulatory (e.g. variable speed limits) or advisory. The purpose of speed harmonization is to change traffic speed on links that approach areas of traffic congestion, bottlenecks, incidents, special events, and other conditions that affect flow. Speed harmonization assists in maintaining flow, reducing unnecessary stops and starts, and maintaining consistent speeds. The service package utilizes connected vehicle V2I communication to detect the precipitating roadway or congestion conditions that might necessitate speed harmonization, to generate the appropriate response plans and speed recommendation strategies for upstream traffic, and to broadcast such recommendations to the affected vehicles. The speed recommendations can be provided in-vehicle for connected vehicles, or through roadside signage for non-connected vehicles.	Planned	County Field Equipment, County TOC, Municipal Field Equipment, Municipal TOC, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT Probe Data Collector, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Speed Monitoring Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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).	Planned	County Field Equipment, County TOC, Municipal Field Equipment, Municipal TOC, TDOT DSRC, TDOT Field Sensors, TDOT Probe Data Collector, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, THP Enforcement

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Vehicle Safety	VS01	Autonomous Vehicle Safety Systems	This service package improves vehicle safety using on-board sensors that monitor the driving environment surrounding the vehicle. All levels of driving automation are supported ranging from basic warning systems that warn the driver through full automation where the vehicle controls the steering and acceleration/deceleration in all scenarios and environments, without driver intervention. Unlike other Vehicle Safety service packages, this service package includes autonomous capabilities that rely only on on-board systems without communication with other vehicles or the infrastructure.	Planned	Commercial Vehicle, Driver, Private Vehicle
	VS02	V2V Basic Safety	This service package exchanges basic safety messages with surrounding Connected Vehicles to support and augment the safety warning and control automation features identified in VS01. These exchanges support Connected Vehicle safety applications defined in SAE J2945/1: Emergency Electronic Brake Lights, Forward Crash Warning, Blind Spot Warning/Lane Change Warning, Intersection Movement Assist, Left Turn Assist, and Control Loss Warning. It also supports Do Not Pass Warning, Motorcycle Approaching indication, Tailgating Advisory, Stationary Vehicle, and Pre-Crash Actions applications from CVRIA.	Planned	Commercial Vehicle, Driver, Private Vehicle

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	VS03	Situational Awareness	This service package shares information about potentially hazardous road conditions or road hazards with other vehicles to support enhanced driver warnings and control automation. Vehicles broadcast relevant road condition information that is collected by the vehicle, such as fog or icy roads. This service package supports the capability for connected vehicles to share situational awareness information even in areas where no roadside communications infrastructure exists. It can be useful to vehicles that are not fully equipped with sensors, or vehicles entering an area with hazardous conditions. Roadside communications infrastructure, if available, can extend the situational awareness range to cover wrong way vehicles where closing rates can require notification beyond DSRC communications range.	Planned	Commercial Vehicle, Driver, Private Vehicle, TDOT Communications Network, TDOT DSRC, TDOT Smart Work Zone Equipment
	VS04	V2V Special Vehicle Alert	This service package alerts the driver about the location of and the movement of public safety vehicles responding to an incident, slow moving vehicles, oversized vehicles, and other special vehicles that may require special attention from the driver. These public safety, commercial, and maintenance vehicles share their current status and location with surrounding vehicles so that other drivers in the vicinity can avoid interfering with their actions and avoid collisions.	Planned	Commercial Vehicle, Commercial Vehicle Driver, County Public Safety Vehicles, Demand Response Transit Vehicles, Driver, Municipal Public Safety Vehicles, Private Vehicle, TDOT HELP Vehicles, TDOT Maintenance Vehicles, THP Vehicles, Transit Vehicle

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Planned	County Field Equipment, County TOC, Municipal Field Equipment, Municipal TOC, Private Vehicle, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment
	VS06	Stop Sign Gap Assist	This service package is intended to improve safety at non-signalized intersections where only the minor road has posted stop signs. It includes both onboard (for connected vehicles) and roadside signage warning systems (for non-equipped vehicles). The service package helps drivers on a minor road stopped at an intersection understand the state of activities associated with that intersection by providing a warning of unsafe gaps on the major road. The SSGA service package collects all available sensor information (major road, minor road, and median sensors) data and computes the dynamic state of the intersection in order to issue appropriate warnings and alerts.	Planned	County Field Equipment, County TOC, Driver, Municipal TOC, Private Vehicle, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Speed Monitoring Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	VS07	Road Weather Motorist Alert and Warning	This service package collects road weather data from connected vehicles and uses that data to develop short term warnings or advisories that can be provided to individual motorists. The information may come from either vehicles operated by the general public and commercial entities (including passenger cars and trucks) or specialty vehicles and public fleet vehicles (such as snowplows, maintenance trucks, and other agency pool vehicles). The raw data will be processed in a controlling center to generate road segment-based data outputs. The processing will also include a road weather motorist alerts algorithm to generate short time horizon alerts that will be pushed to user systems and available to commercial service providers. In addition the information collected can be combined with observations and forecasts from other sources to provide medium (next 2-12 hours) or long term (more than 12 hours) advisories through a variety of interfaces including web based and connected vehicle based interfaces.	Planned	County Field Equipment, County Maintenance, County TOC, Driver, Municipal Field Equipment, Municipal Maintenance, Municipal TOC, Private Vehicle, TDOT Anti-icing Equipment, TDOT Communications Network, TDOT DSRC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, TDOT RWIS Sensors, USGS Field Equipment, USGS Flood Monitoring System

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	VS08	Queue Warning	This service package utilizes connected vehicle technologies, including vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) communications, to enable vehicles within the queue event to automatically broadcast their queued status information (e.g., rapid deceleration, disabled status, lane location) to nearby upstream vehicles and to centers (such as the TMC). The infrastructure will broadcast queue warnings to vehicles in order to minimize or prevent rear-end or other secondary collisions. This service package is not intended to operate as a crash avoidance system. In contrast to such systems, this service package will engage well in advance of any potential crash situation, providing messages and information to the driver in order to minimize the likelihood of his needing to take crash avoidance or mitigation actions later. It performs two essential tasks: queue determination (detection and/or prediction) and queue information dissemination using vehicle-based, infrastructure-based, or hybrid solutions.	Planned	County Field Equipment, County TOC, Cumberland Gap TOC, Municipal Field Equipment, Municipal TOC, Private Vehicle, TDOT Active Lane Management Systems, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Probe Data Collector, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Speed Monitoring Equipment
	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.	Planned	County Field Equipment, County TOC, Municipal Field Equipment, Municipal TOC, Private Vehicle, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT Probe Data Collector, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	VS10	Restricted Lane Warnings	This service package provides the connected vehicle with restriction information about the travel lanes, such as if the lane is restricted to high occupancy vehicles (HOV), transit, or public safety vehicles only or has defined eco-lane criteria. A connected vehicle can use this information to determine if the vehicle is in a lane that has lane restrictions.	Planned	County Field Equipment, County TOC, Driver, Municipal Field Equipment, Municipal TOC, Private Vehicle, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT Probe Data Collector, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors
	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.	Planned	County Field Equipment, County Maintenance, County TOC, Municipal Field Equipment, Municipal Maintenance, Municipal TOC, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Planned	Commercial Vehicle, County Field Equipment, County TOC, County Traffic Signals, Driver, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, Private Traveler Personal Computing Devices, Private Vehicle, TDOT Active Lane Management Systems, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	VS13	Intersection Safety Warning and Collision Avoidance	This service package enables a connected vehicle approaching an instrumented signalized intersection to receive information from the infrastructure regarding the signal timing and the geometry of the intersection. The vehicle uses its speed and acceleration profile, along with the signal timing and geometry information to determine if it appears likely that the vehicle will be able to pass safely through the intersection without violating the signal or colliding with other vehicles. If the vehicle determines that proceeding through the intersection is unsafe, a warning is provided to the driver and/or collision avoidance actions are taken, depending on the automation level of the vehicle.	Planned	County Field Equipment, County TOC, County Traffic Signals, Driver, Municipal TOC, Municipal Traffic Signals, Private Vehicle, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis
	VS14	Cooperative Adaptive Cruise Control	This service package adds vehicle to vehicle (V2V) communications to adaptive cruise control (ACC) systems, which provides enhanced information so that groups or 'strings' of CACC-equipped vehicles can follow a lead vehicle with better accuracy, quicker response, and shorter time gaps, enhancing traffic flow stability. In ACC systems, sensors (e.g., radar or lidar) and longitudinal control automation are used to measure and maintain a safe distance from the lead vehicle. V2V communications enables direct communication between the vehicles so that acceleration and deceleration can be more directly coordinated between vehicles in the string.	Planned	Commercial Vehicle, Driver, Private Vehicle

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	VS15	Infrastructure Enhanced Cooperative Adaptive Cruise Control	This service package adds Infrastructure to Vehicle (I2V) communications to Cooperative Adaptive Cruise Control systems so that strings of compatible CACC-equipped vehicles can be more efficiently formed and cooperating vehicles gain access to speed recommendations and traffic control status from the infrastructure, further enhancing traffic flow stability and improving highway capacity and throughput. Speed recommendations provided by the infrastructure can be used to stabilize traffic flow, reducing speed differentials and enhancing throughput along a route that includes a bottleneck. Access to traffic control information such as signal phase and timing enables synchronized starts by adjacent CACC-equipped strings of vehicles, increasing intersection throughput. The infrastructure can also assist with broader coordination between CACC-equipped vehicles, enabling strings of vehicles to be more efficiently formed that share performance parameters and destinations.	Planned	County Field Equipment, County TOC, County Traffic Signals, Driver, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, Private Vehicle, TDOT Active Lane Management Systems, TDOT Anti-icing Equipment, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT Probe Data Collector, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Speed Monitoring Equipment

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	VS16	Automated Vehicle Operations	This service package provides full vehicle automation, controlling both the steering and acceleration/deceleration on areas of the highway system that support full automation. Communications between vehicles and between the vehicles and supporting infrastructure equipment supports cooperative check-in to the automated portion of the system and transition to automated mode, coordination of maneuvers between vehicles in automated mode, and checkout from the automated system. This service package is distinguished from the most advanced CACC systems in that full longitudinal and lateral control automation are supported, enabling closely spaced, tightly coupled platoons of vehicles to operate with short fixed gaps, providing greatly enhanced highway capacity and throughput with enhanced efficiency since aerodynamic drag is reduced.	Planned	Commercial Vehicle, County Field Equipment, County TOC, County Traffic Signals, Driver, Municipal Field Equipment, Municipal TOC, Municipal Traffic Signals, Private Vehicle, TDOT Active Lane Management Systems, TDOT Anti-icing Equipment, TDOT Communications Network, TDOT DSRC, TDOT Field Sensors, TDOT Ramp Meters, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment
	VS17	Traffic Code Dissemination	This service package disseminates current local statutes, regulations, ordinances, and rules that have been adopted by local, state, and federal authorities that govern the safe, orderly operation of motor vehicles, bicycles, and pedestrians on public roads. The focus of this service package is electronic distribution to automated vehicles and their drivers so that automated vehicles can safely operate in compliance with the traffic or motor vehicle code for the current state and locality, though this information would also be useful to human drivers.	Planned	Commercial Vehicle, County TOC, Driver, Municipal TOC, Private Vehicle, TDOT Public Information Office, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
Weather	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.	Existing	County Field Equipment, County Maintenance, Municipal Field Equipment, Municipal Maintenance, Municipal TOC, National Weather Service, Other TDOT Region Maintenance, Private Vehicle, TDOT Anti-icing Equipment, TDOT Communications Network, TDOT DSRC, TDOT Emergency Services Coordinator, TDOT Field Sensors, TDOT Maintenance Vehicles, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, USGS Field Equipment, USGS Flood Monitoring System

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	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.	Existing	County EMA, County Maintenance, County Public Safety Dispatch, County TOC, Demand Response Transit Dispatch, Local Print and Broadcast Media, Municipal EMA, Municipal Public Safety Dispatch, Municipal TOC, National Weather Service, Private Sector Traveler Information Services, Regional Websites, TDOT Emergency Services Coordinator, TDOT Public Information Office, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Maintenance, TEMA, Transit Website

Category	Service Package	Service Package Name	Service Package Description	Service Package Status	Included Elements
	WX03	Spot Weather Impact Warning	This service package will alert drivers to unsafe conditions or road closure at specific points on the downstream roadway as a result of weather-related impacts, which include, but are not limited to high winds, flood conditions, ice, or fog. The service packages is designed to use standalone weather systems to warn drivers about inclement weather conditions that may impact travel conditions. Real time weather information is collected from fixed environmental sensor stations and vehicle based sensors. The information is processed to determine the nature of the alert or warning to be delivered and then communicated to connected vehicles. If the warning includes road closure then diversion information can be provided. For non-equipped vehicles the alerts or warnings will be provided via roadway signage. In addition, the roadway equipment may calculate the appropriate speed for current weather conditions and provide this information to the connected vehicle or on roadway signage.	Existing	County Field Equipment, County TOC, Driver, Municipal Field Equipment, Municipal TOC, Private Sector Traveler Information Services, Private Vehicle, Regional Websites, TDOT Anti-icing Equipment, TDOT CCTV, TDOT Closure Equipment, TDOT Communications Network, TDOT DMS, TDOT DSRC, TDOT Field Sensors, TDOT HAR, TDOT HELP Dispatch, TDOT Probe Data Collector, TDOT Public Information Office, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT RWIS Sensors, TDOT Smart Work Zone Equipment, TDOT SmartWay, TDOT Speed Monitoring Equipment, THP Dispatch, USGS Field Equipment

Appendix B FUNCTIONAL REQUIREMENTS

Table 11: Functional Requirements

Element Name	Physical Object	Functional Object	Functional Object Description
Airport, Archived Data User Systems, County EMA, County Maintenance, County Public Safety Dispatch, County TOC, Cumberland Gap TOC, CVIEW, Financial Institution, IFTA, IRP, Municipal TOC, National Weather Service, Other Maintenance and Construction Management, Other Traffic Management, Rail Operations Centers, Service Agency, SSRS, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TDOT Region Engineers Office, THP Enforcement, THP Truck Weigh and Inspection Station	Center	Center Data Collection	'Center Data Collection' collects and stores information that is created in the course of center operations. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.
Airport, IFTA, IRP, National Weather Service, Other Traffic Management, Rail Operations Centers, SSRS, TDOT Region Engineers Office, THP Enforcement	Center	Center Support Services	'Center Support Services' provides foundational functions that support data collection, management, and distribution. It coordinates with Object Registration and Discovery to maintain its registration with respect to location/geographic scope and credentialing information. It maintains the necessary security credentials, authorizations, and associated keys to support communications in the connected vehicle environment.
Alabama DOT, Arkansas DOT, County TOC, Georgia DOT, Kentucky DOT, Mississippi DOT, Municipal TOC, North Carolina DOT, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, Virginia DOT	Traffic Management Center	TMC Regional Traffic Management	'TMC Regional Traffic Management' supports coordination between Traffic Management Centers in order to share traffic information between centers as well as control of traffic management field equipment. This coordination supports wide area optimization and regional coordination that spans jurisdictional boundaries; for example, coordinated signal control in a metropolitan area or coordination between freeway operations and arterial signal control within a corridor.
Archived Data User Systems	Center	Center Permission Management	'Center Permission Management' enables Connected Vehicle system users to request permission to access connected vehicle services. A center may request permission for the center or the infrastructure devices and vehicles associated with the center.

Element Name	Physical Object	Functional Object	Functional Object Description
Archived Data User Systems, Rail Operations Centers	Center	Center Field Equipment Management	'Center Field Equipment Management' is the back office application that supports monitoring and maintenance of field equipment. It monitors the performance and configuration of the field equipment. This includes management of the infrastructure configuration as well as detection, isolation, and correction of field equipment problems. The application also includes monitoring of performance of the field equipment, including communications links.
Commercial Vehicle	Commercial Vehicle OBE	CV On-Board Cargo Monitoring	'CV On-Board Cargo Monitoring' monitors the location and status of the commercial vehicle and its cargo. It sends the collected data to appropriate centers and roadside facilities, including emergency management in the case of HAZMAT incidents. Depending on the nature of the cargo, it may include sensors that measure temperature, pressure, load leveling, acceleration, and other attributes of the cargo.
Commercial Vehicle	Commercial Vehicle OBE	CV On-board Driver Authentication	'CV On-board Driver Authentication' monitors the identity of the commercial vehicle driver and compares it with the planned drivers for the commercial vehicle. Any change in driver is sent to the Fleet and Freight Management Center. Notification of any unexpected drivers will also be sent to the Fleet and Freight Management Center which, in turn, may send a disable vehicle command to cause the vehicle to stop. On receipt of a disable vehicle message from the Fleet and Freight Management Center or on detection of an unauthorized driver, the commercial vehicle will be safely disabled.

Element Name	Physical Object	Functional Object	Functional Object Description
Commercial Vehicle	Commercial Vehicle OBE	CV On-Board Electronic Screening Support	'CV On-Board Electronic Screening Support' exchanges information with roadside facilities, providing information such as driver, vehicle, and carrier identification to roadside facilities that can be used to support electronic screening. Pass/pull-in messages are received and presented to the commercial vehicle driver and screening events are recorded. Additional information, including trip records (e.g., border clearance information), safety inspection records, cargo information, and driver status information may also be collected, stored, and made available to the roadside facility.
Commercial Vehicle	Commercial Vehicle OBE	CV On-Board Safety and Security	'CV On-Board Safety and Security' collects and processes vehicle and driver safety and security information and provides safety and security information to the Fleet and Freight Management Center. It also supplies this information to the roadside facilities both at mainline speeds and while stopped for inspections. Safety information may also be provided at predetermined trigger areas using wireless communications. The capability to alert the commercial vehicle driver whenever there is a critical safety or security problem or potential emergency is also provided. It also supports on-board driver safety log maintenance and checking.
Commercial Vehicle	Commercial Vehicle OBE	CV On-Board Trip Monitoring	'CV On-Board Trip Monitoring' provides the capabilities to support fleet management with automatic vehicle location and automated mileage and fuel reporting and auditing. In addition, this equipment is used to monitor the planned route and notify the Fleet and Freight Management Center of any deviations. Freight-specific traveler information and restrictions are also collected and reported to the driver to support the trip.
Commercial Vehicle, Private Vehicle	Vehicle OBE	Vehicle Basic Toll/Parking Payment	'Vehicle Basic Toll/Parking Payment' includes the traditional on-board systems that pay for tolls and parking electronically. It includes the 'tag' in-vehicle equipment that communicates with the toll/parking plaza and an optional interface to a carry-in payment device. See also 'Vehicle Payment Services', which provides a broader range of payment services.

Element Name	Physical Object	Functional Object	Functional Object Description
Commercial Vehicle, Private Vehicle	Vehicle OBE	Vehicle Payment Service	'Vehicle Payment Service' supports vehicle payments including VMT- and zone-based payments and payments for other services including fuel/charging services, tolls, and parking. To support VMT-based payment, this application tracks the location of the vehicle at specific times and reports this VMT data along with vehicle identification. A variety of pricing strategies are supported, including strategies that include credits or incentives that reward desired driving patterns and behavior. The onboard equipment supports secure short range communications with connected vehicle roadside equipment to support secure payments.
Contractor Equipment, TDOT Maintenance Vehicles	Maint and Constr Vehicle OBE	MCV Work Zone Support	'MCV Work Zone Support' provides communications and support for local management of a work zone. It supports communications between field personnel and the managing center to keep the center appraised of current work zone status. It controls vehicle-mounted driver information systems (e.g., dynamic message signs) and uses short range communications to monitor and control other fixed or portable driver information systems in the work zone.
County EMA, County Public Safety Dispatch, Municipal EMA, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Emergency Management Center	Emergency Data Collection	'Emergency Data Collection' collects and stores emergency information that is collected in the course of operations by the Emergency Management Center. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

Element Name	Physical Object	Functional Object	Functional Object Description
County EMA, County Public Safety Dispatch, Municipal EMA, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch	Emergency Management Center	Emergency Evacuation Support	'Emergency Evacuation Support' coordinates evacuation plans among allied agencies and manages evacuation and reentry of a population in the vicinity of a disaster or other emergency that poses a risk to public safety. Where appropriate, the affected population is evacuated in shifts, using more than one evacuation route, and including several evacuation destinations to spread demand and thereby expedite the 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. The public is provided with real-time evacuation guidance including basic information to assist potential evacuees in determining whether evacuation is necessary. 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. The evacuation and reentry status are monitored and used to refine the plan and resource allocations during the evacuation and subsequent reentry. It communicates with public health systems to develop evacuation plans and recommended strategies for disasters and evacuation scenarios involving biological or other medical hazards.
County Field Equipment, Municipal Field Equipment, TDOT Speed Monitoring Equipment	ITS Roadway Equipment	Roadway Speed Monitoring and Warning	'Roadway Speed Monitoring and Warning' includes the field elements that monitor vehicle speeds. If the speed is determined to be excessive, an advisory or warning is displayed. Current environmental conditions and other factors that may reduce safe operating speeds may also be taken into account. The operational status (state of the device, configuration, and fault data) is provided to the center. This application can also provide an enforcement function, reporting speed violations to an enforcement agency.

Element Name	Physical Object	Functional Object	Functional Object Description
County Maintenance, Municipal Maintenance	Maint and Constr Management Center	MCM Vehicle Maintenance Management	'MCM Vehicle Maintenance Management' monitors vehicle and equipment condition, tracks maintenance history, and schedules routine and corrective maintenance based on vehicle/equipment utilization and availability schedules.
County Maintenance, Municipal Maintenance, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, TDOT Region Construction Office, TDOT Region Maintenance	Maint and Constr Management Center	MCM Field Equipment Maintenance	'MCM Field Equipment Maintenance' provides overall management and support for maintenance of field equipment on a roadway system or right-of-way. Services include repair and maintenance of ITS field equipment on the roadway (e.g., electronic toll collection equipment, electronic clearance equipment, weigh-in-motion sensors, , etc.).
County Maintenance, Municipal Maintenance, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, TDOT Region Construction Office, TDOT Region Maintenance	Maint and Constr Management Center	MCM Work Activity Coordination	'MCM Work Activity Coordination' disseminates work activity schedules and current asset restrictions to other agencies. Work schedules are coordinated with operating agencies, factoring in the needs and activities of other agencies and adjacent jurisdictions. Work schedules are also distributed to Transportation Information Centers for dissemination to the traveling public.
County Maintenance, Municipal Maintenance, Other States Maintenance, TDOT Region Maintenance	Maint and Constr Management Center	MCM Environmental Information Processing	'MCM Environmental Information Processing' processes current and forecast weather data, road condition information, local environmental data, and uses internal models to develop specialized detailed forecasts of local weather and surface conditions. The processed environmental information products are presented to center personnel and disseminated to other centers.
County Maintenance, Municipal Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance	Maint and Constr Management Center	MCM Vehicle Tracking	'MCM Vehicle Tracking' tracks the location of maintenance and construction vehicles and other equipment. Vehicle/equipment location and associated information is presented to the operator.

Element Name	Physical Object	Functional Object	Functional Object Description
County Public Safety Dispatch, Municipal Public Safety Dispatch	Emergency Management Center	Emergency Routing	'Emergency Routing' supports routing of emergency vehicles and enlists support from the Traffic Management Center to facilitate travel along these routes. Routes may be determined based on real-time traffic information and road conditions or routes may be provided by the Traffic Management Center on request. Vehicles are tracked and routes are based on current vehicle location. It may coordinate with the Traffic Management Center to provide preemption or otherwise adapt the traffic control strategy along the selected route.
County Public Safety Dispatch, Municipal Public Safety Dispatch	Emergency Management Center	Emergency Secure Area Alarm Support	'Emergency Secure Area Alarm Support' receives traveler or transit vehicle operator alarm messages, notifies the system operator, and provides acknowledgement of alarm receipt back to the originator of the alarm. The alarms received can be generated by silent or audible alarm systems and may originate from public areas (e.g. transit stops, park and ride lots, transit stations, rest areas) or transit vehicles. The nature of the emergency may be determined based on the information in the alarm message as well as other inputs.
County Public Safety Dispatch, Municipal Public Safety Dispatch, Regional Amber Alert Network, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch, TN Bureau of Investigation	Emergency Management Center	Emergency Early Warning System	'Emergency Early Warning System' monitors alerting and advisory systems, information collected by ITS surveillance and sensors, and reports from other agencies and uses this information to identify potential, imminent, or in-progress major incidents or disasters. Notification is provided to initiate the emergency response, including public notification using ITS traveler information systems, where appropriate.

Element Name	Physical Object	Functional Object	Functional Object Description
County Public Safety Dispatch, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Emergency Management Center	Emergency Secure Area Sensor Management	'Emergency Secure Area Sensor Management' manages sensors that monitor secure areas in the transportation system, processes the collected data, performs threat analysis in which data is correlated with other sensor, surveillance, and advisory inputs, and then disseminates resultant threat information to emergency personnel and other agencies. In response to identified threats, the operator may request activation of barrier and safeguard systems to preclude an incident, control access during and after an incident or mitigate impact of an incident. The sensors may be in secure areas frequented by travelers (i.e., transit stops, transit stations, rest areas, park and ride lots, modal interchange facilities, on-board a transit vehicle, etc.) or around transportation infrastructure such as bridges, tunnels and transit railways or guideways. The types of sensors include acoustic, threat (e.g. chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors), infrastructure condition and integrity, motion and object sensors.
County Public Safety Dispatch, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Emergency Management Center	Emergency Secure Area Surveillance	'Emergency Secure Area Surveillance' monitors surveillance inputs from secure areas in the transportation system. The surveillance may be of secure areas frequented by travelers (i.e., transit stops, transit stations, rest areas, park and ride lots, modal interchange facilities, on-board a transit vehicle, etc.) or around transportation infrastructure such as bridges, tunnels and transit railways or guideways. It provides both video and audio surveillance information to emergency personnel and automatically alerts emergency personnel of potential incidents.
County Public Safety Dispatch, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Emergency Management Center	Emergency Environmental Monitoring	'Emergency Environmental Monitoring' collects current and forecast road conditions and surface weather information from a variety of sources. The collected environmental information is monitored and presented to the operator and used to more effectively manage incidents.

Element Name	Physical Object	Functional Object	Functional Object Description
County Public Safety Dispatch, Municipal Public Safety Dispatch, THP Dispatch	Emergency Management Center	Emergency Call-Taking	'Emergency Call-Taking' supports the emergency call-taker, collecting available information about the caller and the reported emergency, and forwarding this information to other objects that formulate and manage the emergency response. It receives 9-1-1, 7-digit local access, and motorist call-box calls and interfaces to other agencies to assist in the verification and assessment of the emergency and to forward the emergency information to the appropriate response agency.
County Public Safety Dispatch, Municipal Public Safety Dispatch, THP Dispatch	Emergency Management Center	Emergency Dispatch	'Emergency Dispatch' tracks the location and status of emergency vehicles and dispatches these vehicles to incidents. Pertinent incident information is gathered from the public and other public safety agencies and relayed to the responding units. Incident status and the status of the responding units is tracked so that additional units can be dispatched and/or unit status can be returned to available when the incident is cleared and closed.
County Public Safety Vehicles, Municipal Public Safety Vehicles	Emergency Vehicle OBE	EV On-Board Incident Management Communication	'EV On-board Incident Management Communication' provides communications support to first responders. Information about the incident, information on dispatched resources, and ancillary information such as road and weather conditions are provided to emergency personnel. Emergency personnel transmit information about the incident such as identification of vehicles and people involved, the extent of injuries, hazardous material, resources on site, site management strategies in effect, and current clearance status. Emergency personnel may also send in-vehicle signing messages to approaching traffic using short range communications.
County Public Safety Vehicles, Municipal Public Safety Vehicles, THP Vehicles	Emergency Vehicle OBE	EV On-Board En Route Support	'EV On-Board En Route Support' provides communications functions to responding emergency vehicles that reduce response times and improve safety of responding public safety personnel and the general public. It supports traffic signal preemption via short range communication directly with signal control equipment and sends alert messages to surrounding vehicles.

Element Name	Physical Object	Functional Object	Functional Object Description
County TOC, Municipal TOC	Traffic Management Center	TMC Signal Control	'TMC Signal Control' provides the capability for traffic managers to monitor and manage the traffic flow at signalized intersections. This capability includes analyzing and reducing the collected data from traffic surveillance equipment and developing and implementing control plans for signalized intersections. Control plans may be developed and implemented that coordinate signals at many intersections under the domain of a single Traffic Management Center and are responsive to traffic conditions and adapt to support incidents, preemption and priority requests, pedestrian crossing calls, etc.
County TOC, Municipal TOC	Traffic Management Center	TMC Standard Rail Crossing Management	'TMC Standard Rail Crossing Management' monitors and controls rail crossing traffic control equipment. This version provides basic support for standard active warning systems at grade crossings. It remotely monitors and reports the status of the rail crossing equipment and sends control plan updates to the equipment.
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC Advanced Rail Crossing Management	'TMC Advanced Rail Crossing Management' monitors and controls rail crossing traffic control equipment at advanced crossings that provide additional information on approaching trains, detect and report obstructions on the grade crossing, and communicate directly with equipped vehicles approaching the crossing. It remotely monitors and reports the status of the rail crossing equipment and sends control plan updates to the equipment. It also provides enhanced coordination between rail operations and traffic management centers that supports forecast of closure times and durations that may be applied to advanced traffic control strategies or delivered as enhanced traveler information.
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC Data Collection	'TMC Data Collection' collects and stores information that is created in the course of traffic operations performed by the Traffic Management Center. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

Element Name	Physical Object	Functional Object	Functional Object Description
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC Roadway Equipment Monitoring	'TMC Roadway Equipment Monitoring' monitors the operational status of field equipment and detects failures. It presents field equipment status to Traffic Operations Personnel and reports failures to the Maintenance and Construction Management Center. It tracks the repair or replacement of the failed equipment. The entire range of ITS field equipment may be monitored including sensors (traffic, infrastructure, environmental, security, speed, etc.) and devices (highway advisory radio, dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, beacons, security surveillance equipment, etc.).
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC Speed Warning	'TMC Speed Warning' supports remote control and monitoring of reduced speed zone warning roadside equipment. It provides the location and extent of the reduced speed zone, the posted speed limit(s) with information about the applicability of the speed limit(s) (e.g., time of day, day of week, seasonality, relevant vehicle types) and information about associated road configuration changes including lane merges and shifts. It monitors field equipment operation and reports current status to the operator.
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Basic Surveillance	'TMC Basic Surveillance' remotely monitors and controls traffic sensor systems and surveillance (e.g., CCTV) equipment, and collects, processes and stores the collected traffic data. Current traffic information and other real-time transportation information is also collected from other centers. The collected information is provided to traffic operations personnel and made available to other centers.

Element Name	Physical Object	Functional Object	Functional Object Description
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Evacuation Support	'TMC Evacuation Support' supports development, coordination, and execution of special traffic management strategies during evacuation and subsequent reentry of a population in the vicinity of a disaster or major emergency. A traffic management strategy is developed based on anticipated demand, the capacity of the road network including access to and from the evacuation routes, and existing and forecast conditions. The strategy supports efficient evacuation and also protects and optimizes movement of response vehicles and other resources that are responding to the emergency.
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Traffic Information Dissemination	'TMC Traffic Information Dissemination' disseminates traffic and road conditions, closure and detour information, incident information, driver advisories, and other traffic-related data to other centers, the media, and driver information systems. It monitors and controls driver information system field equipment including dynamic message signs and highway advisory radio, managing dissemination of driver information through these systems.
County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Work Zone Traffic Management	'TMC Work Zone Traffic Management' coordinates work plans with maintenance systems so that work zones are established that have minimum traffic impact. Traffic control strategies are implemented to further mitigate traffic impacts associated with work zones that are established, providing work zone information to driver information systems such as dynamic message signs.
County Traffic Signals, Municipal Traffic Signals	ITS Roadway Equipment	Roadway Field Management Station Operation	'Roadway Field Management Station Operation' supports direct communications between field management stations and the local field equipment under their control.

Element Name	Physical Object	Functional Object	Functional Object Description
County Traffic Signals, Municipal Traffic Signals	ITS Roadway Equipment	Roadway Signal Control	'Roadway Signal Control' includes the field elements that monitor and control signalized intersections. It includes the traffic signal controllers, detectors, conflict monitors, signal heads, and other ancillary equipment that supports traffic signal control. It also includes field masters, and equipment that supports communications with a central monitoring and/or control system, as applicable. The communications link supports upload and download of signal timings and other parameters and reporting of current intersection status. It represents the field equipment used in all levels of traffic signal control from basic actuated systems that operate on fixed timing plans through adaptive systems. It also supports all signalized intersection configurations, including those that accommodate pedestrians. In advanced, future implementations, environmental data may be monitored and used to support dilemma zone processing and other aspects of signal control that are sensitive to local environmental conditions.
County Traffic Signals, Municipal Traffic Signals	ITS Roadway Equipment	Roadway Signal Preemption	'Roadway Signal Preemption' includes the field elements that receive signal preemption requests from emergency vehicles approaching a signalized intersection and overrides the current operation of the traffic signals to stop conflicting traffic and grant right-of-way to the approaching vehicle.

Element Name	Physical Object	Functional Object	Functional Object Description
County Traffic Signals, Municipal Traffic Signals	ITS Roadway Equipment	Roadway Standard Rail Crossing	'Roadway Standard Rail Crossing' manages highway traffic at highway-rail intersections (HRIs) where operational requirements do not dictate advanced features (e.g., where rail operational speeds are less than 80 miles per hour). Either passive (e.g., the crossbuck sign) or active warning systems (e.g., flashing lights and gates) are supported depending on the specific requirements for each intersection. 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 through interfaces to the wayside interface equipment and the Traffic Management Center.
CVIEW, Tennessee Pre-Pass, THP Truck Weigh and Inspection Station	Commercial Vehicle Administration Center	CVAC Credentials and Taxes Administration	'CVAC Credentials and Taxes Administration' issues credentials, collects fees and taxes, and supports enforcement of credential requirements. It manages driver licensing and enrolls carriers in additional CVO programs such as wireless roadside inspection programs. It communicates with the Fleet and Freight Management Centers associated with the motor carriers to process applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations. It also receives applications for, and issues special Oversize/Overweight and HAZMAT permits in coordination with other cognizant authorities. It supports user account management and receives and processes requests for review of carrier and driver status. It communicates with peer functional objects in other jurisdictions to exchange credentials database information.

Element Name	Physical Object	Functional Object	Functional Object Description
CVIEW, Tennessee Pre-Pass, THP Truck Weigh and Inspection Station	Commercial Vehicle Administration Center	CVAC Information Exchange	'CVAC Information Exchange' supports the exchange of safety, credentials, permit data, and other data concerning the operation of commercial vehicles among jurisdictions. The object also supports the exchange of safety, credentials, permit, and operations data between systems (for example, an administrative center and the roadside check facilities) within a single jurisdiction. Data are collected from multiple authoritative sources and packaged into snapshots (top-level summary and critical status information) and profiles (detailed and historical data). Data is made available to fleet operators and other information requestors on request or based on subscriptions established by the requestor.
CVIEW, Tennessee Pre-Pass, THP Truck Weigh and Inspection Station	Commercial Vehicle Administration Center	CVAC Safety and Security Administration	'CVAC Safety and Security Administration' provides commercial vehicle safety and security criteria to roadside check facilities, collects and reviews safety and security data from the field and distributes safety and security information to other centers, carriers, and enforcement agencies. It also supports wireless roadside inspections, including carrier enrollment, managing and distributing information about trigger areas where wireless inspections may occur, and monitoring the condition of the commercial vehicle and driver using wireless communications at identified trigger areas. It supports the collection and review of carrier and driver safety and security data and supports determination of the carrier and driver safety and security ratings. It clears the out-of-service status when the responsible carrier or driver reports that deficiencies flagged during inspections have been corrected.
CVIEW, THP Truck Weigh and Inspection Station	Commercial Vehicle Administration Center	CVAC Data Collection	'CVAC Data Collection' collects and stores commercial vehicle information that is collected in the course of Commercial Vehicle Administration Center operations. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.

Element Name	Physical Object	Functional Object	Functional Object Description
Demand Response Transit Dispatch	Transit Management Center	Transit Center Fare Management	'Transit Center Fare Management' manages fare collection and passenger load management at the transit center. It provides the back office functions that support transit fare collection, supporting payment reconciliation with links to financial institutions and enforcement agencies for fare violations. It collects data required to determine accurate ridership levels, establish fares, and distribute fare information. It loads fare data into the vehicle prior to the beginning of normal operations and unloads fare collection data from the vehicle at the close out of normal operations.
Demand Response Transit Dispatch	Transit Management Center	Transit Center Information Services	'Transit Center Information Services' collects the latest available information for a transit service and makes it available to transit customers and to Transportation Information Centers for further distribution. Customers are provided information at transit stops and other public transportation areas before they embark and on-board the transit vehicle once they are enroute. Information provided can include the latest available information on transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, yellow pages, and special events. In addition to general service information, tailored information (e.g., itineraries) are provided to individual transit users.
Demand Response Transit Dispatch	Transit Management Center	Transit Center Operator Assignment	'Transit Center Operator Assignment' automates and supports the assignment of transit vehicle operators to runs. It assigns operators to runs in a fair manner while minimizing labor and overtime services, considering operator preferences and qualifications, and automatically tracking and validating the number of work hours performed by each individual operator. It also provides an exception handling process for the operator assignment function to generate supplemental operator assignments when required by changes during the operating day.

Element Name	Physical Object	Functional Object	Functional Object Description
Demand Response Transit Dispatch	Transit Management Center	Transit Center Paratransit Operations	'Transit Center Paratransit Operations' manages demand responsive transit services, including paratransit services. It supports planning and scheduling of these services, allowing paratransit and other demand response transit services to plan efficient routes and better estimate arrival times. It also supports automated dispatch of paratransit vehicles and tracks passenger pick-ups and drop-offs. Customer service operator systems are updated with the most current schedule information.
Demand Response Transit Dispatch	Transit Management Center	Transit Center Security	'Transit Center Security' monitors transit vehicle operator or traveler activated alarms received from on-board a transit vehicle. It supports transit vehicle operator authentication and provides the capability to remotely disable a transit vehicle. It also includes the capability to alert operators and police to potential incidents identified by these security features.
Demand Response Transit Dispatch	Transit Management Center	Transit Center Vehicle Tracking	'Transit Center Vehicle Tracking' monitors transit vehicle location. The location information is collected via a data communication link between the transit vehicles and the transit center. The location information is presented to the transit operator on a digitized map of the transit service area. The location data may be used to determine real time schedule adherence and update the transit system's schedule in real-time. The real-time schedule information is disseminated to other information providers, which furnish the information to travelers.

Element Name	Physical Object	Functional Object	Functional Object Description
Demand Response Transit Dispatch	Transit Management Center	Transit Evacuation Support	'Transit Evacuation Support' manages transit resources to support evacuation and subsequent reentry of a population in the vicinity of a disaster or other emergency. It supports coordination of regional evacuation plans, identifying the transit role in a regional evacuation and identifying transit resources that would be used. During an evacuation, it coordinates the use of transit and school bus fleets, supporting evacuation of those with special needs and the general population. Transit service and fare schedules are adjusted and updated service and fare information is made available through traveler information systems.
Demand Response Transit Dispatch, Private Long Distance Bus Company Operations	Transit Management Center	Transit Center Multi-Modal Coordination	'Transit Center Multi-Modal Coordination' supports transit service coordination between transit properties and coordinates with other surface and air transportation modes. As part of service coordination, it shares schedule and trip information, as well as transit transfer cluster (a collection of stop points, stations, or terminals where transfers can be made conveniently) and transfer point information between Multimodal Transportation Service Providers, Transit Agencies, and ISPs. An interface to Traffic Management also supports demand management strategies.
Demand Response Transit Dispatch, Transit Agency Archive	Transit Management Center	Transit Center Data Collection	'Transit Center Data Collection' collects and stores transit information that is collected in the course of transit operations performed by the Transit Management Center. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.
Demand Response Transit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Paratransit Operations	'Transit Vehicle On-board Paratransit Operations' forwards paratransit and flexible-route dispatch requests to the operator and forwards acknowledgements to the center. It coordinates with, and assists the operator in managing multi-stop runs associated with demand responsive transit services including paratransit. It collects transit vehicle passenger data and makes it available to the center.

Element Name	Physical Object	Functional Object	Functional Object Description
Demand Response Transit Vehicles	Transit Vehicle OBE	Transit Vehicle On-Board Trip Monitoring	'Transit Vehicle On-Board Trip Monitoring' tracks vehicle location, monitors fuel usage, collects operational status (doors opened/closed, running times, etc.) and sends the collected, time stamped data to the Transit Management Center.
Demand Response Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Schedule Management	'Transit Vehicle Schedule Management' monitors schedule performance and identifies corrective actions when a deviation is detected. It provides two-way communication between the transit vehicle and center, enabling the center to communicate with the vehicle operator and monitor on-board systems.
Demand Response Transit Vehicles	Transit Vehicle OBE	Transit Vehicle Security	'Transit Vehicle Security' provides security and safety functions on-board the transit vehicle. It includes surveillance and sensor systems that monitor the on-board environment, silent alarms that can be activated by transit user or vehicle operator, operator authentication, and a remote vehicle disable function. 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).
Demand Response Transit Vehicles, Transit Vehicle	Transit Vehicle OBE	Transit Vehicle On-Board Fare Management	'Transit Vehicle On-board Fare Management' supports fare collection using a standard fare card or other non-monetary fare medium and detects payment violations. Collected fare data are made available to the center.
Freight Equipment	Freight Equipment	Freight Equipment Monitoring	'Freight Equipment Monitoring' includes the on-board devices used to monitor intermodal freight equipment. These devices provide freight equipment location and status of the freight, container, or chassis equipment.

Element Name	Physical Object	Functional Object	Functional Object Description
Local Print and Broadcast Media	Center	Center Data Subscription Management	'Center Data Subscription Management' manages data subscriptions for an end user. It provides access to a catalog of available data, manages the necessary user information and rules that govern the data subscriptions, supports communications with data providers to collect data per the subscription rules, and makes the data available to the end user. It provides the local user interface through which a user can specify and manage subscriptions. It supports different mechanisms for collecting subscribed data for the end-user including one-time query-response as well as publish-subscribe services.
Other TDOT Region Maintenance	Maint and Constr Management Center	MCM Data Collection	'MCM Data Collection' collects and stores maintenance and construction information that is collected in the course of operations by the Maintenance and Construction Management Center. This data can be used directly by operations personnel or it can be made available to other data users and archives in the region.
Private Fleet Operations	Fleet and Freight Management Center	Fleet Administration	'Fleet Administration' provides vehicle tracking, dispatch, and reporting capabilities to fleet management personnel. It gathers current road conditions and traffic information, prepares vehicle routes, and provides a fleet interface for toll collection. It also provides route plan information for network performance evaluation. As part of the tracking function, it monitors commercial vehicle location, compares it against the known route and notifies the Emergency Management Center and Fleet-Freight Manager of any deviations, including HAZMAT route restriction violations. It supports carrier participation in wireless roadside inspection programs, monitoring geographic trigger areas and providing current safety data on behalf of the commercial vehicles it manages. It supports pre-hiring checks for potential drivers and monitors the performance of each driver who is hired. It also supports ongoing monitoring of the company's safety performance.

Element Name	Physical Object	Functional Object	Functional Object Description
Private Fleet Operations	Fleet and Freight Management Center	Fleet Credentials and Taxes Management and Reporting	'Fleet Credentials and Taxes Management and Reporting' provides the capability to purchase credentials, file taxes and trip reports electronically, apply for permits, and perform electronic enrollment in expedited border crossing programs. It tracks and manages credentials and provides electronic interfaces to appropriate state and federal commercial vehicle administration centers.
Private Fleet Operations	Fleet and Freight Management Center	Fleet Driver Authentication	'Fleet Driver Authentication' collects and stores driver identification records including driver issued PINS and/or individual driver biometric measurements. It manages the storage of driver PINs, data from a driver identification card, and/or biometric measurements for authorized drivers on individual commercial vehicles. Based on information reported by the commercial vehicle, it will determine if the driver is authorized, and notify the Commercial Vehicle Manager when an unauthorized driver is detected. The Commercial Vehicle Manager may override the disable vehicle action. When an unauthorized driver is detected and the system is not overridden, it will issue a message to the commercial vehicle to safely disable the vehicle. If an unauthorized driver is detected, it will send the Emergency Management Center an alert that includes: incident location, current location of the CV, Vehicle ID, Carrier ID, Driver ID, CV Credentials information, and cargo manifest (if known).
Private Fleet Operations	Fleet and Freight Management Center	Fleet Maintenance Management	'Fleet Maintenance Management' tracks and monitors diagnostic results, vehicle mileage, inspection records, driver logs, and repair and service records collected from a commercial vehicle fleet equipped with on-board monitoring equipment. The data is used to develop preventative maintenance and repair schedules and repair and service records are maintained.

Element Name	Physical Object	Functional Object	Functional Object Description
Private Fleet Operations	Fleet and Freight Management Center	Freight Administration and Management	'Freight Administration and Management' manages the movement of freight from source to destination. It interfaces to intermodal customers to setup and schedule transportation and coordinates with intermodal terminals and freight consolidation stations to coordinate the shipment. It coordinates with the appropriate government agencies to expedite the movement of trucks, their drivers, and their cargo across international borders. The application monitors the status of the freight and freight equipment (container, trailer, or chassis) and monitors freight location and compares it against the planned route.
Private Sector Traveler Information Services, Regional Websites, TDOT Public Information Office, TDOT SmartWay, Transit Website	Transportation Information Center	TIC Data Collection	'TIC Data Collection' collects transportation-related data from other centers, performs data quality checks on the collected data and then consolidates, verifies, and refines the data and makes it available in a consistent format to applications that support operational data sharing between centers and deliver traveler information to end-users. A broad range of data is collected including traffic and road conditions, transit data, emergency information and advisories, weather data, special event information, traveler services, parking, multimodal data, and toll/pricing data. It also shares data with other transportation information centers.

Element Name	Physical Object	Functional Object	Functional Object Description
Private Sector Traveler Information Services, Transit Website	Transportation Information Center	TIC Trip Planning	'TIC Trip Planning' provides pre-trip and en-route trip planning services for travelers. It receives origin, destination, constraints, and preferences and returns trip plan(s) that meet the supplied criteria. Trip plans may be based on current traffic and road conditions, transit schedule information, and other real-time traveler information. Candidate trip plans are multimodal and may include vehicle, transit, and alternate mode segments (e.g., rail, ferry, bicycle routes, and walkways) based on traveler preferences. It also confirms the trip plan for the traveler and supports reservations and advanced payment for portions of the trip. The trip plan includes specific routing information and instructions for each segment of the trip and may also include information and reservations for additional services (e.g., parking) along the route.
Private Traveler Personal Computing Devices	Personal Information Device	Personal Interactive Traveler Information	'Personal Interactive Traveler Information' provides traffic information, road conditions, transit information, yellow pages (traveler services) information, special event information, and other traveler information that is specifically tailored based on the traveler's request and/or previously submitted traveler profile information. It also supports interactive services that support enrollment, account management, and payments for transportation services. The interactive traveler information capability is provided by personal devices including personal computers and personal portable devices such as smart phones.

Element Name	Physical Object	Functional Object	Functional Object Description
Regional Toll Authority	Payment Administration Center	PAC Payment Administration	'PAC Payment Administration' provides administration and management of payments associated with electronic toll collection, parking payments, and other e-payments. It provides the back office functions that support enrollment, pricing, payment reconciliation with financial institutions, and violation notification to enforcement agencies. It also supports dynamic pricing to support demand management. Secure communications with the financial infrastructure and distributed payment infrastructure, including toll plazas, support electronic payments and other ancillary requirements such as lost payment device identification and management.
Regional Toll Authority Toll Plazas	ITS Roadway Payment Equipment	Roadway Toll Collection Support	'Roadway Toll Collection Support' provides toll plazas the capability to identify properly equipped vehicles, collect electronic tolls, and provide a positive indication to the driver that a toll was collected. Violators are identified and images are collected. Toll transactions are stored and reported to the Payment Administration Center.
Regional Websites, TDOT SmartWay	Transportation Information Center	TIC Emergency Traveler Information	'TIC Emergency Traveler Information' provides emergency information to the public, including wide-area alerts and evacuation information. It provides emergency alerts, information on evacuation zones and evacuation requirements, evacuation destinations and shelter information, available transportation modes, and traffic and road conditions at the origin, destination, and along the evacuation routes. In addition to general evacuation information, personalized information including tailored evacuation routes, service information, and estimated travel times is also provided based on traveler specified origin, destination, and route parameters. Updated information is provided throughout the evacuation and subsequent reentry as status changes and plans are adapted.

Element Name	Physical Object	Functional Object	Functional Object Description
Regional Websites, TDOT SmartWay	Transportation Information Center	TIC Traveler Telephone Information	'TIC Traveler Telephone Information' services voice-based traveler requests for information that supports traveler telephone information systems like 511. It takes requests for traveler information, which could be voice-formatted traveler requests, dual-tone multi-frequency (DTMF)-based requests, or a simple traveler information request, and returns the requested traveler information in the proper format. In addition to servicing requests for traveler information, it also collects and forwards alerts and advisories to traveler telephone information systems.
TDOT Active Lane Management Systems	ITS Roadway Equipment	Roadway Dynamic Lane Management and Shoulder Use	'Roadway Dynamic Lane Management and Shoulder Use' 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 centrally controlled by a Traffic Management Center or it can be autonomous and monitor traffic conditions and demand along the roadway and determine how to change the lane controls to respond to current conditions. Lane controls can be used to change the lane configuration of the roadway, reconfigure intersections and/or interchanges, allow use of shoulders as temporary travel lanes, designate lanes for use by special vehicles only, such as buses, high occupancy vehicles (HOVs), vehicles attending a special event, etc. and/or prohibit or restrict types of vehicles from using particular lanes. Guidance and information for drivers can be posted on dynamic message signs.
TDOT Active Lane Management Systems	ITS Roadway Equipment	Roadway Reversible Lanes	'Roadway Reversible Lanes' includes field elements that monitor and control reversible lane facilities. It includes the traffic sensors, surveillance equipment, lane control signals, physical lane access controls, and other field elements that manage traffic on these facilities. It provides current reversible lane facility status information and accepts requests and control commands from the controlling center.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Active Lane Management Systems	ITS Roadway Equipment	Roadway Variable Speed Limits	'Roadway Variable Speed Limits' includes the field equipment, physical overhead lane signs and associated control electronics that are used to manage and control variable speed limits systems. This equipment monitors traffic and environmental conditions along the roadway. The system can be centrally monitored and controlled by a Traffic Management Center or it can be autonomous, calculating and setting suitable speed limits, usually by lane. This application displays the speed limits and additional information such as basic safety rules and current traffic information to drivers.
TDOT Anti-icing Equipment	ITS Roadway Equipment	Roadway Automated Treatment	'Roadway Automated Treatment' automatically treats a roadway section based on environmental or atmospheric conditions or under center control. Treatments include fog dispersion, anti-icing chemicals, etc. It communicates with the center and environmental sensors to support system activation and optionally with sign(s) that warn the driver in adverse conditions when the system is activated.
TDOT Anti-icing Equipment, TDOT RWIS Sensors, USGS Field Equipment	ITS Roadway Equipment	Roadway Environmental Monitoring	'Roadway Environmental Monitoring' measures environmental conditions and communicates the collected information back to a center where it can be monitored and analyzed or to other field devices to support communications to vehicles. A broad array of general weather and road surface information may be collected. Weather conditions that may be measured include temperature, wind, humidity, precipitation, and visibility. Surface and sub-surface sensors can measure road surface temperature, moisture, icing, salinity, and other measures.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Data Warehouse, TDOT Strategic Transportation Investments Division, Transit Agency Archive	Archived Data System	Archive Data Repository	'Archive Data Repository' collects data and data catalogs from one or more data sources and stores the data in a focused repository that is suited to a particular set of ITS data users. It includes capabilities for performing quality checks on the incoming data, error notification, and archive to archive coordination. It supports a broad range of implementations, ranging from simple data marts that collect a focused set of data and serve a particular user community to large-scale data warehouses that collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a region. Repositories may be established to support operations planning, performance monitoring and management, and policy and investment decisions.
TDOT Data Warehouse, TDOT Strategic Transportation Investments Division, Transit Agency Archive	Archived Data System	Archive Situation Data Archival	'Archive Situation Data Archival' collects and archives traffic, roadway, and environmental information for use in off-line planning, research, and analysis. It controls and collects information directly from equipment at the roadside, reflecting the deployment of traffic detectors that are used primarily for traffic monitoring and planning purposes, rather than for traffic management. It also collects situation data from connected vehicles. The data collected, quality checks performed, and aggregation strategies are defined to support transportation system performance monitoring and management.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Automated Vehicle Operations	'RSE Automated Vehicle Operations' includes the field elements that monitor and control access to and egress from automated lanes. It monitors and coordinates automated vehicle operations within the lanes. These lanes support vehicles operating in platoons with short headways.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Data Subscription Management	'RSE Data Subscription Management' manages data subscriptions for an RSE. It provides access to a catalog of available data, manages the necessary identification information and rules that govern the data subscriptions, supports communications with data providers to collect data per the subscription rules, and makes the data available to other RSE applications. It supports different mechanisms for collecting data including one-time query-response as well as publish-subscribe services.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Infrastructure Monitoring	'RSE Infrastructure Monitoring' collects environmental situation (probe) data from passing vehicles that are equipped with short range communications capability with particular focus on measures that may indicate infrastructure condition. The collected data includes current environmental conditions as measured by on-board sensors (e.g., ambient temperature and precipitation measures) and current status of vehicle systems that can be used to infer infrastructure condition (e.g., status of ABS, traction control systems, vertical acceleration measures) as reported by the vehicle. This functional object also supports short range communications with maintenance and construction vehicles, providing local control and monitoring of infrastructure sensors.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Intersection Management	'RSE Intersection Management' uses short range communications to support connected vehicle applications that manage signalized intersections. It communicates with approaching vehicles and ITS infrastructure (e.g., the traffic signal controller) to enhance traffic signal operations. Coordination with the ITS infrastructure also supports conflict monitoring to ensure the RSE output and traffic signal control output are consistent and degrade in a fail safe manner.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Intersection Safety	'RSE Intersection Safety' uses short range communications to support connected vehicle applications that improve intersection safety. It communicates with approaching vehicles and ITS infrastructure to alert and warn drivers of potential stop sign, red light, and non-motorized user crossing conflicts or violations.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Queue Warning	'RSE Queue Warning' provides V2I communications to support queue warning systems. It monitors connected vehicles to identify and monitor queues in real-time and provides information to vehicles about upcoming queues, including downstream queues that are reported by the Traffic Management Center.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Rail Crossing Warning	'RSE Rail Crossing Warning' is a connected vehicle application that improves safety at rail crossings. It communicates with wayside equipment that detects or communicates with approaching trains. It provides rail crossing warnings and train arrival information to approaching vehicles and monitors connected vehicles that may intrude on the crossing.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Restricted Lanes Application	The 'RSE Restricted Lanes Application' uses short range communications to monitor and manage dynamic and static restricted lanes. It collects vehicle profile information from vehicles entering the lanes and monitors vehicles within the lanes, providing aggregate data to the back office center. It provides lane restriction information and signage data to the vehicles and optionally identifies vehicles that violate the current lane restrictions. These functions are performed based on operating parameters provided by the back office managing center(s).
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Road Closure Management	'RSE Road Closure Management' communicates with qualified Connected Vehicles and barrier control systems to support local road closure management. It validates and requests implementation of road closure requests. During a closure, it can also support selective access to the closed area, only granting entry permission to allowed vehicles.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Situation Monitoring	'RSE Situation Monitoring' is a general functional object that supports collection of traffic, environmental, and emissions data from passing vehicles. The data is collected, filtered, and forwarded based on parameters provided by the back office. Parameters are provided to passing vehicles that are equipped to collect and send situation data to the infrastructure in snapshots. In addition, this object collects current status information from local field devices including intersection status, sensor data, and signage data, providing complete, configurable monitoring of the situation for the local transportation system in the vicinity of the RSE.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Speed Management	'RSE Speed Management' provides infrastructure information including road grade, roadway geometry, road weather information, and current speed limits to assist vehicles in maintaining safe speeds and headways. It also provides speed recommendations to vehicles based on current conditions and overall speed limits and strategies established by the back office.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Speed Warning	'RSE Speed Warning' notifies connected vehicles that are approaching a reduced speed zone, providing: (1) the zone's current posted speed limit and (2) any roadway configuration changes associated with the reduced speed zone (e.g., lane closures, lane shifts) if applicable, and (3) associated warning information (i.e., the reason for the reduced speed warning). Configuration parameters that define the applicable speed limit(s), geographic location and extent of the reduced speed zone, and roadway configuration information are received from a center or provided through a local interface. The characteristics of individual vehicles may also be monitored and used to warn vehicles with specific limitations that reduce safe operating speeds, (e.g., rollover risk for tall vehicles). This functional object works in conjunction with the 'Roadway Speed Monitoring and Warning' functional object, which uses traditional ITS field equipment to warn non-equipped vehicles.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Support Services	'RSE Support Services' provides foundational functions that supports data collection, management, and distribution. It coordinates with Object Registration and Discovery to maintain its registration with respect to location/geographic scope and credentialing information. It maintains the necessary security credentials, authorizations, and associated keys to support communications in the connected vehicle environment. It maintains precise location and time information to support other services.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Traffic Gap Assist	'RSE Traffic Gap Assist' provides advisory information to minor road drivers at a stop-sign controlled intersection to facilitate gap selection to proceed through the intersection. The application can be configured depending on the intersection geometry. It monitors Connected Vehicle traffic on the major road, augmenting infrastructure traffic detectors, to identify and measure traffic gaps. The intersection geometry, measured traffic gaps, and current gap assist sign displays are communicated to the connected vehicle that is navigating the intersection for use in driver advisories and warnings. The application may also collect vehicle size and performance profile from the connected vehicle to optimize the alerts and warnings to the capabilities of the vehicle and driver preferences.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Traffic Metering	'RSE Traffic Metering' uses V2I communications to support ramp metering and other traffic metering applications. Data is collected from connected vehicles on both the mainline and approach to the traffic meters. The collected data is processed and filtered and provided to the metering controller. Status and current signal indications from the ramp meter are also collected and provided to approaching and queued connected vehicles.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Traffic Monitoring	'RSE Traffic Monitoring' monitors the basic safety messages that are shared between connected vehicles and distills this data into traffic flow measures that can be used to manage the network in combination with or in lieu of traffic data collected by infrastructure-based sensors. As connected vehicle penetration rates increase, the measures provided by this application can expand beyond vehicle speeds that are directly reported by vehicles to include estimated volume, occupancy, and other measures. This object also supports incident detection by monitoring for changes in speed and vehicle control events that indicate a potential incident.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Transit User Guidance	'RSE Transit User Guidance' uses short range communications to provide terminal or stop-specific guidance to transit user devices that assists users in finding the right stop and the right bus. Optionally, this object can collect the transit user location and planned itinerary so that tailored guidance can be provided.
TDOT DSRC	Connected Vehicle Roadside Equipment	RSE Trust Management	'RSE Trust Management' manages the certificates and associated keys that are used to sign, encrypt, decrypt, and authenticate messages. It communicates with the Security and Credentials Management System to maintain a current, valid set of security certificates and keys and identifies, logs, and reports events that may indicate a threat to Connected Vehicle Environment security.
TDOT DSRC, TDOT Active Lane Management Systems	ITS Roadway Equipment	Roadway Traffic Gap Assist	'Roadway Traffic Gap Assist' measures the headway to the next approaching vehicle. Based on programmed thresholds, unsafe gaps are identified and reported via roadside signs. Traffic gaps and associated advisories and warnings are also provided to the RSE for communication to connected vehicles.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT DSRC, TDOT Communications Network	ITS Roadway Equipment	Roadway Communications Support	'Roadway Communications Support' supports secure, reliable communications with other connected devices. It provides the communications functions that add a timestamp, the message origin, and a digital signature in outbound messages and processes, verifies, and authenticates the same fields in inbound messages. It also encrypts (outbound) and decrypts (inbound) sensitive data.
TDOT DSRC, TDOT Field Sensors, TDOT CCTV, TDOT Probe Data Collector	ITS Roadway Equipment	Roadway Incident Detection	'Roadway Incident Detection' provides incident detection using traffic detectors and surveillance equipment. It monitors for unusual traffic conditions that may indicate an incident or processes surveillance images, watching for potential incidents. It provides potential incident information as well as traffic flow and images to the center for processing and presentation to traffic operations personnel.
TDOT DSRC, TDOT Field Sensors, TDOT HAR, County Field Equipment, Municipal Field Equipment, TDOT Anti-icing Equipment, TDOT CCTV, TDOT Closure Equipment, TDOT DMS, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment	ITS Roadway Equipment	Roadway Traffic Information Dissemination	'Roadway Traffic Information Dissemination' includes field elements that provide information to drivers, including dynamic message signs and highway advisory radios.
TDOT DSRC, TDOT Probe Data Collector	ITS Roadway Equipment	Roadway Data Collection	'Roadway Data Collection' collects traffic, road, and environmental conditions information for use in transportation planning, research, and other off-line applications where data quality and completeness take precedence over real-time performance. It includes the sensors, supporting roadside infrastructure, and communications equipment that collects and transfers information to a center for archival.
TDOT DSRC, TDOT Ramp Meters	ITS Roadway Equipment	Roadway Traffic Metering	'Roadway Traffic Metering' includes the field equipment used to meter traffic on ramps, through interchanges, and on the mainline roadway. The equipment includes dynamic messages signs to provide guidance and information to drivers at and approaching a meter, including information for any special bypass lanes.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT DSRC, TDOT Smart Work Zone Equipment	Connected Vehicle Roadside Equipment	RSE Traveler Information Communications	'RSE Traveler Information Communications' includes field elements that distribute information to vehicles for in-vehicle display. The information may be provided by a center (e.g., variable information on traffic and road conditions in the vicinity of the field equipment) or it may be determined and output locally (e.g., static sign information and signal phase and timing information). This includes the interface to the center or field equipment that controls the information distribution and the short range communications equipment that provides information to passing vehicles.
TDOT DSRC, TDOT Smart Work Zone Equipment	Connected Vehicle Roadside Equipment	RSE Work Zone Safety	'RSE Work Zone Safety' communicates with Connected Vehicles and Personal Information Devices carried or worn by the work crew to detect vehicle intrusions in work zones and warn crew workers and drivers of imminent encroachment. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone.
TDOT Emergency Services Coordinator, County Maintenance, Municipal Maintenance, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, TDOT Region Construction Office, TDOT Region Maintenance	Maint and Constr Management Center	MCM Roadway Maintenance	'MCM Roadway Maintenance' provides overall management and support for routine maintenance on a roadway system or right-of-way. Services managed include landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of non-ITS equipment on the roadway (e.g., signs, gantries, cabinets, guard rails, etc.). Environmental conditions information is also received from various weather sources to aid in scheduling routine maintenance activities. See also MCM Field Equipment Maintenance for maintenance of ITS field equipment.
TDOT Emergency Services Coordinator, County Maintenance, Municipal Maintenance, TDOT Region Maintenance	Maint and Constr Management Center	MCM Incident Management	'MCM Incident Management' supports maintenance and construction participation in coordinated incident response. Incident notifications are shared, incident response resources are managed, and the overall incident situation and incident response status is coordinated among allied response organizations.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Emergency Services Coordinator, TDOT HELP Dispatch, County EMA, County Public Safety Dispatch, Municipal EMA, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch	Emergency Management Center	Emergency Commercial Vehicle Response	'Emergency Commercial Vehicle Response' identifies and initiates a response to commercial vehicle and freight equipment related emergencies. These emergencies may include incidents involving hazardous materials as well as the detection of non-permitted transport of security sensitive hazmat. It identifies the location of the vehicle, the nature of the incident, the route information, and information concerning the freight itself. The information supports the determination of the response and identifies the responding agencies to notify.
TDOT Emergency Services Coordinator, TDOT HELP Dispatch, County EMA, County Public Safety Dispatch, Municipal EMA, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch	Emergency Management Center	Emergency Incident Command	'Emergency Incident Command' provides 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. It supports communications with public safety, emergency management, transportation, and other allied response agency centers, tracks and maintains resource information, action plans, and the incident command organization itself. Information is shared with agency centers including resource deployment status, hazardous material information, traffic, road, and weather conditions, evacuation advice, and other information that enables emergency or maintenance personnel in the field to implement an effective, safe incident response. It supports the functions and interfaces commonly supported by a mobile command center.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Emergency Services Coordinator, TDOT HELP Dispatch, County EMA, County Public Safety Dispatch, Municipal EMA, Municipal Public Safety Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, TEMA, THP Dispatch	Emergency Management Center	Emergency Response Management	'Emergency Response Management' provides the strategic emergency response capabilities and broad inter-agency interfaces that are implemented for extraordinary incidents and disasters that require response from outside the local community. It provides the functional capabilities and interfaces commonly associated with Emergency Operations Centers. It develops and stores emergency response plans and manages overall coordinated response to emergencies. It monitors real-time information on the state of the regional transportation system including current traffic and road conditions, weather conditions, special event and incident information. It tracks the availability of resources and assists in the appropriate allocation of these resources for a particular emergency response. It also provides coordination between multiple allied agencies before and during emergencies to implement emergency response plans and track progress through the incident. It also coordinates with the public through the Emergency Telecommunication Systems (e.g., Reverse 911). It coordinates with public health systems to provide the most appropriate response for emergencies involving biological or other medical hazards.
TDOT Field Sensors, County Traffic Signals, Municipal Traffic Signals, TDOT CCTV, TDOT Closure Equipment, TDOT Probe Data Collector	ITS Roadway Equipment	Roadway Basic Surveillance	'Roadway Basic Surveillance' monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Field Sensors, TDOT CCTV	ITS Roadway Equipment	Roadway Passive Monitoring	'Roadway Passive Monitoring' monitors passing vehicles for a signature that can be used to recognize the same vehicle at different points in the network and measure travel times. Depending on the implementation and the penetration rate of the technology that is monitored, other point traffic measures may also be inferred by monitoring the number of vehicles within range over time. Today this approach is implemented most commonly using a Bluetooth receiver that passively monitors Bluetooth devices on-board passing vehicles and license plate readers that record the vehicle license plate number, but any widely deployed vehicle communications technology or feature that can be passively monitored to uniquely identify a vehicle could be used.
TDOT Field Sensors, TDOT CCTV, TDOT Closure Equipment	ITS Roadway Equipment	Roadway Barrier System Control	'Roadway Barrier System Control' includes the field equipment that controls barrier systems used to control access to transportation facilities and infrastructure. Barrier systems include automatic or remotely controlled gates, barriers and other access control systems.
TDOT Field Sensors, TDOT HAR, County Field Equipment, TDOT CCTV, TDOT Closure Equipment, TDOT Smart Work Zone Equipment, TDOT Speed Monitoring Equipment	ITS Roadway Equipment	Roadway Work Zone Traffic Control	'Roadway Work Zone Traffic Control' controls traffic in areas of the roadway where maintenance and construction activities are underway, monitoring and controlling traffic using field equipment such as CCTV cameras, dynamic messages signs, and gates/barriers. Work zone speeds and delays are provided to the motorist prior to the work zones.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT HELP Dispatch, County TOC, Municipal TOC, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Incident Dispatch Coordination	'TMC Incident Dispatch Coordination' formulates and manages an incident response that takes into account the incident potential, incident impacts, and resources required for incident management. It provides information to support dispatch and routing of emergency response and service vehicles as well as coordination with other cooperating agencies. It provides access to traffic management resources that provide surveillance of the incident, traffic control in the surrounding area, and support for the incident response. It monitors the incident response and collects performance measures such as incident response and clearance times.
TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC Service Patrol Management	'TMC Service Patrol Management' supports dispatch and communication with service patrol vehicles that monitor roads to aid motorists, offering rapid response to minor incidents.
TDOT HELP Dispatch, TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Incident Detection	'TMC Incident Detection' identifies and reports incidents to Traffic Operations Personnel. It remotely monitors and controls traffic sensor and surveillance systems that support incident detection and verification. It analyzes and reduces the collected sensor and surveillance data, external alerting and advisory and incident reporting systems, anticipated demand information from intermodal freight depots, border crossings, special event information, and identifies and reports incidents and hazardous conditions
TDOT HELP Vehicles	Emergency Vehicle OBE	EV Service Patrol Vehicle Operations	'EV Service Patrol Vehicle Operations' provides on-board processing and communications to service patrol vehicles that reduce response times and improve safety of responding personnel. It supports service patrol vehicle dispatch and provides incident information back to the dispatching center.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Maintenance Headquarters, County Maintenance, Municipal Maintenance, Other States Maintenance, Other TDOT Region Construction Offices, Other TDOT Region Maintenance, TDOT Region Construction Office, TDOT Region Maintenance	Maint and Constr Management Center	MCM Maintenance Decision Support	'MCM Maintenance Decision Support' recommends maintenance courses of action based on current and forecast environmental and road conditions and additional application specific information. Decisions are supported through understandable presentation of filtered and fused environmental and road condition information for specific time horizons as well as specific maintenance recommendations that are generated by the system based on this integrated information. The recommended courses of action are supported by information on the anticipated consequences of action or inaction, when available.
TDOT Maintenance Headquarters, County Maintenance, Municipal Maintenance, TDOT Region Maintenance	Maint and Constr Management Center	MCM Winter Maintenance Management	'MCM Winter Maintenance Management' manages winter road maintenance, tracking and controlling snow plow operations, roadway treatment (e.g., salt spraying and other material applications), and other snow and ice control operations. It monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities, determine the appropriate snow and ice control response, and track and manage response operations.
TDOT Maintenance Headquarters, County Maintenance, Municipal Maintenance, TDOT Region Maintenance, USGS Flood Monitoring System	Maint and Constr Management Center	MCM Environmental Information Collection	'MCM Environmental Information Collection' collects current road and weather conditions using data collected from environmental sensors deployed on and about the roadway. In addition to fixed sensor stations at the roadside, this functional object also collects environmental information from sensor systems located on Maintenance and Construction Vehicles. It also collects current and forecast environmental conditions information that is made available by other systems. The functional object aggregates the sensor system data and provides it, along with data attributes to other applications.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Maintenance Vehicles	Maint and Constr Vehicle OBE	MCV Environmental Monitoring	'MCV Environmental Monitoring' collects current road and surface weather conditions from sensors on-board the maintenance and construction vehicle or by querying fixed sensors on or near the roadway. Environmental information including road surface temperature, air temperature, and wind speed is measured and spatially located and time stamped, and reported back to a center.
TDOT Maintenance Vehicles	Maint and Constr Vehicle OBE	MCV Vehicle Location Tracking	'MCV Vehicle Location Tracking' monitors vehicle location and reports the position and timestamp information to the dispatch center.
TDOT Maintenance Vehicles	Maint and Constr Vehicle OBE	MCV Vehicle System Monitoring and Diagnostics	'MCV Vehicle System Monitoring and Diagnostics' includes on-board sensors capable of monitoring the condition of each of the vehicle systems and diagnostics that can be used to support vehicle maintenance. The status of the vehicle and ancillary equipment and diagnostic information is provided to the vehicle operator, repair facility, and dispatch center.
TDOT Maintenance Vehicles	Maint and Constr Vehicle OBE	MCV Winter Maintenance	'MCV Winter Maintenance' supports snow plow operations and other roadway treatments (e.g., salt spraying and other material applications). It supports communications with the center to receive information and instructions that are provided to the vehicle operator and also supports remote control of on-board systems. It tracks operational status of snow and ice control operations and provides this information back to the center.
TDOT Maintenance Vehicles, Contractor Equipment	Maint and Constr Vehicle OBE	MCV Roadway Maintenance and Construction	'MCV Roadway Maintenance and Construction' includes the on-board systems that support routine non-winter maintenance on a roadway system or right-of-way. Routine maintenance includes landscape maintenance, hazard removal (roadway debris, dead animals), routine maintenance activities (roadway cleaning, grass cutting), and repair and maintenance of both ITS and non-ITS equipment on the roadway (e.g., signs, traffic controllers, traffic detectors, dynamic message signs, traffic signals, etc.).

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Maintenance Vehicles, Contractor Equipment	Maint and Constr Vehicle OBE	MCV Vehicle Safety Monitoring	'MCV Vehicle Safety Monitoring' detects vehicle intrusions in the vicinity of the vehicle and warns crew workers and drivers of imminent encroachment. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone. It can be used for stationary work zones or in mobile applications where a safe zone is maintained around the moving vehicle.
TDOT Power Network	Service Monitor System	SM Device Management	'SM Device Management' provides the functions necessary to manage devices, including network management, operational status monitoring, and application performance monitoring.
TDOT Power Network, Wayside Detection Equipment	Field	Field System Executive	'Field System Executive' includes the operating system kernel and executive functions that manage the overall device software configuration and operation and support configuration management, computer resource management, and govern software installation and upgrade.
TDOT Power Network, Wayside Detection Equipment	Field	Field System Monitoring and Diagnostics	'Field System System Monitoring and Diagnostics' includes background self-tests, diagnostics, watch dog timers, and other hardware and software that monitors the operating condition of field equipment. The status of the equipment and diagnostic information is provided to local maintenance personnel and the operating center.
TDOT Public Information Office	Transportation Information Center	TIC Connected Vehicle Traveler Info Distribution	In support of connected vehicle applications, 'TIC Connected Vehicle Traveler Info Distribution' disseminates traveler information including traffic and road conditions, incident information, maintenance and construction information, event information, transit information, parking information, and weather information. Location-specific or situation-relevant traveler information is sent to short range communications transceivers at the roadside.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Public Information Office, TDOT SmartWay	Transportation Information Center	TIC Traveler Information Broadcast	'TIC Traveler Information Broadcast' disseminates traveler information including traffic and road conditions, incident information, maintenance and construction information, event information, transit information, parking information, and weather information. The same information is broadcast to all equipped traveler interface systems and vehicles.
TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC In-Vehicle Signing Management	'TMC In-Vehicle Signing Management' controls and monitors RSEs that support in-vehicle signing. Sign information that may include static regulatory, service, and directional sign information as well as variable information such as traffic and road conditions can be provided to the RSE, which uses short range communications to send the information to in-vehicle equipment. Information that is currently being communicated to passing vehicles and the operational status of the field equipment is monitored by this application. The operational status of the field equipment is reported to operations personnel.
TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC Passive Surveillance	'TMC Passive Surveillance' collects time stamped vehicle identities from different detection zones, correlates the identities, and calculates link travel times and derives other traffic measures.
TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis	Traffic Management Center	TMC Safeguard System Management	'TMC Safeguard System Management' remotely monitors and controls safeguard systems for transportation facilities and infrastructure. Safeguard systems include blast shielding, exhaust systems and other automatic or remotely controlled systems intended to mitigate the impact of an incident. When access to a transportation facility is impacted by the activation of a safeguard system, impacted systems and travelers are notified.
TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Barrier System Management	'TMC Barrier System Management' remotely monitors and controls barrier systems for transportation facilities and infrastructure under control of center personnel. Barrier systems include automatic or remotely controlled gates, barriers and other access control systems. It also provides an interface to other centers to allow monitoring and control of the barriers from other centers (e.g., public safety or emergency operations centers).

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Region 1 TMC - Knoxville, TDOT Region 2 TMC - Chattanooga, TDOT Region 3 TMC - Nashville, TDOT Region 4 TMC - Memphis, THP Dispatch	Traffic Management Center	TMC Environmental Monitoring	'TMC Environmental Monitoring' assimilates current and forecast road conditions and surface weather information using a combination of weather service provider information, information collected by other centers such as the Maintenance and Construction Management Center, data collected from environmental sensors deployed on and about the roadway, and information collected from connected vehicles. The collected environmental information is monitored and presented to the operator. This information can be used to issue general traveler advisories and support location specific warnings to drivers.
TDOT Region Construction Office	Maint and Constr Management Center	MCM Work Zone Management	'MCM Work Zone Management' remotely monitors and supports work zone activities, controlling traffic through dynamic message signs (DMS), Highway Advisory Radio (HAR), gates and barriers, and informing other groups of activity (e.g., traveler information, traffic management, other maintenance and construction centers) for better coordination management. Work zone speeds, and delays, and closures are provided to the motorist prior to the work zones. This application provides control of field equipment in all maintenance areas, including fixed and portable field equipment supporting both stationary and mobile work zones.
TDOT Region Construction Office	Maint and Constr Management Center	MCM Work Zone Safety Management	'MCM Work Zone Safety Management' remotely monitors work zone safety systems that detect vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Region Maintenance	Maint and Constr Management Center	MCM Automated Treatment System Control	'MCM Automated Treatment System Control' remotely monitors and controls automated road treatment systems that disperse anti-icing chemicals or otherwise treat a road segment. The automated treatment system may be remotely activated by this object or it may include environmental sensors that activate the system automatically based on sensed environmental conditions. This object monitors treatment system operation, sets operating parameters, and directly controls system activation if necessary.
TDOT Security Monitoring Field Equipment	Security Monitoring Equipment	Field Secure Area Sensor Monitoring	'Field Secure Area Sensor Monitoring' includes sensors that monitor conditions of secure areas including facilities (e.g. transit yards), transportation infrastructure (e.g. Bridges, tunnels, interchanges, and transit railways or guideways), and public areas (e.g., transit stops, transit stations, rest areas, park and ride lots, modal interchange facilities). A range of acoustic, environmental threat (e.g. Chemical agent, toxic industrial chemical, biological, explosives, and radiological sensors), infrastructure condition and integrity and motion and object sensors are included.
TDOT Security Monitoring Field Equipment	Security Monitoring Equipment	Field Secure Area Surveillance	'Field Secure Area Surveillance' includes video and audio surveillance equipment that monitors conditions of secure areas including facilities (e.g. transit yards), transportation infrastructure (e.g. as bridges, tunnels, interchanges, and transit railways or guideways), and public areas (e.g., transit stops, transit stations, rest areas, park and ride lots, modal interchange facilities). It provides the surveillance information to the Emergency Management Center for possible threat detection. It also provides local processing of the video or audio information, providing processed or analyzed results to the Emergency Management Center.

Element Name	Physical Object	Functional Object	Functional Object Description
TDOT Smart Work Zone Equipment	ITS Roadway Equipment	Roadway Field Device Support	'Roadway Field Device Support' monitors the operational status of field devices and detects and reports fault conditions. Consolidated operational status (device status, configuration, and fault information) are reported for resolution and repair. A local interface is provided to field personnel for local monitoring and diagnostics, supporting field maintenance, upgrade, repair, and replacement of field devices.
TDOT Smart Work Zone Equipment	ITS Roadway Equipment	Roadway Work Zone Safety	'Roadway Work Zone Safety' includes field elements that detect vehicle intrusions in work zones and warns crew workers and drivers of imminent encroachment. Crew movements are also monitored so that the crew can be warned of movement beyond the designated safe zone.
TDOT SmartWay, Transit Website	Transportation Information Center	TIC Interactive Traveler Information	'TIC Interactive Traveler Information' disseminates personalized traveler information including traffic and road conditions, transit information, parking information, maintenance and construction information, multimodal information, event information, and weather information. Tailored information is provided based on the traveler's request in this interactive service.
THP Truck Weigh and Inspection Station, THP Weigh-in-Motion, Violation Detection	Commercial Vehicle Check Equipment	CVCE Citation and Accident Electronic Recording	'CVCE Citation and Accident Electronic Recording' documents accidents, citations, and violations identified during roadside safety inspections and forwards the information to the Commercial Vehicle Administration Center for processing. It collects data from the vehicle to help characterize the circumstances surrounding the accident.
THP Truck Weigh and Inspection Station, THP Weigh-in-Motion, Violation Detection	Commercial Vehicle Check Equipment	CVCE Electronic Screening	'CVCE Electronic Screening' supports electronic credentials and safety screening of commercial vehicles at mainline speeds. It processes the data from the commercial vehicles along with accessed database information to determine whether a pull-in message is needed. It may also generate random pull-in messages with provisions for facility operators and enforcement officials to have manual override capabilities.

Element Name	Physical Object	Functional Object	Functional Object Description
THP Truck Weigh and Inspection Station, THP Weigh-in-Motion, Violation Detection	Commercial Vehicle Check Equipment	CVCE Safety and Security Inspection	'CVCE Safety and Security Inspection' supports the roadside safety inspection process, including wireless roadside inspections that are conducted remotely. It reads on-board safety data at mainline speeds to rapidly check the vehicle and driver and accesses historical safety data after identifying vehicles at mainline speeds or while stopped at the roadside. The capabilities to process safety data and issue pull-in messages or provide warnings to the driver, carrier, and enforcement agencies are also provided. It includes hand held or automatic devices to rapidly inspect the vehicle and driver. Results of screening and summary safety inspection data are stored and maintained. Since a vehicle may cross jurisdictional boundaries during a trip, it supports the concept of a last clearance event record carried on the vehicle tag. The last clearance event record reflects the results of the roadside verification action. For example, if the vehicle is pulled over in State A and undergoes credential, weight, and safety checks, the results of the clearance process are written to the vehicle s tag. If the vehicle continues the trip and passes a roadside station in State B, the State B station has access to the results of the previous pull-in because it can read the last clearance event record written by the State A roadside station. It associates high-risk cargo with the container/chassis, manifest, carrier, vehicle and driver transporting it.
THP Truck Weigh and Inspection Station, THP Weigh-in-Motion, Violation Detection	Commercial Vehicle Check Equipment	CVCE Weigh-In-Motion	'CVCE Weigh-In-Motion' measures and records axle weights and gross vehicle weight without requiring the vehicle to come to a stop. Both permanent and portable installations are supported and may be performed in conjunction with electronic clearance or as a separate application.

Element Name	Physical Object	Functional Object	Functional Object Description
Transit Kiosks	Traveler Support Equipment	Transit Stop Information Services	'Transit Stop Information Services' furnishes transit users with real-time travel-related information at transit stops, multi-modal transfer points, and other public transportation areas. It provides transit users with information on transit routes, schedules, transfer options, available services, fares, and real-time schedule adherence. In addition to tailored information for individual transit users, it supports general annunciation and/or display of imminent arrival information and other information of general interest to transit users.
Transit Kiosks	Traveler Support Equipment	Traveler Fare Management	'Traveler Fare Management' provides the capability for the traveler to access and use a common fare medium for transit fares, tolls, and/or parking lot charges using a public device at or near the point of service. It accepts a service request and means of payment, verifies eligibility, calculates the amount due, collects payment, and identifies payment problems. It may be implemented using a card reader/dispenser in a point of sale device that includes a communications interface to the financial infrastructure to support payment collection and reconciliation.
Transit Vehicle	Transit Vehicle OBE	Transit Vehicle Emissions Monitoring	'Transit Vehicle Emissions Monitoring' directly measures or estimates vehicle emissions and provides current and average emissions measures to the Transit Management Center.
Transit Vehicle	Transit Vehicle OBE	Transit Vehicle On-Board Information Services	'Transit Vehicle On-board Information Services' furnishes en-route transit users with real-time travel-related information on-board a transit vehicle. Current information that can be provided to transit users includes transit routes, schedules, transfer options, fares, real-time schedule adherence, current incidents, weather conditions, non-motorized transportation services, and special events are provided. In addition to tailored information for individual transit users, it also supports general annunciation and/or display of general schedule information, imminent arrival information, and other information of general interest to transit users.

Element Name	Physical Object	Functional Object	Functional Object Description
Transit Vehicle	Transit Vehicle OBE	Transit Vehicle On-Board Maintenance	'Transit Vehicle On-Board Maintenance' collects and processes transit vehicle maintenance data on-board the vehicle, including mileage and vehicle operating conditions. This maintenance information is provided to the management center and used to schedule future vehicle maintenance and repair.

Appendix C INTERCONNECT CONTEXT DIAGRAMS

Table 12: Flow Definitions

Flow Name	Flow Description	Flow Type
access violation notification	Notification to an individual vehicle that it has committed a lane violation. The flow identifies the nature of the violation and the time and location where the violation was recorded.	Information
accident report	Report of commercial vehicle safety accident. The information may be provided as a response to a real-time query or proactively by the source. The query flow is not explicitly shown.	Information
alarm acknowledge	Confirmation that alarm was received, instructions and additional information for the alarm initiator, and requests for additional information.	Information
alarm notification	Notification of activation of an audible or silent alarm by a traveler in a public area or by a transit vehicle operator using an on-board device.	Information
alert information	distribution of wide area alert information	Information
alert notification coordination	Coordination of emergency alerts to be distributed to the public. This includes notification of a major emergency such as a natural or man-made disaster, civil emergency, or child abduction for distribution to the public and status of the public notification.	Information
alert status	Information indicating the current status of the emergency alert including identification of the traveler and driver information systems that are being used to provide the alert.	Information
archive analysis requests	A user request that initiates data mining, analytical processing, aggregation or summarization, report formulation, or other advanced processing and analysis of archived data. The request also includes information that is used to identify and authenticate the user and support electronic payment requirements, if any.	Request
archive analysis results	Processed information products, supporting meta data, and any associated transaction information resulting from data mining, analytical processing, aggregation or summarization, report formulation, or other on-line processing and analysis of archived data.	Information
archive request confirmation	Confirmation that an archive request has been received and processed with information on the disposition of the request.	Information
archive requests	A request to a data source for information on available data (i.e., "catalog") or a request that defines the data to be archived. The request can be a general subscription intended to initiate a continuous or regular data stream or a specific request intended to initiate a one-time response from the recipient.	Request
archive status	Notification that data provided to an archive contains erroneous, missing, or suspicious data or verification that the data provided appears valid. If an error has been detected, the offending data and the nature of the potential problem are identified.	Information
archived data product requests	A user-specified request for archived data products (i.e., data, meta data, or data catalogs). The request also includes information that is used to identify and authenticate the user and support electronic payment requirements, if any.	Request
archived data products	Raw or processed data, meta data, data catalogs and other data products provided to a user system upon request. The response may also include any associated transaction information.	Information

Flow Name	Flow Description	Flow Type
arriving train information	Information for a train approaching a highway-rail intersection that may include direction and allow calculation of approximate arrival time and closure duration.	Information
audit data	Information to support a tax audit.	Information
automated lane control data	Control commands and operating parameters provided to RSEs that control and monitor automated vehicle operations, including tightly coupled platooned groups of vehicles operating in dedicated or mixed-mode lanes. This flow includes platoon parameters including maximum platoon size, target speeds and gaps, and vehicle restrictions.	Information
automated lane status	Current operational status of lanes supporting automated vehicle operations. The flow includes the status of the RSEs, associated field equipment, and vehicles using the facility.	Information
automated vehicle control parameters	Information, instructions, and control parameters for automated vehicle operations including current system conditions and advisories, control parameters (e.g., speed, required vehicle performance profiles, gaps or headways) and check in/checkout instructions.	Information
automated vehicle control status	Data provided by a connected vehicle identifying it's current mode and operational status and information provided to support check-in/checkout of the lane and coordinated maneuvers while on the automated facility.	Information
barrier system control	Information used to configure and control barrier systems that are represented by gates, barriers and other automated or remotely controlled systems used to manage entry to roadways.	Information
barrier system status	Current operating status of barrier systems. Barrier systems represent gates, barriers and other automated or remotely controlled systems used to manage entry to roadways. Status of the systems includes operating condition and current operational state.	Information
broadcast traveler information	General traveler information that contains traffic and road conditions, link travel times, incidents, advisories, restrictions, transit service information, weather information, parking information, and other related traveler information.	Information
carrier participation report	Report that summarizes motor carrier participation in CVO programs. Used to identify the level of active participation and to report which enrolled carriers are not participating as expected.	Information
citation	Report of commercial vehicle citation. The citation includes references to the statute(s) that was (were) violated. It includes information on the violator and the officer issuing the citation. A citation differs from a violation because it is adjudicated by the courts. The information may be provided as a response to a real-time query or proactively by the source. The query flow is not explicitly shown.	Information
commercial vehicle archive data	Information describing commercial vehicle travel and commodity flow characteristics. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.	Information
commercial vehicle disable	This flow safely disables a specific commercial vehicle.	Information
commercial vehicle identities	Identification information for the Commercial Vehicle (e.g., license plate number or USDOT number), Freight Equipment (e.g., container, chassis, or trailer identification), Carrier, and Driver.	Information
commercial vehicle incident notification	Information about a Commercial Vehicle or Freight Equipment breach, non-permitted security sensitive hazmat detected at the roadside, route deviation, or Commercial Vehicle Driver / Commercial Vehicle / Freight Equipment assignment mismatches which includes the location of the Commercial Vehicle and appropriate identities.	Information

Flow Name	Flow Description	Flow Type
commercial vehicle incident response information	This flow provides data containing an acknowledgement of the commercial vehicle incident notification and provides post-incident instructions.	Information
commercial vehicle permit	Australia-specific flow	Information
commercial vehicle permit information	Information about commercial vehicle permits for oversize, overweight, or for dangerous goods.	Information
commercial vehicle status	Current status of the commercial vehicle and associated freight equipment. This includes temperature, humidity, power, battery levels, brake wear data, door open/closed status, chassis bare/covered status)	Information
commercial vehicle violation notification	Notification to enforcement agency of a violation. The violation notification flow describes the statute or regulation that was violated and how it was violated (e. g., overweight on specific axle by xxx pounds or which brake was out of adjustment and how far out of adjustment it was). A violation differs from a citation because it is not adjudicated by the courts.	Information
compliance review report	Report containing results of carrier compliance review, including concomitant out-of-service notifications, carrier warnings/notifications. The information may be provided as a response to a real-time query of proactively by the source. The query flow is not explicitly shown.	Information
conflict monitor status	A control flow that supports failsafe operation in the event that a conflict is detected that requires the RSE to enter a failsafe operating mode.	Information
cooperative adaptive cruise control parameters	Information, instructions, and control parameters for CACC operations including current system conditions and advisories, control parameters (e.g., target speeds, required vehicle profiles, recommended gaps, lane information) and cluster instructions that support CACC vehicle string creation and dissolution.	Information
cooperative adaptive cruise control status	Data provided by a connected vehicle identifying it's current mode and operational status and information provided to support CACC string creation and dissolution.	Information
cooperative cruise control application data	Control commands and operating parameters provided to RSEs that monitor and assist the formation, dissolution, and operation of strings of CACC-equipped vehicles. This flow includes recommended CACC operating parameters including maximum string size, target speeds, gaps, and restrictions. In implementations that support destination-based and optimum performance based formation of strings, this flow also supports regional coordination that assists in the assignment of vehicles to CACC strings.	Information
cooperative cruise control application status	Current operational status of the infrastructure enhanced cooperative adaptive cruise control application. The flow includes the status of the RSEs, associated field equipment, and CACC-equipped vehicle strings using the facility.	Information
credential application	Application for commercial vehicle credentials. Authorization for payment is included.	Information
credential fee coordination	Jurisdiction's rates for various credentials (IRP, IFTA, etc.) that are exchanged between agencies.	Information
credentials information	Response containing full vehicle fuel tax and registration credentials information. "Response" may be provided in reaction to a real-time query or a standing request for updated information. The query flow is not explicitly shown.	Information

Flow Name	Flow Description	Flow Type
credentials status information	Credentials information such as registration, licensing, insurance, check flags, and electronic screening enrollment data. A unique identifier is included. Corresponds to the credentials portion of CVISN "snapshots." The status information may be provided as a response to a real-time query or as a result of a standing request for updated information (subscription). This may also include information about non-U.S. fleets for use by U.S. authorities, and information regarding U.S. fleets made available to Mexican and Canadian authorities. The query flow is not explicitly shown.	Information
current infrastructure restrictions	Restrictions levied on transportation asset usage based on infrastructure design, surveys, tests, or analyses. This includes standard facility design height, width, and weight restrictions, special restrictions such as spring weight restrictions, and temporary facility restrictions that are imposed during maintenance and construction.	Information
current lane restrictions	Information provided to an enforcement agency that defines the current enforceable lane restrictions. It defines the location, duration, and restrictions for lanes that are reserved for the exclusive use of certain types of vehicles (e.g., transit vehicles) or vehicles that meet other qualifications (e.g., number of occupants, low emissions criteria). It identifies the lane(s), the start and stop locations, start and end times, vehicle restrictions, and speed limits.	Information
cv driver information presentation	Presentation of information to the commercial vehicle driver that includes current status of on-board systems.	Information
cv driver input	This flow represents the tactile or auditory interface with ITS equipment containing the commercial vehicle driver and vehicle information. This flow contains inquiries to the commercial vehicle managing system, interaction with on-board equipment including setup, configuration, and initiation of self tests, and entry of carrier, driver, vehicle, and route information.	Information
cv driver record	Information typically maintained by a state driver licensing agency about a driver of a commercial vehicle including driver identification data, license data, permit data, and driving history details. The query flow is not explicitly shown.	Information
cv repair status	Information about the completion of a repair to a commercial vehicle.	Information
CVC override mode	This flow represents the tactile or auditory interface with ITS equipment containing the manual override of automated pass/pull-in decisions generated by the Commercial Vehicle Check station.	Information
CVO enforcement information	information for CVO enforcement	Information
CVO inspector information	This flow represents the visual or auditory interface with ITS equipment containing credential, safety, and preclearance information and instructions to the commercial vehicle inspector.	Information
CVO inspector input	This flow represents the tactile or auditory interface with ITS equipment containing requests from the commercial vehicle inspector to operate the commercial vehicle inspection station.	Information
CVO pass/pull-in message	This flow represents the visual or auditory interface with ITS equipment containing a message sent to commercial vehicle driver indicating whether to bypass or requesting pull in to inspection/verification stop along with inspection results (e. g., LED indicator on transponder or variable message sign).	Information
daily site activity data	Record of daily activities at commercial vehicle check stations including summaries of screening events and inspections.	Information
decision support information	Information provided to support effective and safe incident response, including local traffic, road, and weather conditions, hazardous material information, and the current status of resources (including vehicles, other equipment, supplies) that have been allocated to an incident.	Information

Flow Name	Flow Description	Flow Type
demand response passenger and use data	Data collected on board a demand response vehicle relating to the picking up and discharging of passengers.	Information
demand responsive transit plan	Plan regarding overall demand responsive transit schedules and deployment.	Information
demand responsive transit request	Request for paratransit support.	Request
device control request	Request for device control action	Information
device data	Data from detectors, environmental sensor stations, roadside equipment, and traffic control devices, including device inventory information.	Information
device identification	An identifier and device type designation that is used to uniquely identify a device in the Connected Vehicle Environment.	Information
device status	Status information from devices	Information
disable commercial vehicle	A request that a specific commercial vehicle should be safely disabled.	Information
driver identity characteristics	The physical or visible characteristics of a commercial vehicle driver that can be measured to uniquely identify a driver. Could be an Identification Card with a Personal Identification Number, biometrics, or visual verification by an operator.	Information
driver information	Regulatory, warning, and guidance information provided to the driver while en route to support safe and efficient vehicle operation.	Information
driver input	Driver input to the vehicle on-board equipment including configuration data, settings and preferences, interactive requests, and control commands.	Information
driver log	A daily log showing hours in service for the current driver. The query flow is not explicitly shown.	Information
driver to fleet request	Requests from the driver and vehicle for routing, payment, and enrollment information.	Request
driver updates	Information provided to the driver including visual displays, audible information and warnings, and haptic feedback. The updates inform the driver about current conditions, potential hazards, and the current status of vehicle on-board equipment.	Information
emergency archive data	Logged emergency information including information that characterizes identified incidents (routine highway incidents through disasters), corresponding incident response information, evacuation information, surveillance data, threat data, and resource information. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.	Information
emergency dispatch requests	Emergency vehicle dispatch instructions including incident location and available information concerning the incident.	Request
emergency dispatch response	Request for additional emergency dispatch information and provision of en route status.	Information
emergency plan coordination	Information that supports coordination of emergency management plans, continuity of operations plans, emergency response and recovery plans, evacuation plans, and other emergency plans between agencies. This includes general plans that are coordinated prior to an incident and shorter duration tactical plans that are prepared during an incident.	Information
emergency route request	Request for access routes for emergency response vehicles and equipment. This may be a request for ingress or egress routes or other emergency routes.	Request
emergency routes	Suggested ingress and egress routes for access to and between the scene and staging areas or other specialized emergency access routes.	Information

Flow Name	Flow Description	Flow Type
emergency traffic control information	Status of a special traffic control strategy or system activation implemented in response to an emergency traffic control request, a request for emergency access routes, a request for evacuation, a request to activate closure systems, a request to employ driver information systems to support public safety objectives, or other special requests. Identifies the selected traffic control strategy and system control status.	Information
emergency traffic control request	Special request to preempt the current traffic control strategy in effect at one or more signalized intersections or highway segments, activate traffic control and closure systems such as gates and barriers, activate safeguard systems, or use driver information systems. For example, this flow can request all signals to red-flash, request a progression of traffic control preemptions along an emergency vehicle route, request a specific evacuation traffic control plan, request activation of a road closure barrier system, or place a public safety or emergency-related message on a dynamic message sign.	Request
emergency traffic coordination	Coordination supporting disaster response including evacuation and reentry. Includes coordination of special traffic control strategies that support efficient evacuation and reentry while protecting and optimizing movement of response vehicles and other resources responding to the emergency.	Information
emergency transit schedule information	Information on transit schedule and service changes that adapt the service to better meet needs of responders and the general public in an emergency situation, including special service schedules supporting evacuation.	Information
emergency traveler information	Public notification of an emergency such as a natural or man-made disaster, civil emergency, or child abduction. This flow also includes evacuation information including evacuation instructions, evacuation zones, recommended evacuation times, tailored evacuation routes and destinations, traffic and road conditions along the evacuation routes, traveler services and shelter information, and reentry times and instructions.	Information
emergency traveler information request	Request for alerts, evacuation information, and other emergency information provided to the traveling public.	Request
emergency vehicle tracking data	The current location and operating status of the emergency vehicle.	Information
environmental conditions data	Current road conditions (e.g., surface temperature, subsurface temperature, moisture, icing, treatment status) and surface weather conditions (e.g., air temperature, wind speed, precipitation, visibility) as measured and reported by fixed and/or mobile environmental sensors and aggregated by the data collector. Attributes relating to the data collection (and aggregation) are also included.	Information
environmental conditions data status	Status of the data quality of environmental conditions data provided by a data contributor. Includes not only status by sensor, but statistical data regarding the quality checking of data provided.	Information
environmental monitoring application info	Environmental monitoring application parameters and thresholds that control the filtering, aggregation, and range of measures that are collected, derived, and reported. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
environmental monitoring application status	Environmental monitoring application status reported by the RSE. This includes current operational state and status of the RSE and a record of system operation.	Information
environmental sensor data	Current road conditions (e.g., surface temperature, subsurface temperature, moisture, icing, treatment status) and surface weather conditions (e.g., air temperature, wind speed, precipitation, visibility) as measured and reported by fixed and/or mobile environmental sensors. Operational status of the sensors is also included.	Information

Flow Name	Flow Description	Flow Type
environmental sensors control	Data used to configure and control environmental sensors.	Information
environmental situation data	Aggregated and filtered vehicle environmental data collected from vehicle safety and convenience systems including measured air temperature, exterior light status, wiper status, sun sensor status, rain sensor status, traction control status, anti-lock brake status, and other collected vehicle system status and sensor information. This information flow represents the aggregated and filtered environmental data sets that are provided by the RSE to the back office center. Depending on the RSE configuration and implementation, the data set may also include environmental sensor station data collected by the RSE.	Information
equipment control commands	System-level control commands issued to the RSE such as reset and remote diagnostics.	Information
equipment maintenance request	Identification of field equipment requiring repair and known information about the associated faults.	Information
equipment maintenance status	Current status of field equipment maintenance actions.	Information
evacuation assistance information	Information on evacuation resources including self-evacuation options, anticipated pickup time and location if a transportation asset is to be deployed, destination shelter, and supporting information on what to bring, estimated reentry date/time.	Information
evacuation assistance request	A request for evacuation assistance, which may be registered in advance or issued during an evacuation. It specifies the location, number of people that need to be evacuated, and any special needs/requirements.	Request
evacuation coordination	Coordination of information regarding a pending or in-process evacuation. Includes evacuation zones, evacuation times, evacuation routes, forecast network conditions, and reentry times.	Information
evacuation information	Evacuation instructions and information including evacuation zones, evacuation times, and reentry times.	Information
expected driver identity characteristics	Driver identification information e.g., encrypted PIN codes issued to drivers, encrypted driver biometric parameters.	Information
external reports	Traffic and incident information that is collected by the media through a variety of mechanisms (e.g., radio station call-in programs, air surveillance).	Information
fare collection data	Fare collection information including the summary of fare system data and financial payment transaction data.	Information
fare management information	Transit fare information and transaction data used to manage transit fare processing.	Information
field equipment commands	System-level control commands issued to field equipment such as reset and remote diagnostics.	Information
field equipment configuration settings	Control settings and parameters that are used to configure field equipment.	Information
field equipment software install/upgrade	This flow supports installation and update of software residing in ITS roadway equipment. It supports download of the software installation files, including executable code and associated support files.	Information
field equipment status	Reports from field equipment (sensors, signals, signs, controllers, etc.) which indicate current operational status.	Information
fleet to driver update	Updated instructions to the driver including dispatch, routing, and special instructions, including alerts and other advisories.	Information
flood warning	flood warning information	Information

Flow Name	Flow Description	Flow Type
freight equipment information	Container, trailer, or chassis information regarding identity, type, location, brake wear data, mileage, seal #, seal type, door open/close status, chassis bare/covered status, tethered / untethered status, temperature, humidity, power, battery levels, brake wear data, and bill of lading/information regarding the cargo/content.	Information
freight monitoring parameters	Parameters to configure the Freight Equipment for event reporting and keep alive functions.	Information
hazmat information	Information about a particular hazmat load including nature of the load and unloading instructions. May also include hazmat vehicle route and route update information.	Information
hazmat information request	Request for information about a particular hazmat load.	Request
hazmat spill notification	Information provided to emergency response organizations when cargo sensors detect a release of hazardous material. This information will include sensor information, vehicle location and identification, and carrier identification.	Information
incident command information coordination	Information that supports local management of an incident. It includes resource deployment status, hazardous material information, traffic, road, and weather conditions, evacuation advice, and other information that enables emergency or maintenance personnel in the field to implement an effective, safe incident response.	Information
incident information	Notification of existence of incident and expected severity, location, time and nature of incident. As additional information is gathered and the incident evolves, updated incident information is provided. Incidents include any event that impacts transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) through large-scale natural or human-caused disasters that involve loss of life, injuries, extensive property damage, and multi-jurisdictional response. This also includes special events, closures, and other planned events that may impact the transportation system.	Information
incident information for media	Report of current desensitized incident information prepared for public dissemination through the media.	Information
incident information for public	Report of current desensitized incident information prepared for public dissemination.	Information
incident report	Report of an identified incident including incident location, type, severity and other information necessary to initiate an appropriate incident response.	Information
incident response coordination	Incident response procedures and current incident response status that are shared between allied response agencies to support a coordinated response to incidents. This flow provides current situation information, including a summary of incident status and its impact on the transportation system and other infrastructure, and current and planned response activities. This flow also coordinates a positive hand off of responsibility for all or part of an incident response between agencies.	Information
incident response status	Status of the current incident response including a summary of incident status and its impact on the transportation system, traffic management strategies implemented at the site (e.g., closures, diversions, traffic signal control overrides), and current and planned response activities.	Information
incident scene safety application info	Incident scene safety application configuration data and warning parameters and thresholds. This includes incident scene configuration including geofenced safe areas and travel lanes that provide a safety boundary between public safety responders and passing vehicles. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information

Flow Name	Flow Description	Flow Type
incident scene safety application status	Incident scene safety application status reported by the RSE. This includes current operational state and status of the RSE and a record of identified safety alerts and warnings issued.	Information
incident scene warning device control	Data used to configure and control incident scene safety monitoring and warning devices.	Information
incident scene warning notification	Notification of an incident scene emergency or safety issue. This flow identifies that an incident scene emergency or safety issue has occurred so that warnings may be generated by more than one system in the work zone.	Information
incident scene warning status	Status of incident scene safety monitoring and warning devices. This flow documents system activations and includes additional supporting information (e.g., an image) that allows verification of the alarm.	Information
incident status	Information gathered at the incident site that more completely characterizes the incident and provides current incident response status. This includes notification of medical facility transport and details about the vehicle occupants being transported.	Information
information on violators	Information on violators provided by a law enforcement agency. May include information about commercial vehicle violations or other kinds of violations associated with the particular entity. The information may be provided as a response to a real-time query or proactively by the source. The query flow is not explicitly shown.	Information
infrastructure conditions data	Current condition of pavement, bridges, culverts, signs, and other roadway infrastructure as measured by on-board sensors or read from infrastructure-based sensors. The data may include raw data or images (e.g., photo logs) that indicate the current status of the infrastructure.	Information
infrastructure monitoring sensor control	Data used to configure and control infrastructure monitoring sensors.	Request
infrastructure monitoring sensor data	Data read from infrastructure-based sensors that monitor the condition or integrity of transportation infrastructure including bridges, tunnels, interchanges, pavement, culverts, signs, transit rail or guideway, and other roadway infrastructure. Includes sensor data and the operational status of the sensors.	Information
infrastructure restriction warning control	Information used to configure and control infrastructure-based sensors that measure the size and weight of passing vehicles and associated signage that provides infrastructure restriction advisories and warnings to drivers.	Information
infrastructure restriction warning status	Infrastructure restriction warning application status reported by the RSE. This includes current operational state and status of the RSE and a record of measured vehicle dimensions and alerts and warnings issued.	Information
interactive traveler information	Traveler information provided in response to a traveler request. The provided information includes traffic and road conditions, advisories, incidents, payment information, transit services, parking information, weather information, and other travel-related data updates and confirmations.	Information
intersection control status	Status data provided by the traffic signal controller including phase information, alarm status, and priority/preempt status.	Information
intersection geometry	The physical geometry of an intersection covering the location and width of each approaching lane, egress lane, and valid paths between approaches and egresses. This flow also defines the location of stop lines, cross walks, specific traffic law restrictions for the intersection (e.g., turning movement restrictions), and other elements that support calculation of a safe and legal vehicle path through the intersection.	Information
intersection infringement info	Vehicle path information sent by a vehicle that is violating the stop bar at an intersection. This flow includes the vehicle's position, heading, speed, acceleration, transmission, steering-wheel angle, braking status, size information and trajectory.	Information

Flow Name	Flow Description	Flow Type
intersection management application info, intersection safety application info	Intersection and device configuration data, including intersection geometry, and warning parameters and thresholds. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
intersection management application status	Infrastructure application status reported by the RSE. This includes current operational state and status of the RSE and a log of operations.	Information
intersection safety application status	Infrastructure safety application status reported by the RSE. This includes current operational state and status of the RSE and a record of intersection safety issues identified and alerts and warnings issued.	Information
intersection safety warning	A warning of an imminent unsafe vehicle infringement at an intersection that may endanger other vehicles or pedestrians. This allows vehicles approaching the intersection to be warned in the event of an imminent red light or stop sign violation or potential infringement on an occupied crosswalk. All connected vehicles at the intersection receive the warning, including both the infringing vehicle and other vehicles at or near the intersection.	Information
intersection status	Current signal phase and timing information for all lanes at a signalized intersection. This flow identifies active lanes and lanes that are being stopped and specifies the length of time that the current state will persist for each lane. It also identifies signal priority and preemption status and pedestrian crossing status information where applicable.	Information
intersection status monitoring	Current signal phase and timing information for all lanes at a signalized intersection. This flow represents monitoring of communications by a receiver at the intersection to support monitoring for conflicts between actual signal states and RSE communications about those states.	Information
lane closure information	Lane closure information provided to passing vehicles. This flow provides information about roadway configuration changes such as lane closures and shifts.	Information
lane management control	Information used to configure and control dynamic lane management systems.	Information
lane management information	System status of managed lanes including current operational state, violations, and logged information. This includes lane usage information including both traditional traffic flow measures and special information associated with managed lanes such as measured passenger occupancies. It also includes the operational status of the lane management equipment.	Information
lane violation notification	Notification to enforcement agency of detected lane entry violations, lane speed violations, or other dynamic lane violations. Lane entry violations may be issued for restricted vehicle types or vehicles that do not meet required emissions or passenger occupancy standards that enter a managed lane. This notification identifies the vehicle and documents the lane parameter that was violated.	Information
local signal preemption request	Direct control signal or message to a signalized intersection that results in preemption of the current control plan and grants right-of-way to the requesting vehicle.	Information
local signal priority request	Request from a vehicle to a signalized intersection for priority at that intersection. This flow also allows the vehicle to cancel a priority request (for example, when the vehicle clears the intersection).	Information
local traveler information	Traveler information including traffic, road, and weather conditions for a particular locality. This flow includes the location-specific traveler information and time effectivity of the information.	Information

Flow Name	Flow Description	Flow Type
maint and constr administrative information	Administrative information that is provided to support maintenance and construction operations. This information includes: equipment and consumables resupply purchase request status, personnel qualifications including training and special certifications, environmental regulations and rules that may impact maintenance activities, and requests and project requirements from contract administration.	Information
maint and constr administrative request	Requests for maintenance and construction administrative information or services. Requests include: requests to purchasing for equipment and consumables resupply and requests to human resources that manage training and special certification for field crews and other personnel.	Request
maint and constr archive data	Information describing road construction and maintenance activities identifying the type of activity, the work performed, and work zone information including work zone configuration and safety (e.g., a record of intrusions and vehicle speeds) information. For construction activities, this information also includes a description of the completed infrastructure, including as-built plans as applicable. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.	Information
maint and constr dispatch information	Information used to dispatch maintenance and construction vehicles, equipment, and crews and information used to keep work zone crews informed. This information includes routing information, traffic information, road restrictions, incident information, environmental information, decision support information, maintenance schedule data, dispatch instructions, personnel assignments, alert notifications, and corrective actions.	Information
maint and constr dispatch status	Current maintenance and construction status including work data, operator status, crew status, and equipment status.	Information
maint and constr resource coordination	Request for road maintenance and construction resources that can be used in the diversion of traffic (cones, portable signs), clearance of a road hazard, repair of ancillary damage, or any other incident response.	Information
maint and constr resource request	Request for road maintenance and construction resources that can be used in the diversion of traffic (cones, portable signs), clearance of a road hazard, repair of ancillary damage, or any other incident response. The request may poll for resource availability or request pre-staging, staging, or immediate dispatch of resources.	Request
maint and constr resource response	Current status of maintenance and construction resources including availability and deployment status. General resource inventory information covering vehicles, equipment, materials, and people and specific resource deployment status may be included.	Information
maint and constr vehicle conditions	Vehicle diagnostics information that is collected, filtered, and selectively reported by a maintenance and construction vehicle. The information includes engine temperature, mileage, tire wear, brake wear, belt wear, and any warnings or alarms concerning the operational condition of the vehicle and ancillary equipment.	Information
maint and constr vehicle location data	The current location and related status (e.g., direction and speed) of the maintenance/construction vehicle.	Information
maint and constr vehicle operational data	Data that describes the maintenance and construction activity performed by the vehicle. Operational data includes materials usage (amount stored and current application rate), operational state of the maintenance equipment (e.g., blade up/down, spreader pattern), vehicle safety status, and other measures associated with the operation of a maintenance, construction, or other special purpose vehicle. Operational data may include basic operational status of the vehicle equipment or a more precise record of the work performed (e.g., application of crack sealant with precise locations and application characteristics).	Information

Flow Name	Flow Description	Flow Type
maint and constr vehicle system control	Configure and control data that supports remote control of on-board maintenance and construction vehicle systems and field equipment that is remotely controlled by the vehicle. For example, the data can be used to adjust material application rates and spread patterns.	Information
maint and constr work performance	Overall project status and work performance information provided to support contract administration.	Information
maint and constr work plans	Future construction and maintenance work schedules and activities including anticipated closures with anticipated impact to the roadway, alternate routes, anticipated delays, closure times, and durations.	Information
mixed use crossing status	Current pedestrian and other mixed use crossing information including an indication of whether the call button has been activated, the current state of the mixed use crossing signal, and information indicating whether non-motorized users are currently occupying the cross walk.	Information
mixed use safety warning control	Configuration and control of equipment that monitors and manages mixed use crossings and provides visual displays and warnings to drivers when non-motorized users are occupying a cross walk or other mixed use path crossing.	Information
mixed use safety warning status	Current operational status and state of pedestrian crossings and other mixed use path crossing warning systems.	Information
multimodal archive data	Operational information from alternate passenger transportation modes including air, rail transit, taxis, and ferries. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.	Information
occupant information	Identification of significant medical conditions of each occupant that would influence critical care decisions made by emergency responders	Information
on-board safety data	Safety data measured by on-board sensors. Includes information about the vehicle, vehicle components, cargo, and driver. The query flow is not explicitly shown.	Information
on-board vehicle data	Information about the commercial vehicle stored on-board (for maintenance purposes, gate access, cargo status, lock status, etc.). The request flow is not explicitly shown.	Information
parking availability	Information on available parking. This flow identifies available spaces with associated information about parking restrictions and location for each available space.	Information
parking information	General parking information and status, including current parking availability.	Information
passive vehicle monitoring control	Control commands used to control detection systems that rely on infrastructure-based identification of individual vehicles to measure travel times and other related measures by identifying the same vehicle at different points in the network. Related technologies include Bluetooth readers and license plate recognition systems.	Information
passive vehicle monitoring data	Time stamped identifiers that identify the vehicles that have passed through a detection zone.	Information
payment	Payment of some kind (e.g., toll, parking, fare) by traveler which, in most cases, can be related to a credit account.	Information
payment application information	Application configuration data and messaging parameters for electronic payment applications for tolls, road use, and other user-pay transportation applications. This flow provides information on services provided, user information, rates and rate criteria, including variable pricing based on calendar, time of day, vehicle type and passenger occupancy. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information

Flow Name	Flow Description	Flow Type
payment application status	Application status for electronic payment applications for tolls, road use, and other user-pay transportation applications. This includes current operational state and status of the RSE and a record of payments collected with identification that can be used to identify the payment account or source and related vehicle and service information that were used to calculate the payment. The flow also includes a record of detected violations.	Information
payment device information	The traveler personal information such as name, address, license number, user account information, trip records and profile data.	Information
payment device update	Information updated concerning traveler's personal data including name, address, user account information, trip records, and profile data.	Information
payment instructions	Information provided to configure and support fixed point payment operations including pricing information.	Information
payment request	Request for payment from financial institution.	Request
payment transactions	Detailed list of transactions including violations. Each transaction includes the date/time, vehicle/customer, and transaction amount. Additional information is included to support delayed payment and violation processing.	Information
personal crossing safety information	Current crossing status including permission to cross, crossing time remaining, and warnings in the event that a vehicle reports an imminent intersection infringement that may impact non-motorized users including pedestrians and cyclists.	Information
personal location	The current location (latitude, longitude, and elevation) reported by the personal information device	Information
personal location information	Pedestrian, bicyclist, and other non-motorized user locations at an intersection as detected and reported by an RSE.	Information
personal signal service request	A request for right of way from a personal device that indicates the type of traveler (pedestrian, special needs pedestrian, bicyclist, etc.), anticipated time of arrival, travel path, and crossing duration.	Information
personal transit information	General and personalized transit information for a particular fixed route, flexible route, or paratransit system.	Information
private location and address flow	Any information flow between Vehicle/PID and Center or CCMS that the initiator needs to be kept private. Privacy in this sense means that the receiver does not receive the network address of the initiator, nor does it receive the geographic location of the initiator. Flows that depend on initiator geographic location cannot use this service.	Information
protected location and address flow	Information flow that has had its geographic location information removed and network address information proxied to protect the privacy of the originator.	Information
proxied personal location	Relay of pedestrian, bicyclist, and other non-motorized user locations at an intersection. This relay or rebroadcast of personal locations supports coordination between motorized and non-motorized users that do not have interoperable communications capability.	Information
qualified environmental conditions data	Current road conditions (e.g., surface temperature, subsurface temperature, moisture, icing, treatment status) and surface weather conditions (e.g., air temperature, wind speed, precipitation, visibility) that has had quality checks performed on it and has been formatted and consolidated by the Clarus system. Attributes relating to the data collection (and aggregation) are also included.	Information
queue warning information	Information regarding formed or impending queues (location of the end of queue, estimated duration of the queue, and other descriptions of the queue condition) and recommendations for upstream vehicles including speed reduction, lane change, or diversion recommendations.	Information

Flow Name	Flow Description	Flow Type
rail crossing advisories	Notification of Highway-Rail Intersection equipment failure, intersection blockage, or other condition requiring attention, and maintenance activities at or near highway rail intersections.	Information
rail crossing application info	Rail crossing and device configuration data and warning parameters and thresholds. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
rail crossing application status	Rail crossing application status reported by the RSE. This includes current operational state and status of the RSE and a record of rail crossing events and alerts and warnings issued.	Information
rail crossing blockage notification	Notification that a highway-rail intersection is obstructed and supporting information.	Information
rail crossing control data	Data required for HRI information transmitted at railroad grade crossings and within railroad operations.	Information
rail crossing request	A request for highway-rail intersection status or a specific control request intended to modify HRI operation.	Request
rail crossing status	Status of the highway-rail intersection equipment including both the current state or mode of operation and the current equipment condition.	Information
rail incident response status	Status of the rail system's response to current incidents.	Information
railroad advisories	Real-time notification of railway-related incident or advisory.	Information
railroad schedules	Train schedules, maintenance schedules, and other information from the railroad that supports forecast of HRI closures.	Information
reduced speed notification	Reduced speed zone information provided to passing vehicles. This flow provides the reduced speed limit, the location and extent of the reduced speed zone, and associated warning information.	Information
reduced speed warning info	Real time notification of vehicle detections, measured vehicle characteristics (e.g., vehicle height), speed measurements, and warnings issued by roadway infrastructure. This flow can also include roadway configuration data, current speed limits, and warning parameters and thresholds enabling local speed management application configuration and management.	Information
remote surveillance control	The control commands used to remotely operate another center's sensors or surveillance equipment so that roadside surveillance assets can be shared by more than one agency.	Information
remote vehicle disable	Signal used to remotely disable a transit vehicle.	Information
request for enforcement	Request for traffic enforcement of speed limits, lane controls, etc. on a roadway including in a work zone or other special situations.	Information
request for payment	Request to deduct cost of service from user's payment account.	Request
request for permit	Request by fleet management for oversize, overweight, or hazmat permit.	Information
request for service	Driver inputs that summon an emergency response, request a financial transaction, or initiate other services.	Request
request tag data	Request for tag information including tag id and associated data.	Request
resource coordination	Coordination of resource inventory information, specific resource status information, resource prioritization and reallocation between jurisdictions, and specific requests for resources and responses that service those requests.	Information
resource deployment status	Status of resource deployment identifying the resources (vehicles, equipment, materials, and personnel) available and their current status. General resource inventory information and specific status of deployed resources may be included.	Information

Flow Name	Flow Description	Flow Type
resource request	A request for resources to implement special traffic control measures, assist in clean up, verify an incident, etc. The request may poll for resource availability or request pre-staging, staging, or immediate deployment of resources. Resources may be explicitly requested or a service may be requested and the specific resource deployment may be determined by the responding agency.	Request
restricted lanes application info	Restricted lane application configuration data and messaging parameters. This flow defines the location, duration, and operating parameters for lanes that are reserved for the exclusive use of certain types of vehicles (e.g., transit vehicles) or vehicles that meet other qualifications (e.g., number of occupants, low emissions criteria). It identifies the lane(s), the start and stop locations, start and end times, vehicle restrictions, speed limits and platooning parameters. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
restricted lanes application status	Current RSE application status that is monitored by the back office center including the operational state of the RSE, current configuration parameters, and a log of lane use (aggregate profiles of vehicles that checked in to the lane and reported vehicle speeds in the lanes) and RSE communications activity.	Information
restricted lanes information	This flow defines the location, duration, and operating parameters for lanes that are reserved for the exclusive use of certain types of vehicles (e.g., transit vehicles) or vehicles that meet other qualifications (e.g., number of occupants, low emissions criteria). It identifies the lane(s), the start and stop locations, start and end times, vehicle restrictions, speed limits and platooning parameters.	Information
restricted lanes parameters	The location, duration, and operating parameters for lanes that are reserved for the exclusive use of certain types of vehicles (e.g., transit vehicles) or vehicles that meet other qualifications (e.g., number of occupants, low emissions criteria). It identifies the lane(s), the start and stop locations, start and end times, vehicle restrictions, speed limits and platooning parameters.	Information
reversible lane control	Control of automated reversible lane configuration and driver information systems.	Information
reversible lane status	Current reversible lane status including traffic sensor and surveillance data and the operational status and mode of the reversible lane control equipment.	Information
right-of-way request notification	Notice that a request has occurred for signal prioritization, signal preemption, pedestrian call, multi-modal crossing activation, or other source for right-of-way.	Information
road closure information	Road closure information provided to passing vehicles. This flow provides information about the road closure with diversion information.	Information
road closure notification	Notification that agency personnel have closed a road due to adverse weather, major incident, or other reason.	Information
road network conditions	Current and forecasted traffic information, road and weather conditions, and other road network status. Either raw data, processed data, or some combination of both may be provided by this flow. Information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements) in effect is included.	Information
road network status assessment	Assessment of damage sustained by the road network including location and extent of the damage, estimate of remaining capacity, required closures, alternate routes, necessary restrictions, and time frame for repair and recovery.	Information

Flow Name	Flow Description	Flow Type
road pricing equipment fault	Provides fault status of the road pricing data collection equipment in a vehicle and vehicle image and other characteristics to allow independent identification of the vehicle and its owner.	Information
road pricing equipment status	Provides an indication of the operational status of the road pricing data collection equipment in a vehicle. Also indicates vehicle ID (VIN) so that the registration of the equipment to a specific vehicle can be verified and confirmed by comparison with vehicle characteristics.	Information
road use charge info	Road use charge rate policies for distribution to travelers.	Information
road use charges	Road use charges per link.	Information
road use history	A vehicle's road use history that records where the vehicle has traveled over time. Optionally includes vehicle speeds as well as distance traveled for some applications. Information is accurate enough to distinguish between adjacent roads, adjacent lanes, and identify direction of travel on the roads.	Information
road weather advisories	Segment-specific weather and road conditions including real-time advisories of deteriorating road and weather conditions, medium-term advisories for the next 2–12 hours, and long-term advisories more than 12 hours into the future. The advisories may include advisories that are issued by the RSE based on locally collected environmental data (e.g., an ice on bridge advisory).	Information
road weather advisories for emergency response	Segment-specific weather and road conditions including real-time advisories of deteriorating road and weather conditions, medium-term advisories for the next 2–12 hours, and long-term advisories more than 12 hours into the future. This flow is filtered, tailored, and augmented to support emergency responders.	Information
road weather advisory info	Road weather advisories and associated configuration and control information that are used to manage the RSE. Advisories include segment-specific weather and road conditions including real-time advisories of deteriorating road and weather conditions, medium-term advisories for the next 2–12 hours, and long-term advisories more than 12 hours into the future. This flow includes a schedule for issuing the included advisories.	Information
road weather advisory status	Current RSE application status that is monitored by the back office center including the operational state of the RSE, current configuration parameters, and a log of advisories issued. The advisories may include advisories that are issued by the RSE based on locally collected environmental data (e.g., an ice on bridge advisory).	Information
road weather information	Road conditions and weather information that are made available by road maintenance operations to other transportation system operators.	Information
roadside data message	Data set collected by roadside sensors to identify and characterize a vehicle, carrier, and (potentially) driver.	Information
roadway advisory radio data	Information used to initialize, configure, and control roadside highway advisory radio. This flow can provide message content and delivery attributes, local message store maintenance requests, control mode commands, status queries, and all other commands and associated parameters that support remote management of these systems.	Information
roadway advisory radio status	Current operating status of highway advisory radios.	Information
roadway dynamic signage data	Information used to initialize, configure, and control dynamic message signs. This flow can provide message content and delivery attributes, local message store maintenance requests, control mode commands, status queries, and all other commands and associated parameters that support remote management of these systems.	Information
roadway dynamic signage status	Current operating status of dynamic message signs, highway advisory radios, or other configurable field equipment that provides dynamic information to the driver.	Information

Flow Name	Flow Description	Flow Type
roadway equipment coordination	The direct flow of information between field equipment. This includes transfer of information between sensors and driver information systems (e.g., DMS, HAR, variable speed limit signs, dynamic lane signs) or control devices (e.g., traffic signals, ramp meters), direct coordination between adjacent control devices, interfaces between detection and warning or alarm systems, and any other direct communications between field equipment.	Information
roadway maintenance status	Summary of maintenance fleet operations affecting the road network. This includes the status of winter maintenance (snow plow schedule and current status).	Information
roadway treatment system control	Control data for remotely located, automated devices, that treat the road surface (e.g., de-icing applications).	Information
roadway treatment system status	Current operational status of automated roadway treatment devices (e.g., anti-icing systems).	Information
roadway warning system control	Information used to configure and control roadway warning systems.	Information
roadway warning system status	Current operating status of roadway warning systems.	Information
route assignment	Route assignment information for transit vehicle operator.	Information
route restrictions	Information about routes, road segments, and areas that do not allow the transport of security sensitive hazmat cargoes or include other restrictions (such as height or weight limits).	Information
RSE application information	RSE application configuration data and parameters that are used to control applications and configure the application for a specific local use. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
RSE application install/upgrade	This flow supports remote installation and update of software applications residing in the RSE. It supports transmission of the secure software installation files, including executable application code and associated support files.	Information
RSE application status	Monitoring of RSE application status including current mode, operational status, and configuration settings. It includes the status of installed applications and the application-specific data provided by the RSE.	Information
safeguard system control	Data that controls safeguard systems (remotely controlled equipment used to mitigate the impact of incidents on transportation infrastructure, such as blast shields, exhaust systems, etc.).	Information
safeguard system status	Current operating status of safeguard systems (remotely controlled equipment used to mitigate the impact of incidents on transportation infrastructure, such as blast shields, exhaust systems, etc.). Status of the systems includes operating condition and current operational state.	Information
safety inspection record	Record containing results of commercial vehicle safety inspection.	Information
safety inspection report	Report containing results of commercial vehicle safety inspection. The information may be provided as a response to a real-time query or proactively by the source. The query flow is not explicitly shown.	Information
safety status information	Safety information such as safety ratings, security ratings or flags, inspection summaries, and violation summaries. A unique identifier is included. Corresponds to the safety and security portion of CVISN "snapshots." The status information may be provided as a response to a real-time query or as a result of a standing request for updated information (subscription). This may also include information about non-U.S. fleets for use by U.S. authorities, and information regarding U.S. fleets made available to Mexican and Canadian authorities. The query flow is not explicitly shown.	Information

Flow Name	Flow Description	Flow Type
secure area sensor control	Information used to configure and control threat sensors (e.g., thermal, acoustic, radiological, chemical), object, motion and intrusion detection sensors. The provided information controls sensor data collection, aggregation, filtering, and other local processing.	Information
secure area sensor data	Data provided by threat sensors (e.g., thermal, acoustic, radiological, chemical), and intrusion, motion, and object detection sensors in secure areas indicating the sensor's operational status, raw and processed sensor data, and alarm indicators when a threat has been detected.	Information
secure area surveillance control	Information used to configure and control audio and video surveillance systems used for transportation infrastructure security in secure areas. The provided information controls surveillance data collection, aggregation, filtering, and other local processing.	Information
secure area surveillance data	Data collected from surveillance systems used to monitor secure areas. Includes video, audio, processed surveillance data, equipment operational status, and alarm indicators when a threat has been detected.	Information
service advertisement	An advertisement of available services and identification of how those services may be accessed (e.g., RF parameters, identifiers, etc.). Services include network services such as IPv6 routing, public roadside services such as intersection safety, back office services including situation data services and security credentials, or private services.	Information
service patrol dispatch request	Service patrol dispatch instructions including incident location and available information concerning the incident.	Request
service patrol dispatch response	Request for additional dispatch information and provision of en route status.	Information
service patrol incident status	Information gathered at the incident site by a service patrol vehicle that more completely characterizes the incident, the services provided, and clearance status.	Information
shelter recommendations	Recommendation identifying the shelter or shelters best suited to the requestor. Hotels/motels may also be included as potential sheltering options. This flow may also include shelter assignments/reservations.	Information
shelter request	A request for shelter information, recommendations, or assignment/reservation. Information provided my include name, current location, number of people in the group, additional requirements (e.g., evacuating with pets, needed medical support).	Request
shoulder management control	Information used to configure and control systems that allow use of a shoulder as a lane for vehicular traffic.	Information
shoulder management information	System status including current operational state, violations and logged information.	Information
signal control commands	Control of traffic signal controllers or field masters including clock synchronization.	Request
signal control data	Information used to configure local traffic signal controllers.	Information
signal control device configuration	Data used to configure traffic signal control equipment including local controllers and system masters.	Information
signal control plans	Traffic signal timing parameters including minimum green time and interval durations for basic operation and cycle length, splits, offset, phase sequence, etc. for coordinated systems.	Information
signal control status	Operational and status data of traffic signal control equipment including operating condition and current indications.	Information
signal fault data	Faults reported by traffic signal control equipment.	Information

Flow Name	Flow Description	Flow Type
signal priority service request	A service request for vehicle priority issued to a traffic signal controller that results in green extension or other accommodation for the priority vehicle, within the current signal timing plan. The request includes the priority level, the desired time and duration of service, and the intended travel path through the intersection. This flow also allows the RSE to cancel a previously issued request for priority.	Information
signal priority status	In response to a request for signal priority, this flow indicates the status of the priority or preemption request.	Information
signal service request	A call for service or extension for a signal control phase that is issued by the RSE for connected vehicles approaching an intersection and/or pedestrians at a crosswalk. This flow identifies the desired phase and service time.	Information
signal system configuration	Data used to configure traffic signal systems including configuring control sections and mode of operation (time based or traffic responsive).	Information
situation data collection parameters	The parameters that are used to control the flow of situation data from the RSE. This flow identifies the type of data/snapshots that are requested from passing vehicles and reporting parameters such as snapshot frequency, filtering criteria (data thresholds for reporting), and reporting interval that control the type and volume of data reported to the back office center.	Information
special vehicle alert	Notification that a vehicle is in the vicinity that requires special attention from drivers. In this context, 'special vehicle' refers to any type of vehicle that uses lights or placards to alert drivers including public safety vehicles, oversize vehicles, slow vehicles, and service vehicles that stop and back up frequently.	Information
speed management application information	Current speed targets, advisories, and limits including time of day, week, or season speed limits as necessary, and application parameters and thresholds. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
speed management application status	Speed management application status reported by the RSE. This includes current operational state and status of the RSE and a record of measured vehicle speeds and current speed targets, advisories, and limits.	Information
speed monitoring control	Information used to configure and control automated speed monitoring, speed warning, and speed enforcement systems.	Information
speed monitoring information	System status including current operational state and logged information including measured speeds, warning messages displayed, and violation records.	Information
speed violation notification	Notification to enforcement agency of detected speed violations. This notification identifies the vehicle and documents the infraction date, time, and location, the measured speed, and current posted speed limit.	Information
speed warning application info	Roadway configuration data, current speed limits including time of day, week, or season speed limits as necessary, and warning parameters and thresholds. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
speed warning application status	Speed warning application status reported by the RSE. This includes current operational state and status of the RSE and a record of measured vehicle speeds and notifications, alerts, and warnings issued.	Information
stop sign gap assist control	Configuration and control of detectors that monitor traffic on the major road and signs that provide stop sign gap assist alerts and warnings to vehicles on the minor road.	Information
stop sign gap assist info	Intersection and device configuration data and warning parameters and thresholds for the stop sign gap assist application. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information

Flow Name	Flow Description	Flow Type
stop sign gap assist RSE status	Stop sign gap assist application status. This includes current operational state and status of the RSE and a log of stop sign gap assist events including alerts and warnings issued.	Information
stop sign gap assist status	The current operational state and status of the field controller, sensors, and signs that support the stop sign gap assist application.	Information
suggested route	Suggested route for a dispatched emergency or maintenance vehicle that may reflect current network conditions and the additional routing options available to en route emergency or maintenance vehicles that are not available to the general public.	Information
tag data	Unique tag ID and related vehicle information.	Information
targeted list	List of carriers, drivers, and/or vehicles of interest for enforcement purposes.	Information
tax filing	Commercial vehicle tax filing data. Authorization for payment is included.	Information
threat information	Threats regarding transportation infrastructure, facilities, or systems detected by a variety of methods (sensors, surveillance, threat analysis of advisories from outside agencies, etc.	Information
threat information coordination	Sensor, surveillance, and threat data including raw and processed data that is collected by sensor and surveillance equipment located in secure areas.	Information
time local form	Time local form includes UTC time synchronized with the external source in a format usable by connected vehicle center functions.	Information
toll data	Current toll schedules for different types of vehicles as well as advanced toll payment information.	Information
toll data request	Request made to obtain toll schedule information or pay a toll in advance. The request can be a subscription that initiates as-needed information updates as well as a one-time request for information.	Request
toll probe data	Aggregate probe data derived from electronic toll collection operations. Data collected could include vehicle speeds and travel times for a given link or collection of links.	Information
toll service change request	Request to change pricing, modify restrictions, or modify operations of a toll road facility	Request
toll service change response	Response to toll service change requests indicating level of compliance with request.	Information
track status	Current status of the wayside equipment and notification of an arriving train.	Information
traffic archive data	Information describing the use and vehicle composition on transportation facilities and the traffic control strategies employed. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.	Information
traffic control information	Represents the flow of traffic control and status information from a TMC to a third party TIC. This is reporting only, not actual control.	Information
traffic detector control	Information used to configure and control traffic detector systems such as inductive loop detectors and machine vision sensors.	Information
traffic detector data	Raw and/or processed traffic detector data which allows derivation of traffic flow variables (e.g., speed, volume, and density measures) and associated information (e.g., congestion, potential incidents). This flow includes the traffic data and the operational status of the traffic sensor system.	Information
traffic gap information	Measured gap to the next approaching vehicle per lane and direction of travel	Information
traffic images	High fidelity, real-time traffic images suitable for surveillance monitoring by the operator or for use in machine vision applications. This flow includes the images and meta data that describes the images.	Information

Flow Name	Flow Description	Flow Type
traffic images relay	relay of traffic images for dissemination to the public	Information
traffic information for media	Report of traffic conditions including traffic incident reports for public dissemination through the media. The reports may also include information on diversions and alternate routes, closures, and special traffic restrictions in effect.	Information
traffic metering control	Control commands and operating parameters for ramp meters, interchange meters, mainline meters, and other systems equipment associated with roadway metering operations.	Information
traffic metering status	Current operational status and operating parameters for ramp meters, interchange meters, mainline meters and other control equipment associated with roadway metering operations.	Information
traffic monitoring application info	Traffic monitoring application parameters and thresholds that control the filtering, aggregation, and range of measures that are collected, derived, and reported. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
traffic monitoring application status	Traffic monitoring application status reported by the RSE. This includes current operational state and status of the RSE and a record of system operation.	Information
traffic regulation information	Traffic rules, regulations, ordinances and statutes that have official status and must be understood by all motor vehicle operators and intelligent vehicles that operate at higher automation levels. The flow includes the regulations and the associated locations, effective date and time periods, and applicable vehicle classes. This flow supports targeted transfer of regulations to end user systems and may be initiated based on a query or pushed so that vehicles have access to relevant regulations for their vehicle classification at the current location, date, and timeframe.	Information
traffic situation data	Current, aggregate traffic data collected from connected vehicles that can be used to supplement or replace information collected by roadside traffic detectors. It includes raw and/or processed reported vehicle speeds, counts, and other derived measures. Raw and/or filtered vehicle control events may also be included to support incident detection.	Information
traffic-related regulations	Traffic rules, regulations, ordinances and statutes that have official status and must be understood by all motor vehicle operators and intelligent vehicles that operate at higher automation levels. The flow includes the regulations and the associated locations, effective date and time periods, and applicable vehicle classes. This flow supports bulk transfer of regulations, rules, statutes, and related attributes between back office systems.	Information
transaction status	Response to transaction request. Normally dealing with a request for payment.	Information
transit and fare schedules	Transit service information including routes, schedules, and fare information.	Information
transit archive data	Data used to describe and monitor transit demand, fares, operations, and system performance. Content may include a catalog of available information, the actual information to be archived, and associated meta data that describes the archived information.	Information
transit information for media	Report of transit schedule deviations for public dissemination through the media.	Information
transit information user request	Request for special transit routing, real-time schedule information, and availability information.	Request
transit probe data	Aggregate probe data derived from tracking transit vehicles. Data collected could include transit vehicle speeds and travel times for a given link or collection of links.	Information

Flow Name	Flow Description	Flow Type
transit schedule adherence information	Dynamic transit schedule adherence and transit vehicle location information.	Information
transit schedule information	Current and projected transit schedule information used to initialize the transit vehicle with a vehicle assignment, monitor schedule performance, and develop corrective actions on-board.	Information
transit service information	Transit service information including routes, schedules, and fare information as well as dynamic transit schedule adherence and transit vehicle location information.	Information
transit stop locations	The current geographic location and dimensions of transit stops. This flow may also include the road geometry in the vicinity of the stops as needed to support transit vehicle safety applications when arriving at or departing from stops.	Information
transit stop request	Notification that a transit stop has been requested by a transit user at a roadside stop. This flow identifies the route, stop, and the time of the request.	Information
transit traveler information	Transit information prepared to support transit users and other travelers. It contains transit schedules, real-time arrival information, fare schedules, alerts and advisories, and general transit service information.	Information
transit traveler request	Request by a Transit traveler to summon assistance, request transit information, or request any other transit services.	Request
transit trip plan	An origin-destination transit trip that may involve multiple modes and connections.	Information
transit trip request	Request for a transit trip plan that is responsive to traveler requirements such as schedule, cost, or duration.	Information
transit user information	Information about individual transit users boarding a transit vehicle, used to track a user's progress on a scheduled transit trip.	Information
transit vehicle conditions	Operating conditions of transit vehicle (e.g., engine running, oil pressure, fuel level and usage).	Information
transit vehicle information	Information about the transit vehicle route and stops, including current location along the route and next stop.	Information
transit vehicle loading data	Data collected on board the transit vehicle relating to passenger boarding and alighting.	Information
transit vehicle location data	Current transit vehicle location and related operational conditions data provided by a transit vehicle.	Information
transit vehicle operator authentication information	Information regarding on-board transit operator authentication	Information
transit vehicle operator authentication update	Results of authentication process or update of on-board authentication database.	Information
transit vehicle operator availability	Transit vehicle operator availability data that can be used to develop vehicle operator assignments and detailed operations schedules.	Information
transit vehicle operator display	Visual, audible, and tactile outputs to the transit vehicle operator including vehicle surveillance information, alarm information, vehicle system status, information from the operations center, and information indicating the status of all other on-board ITS services.	Information
transit vehicle operator information	Transit service instructions, wide area alerts, traffic information, road conditions, and other information for both transit and paratransit operators.	Information
transit vehicle operator input	Transit vehicle operator inputs to on-board ITS equipment, including tactile and verbal inputs. Includes authentication information, on-board system control, emergency requests, and fare transaction data.	Information

Flow Name	Flow Description	Flow Type
transit vehicle schedule performance	Estimated times of arrival and anticipated schedule deviations reported by a transit vehicle.	Information
transportation operational strategies	Operational strategies for each operating agency in a transportation corridor, downtown area, or other travel-impacted area, providing an integrated operations strategy for the freeways, tollways, arterials, transit services, parking facilities, and other transportation-related facilities in the area. These strategies can include dynamic adjustments to transit fares and tolls, parking fees and restrictions, dynamic lane restriction changes, and other active demand management strategies.	Information
transportation system status	Current status and condition of transportation infrastructure (e.g., tunnels, bridges, interchanges, TMC offices, maintenance facilities). In case of disaster or major incident, this flow provides an assessment of damage sustained by the surface transportation system including location and extent of the damage, estimate of remaining capacity and necessary restrictions, and time frame for repair and recovery.	Information
travel services information	Travel service information and reservations for tourist attractions, lodging, dining, service stations, emergency services, and other services and businesses of interest to the traveler.	Information
travel services request	Request for travel service information including tourist attractions, lodging, restaurants, service stations, and emergency services. The request identifies the type of service, the area of interest, optional reservation request information, parameters that are used to prioritize or filter the returned information, and sorting preferences.	Request
traveler information application info	Traveler information and associated parameters, filters, and thresholds that control the RSE's distribution of the traveler information to passing vehicles. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
traveler information application status	Application status reported by the RSE. This includes current operational state and status of the RSE and a record of traveler information distribution.	Information
traveler information for media	General traveler information regarding incidents, unusual traffic conditions, transit issues, or other advisory information that has been desensitized and provided to the media.	Information
traveler payment information	Information provided for payment of road use charges, tolls or parking fees including identification that can be used to identify the payment account or source and related vehicle and service information that are used to determine the type and price of service requested. The information exchange normally supports an account debit to pay fees, but an account credit may be initiated where pricing strategies include incentives.	Information
traveler payment request	Request for information supporting payments. For fee structures that include incentives, the request may support either an account debit or an account credit or reimbursement.	Request
traveler request	A request for traveler information including traffic, transit, toll, parking, road weather conditions, event, and passenger rail information. The request identifies the type of information, the area of interest, parameters that are used to prioritize or filter the returned information, and sorting preferences.	Request
traveler sourced updates	Traveler posts on traffic and road conditions, transit services, traveler services, shelter information and other real-time crowd-sourced data that may be shared with other travelers.	Information
trigger area definition	Information that defines the desired trigger area for wireless roadside inspection safety data message submission.	Information
trigger control	Controls to enable or disable a particular trigger.	Information
trip confirmation	Acknowledgement by the driver/traveler of acceptance of a trip plan with associated personal and payment information required to confirm reservations.	Information

Flow Name	Flow Description	Flow Type
trip feedback	Information provided at the conclusion of a trip that supports performance monitoring and system optimization. Information provided may include a record of the trip including HOV/HOT lane usage and user provided feedback at the conclusion of the trip.	Information
trip log	Driver's daily log, vehicle location, mileage, and trip activity (includes screening, inspection and border clearance event data as well as fare payments). The request flow is not explicitly shown.	Information
trip log information	This flow represents the tactile or auditory interface with ITS equipment containing the information entered into the trip log, or request for update.	Information
trip plan	A travel itinerary identifying a route and associated traveler information and instructions identifying recommended modes and transfer information, ride sharing options, and transit and parking reservation information.	Information
trip request	Request for trip planning services that identifies the trip origin, destination(s), timing, preferences, and constraints. The request may also include the requestor's location or a request for transit and parking reservations and ridesharing options associated with the trip.	Request
unique identifiers	Unique identifiers for the motor carrier, driver, and vehicle. This flow identifies the driver actually operating the vehicle in multi-driver scenarios.	Information
user account reports	Reports on charges	Information
user account setup	Billing information, vehicle information (or registration information), and requests for reports.	Information
user profile	Information provided to register for a travel service and create a user account. The provided information includes personal identification, traveler preferences (e.g., maximum transfer wait time, maximum walking distance, mode preferences, special needs), device information, a user ID and password, and information to support payment transactions, if applicable.	Information
variable speed limit control	Information used to configure and control variable speed limit systems including the equipment used to provide current speed limits and other information to drivers and the equipment used to monitor traffic and environmental conditions along the roadway.	Information
variable speed limit status	Current operating status of the variable speed limit systems including the state of the equipment.	Information
vehicle cluster coordination	Coordination between CACC-equipped vehicles that enable formation and management of strings of adjacent equipped vehicles that coordinate speed management across the string. This flow includes coordination between CACC-equipped vehicles that enable adjacent vehicles in the same lane to identify each other and couple. Depending on the CACC implementation, this flow also supports identification of the lead vehicle in the string, operating performance parameters for the string, destination information so that drivers can join strings that share their destination, and coordination so that strings of vehicles are ordered based on the individual weight and performance profile of each participating vehicle. This flow also supports dissolution of CACC vehicle strings as vehicles depart from the string.	Information
vehicle collision information	The current status of the vehicle systems following a collision including air bag deployment, number of passengers, seat belt usage, sensor data that indicates crash severity (e.g., Delta V speed profile during the crash, vehicle damage, number of impacts), and vehicle type/make/model.	Information

Flow Name	Flow Description	Flow Type
vehicle control event	Notification that the vehicle has performed an emergency action that could impact the safety of surrounding vehicles. This includes hard braking and activation of traction/stability control systems or other actions that warrant immediate notification of surrounding vehicles. The information flow conveys the vehicle's position, heading, speed, acceleration, transmission, steering wheel angle, braking status, size information, and trajectory.	Information
vehicle entries and exits	Information exchanged between an RSE and ITS Roadway Equipment that supports detection of non-equipped vehicles in an automated lane, low emissions zone, or other facility where V2I communications is used to monitor vehicles at entry or exit points. This exchange also supports identification of non-equipped vehicles where an RSE is used for payment collection. This generic exchange can be implemented by any approach that compares vehicle detections with V2I communications by the RSE to identify vehicles that are not equipped or are otherwise unable to communicate with the RSE.	Information
vehicle environmental data	Data from vehicle safety and convenience systems that can be used to estimate environmental and infrastructure conditions, including measured air temperature, exterior light status, wiper status, sun sensor status, rain sensor status, traction control status, anti-lock brake status, vertical acceleration and other collected vehicle system status and sensor information. The collected data is reported along with the location, heading, and time that the data was collected. Both current data and snapshots of recent events (e.g., traction control or anti-lock brake system activations) may be reported.	Information
vehicle location and motion	Data describing the vehicle's position, heading, speed, acceleration, transmission, steering wheel angle, braking status, size information, and trajectory.	Information
vehicle location and motion for surveillance	Data describing the vehicle's position, heading, speed, acceleration, transmission, steering wheel angle, braking status, size information, and trajectory. This flow represents monitoring of basic safety data ('vehicle location and motion') broadcast by passing connected vehicles for use in vehicle detection and traffic monitoring applications.	Information
vehicle occupancy	The number of occupants detected by the vehicle.	Information
vehicle path prediction	The predicted future vehicle path of travel. This flow includes an indication of the future positions of the transmitting vehicle that can be used by receiving vehicles to support coordinated driving maneuvers and enhance in-lane and out-of-lane threat classification.	Information
vehicle payment information	Information provided for payment of tolls, parking, and other transportation fees including identification that can be used to identify the payment account or source and related vehicle and service information that are used to determine the type and price of service requested. The information exchange normally supports an account debit to pay fees, but an account credit may be initiated where pricing strategies include incentives.	Information
vehicle payment request	Request for information supporting payments. For fee structures that include incentives, the request may support either an account debit or an account credit or reimbursement.	Request
vehicle payment update	Data written to vehicle equipment to support electronic toll collection or parking payment.	Information
vehicle platoon coordination	Coordination of control commands between leader and follower vehicles allowing vehicles to join, coordinate with, and separate from platoons of cooperative vehicles. This flow shares platoon size, location, and performance parameters (e.g., platoon speed and spacing) between platooned vehicles. It also coordinates maneuvers between platooned vehicles, including maneuvers as vehicles join and leave the platoon.	Information

Flow Name	Flow Description	Flow Type
vehicle profile	Information about a vehicle such as vehicle make and model, fuel type, engine type, size and weight, vehicle performance and level of control automation, average emissions, average fuel consumption, passenger occupancy, or other data that can be used to classify vehicle eligibility for access to specific lanes, road segments, or regions or participation in cooperative vehicle control applications.	Information
vehicle reported emissions	Current and average vehicle emissions data as measured by vehicle diagnostics systems and reported by the vehicle.	Information
vehicle signage application info	In-vehicle signing application configuration data and messaging parameters. This flow provides a list of regulatory, warning, and information messages to be displayed and parameters that support scheduling and prioritizing messages to be issued to passing vehicles. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
vehicle signage application status	In-vehicle signing application status reported by the RSE. This includes current operational state and status of the RSE and a log of messages sent to passing vehicles.	Information
vehicle signage data	In-vehicle signing data that augments regulatory, warning, and informational road signs and signals. 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, grade crossing information, local traffic and road conditions, detours, advisories, and warnings).	Information
vehicle signage local data	Information provided by adjacent field equipment to support in-vehicle signing of dynamic information that is currently being displayed to passing drivers. This includes the dynamic information (e.g., current signal states, grade crossing information, local traffic and road conditions, detours, advisories, parking availability, etc.) and control parameters that identify the desired timing, duration, and priority of the signage data.	Information
vehicle situation data	This flow represents vehicle snapshots that may be provided by the vehicle to support traffic and environmental conditions monitoring. Snapshots are collected by the vehicle for specific events (e.g., when a sensor exceeds a threshold) or periodically and reported based on control parameters when communications is available. Traffic-related data includes snapshots of measured speed and heading and events including starts and stops, speed changes, and other vehicle control events. Environmental data may include measured air temperature, exterior light status, wiper status, sun sensor status, rain sensor status, traction control status, anti-lock brake status, and other collected vehicle system status and sensor information. The collected data is reported along with the location, heading, and time that the data was collected.	Information
vehicle situation data parameters	A request for vehicle situation data that includes parameters used to control the data that is reported and the flow of data reported by the vehicle. This flow identifies the type of data/snapshots that are requested and reporting parameters such as snapshot frequency, filtering criteria (data thresholds for reporting), and reporting interval.	Information
video surveillance control	Information used to configure and control video surveillance systems.	Information
weather information	Accumulated forecasted and current weather data (e.g., temperature, pressure, wind speed, wind direction, humidity, precipitation, visibility, light conditions, etc.).	Information
weigh-in-motion information	Information from commercial vehicle virtual weigh-in-motion systems including vehicle weight, vehicle dimensions, vehicle identification and driver identification.	Information

Flow Name	Flow Description	Flow Type
work plan coordination	Coordination of work plan schedules and activities between maintenance and construction organizations or systems. This information includes the work plan schedules and comments and suggested changes that are exchanged as work plans are coordinated and finalized.	Information
work plan feedback	Comments and suggested changes to proposed construction and maintenance work schedules and activities. This information influences work plan schedules so that they minimize impact to other system operations and the overall transportation system.	Information
work zone information	Summary of maintenance and construction work zone activities affecting the road network including the nature of the maintenance or construction activity, location, impact to the roadway, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits. This information may be augmented with images that provide a visual indication of current work zone status and traffic impacts.	Information
work zone safety application info	Work zone safety application configuration data and warning parameters and thresholds. This includes work zone configuration including geofenced crew areas and travel lanes that provide a safety boundary between work zone personnel and passing vehicles. This flow also supports remote control of the application so the application can be taken offline, reset, or restarted.	Information
work zone safety application status	Work zone safety application status reported by the RSE. This includes current operational state and status of the RSE and a record of identified work zone safety alerts and warnings issued.	Information
work zone status	Current work zone status including current location (and future locations for moving work zones), impact to the roadway, required lane shifts, expected time(s) and duration of impact, anticipated delays, alternate routes, and suggested speed limits.	Information
work zone warning device control	Data used to configure and control work zone safety monitoring and warning devices.	Information
work zone warning notification	Notification of a work zone emergency or safety issue. This flow identifies that a work zone emergency or safety issue has occurred so that warnings may be generated by more than one system in the work zone.	Information
work zone warning status	Status of a work zone safety monitoring and warning devices. This flow documents system activations and includes additional supporting information (e.g., an image) that allows verification of the alarm.	Information
wrong way vehicle detected	Notification that a vehicle has been detected traveling in the wrong direction. This can be a direct report by an equipped vehicle that is being driven in the wrong direction or a report of a non-equipped vehicle that has been detected traveling in the wrong direction. It includes the current location, speed, acceleration, and heading of the wrong way vehicle.	Information

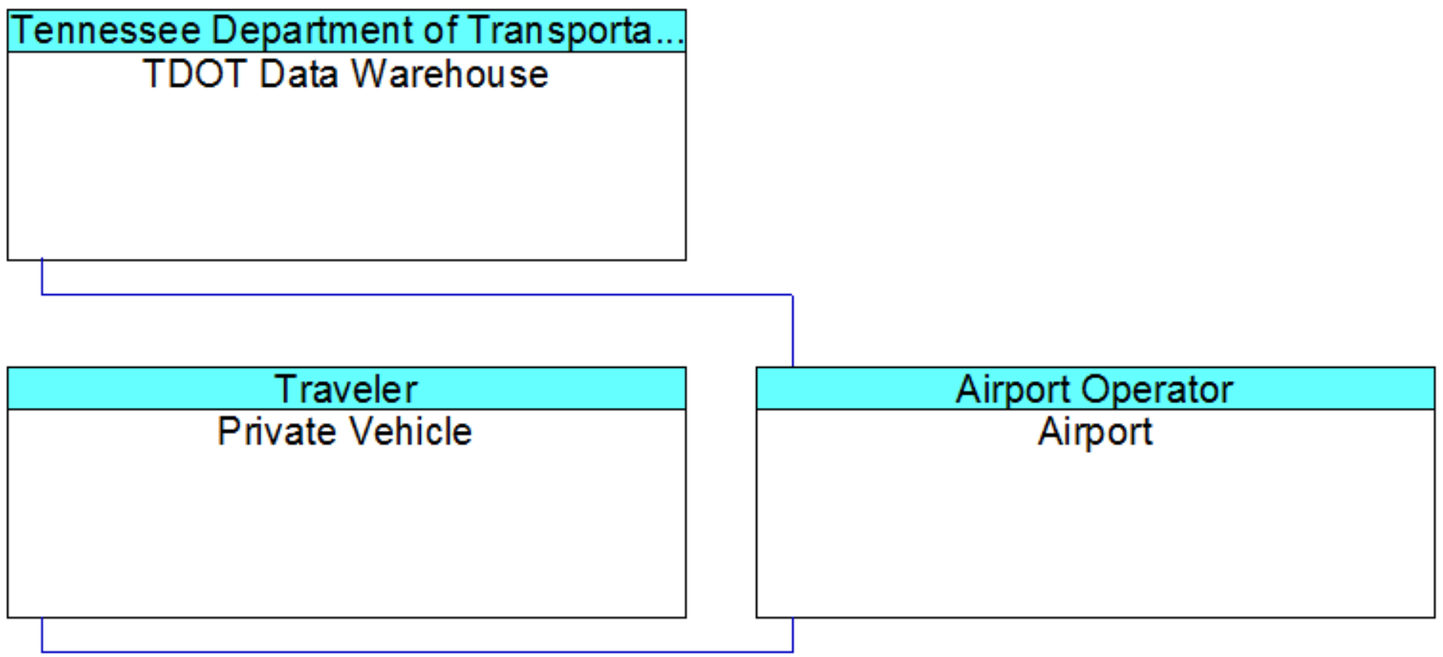


Figure 4: Airport Interconnect Context Diagram

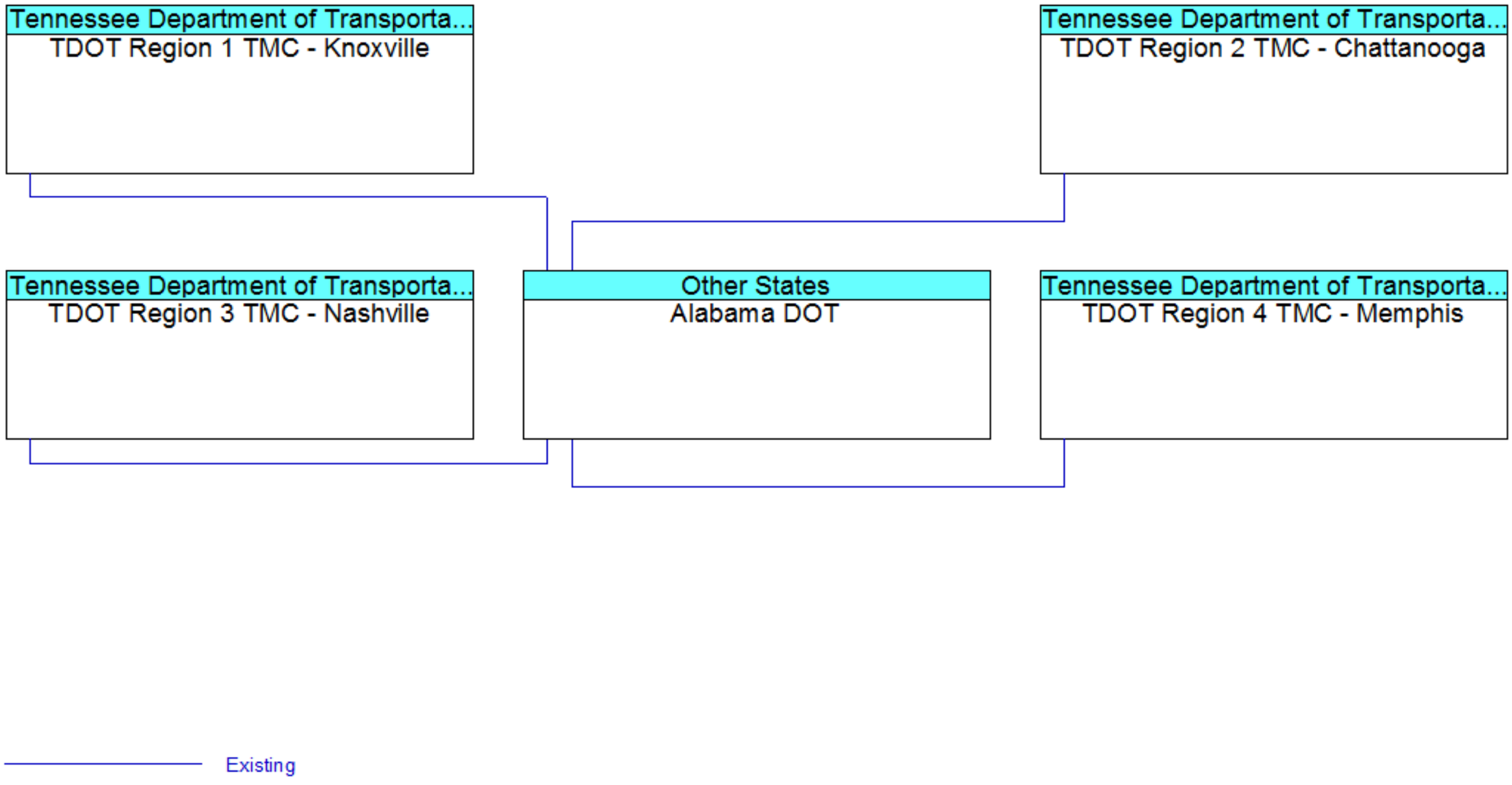


Figure 5: Alabama DOT Interconnect Context Diagram

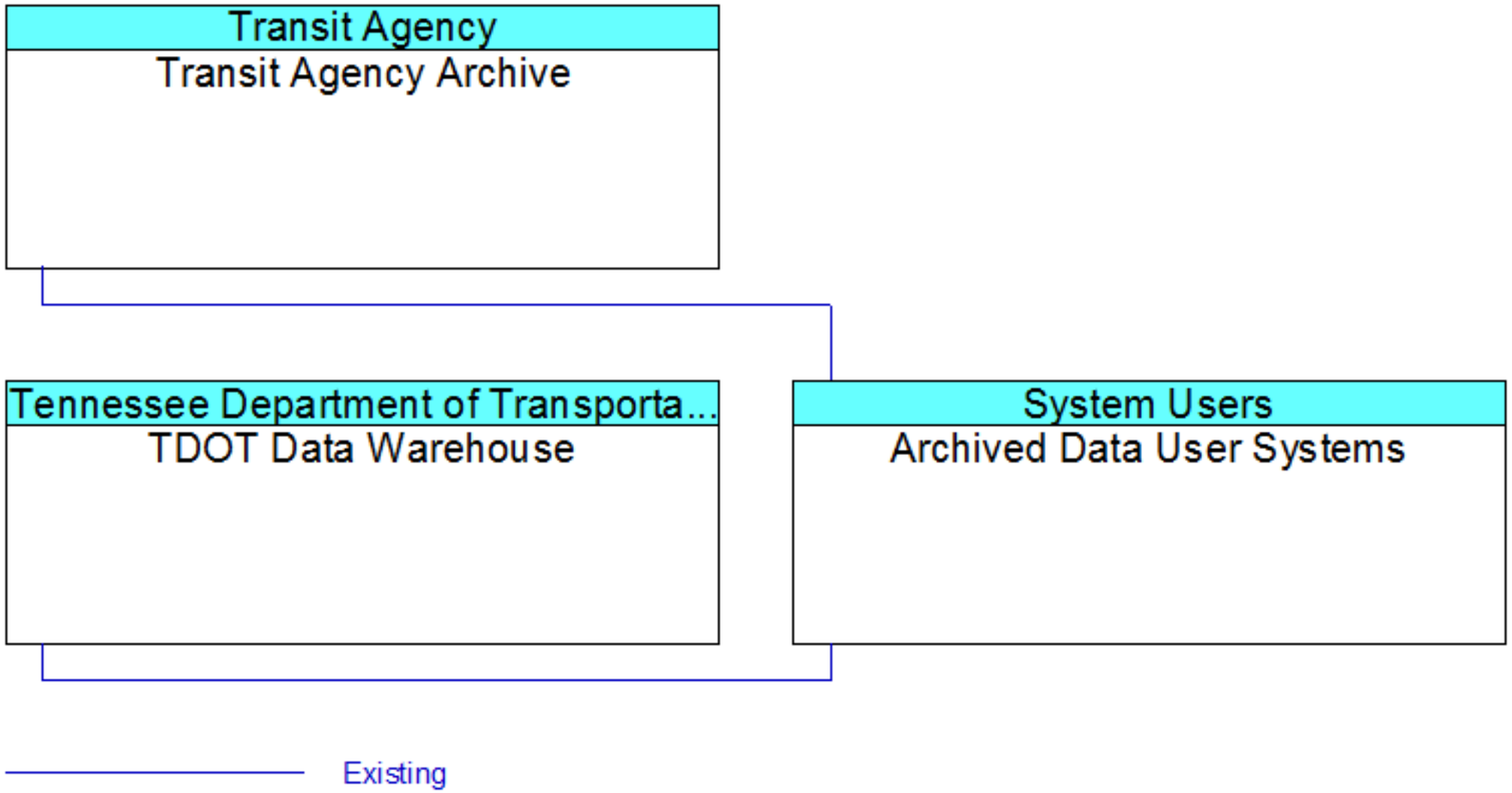


Figure 6: Archive Data User Systems Interconnect Context Diagram

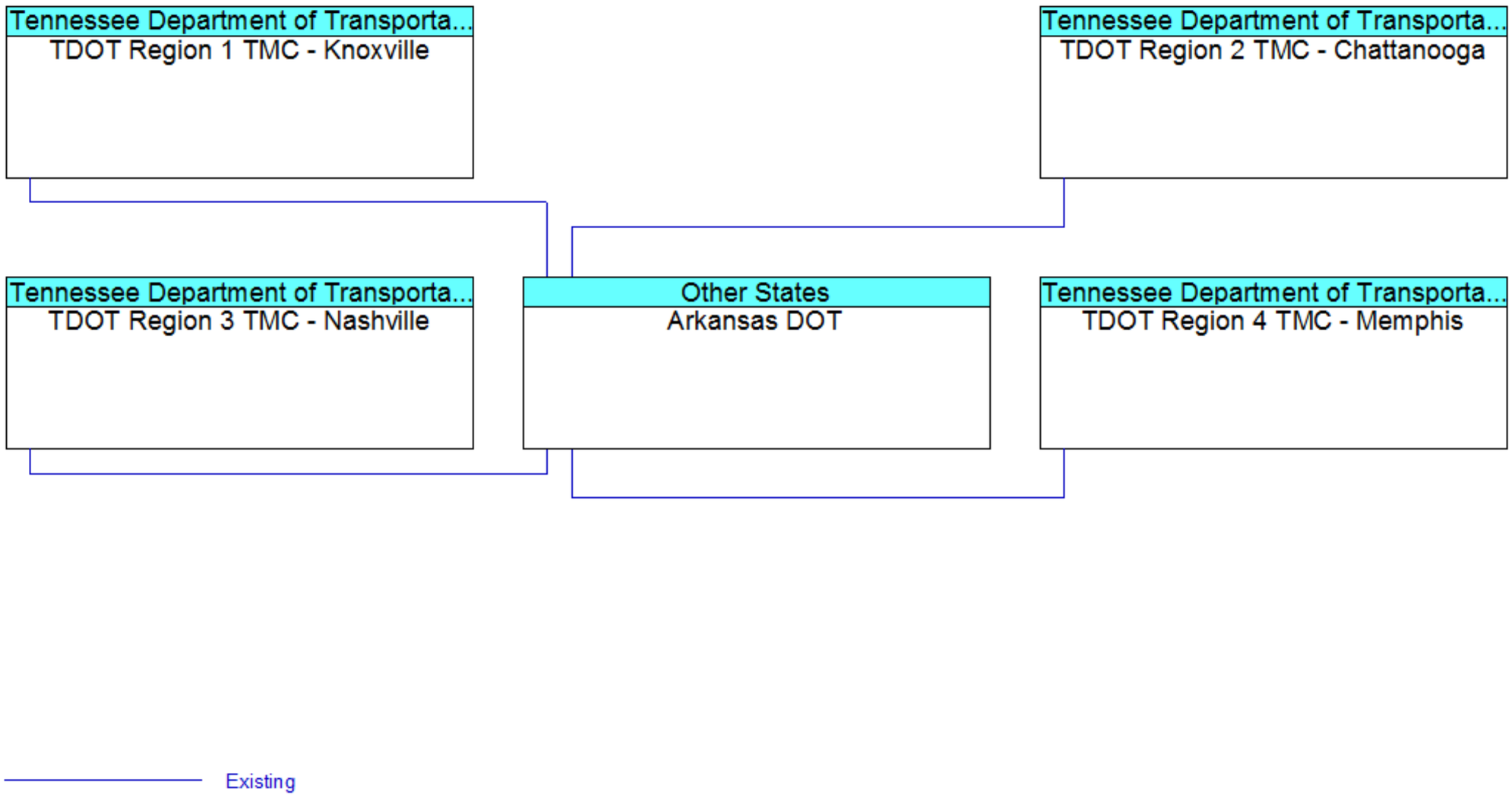


Figure 7: Arkansas DOT Interconnect Context Diagram

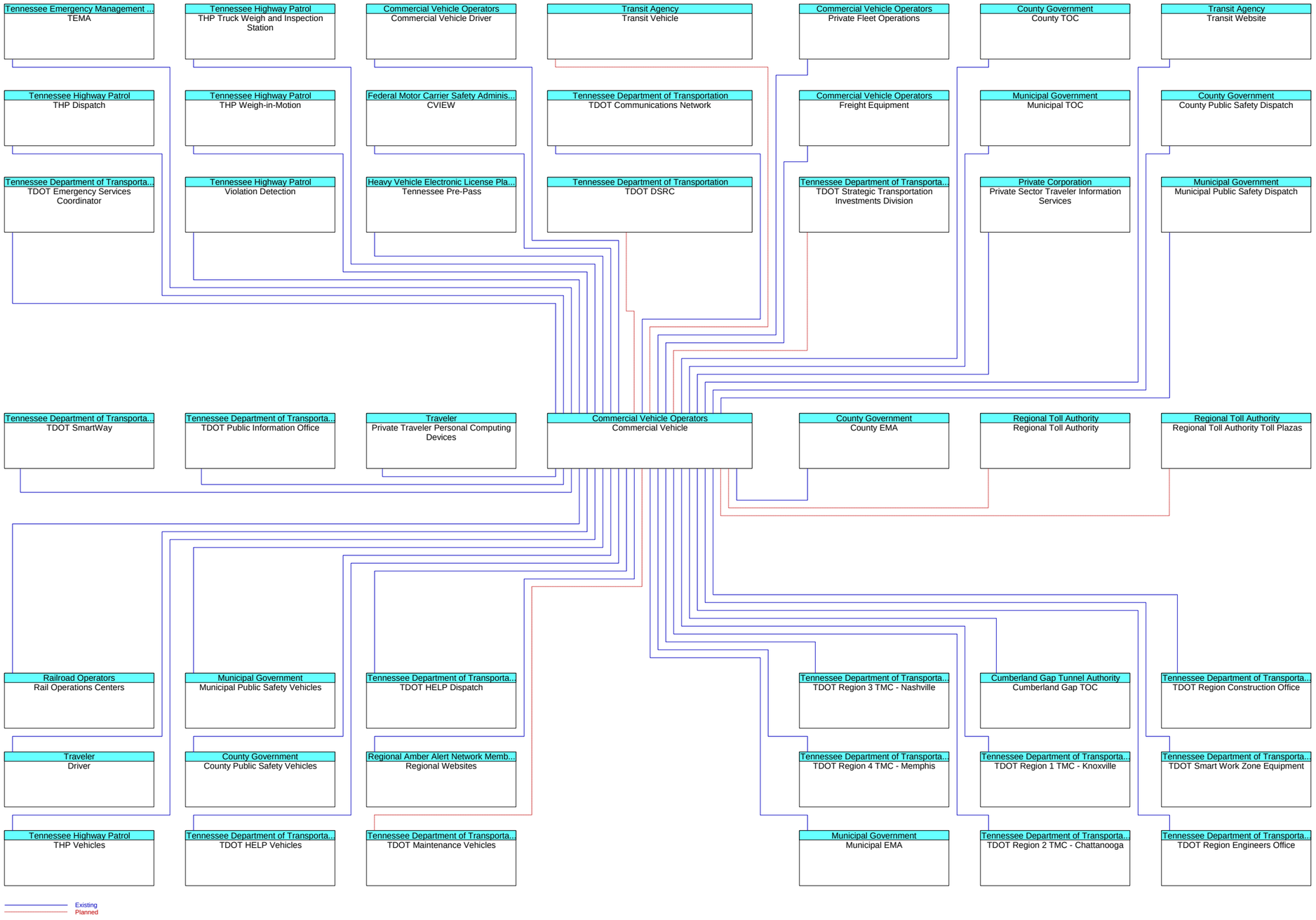


Figure 8: Commercial Vehicle Interconnect Context Diagram

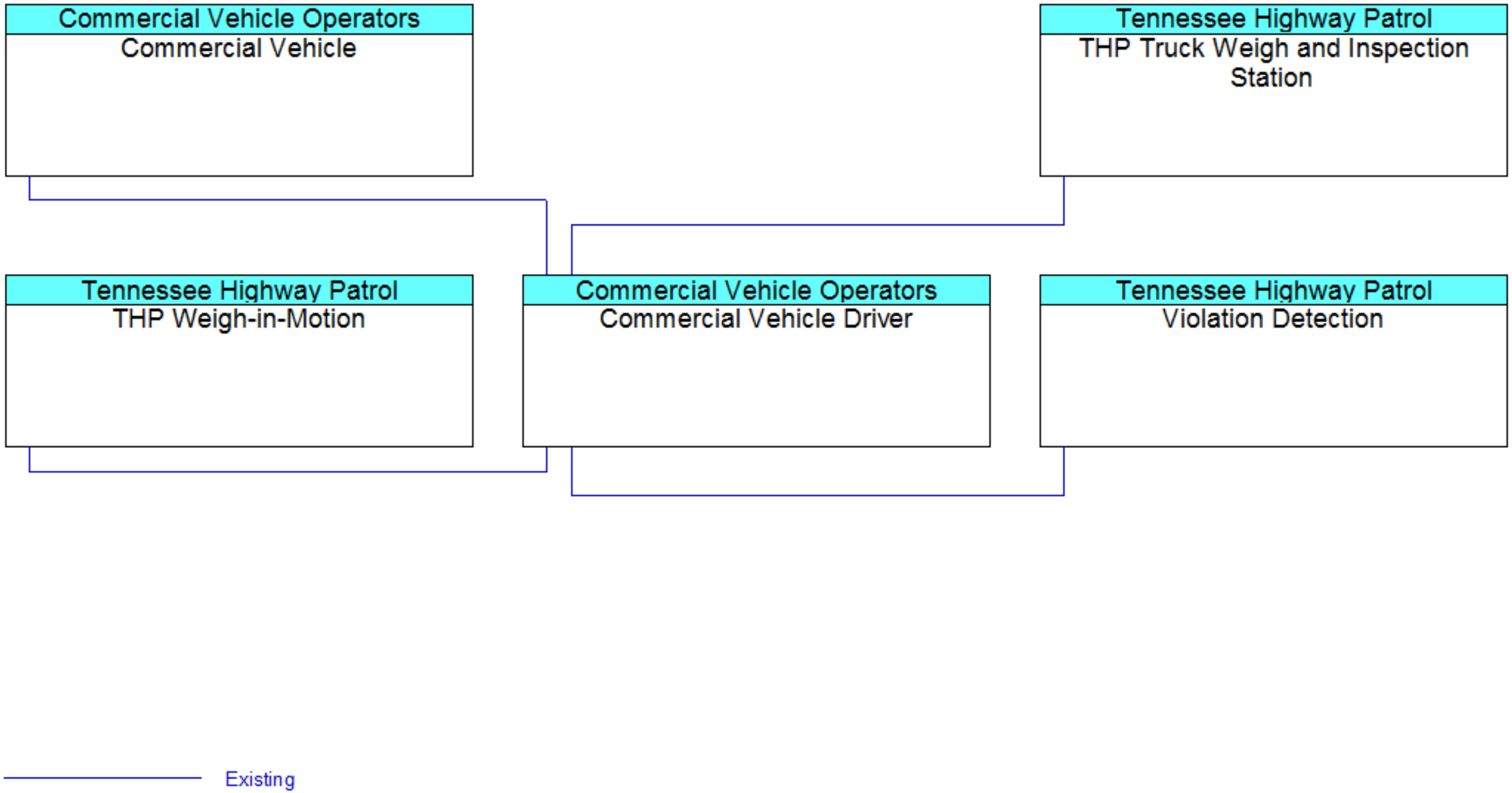


Figure 9: Commercial Vehicle Driver Interconnect Context Diagram

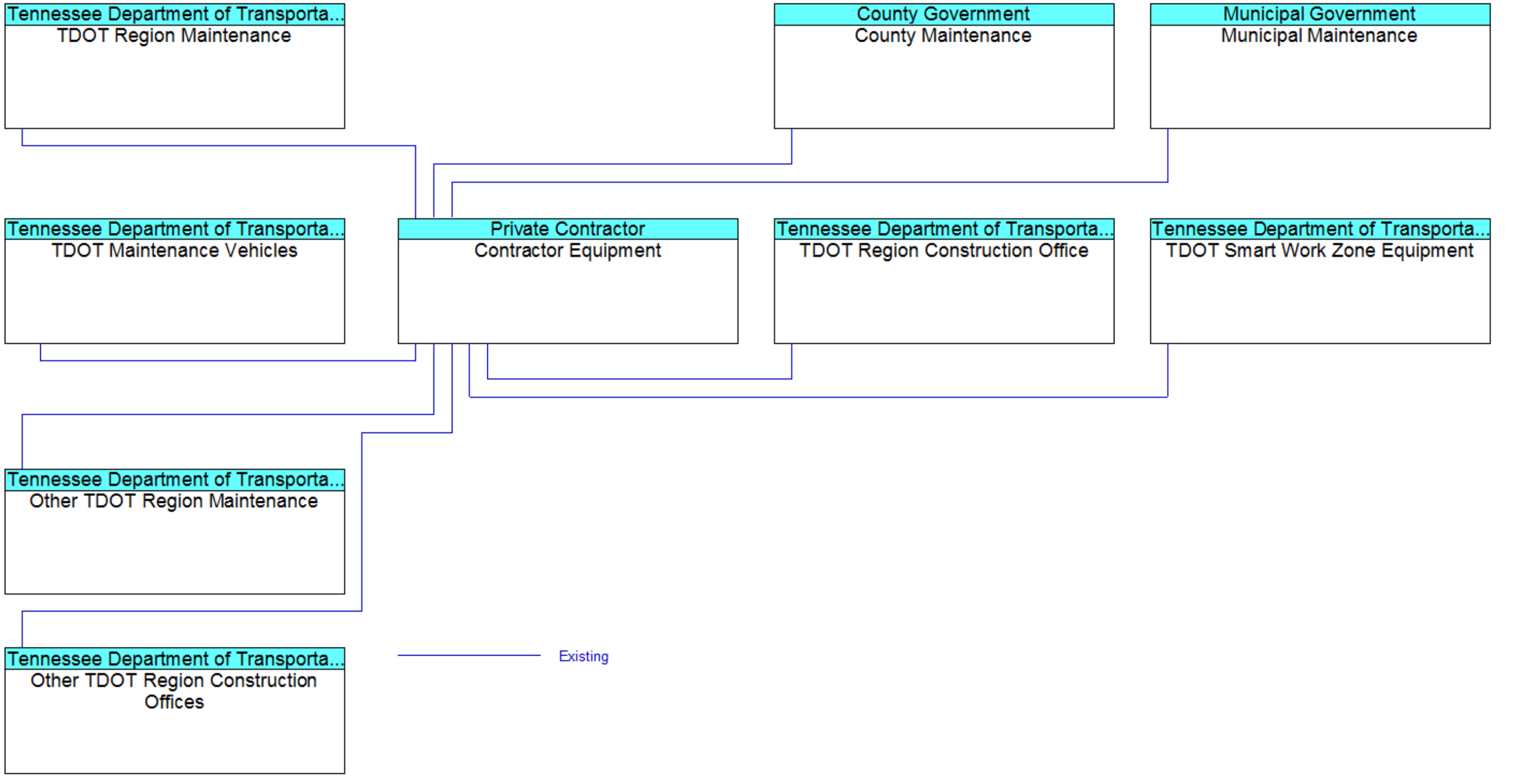


Figure 10: Contractor Equipment Interconnect Context Diagram

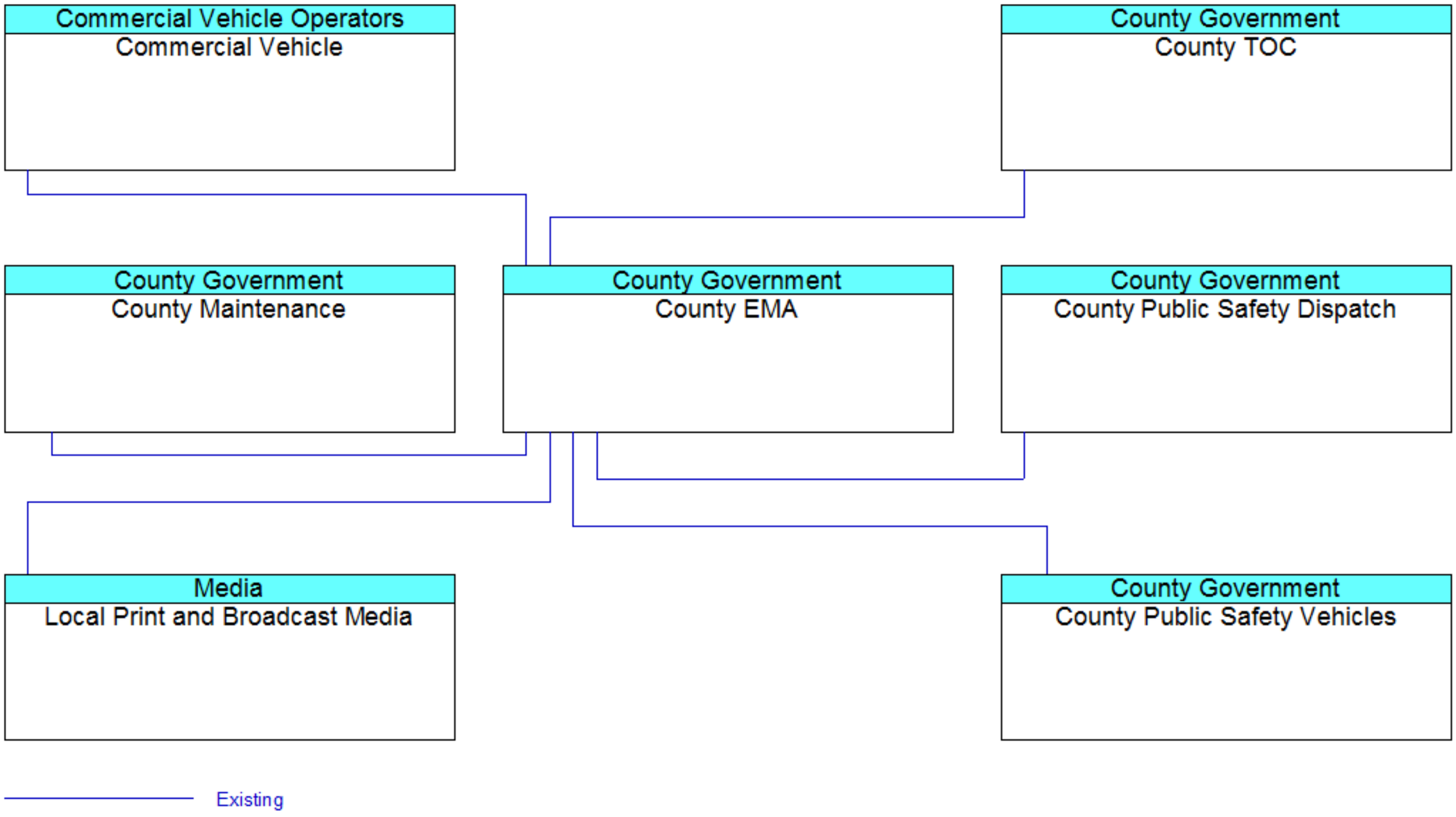


Figure 11: County EMA Interconnect Context Diagram

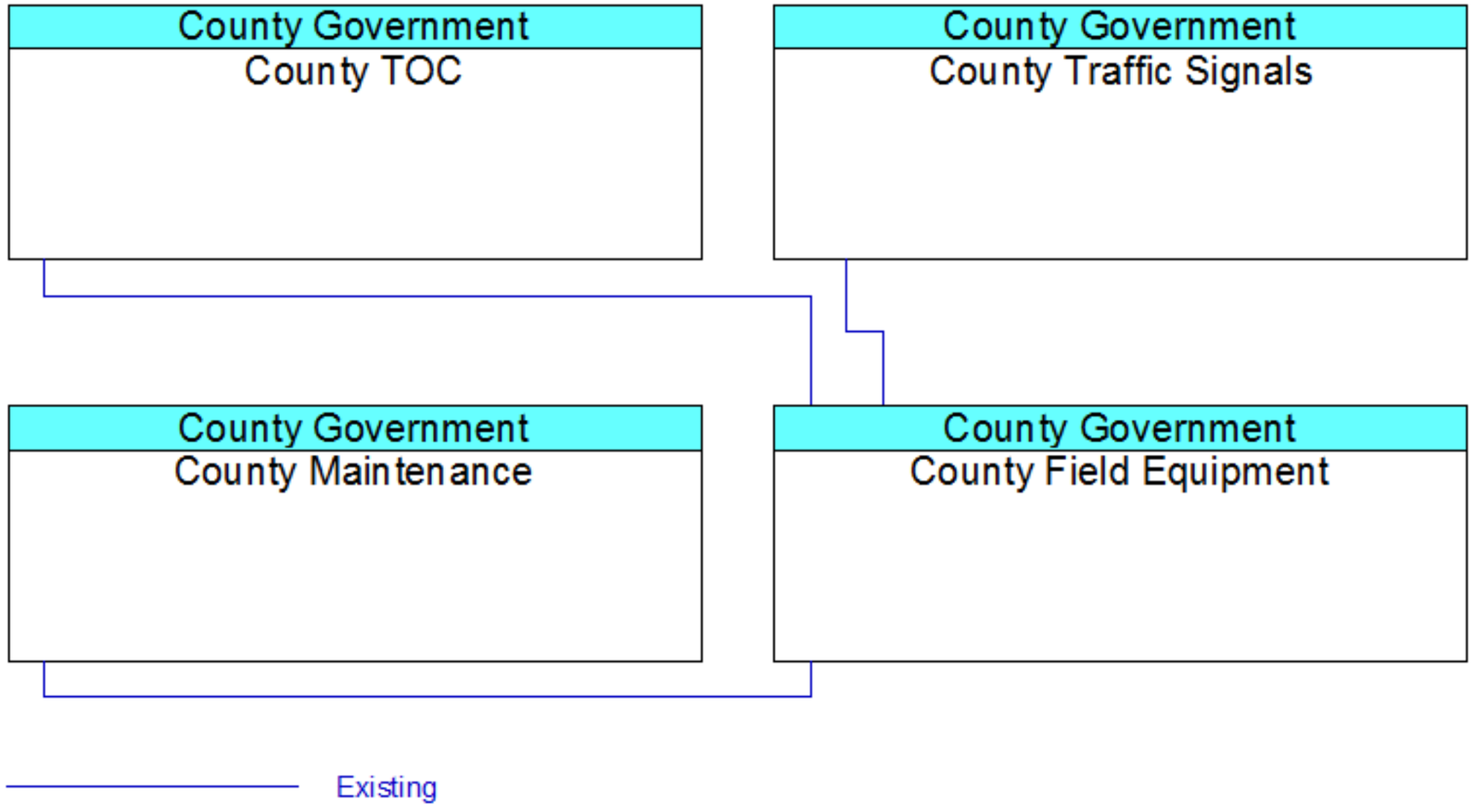


Figure 12: County Field Equipment Interconnect Context Diagram

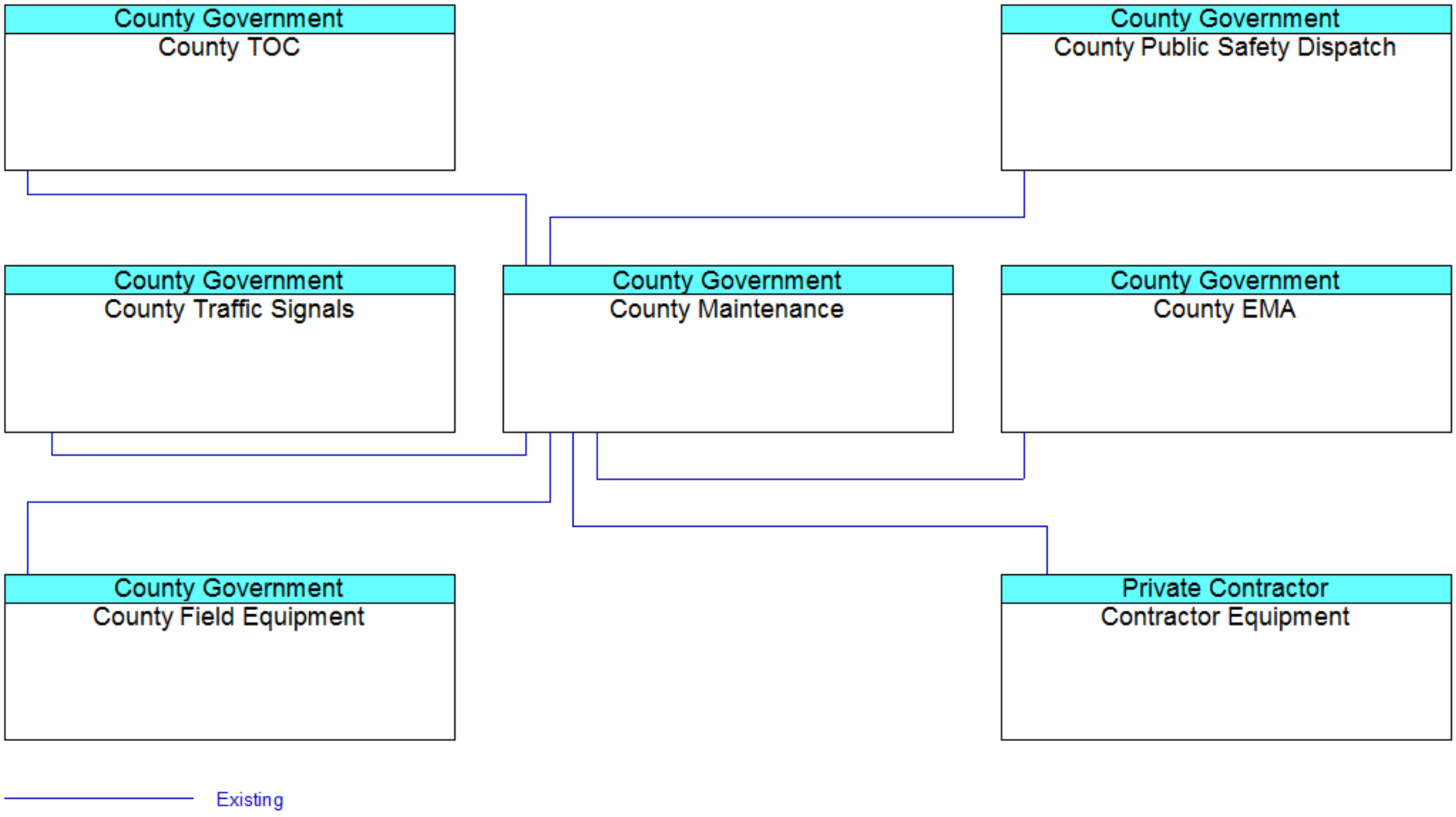


Figure 13: County Maintenance Interconnect Context Diagram

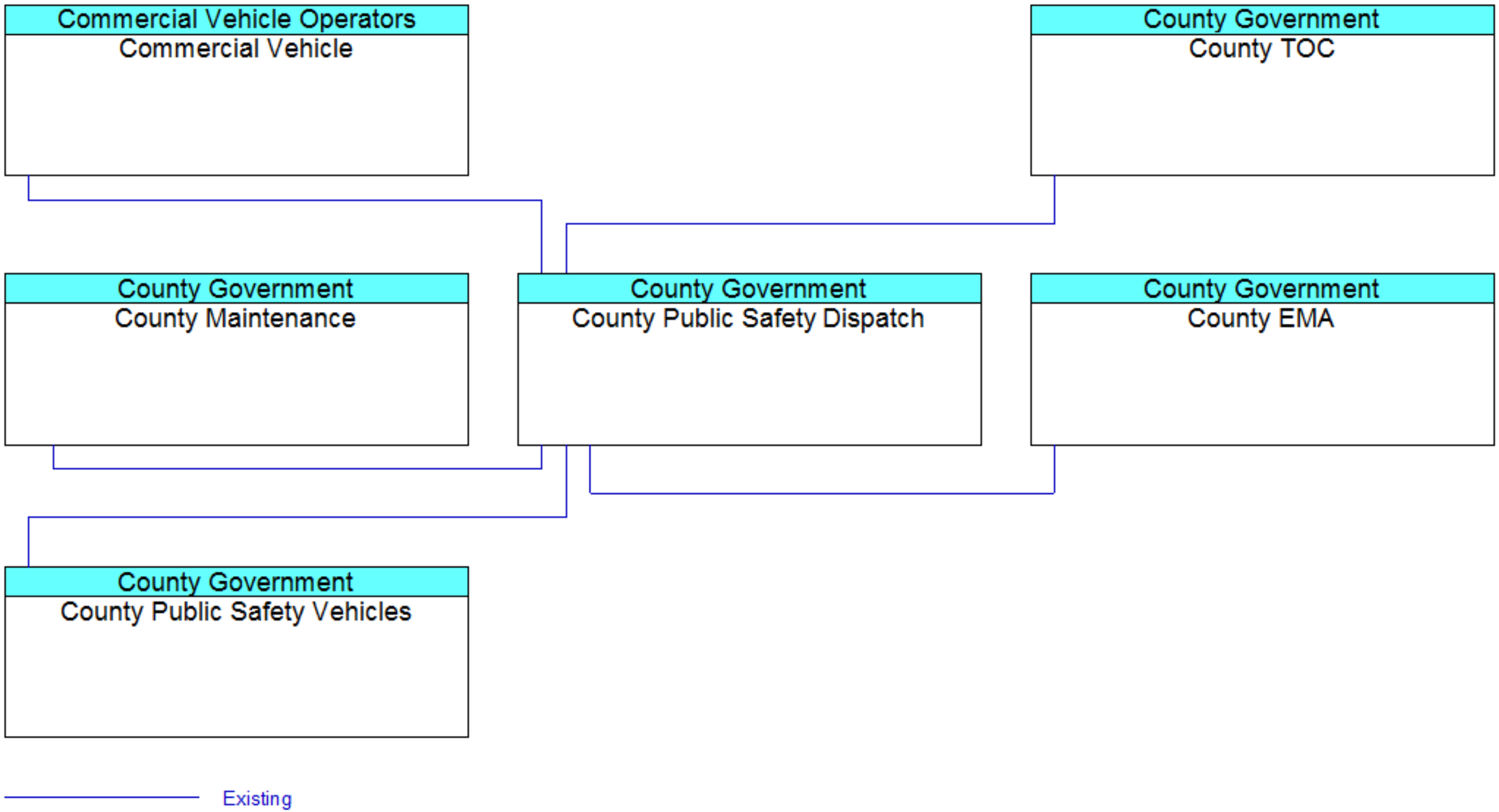


Figure 14: County Public Safety Dispatch Interconnect Context Diagram

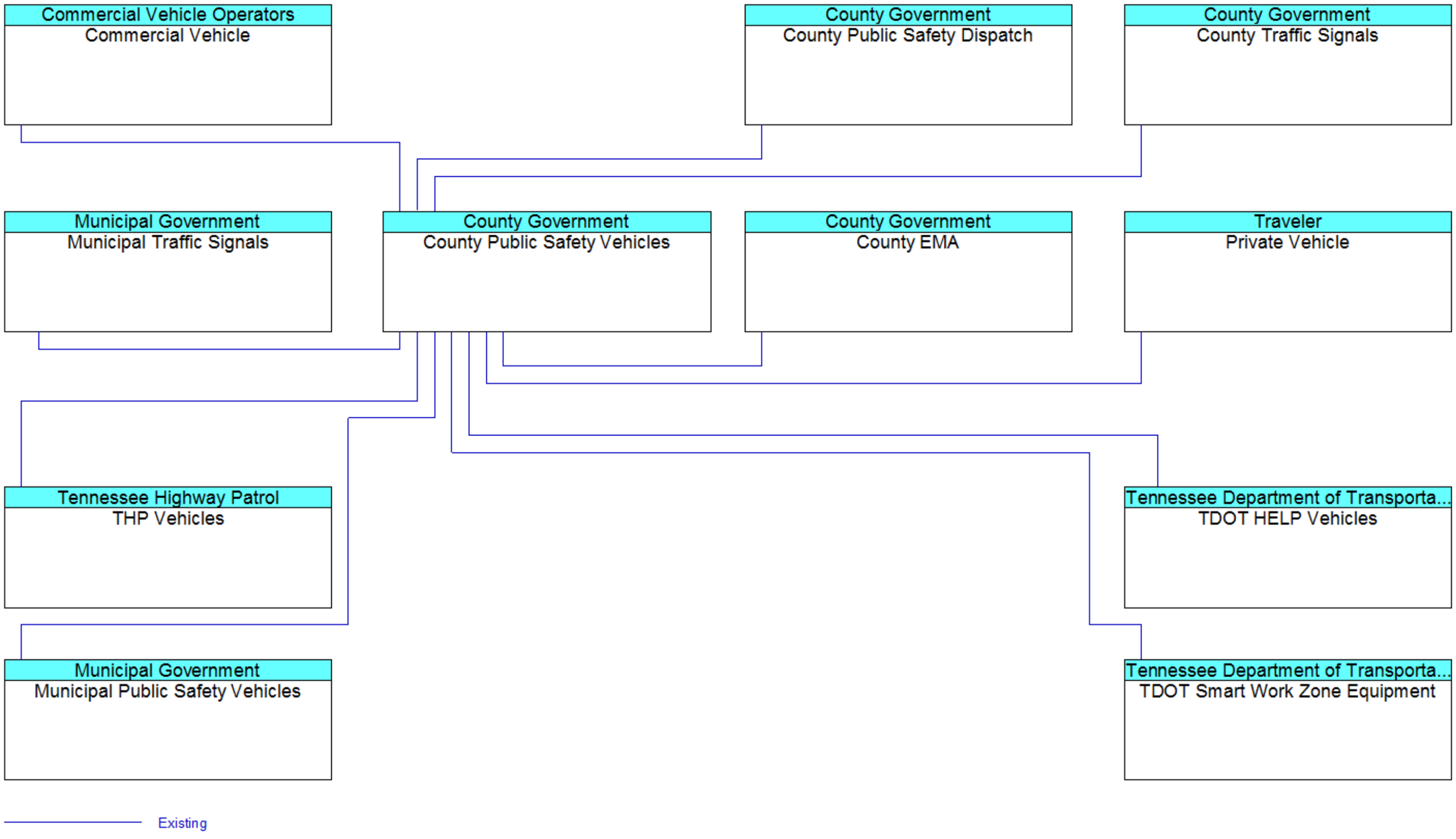


Figure 15: County Public Safety Vehicles Interconnect Context Diagram

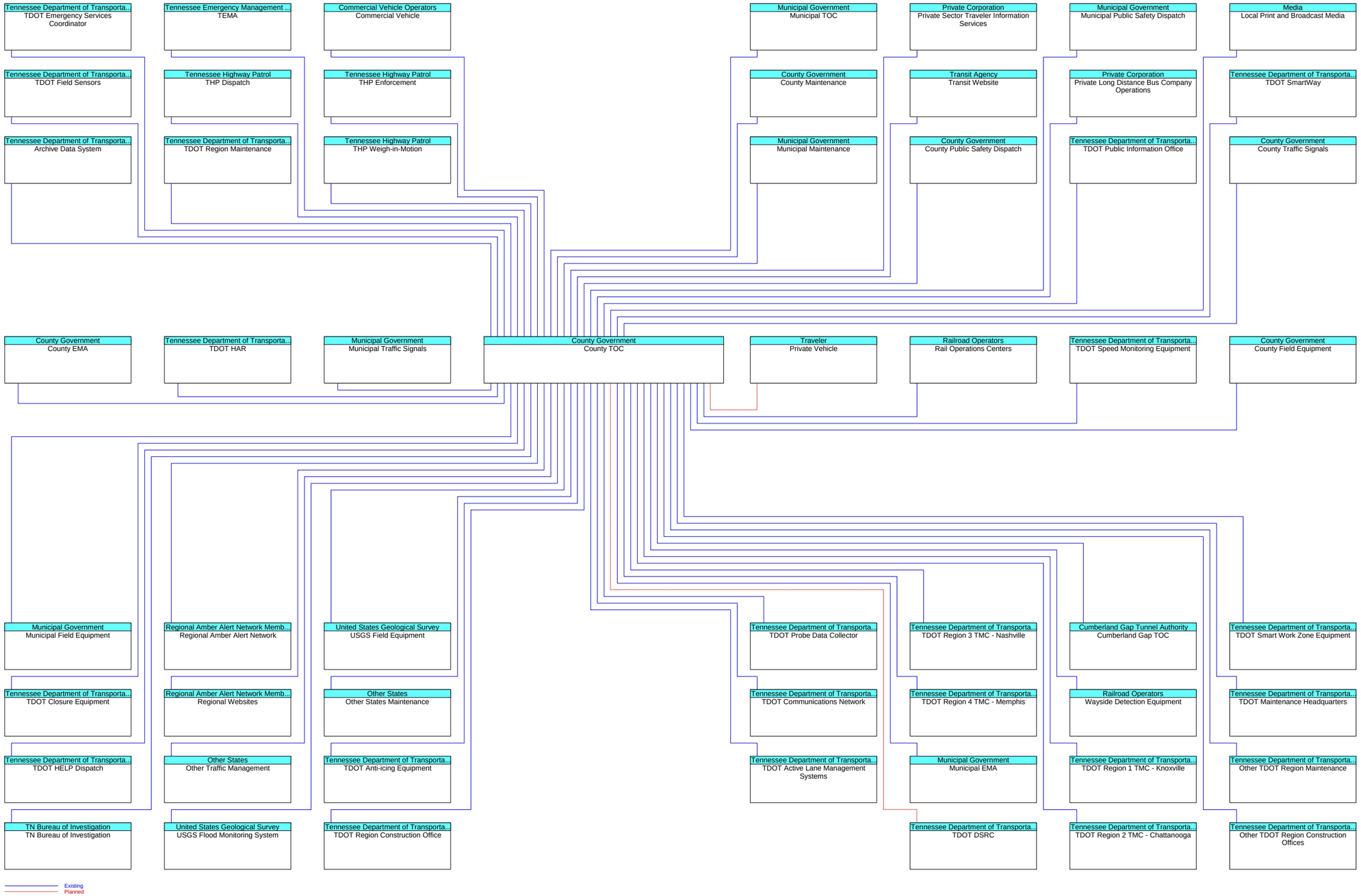


Figure 16: County TOC Interconnect Context Diagram

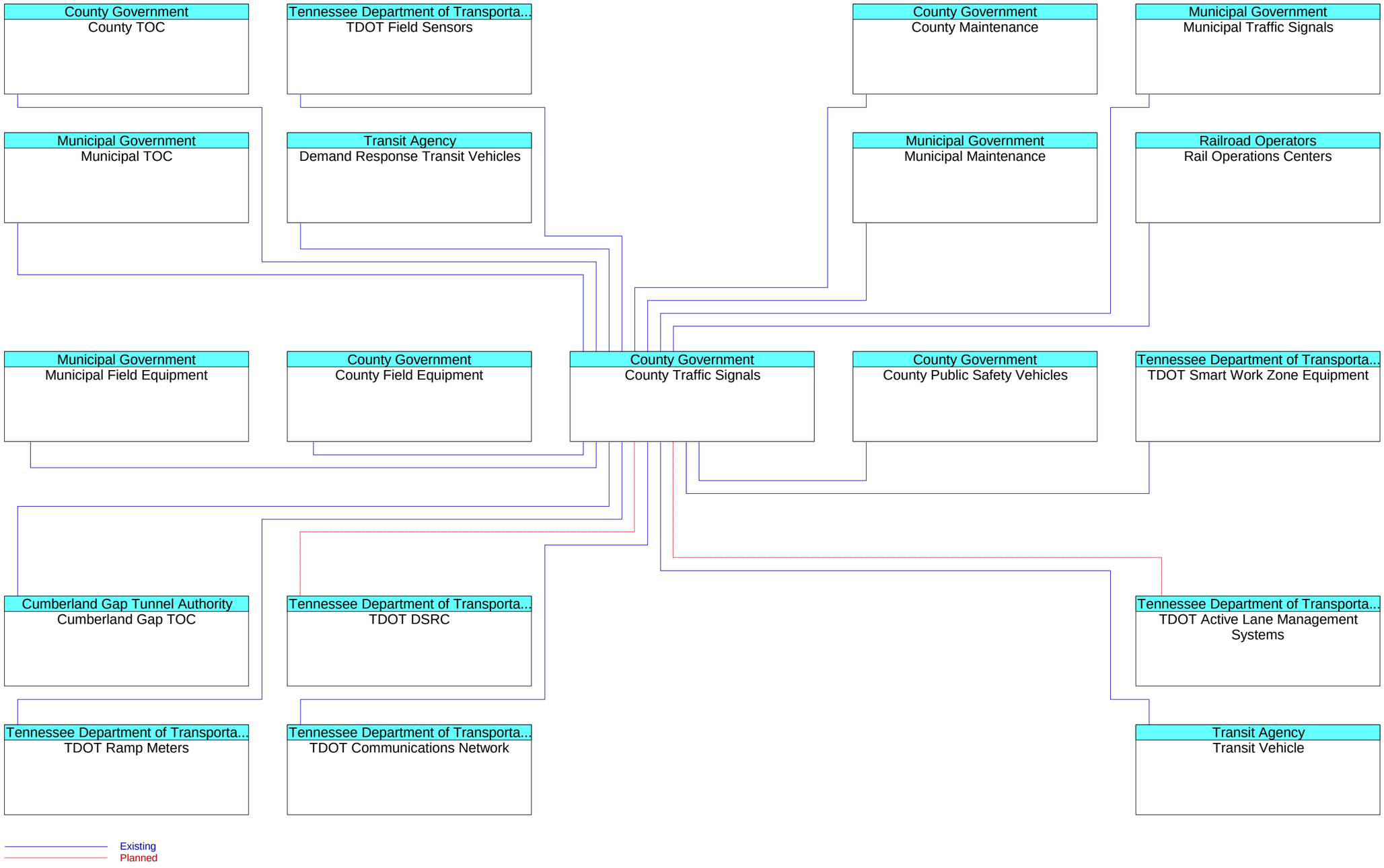


Figure 17: County Traffic Signal Interconnect Context Diagram

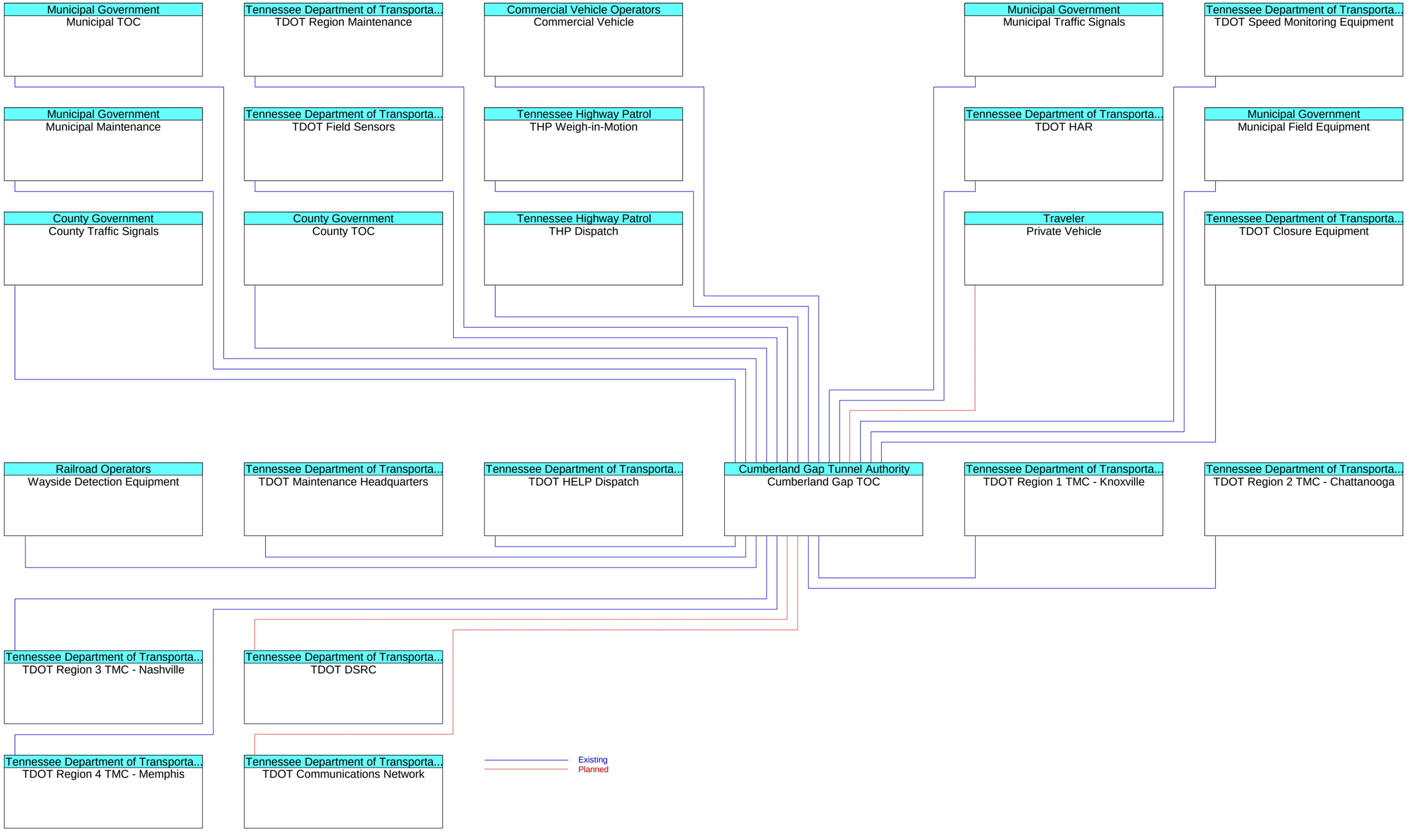


Figure 18: Cumberland Gap TOC Interconnect Context Diagram

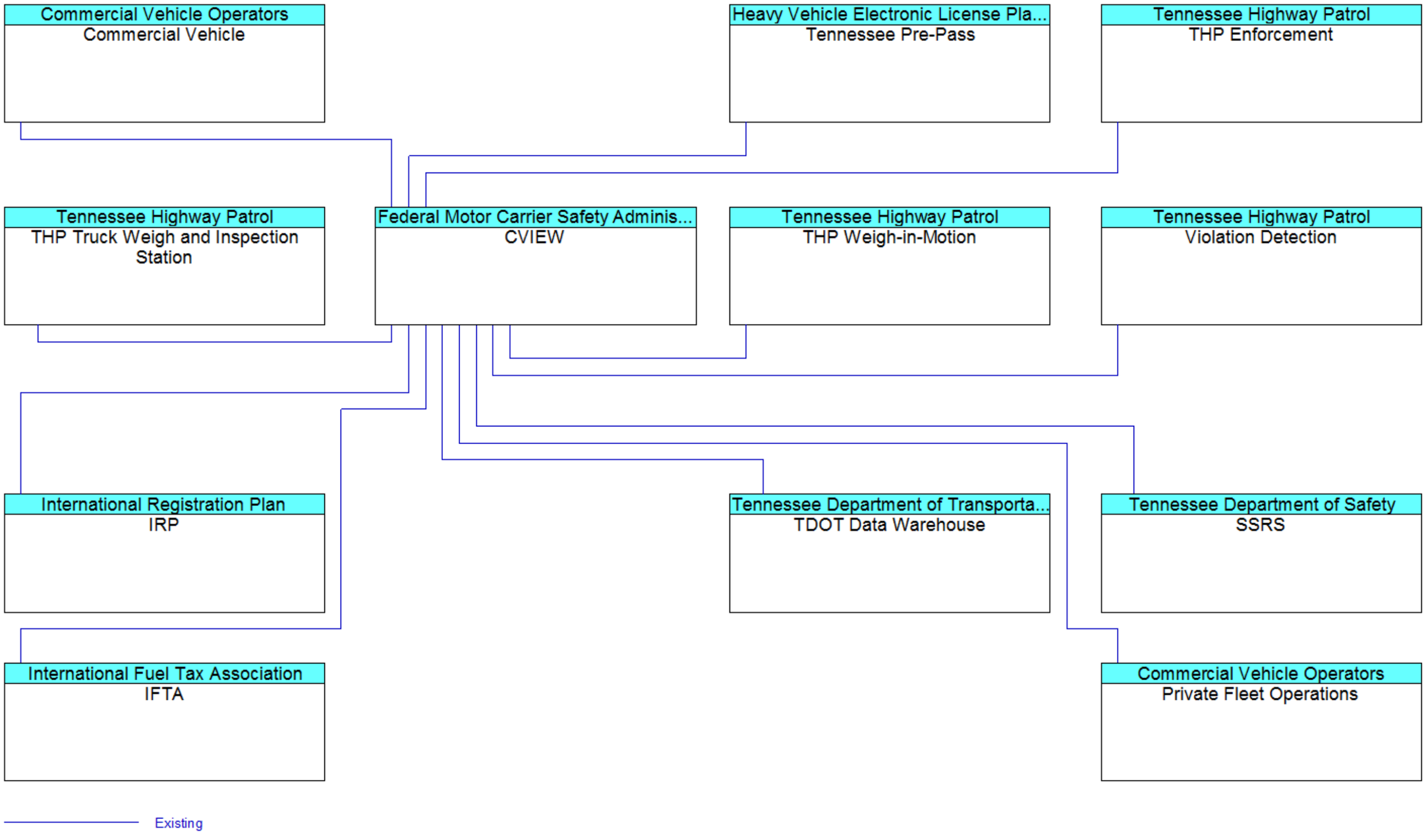


Figure 19: CVIEW Interconnect Context Diagram

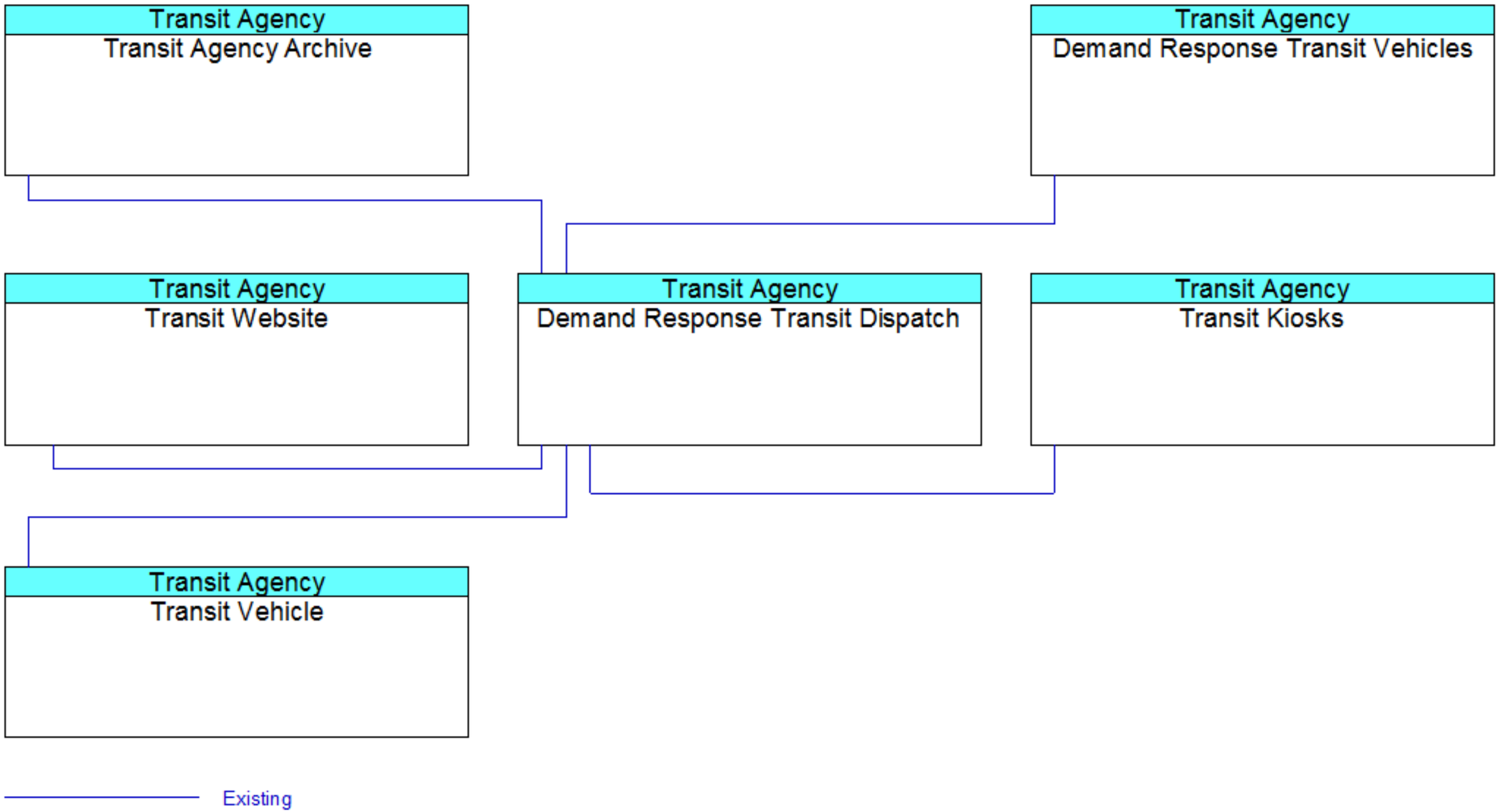


Figure 20: Demand Response Transit Dispatch Interconnect Context Diagram

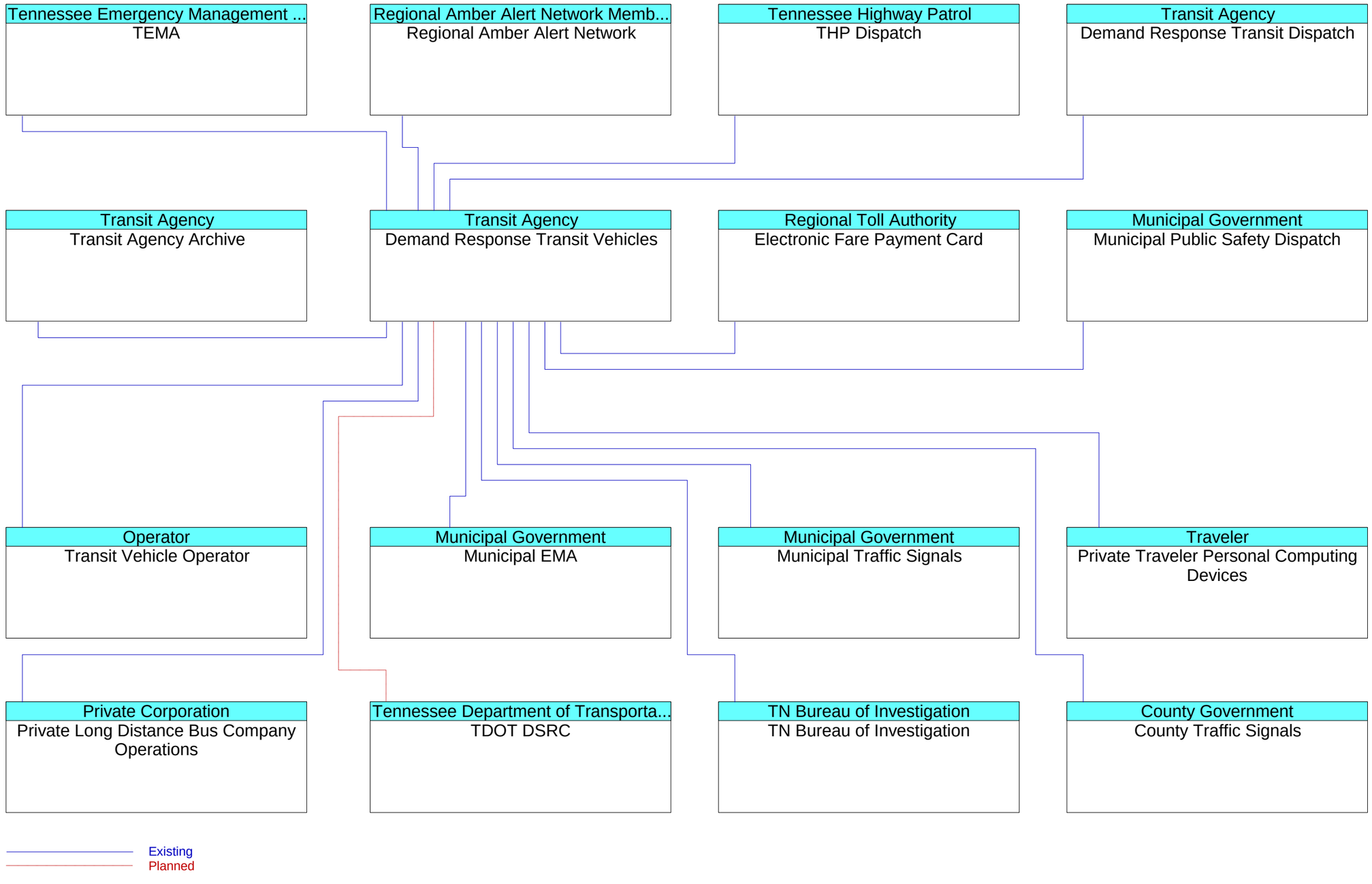


Figure 21: Demand Response Transit Vehicles Interconnect Context Diagram

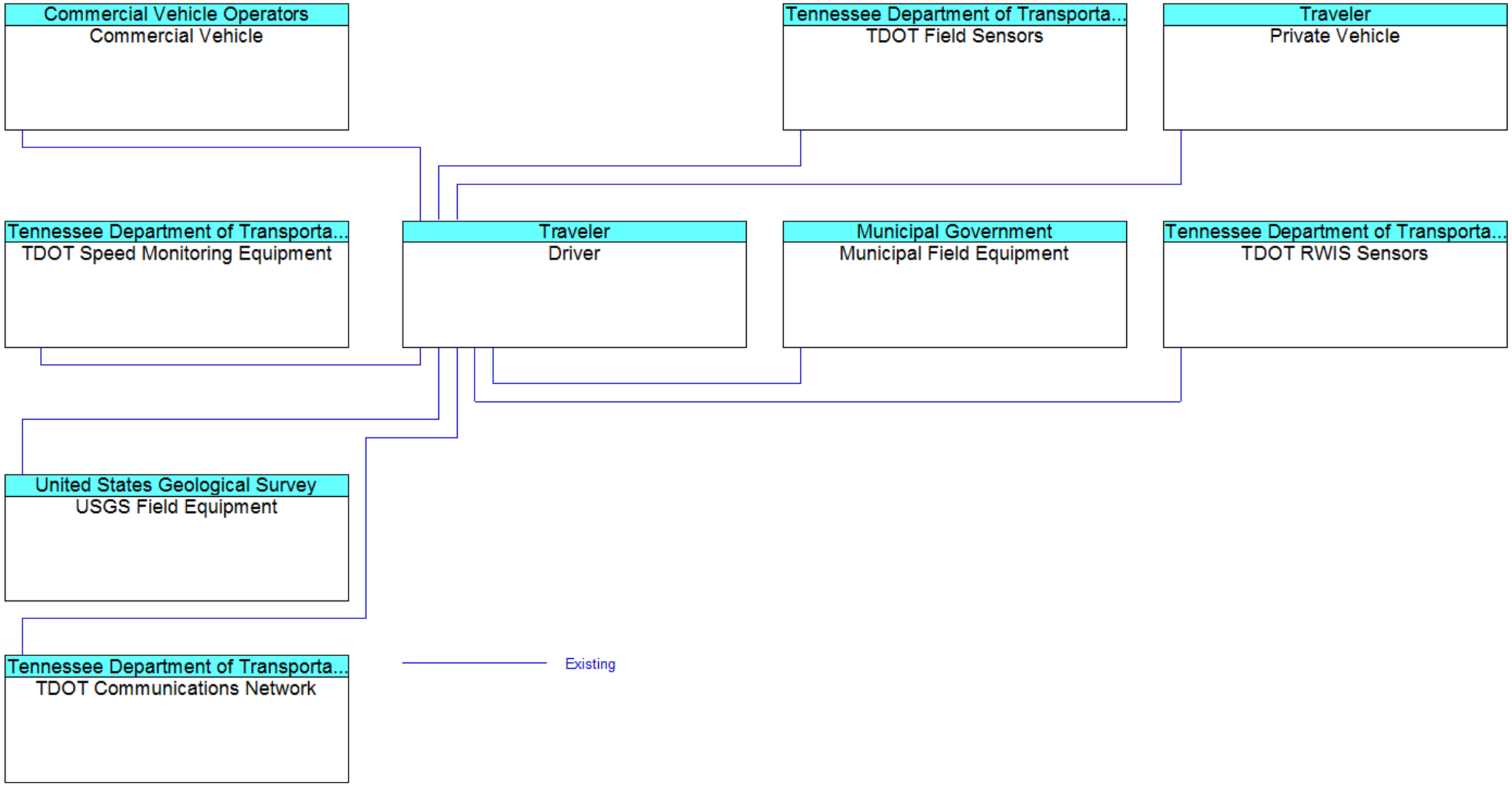


Figure 22: Driver Interconnect Context Diagram

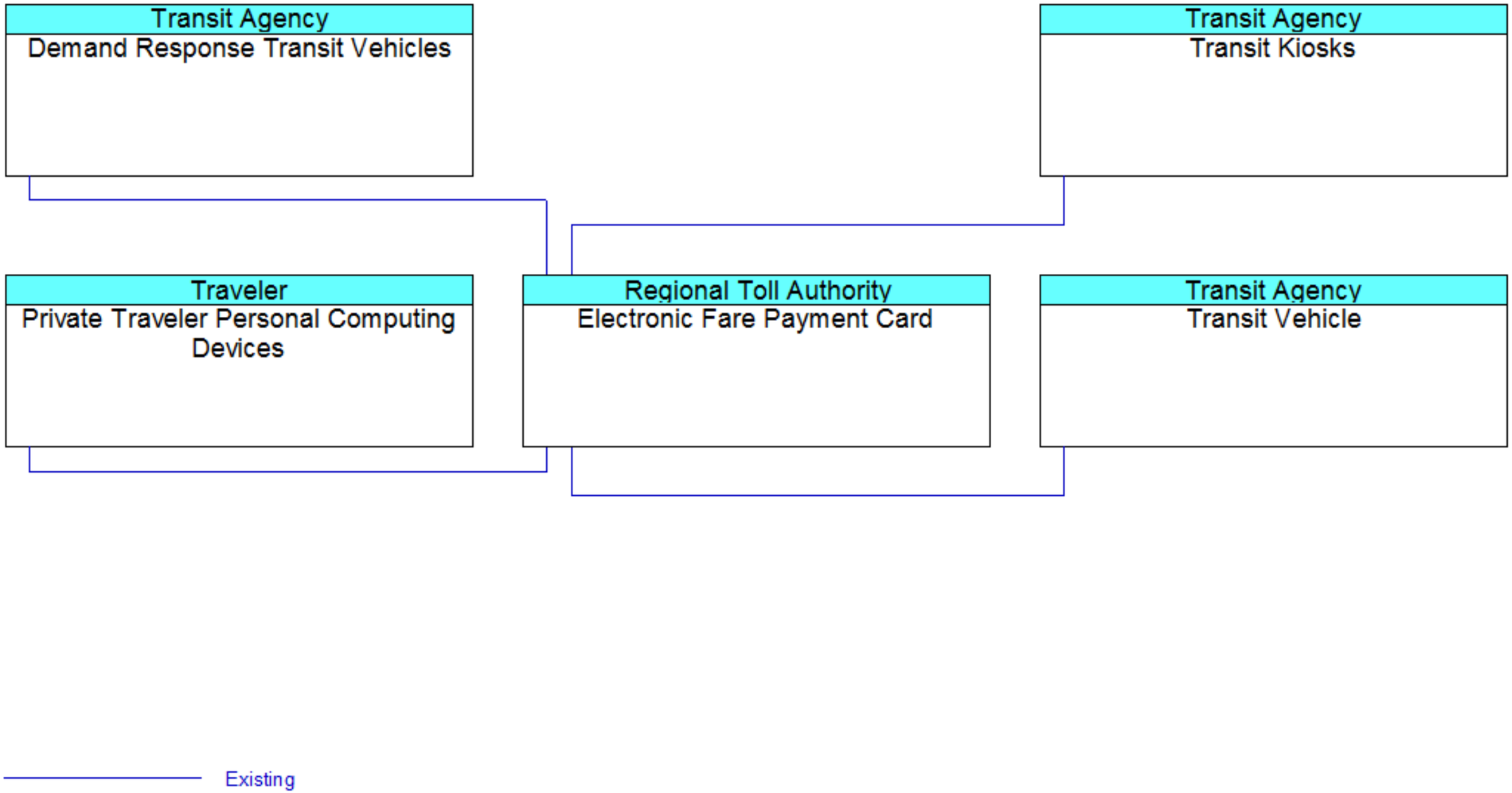


Figure 23: Electronic Fare Payment Interconnect Context Diagram

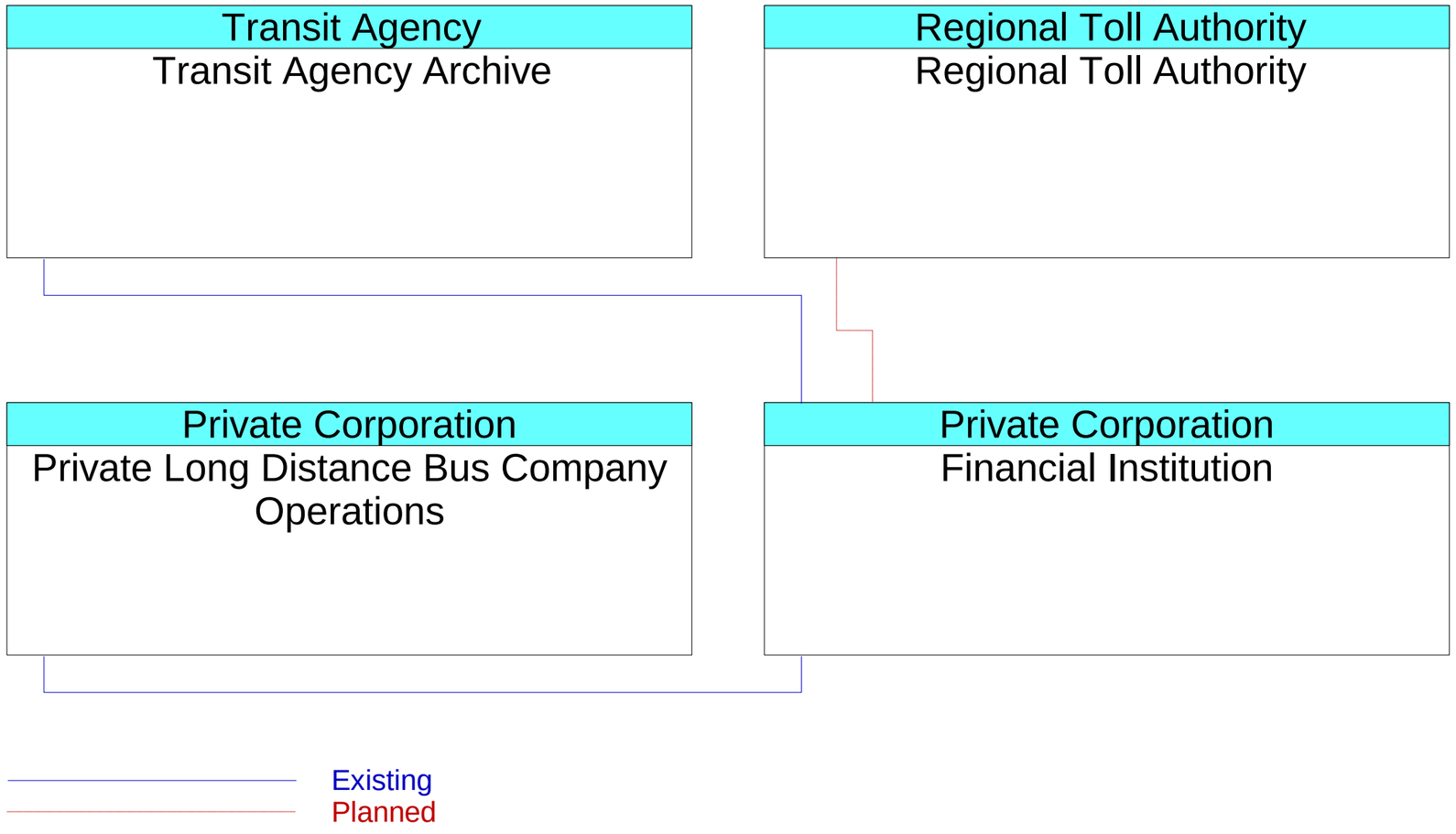


Figure 24: Financial Institutions Interconnect Context Diagram

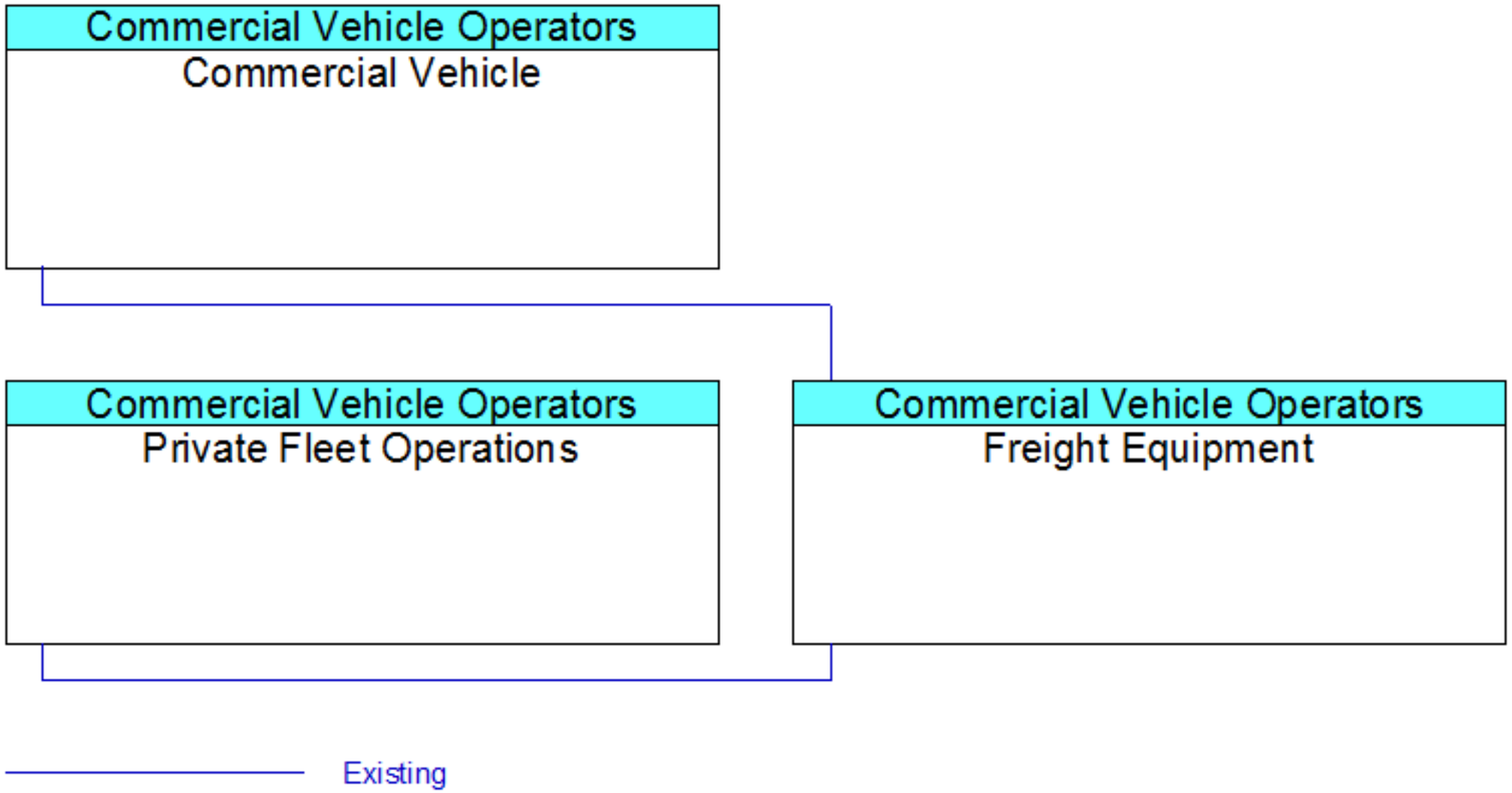


Figure 25: Freight Equipment Interconnect Context Diagram

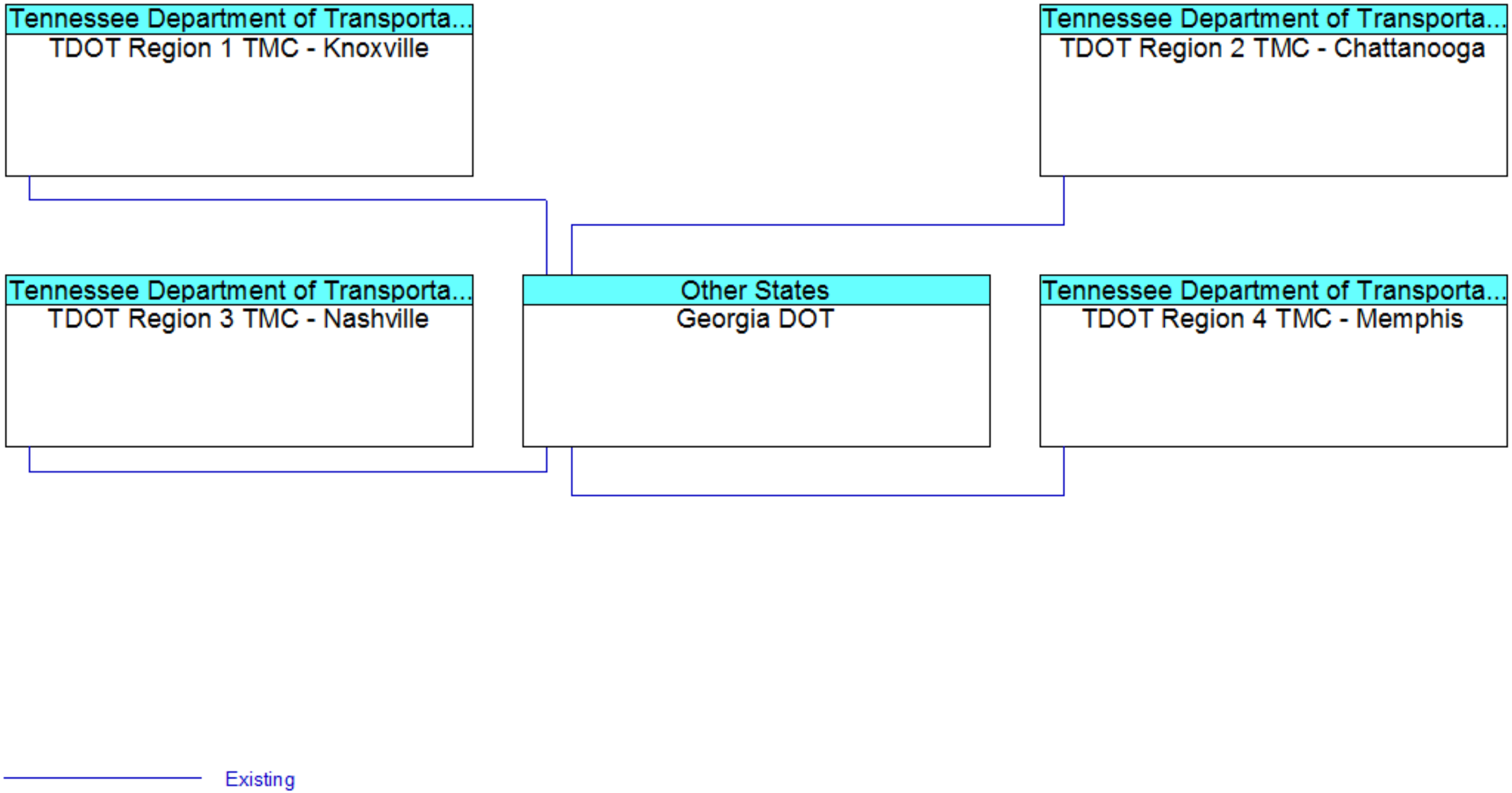


Figure 26: Georgia DOT Interconnect Context Diagram

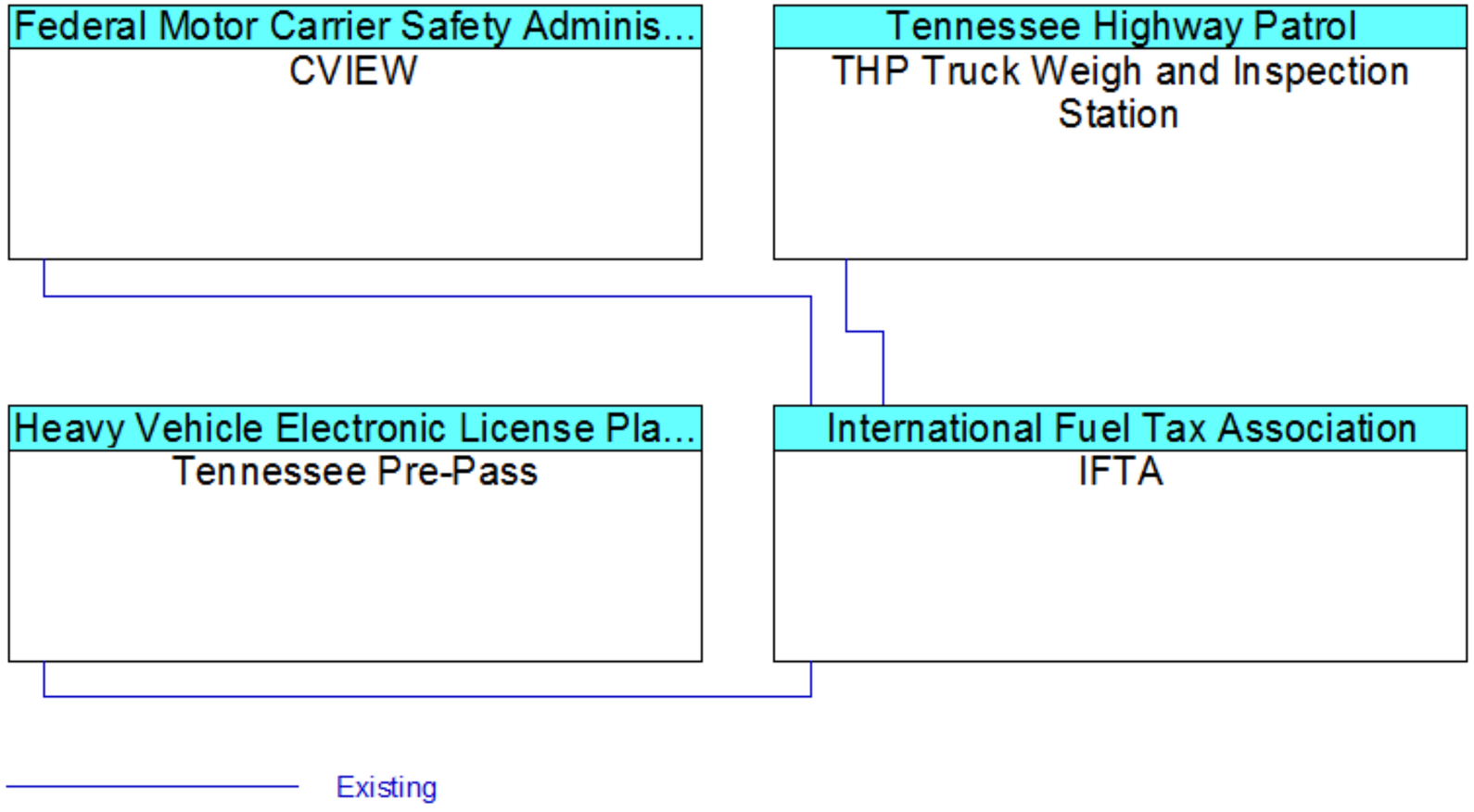


Figure 27: IFTA Interconnect Context Diagram

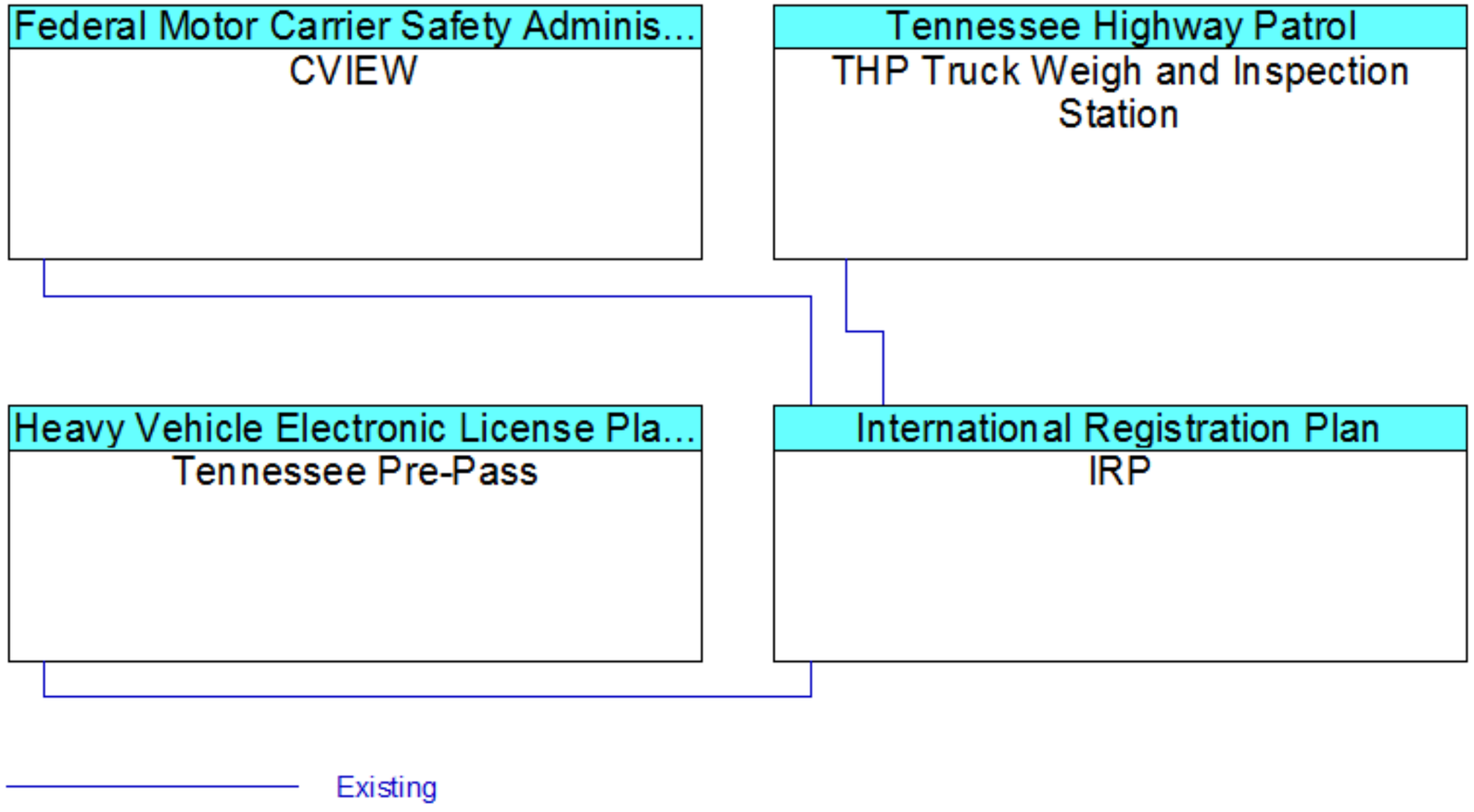


Figure 28: IRP Interconnect Context Diagram

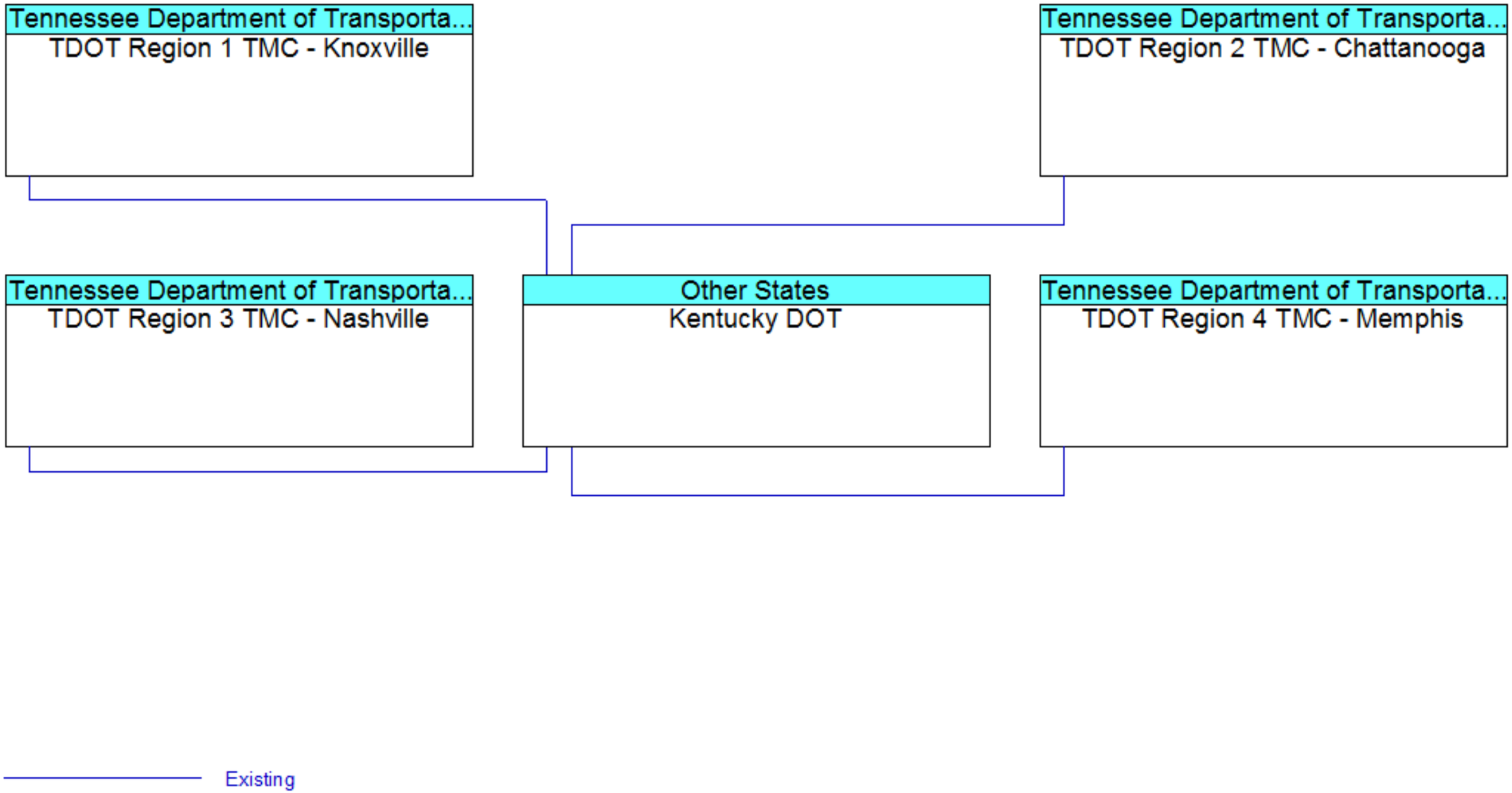


Figure 29: Kentucky DOT Interconnect Context Diagram

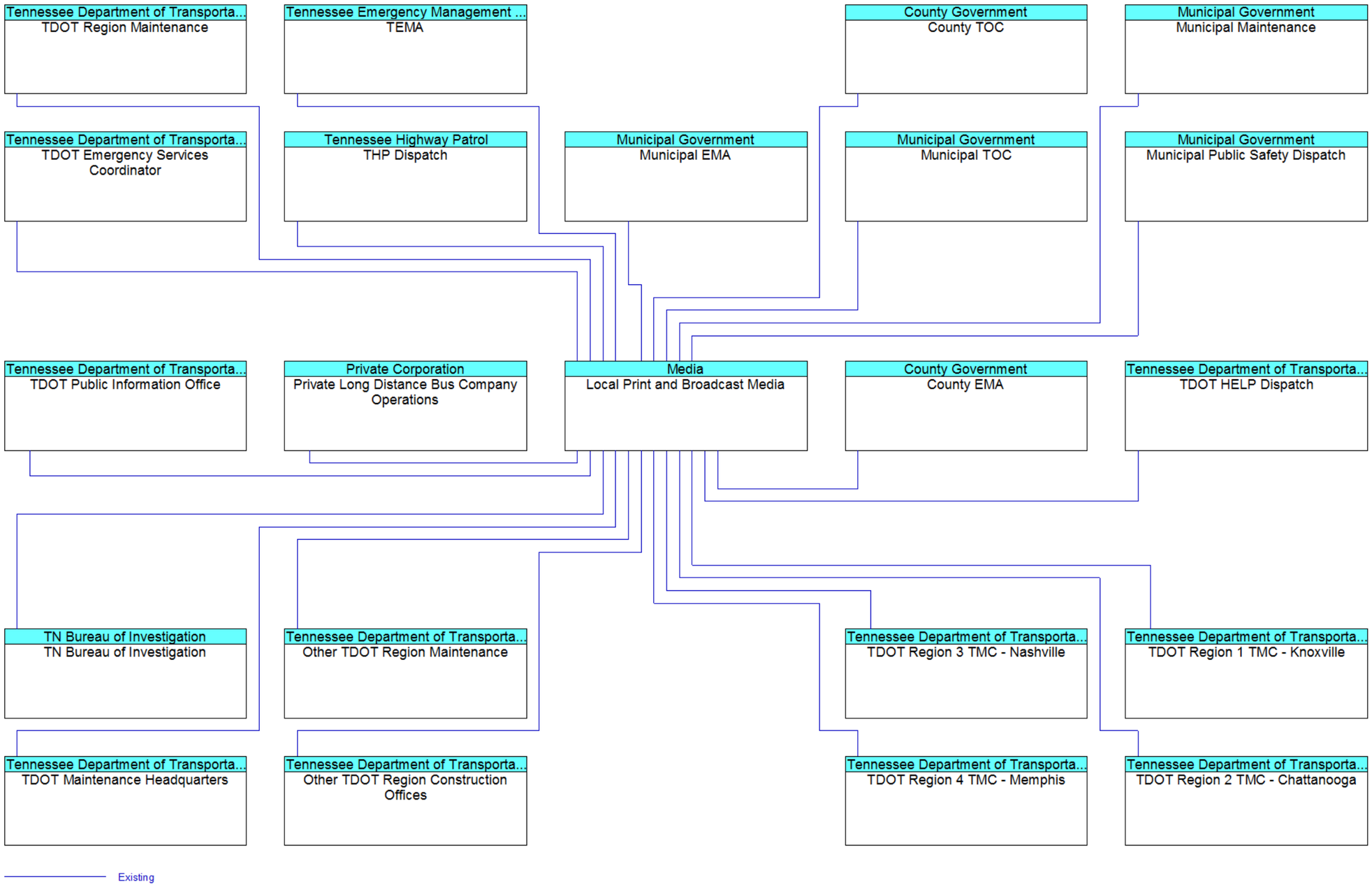


Figure 30: Local Print and Broadcast Media Interconnect Context Diagram

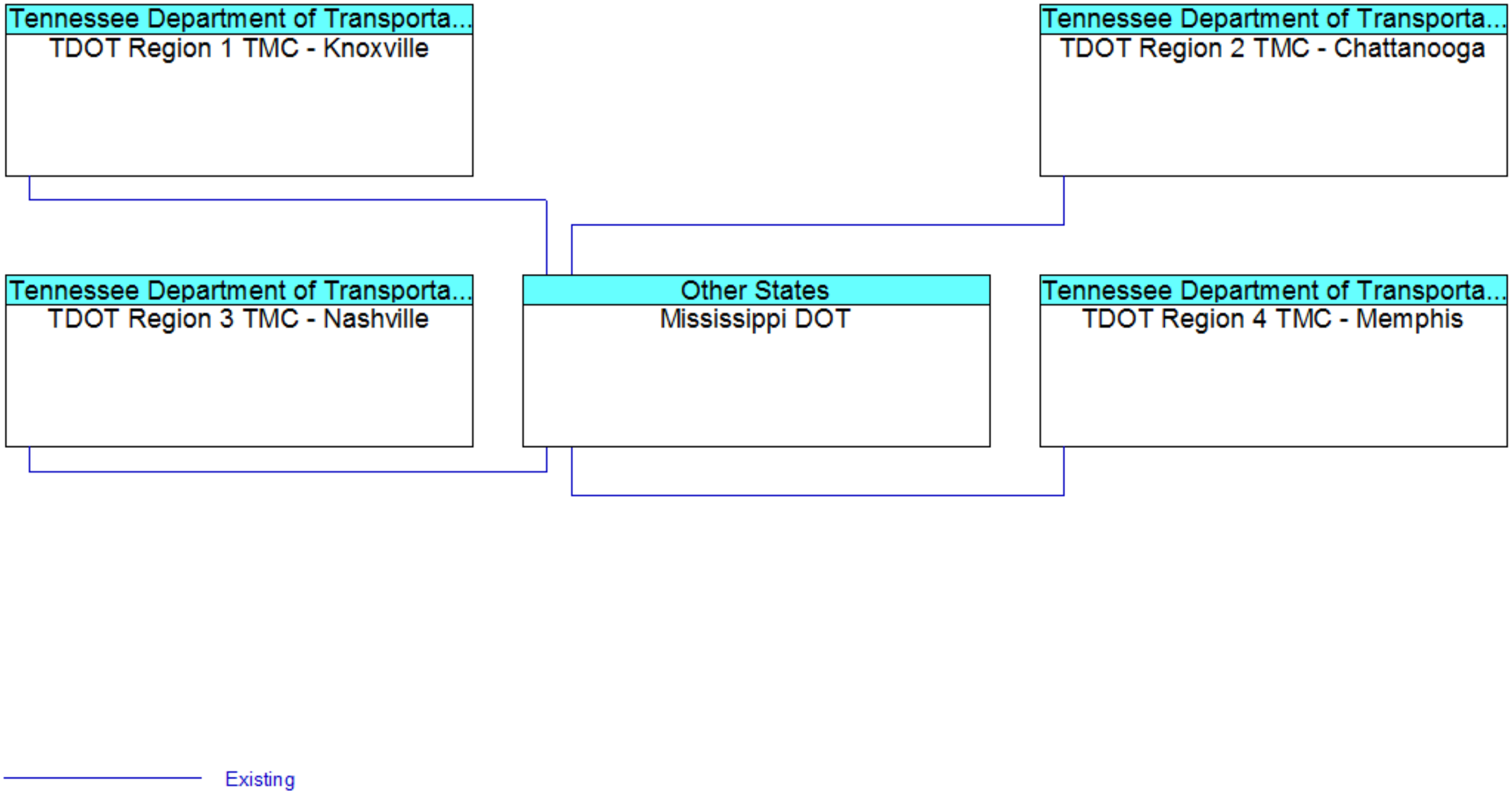


Figure 31: Mississippi DOT Interconnect Context Diagram

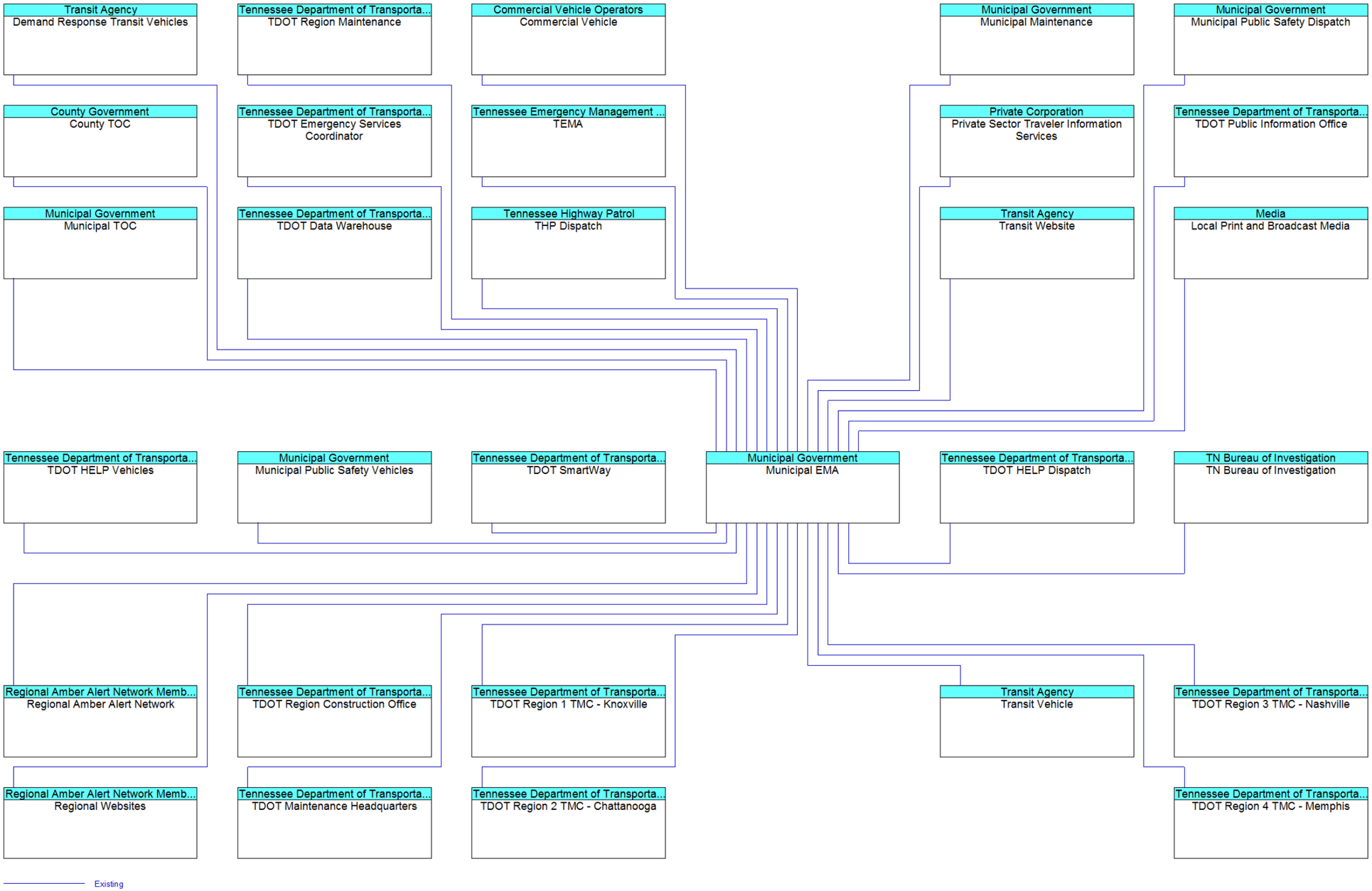


Figure 32: Municipal EMA Interconnect Context Diagram

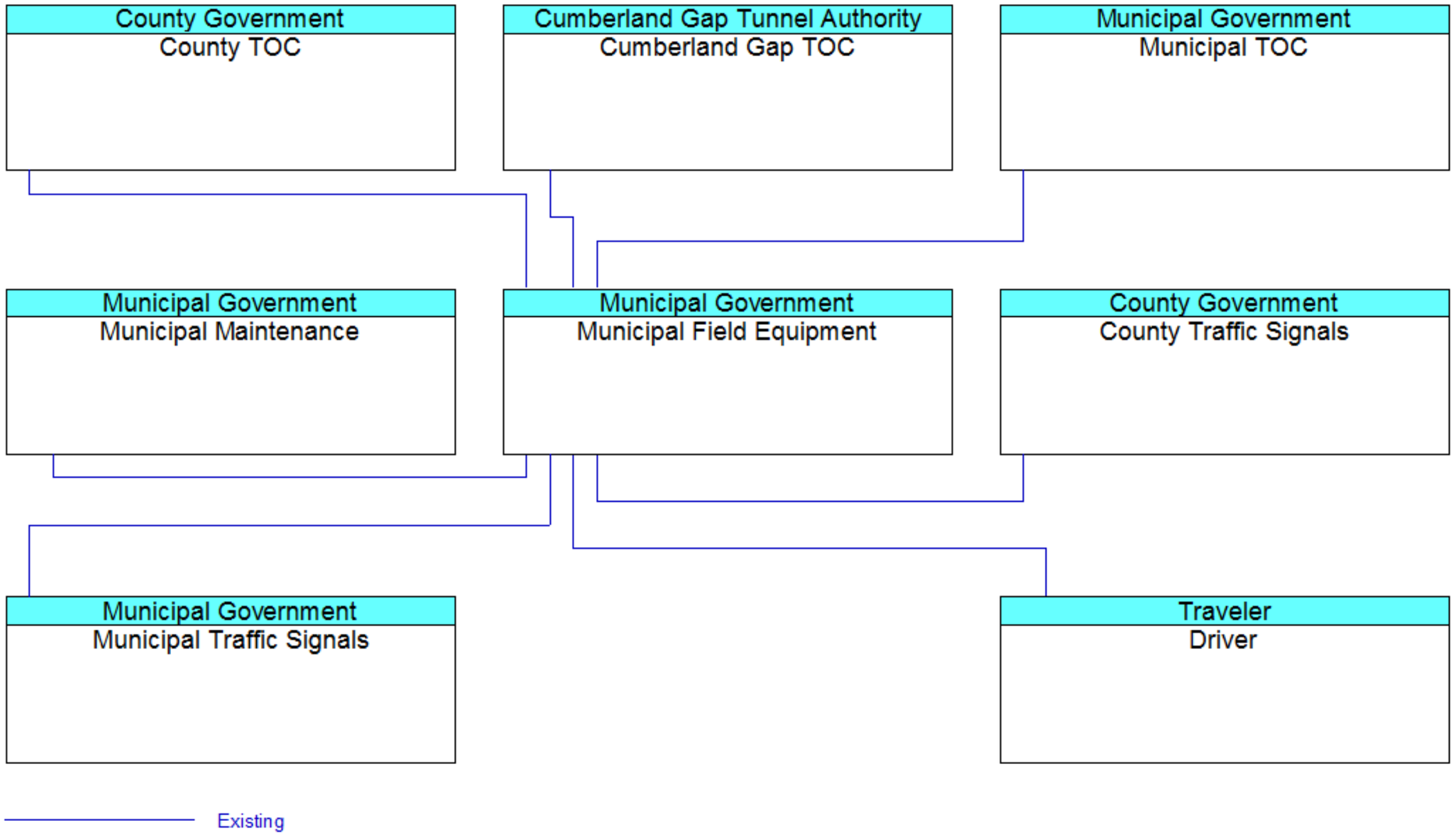


Figure 33: Municipal Field Equipment Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

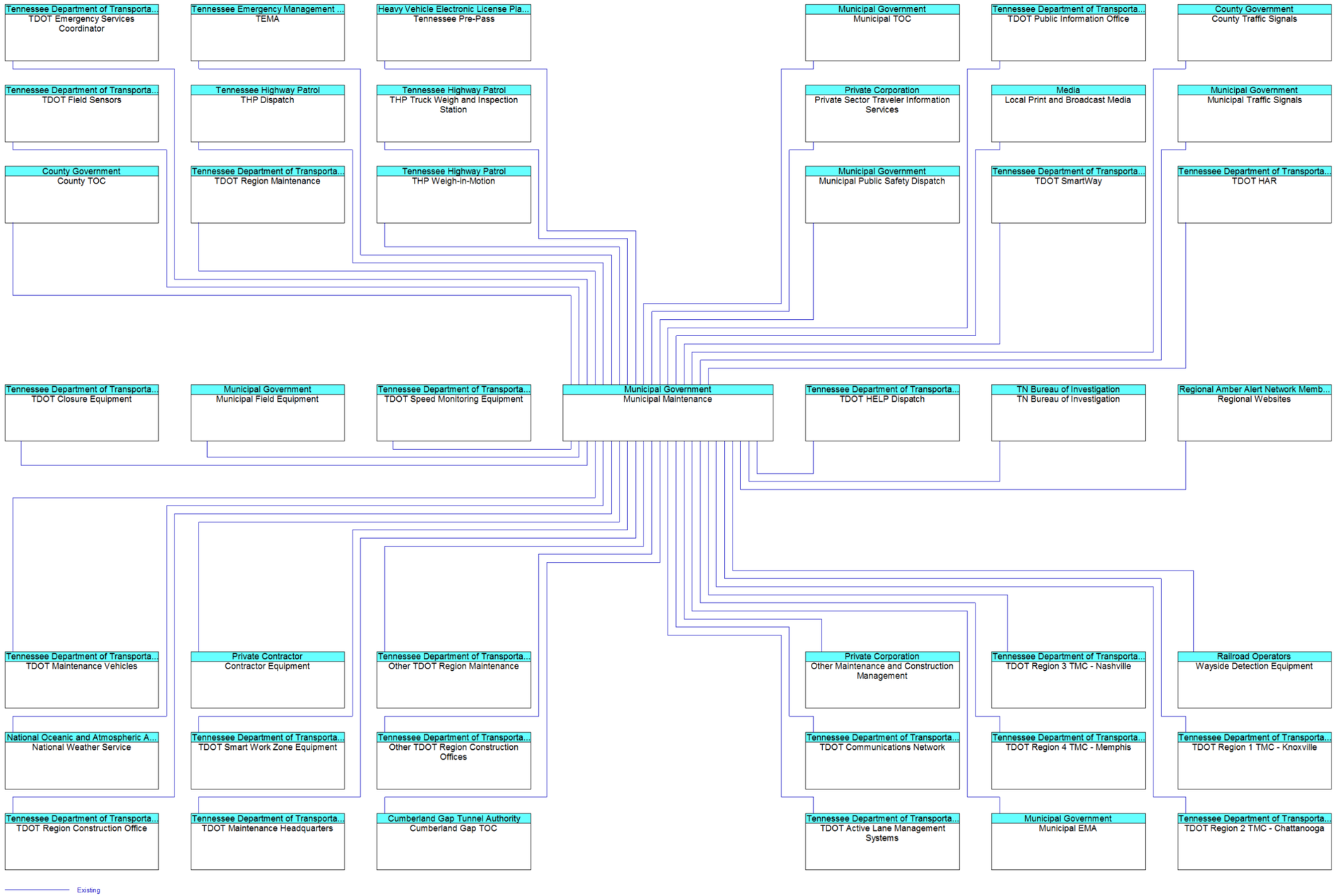


Figure 34: Municipal Maintenance Interconnect Context Diagram

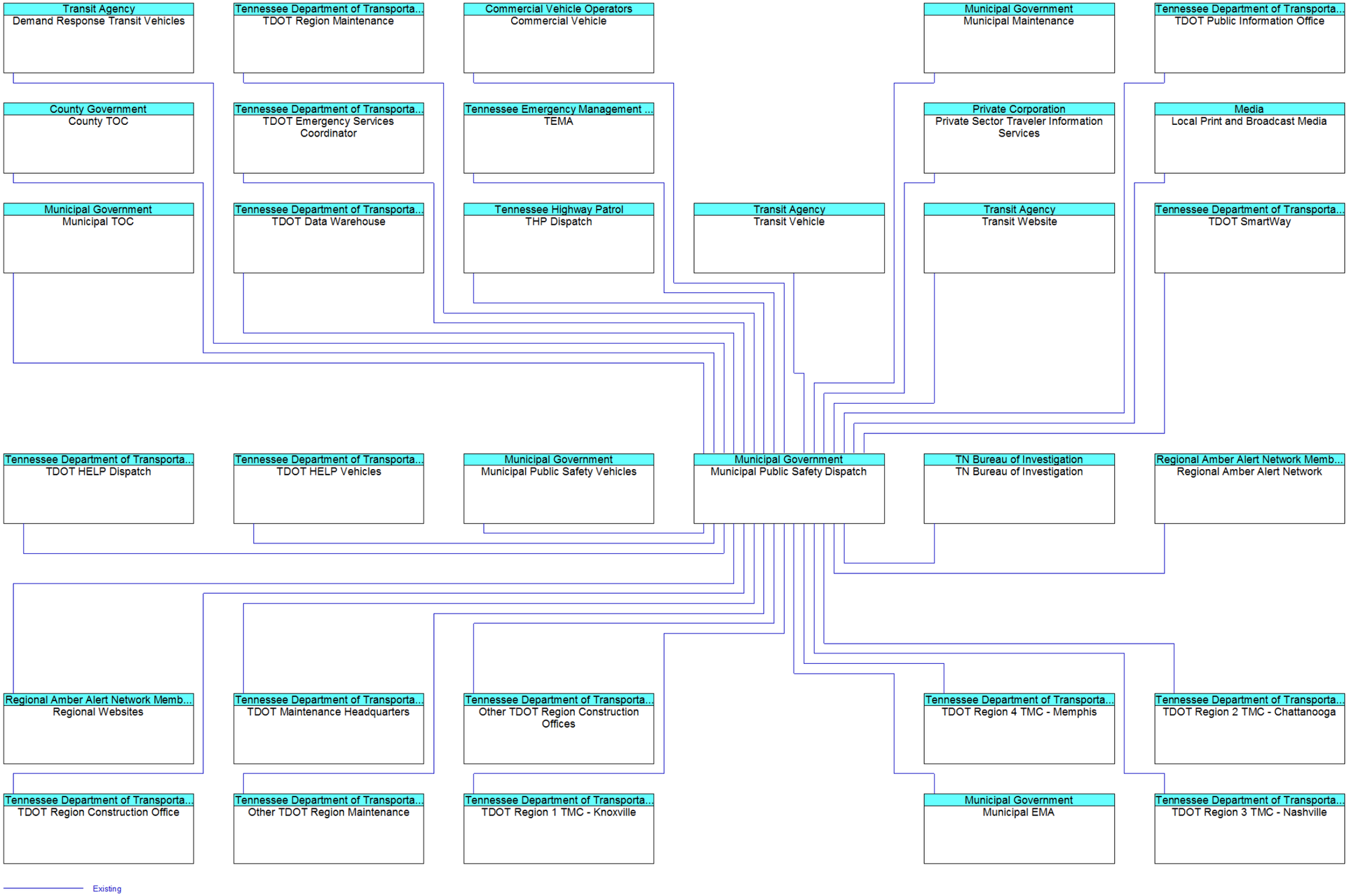


Figure 35: Municipal Public Safety Dispatch Interconnect Context Diagram

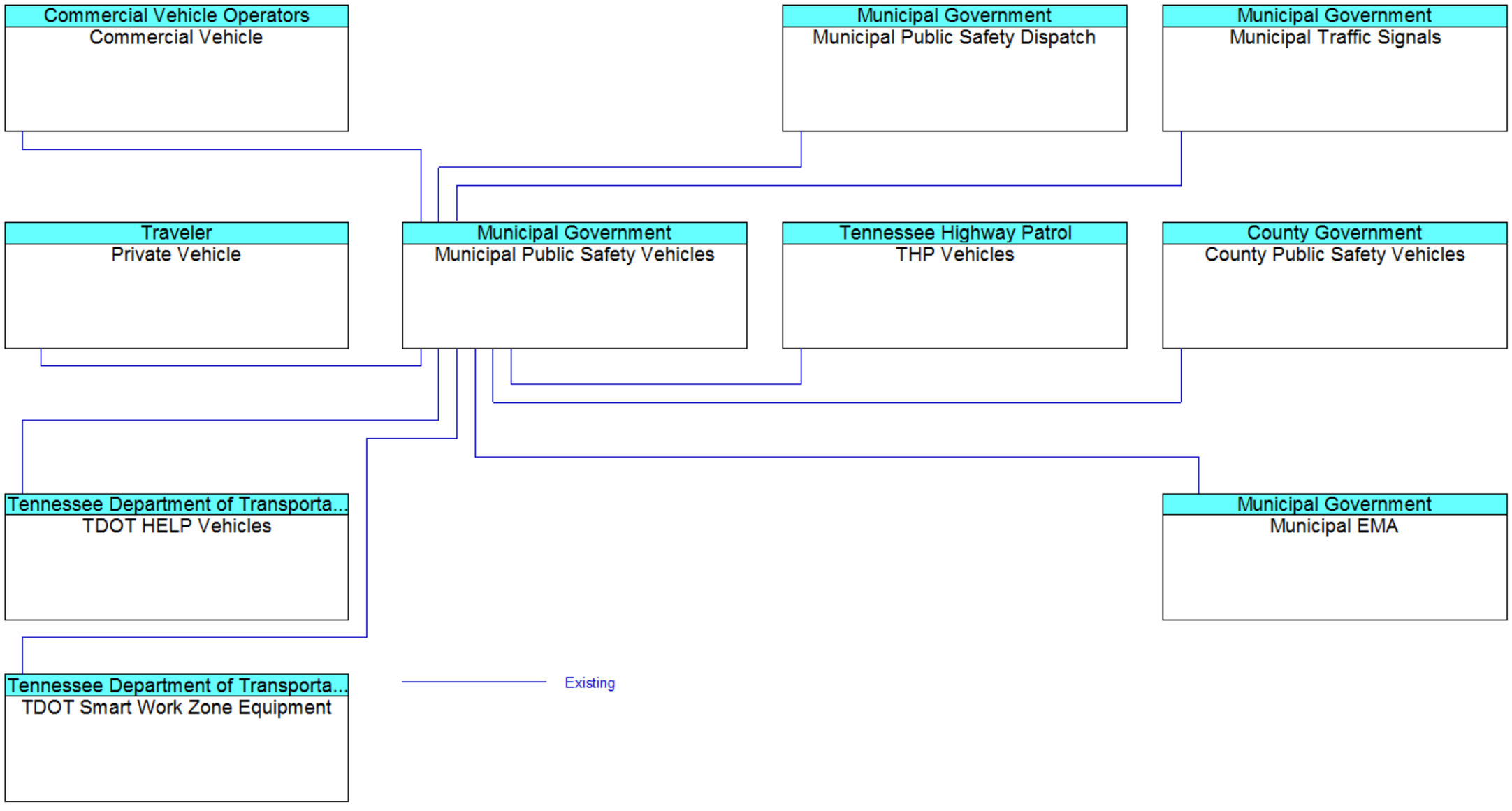


Figure 36: Municipal Public Safety Vehicles Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

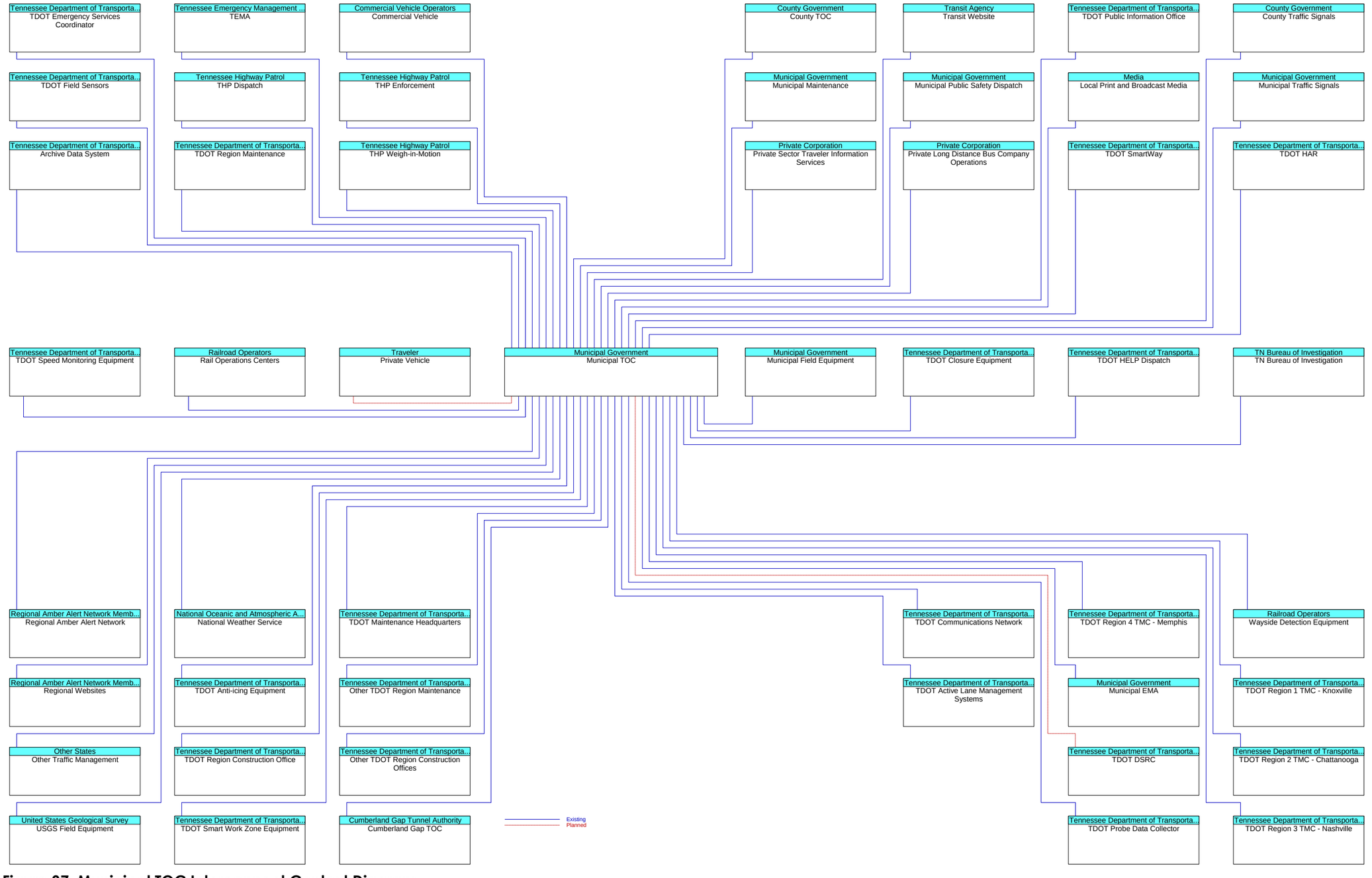


Figure 37: Municipal TOC Interconnect Context Diagram

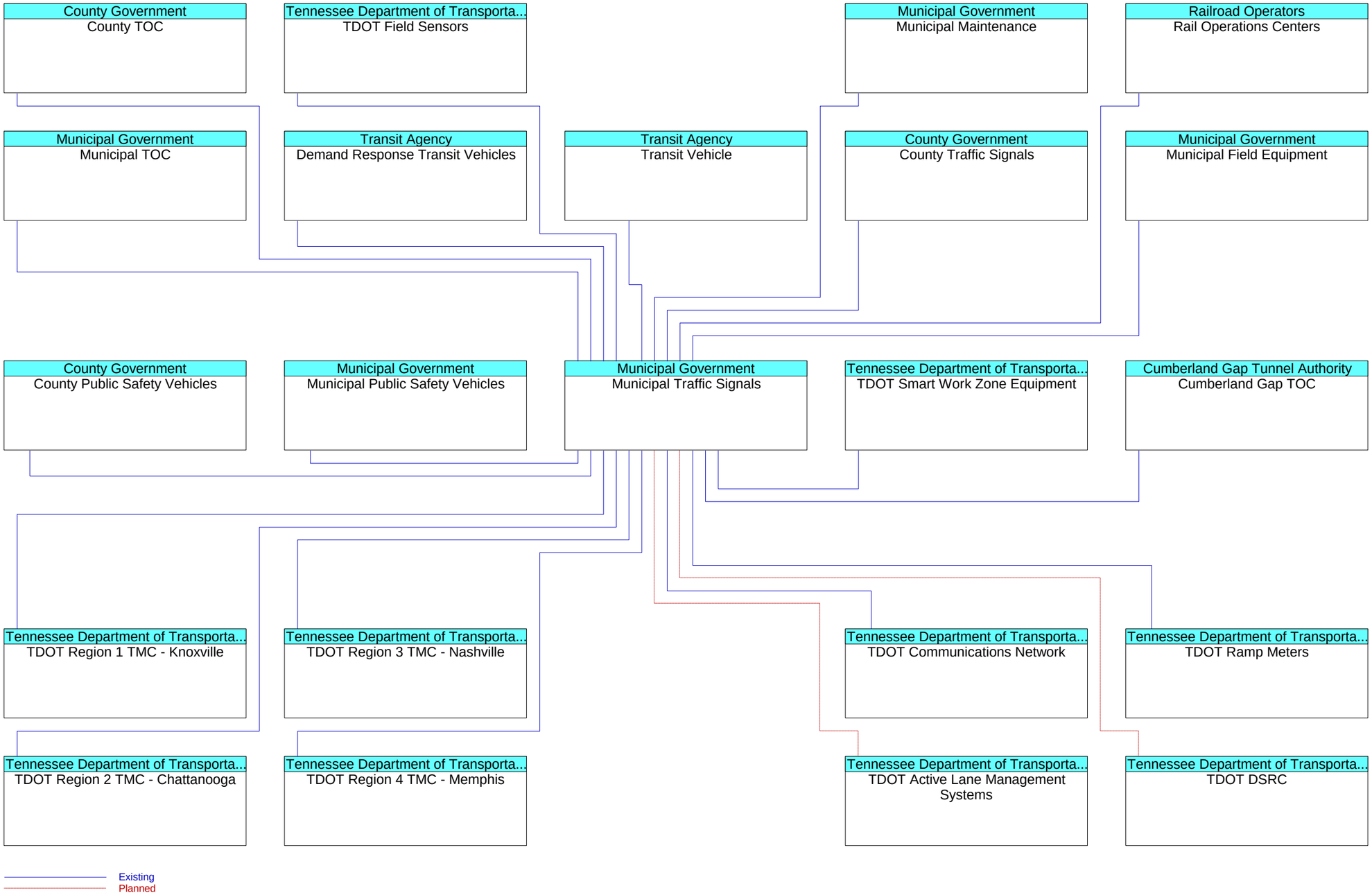


Figure 38: Municipal Traffic Signals Interconnect Context Diagram

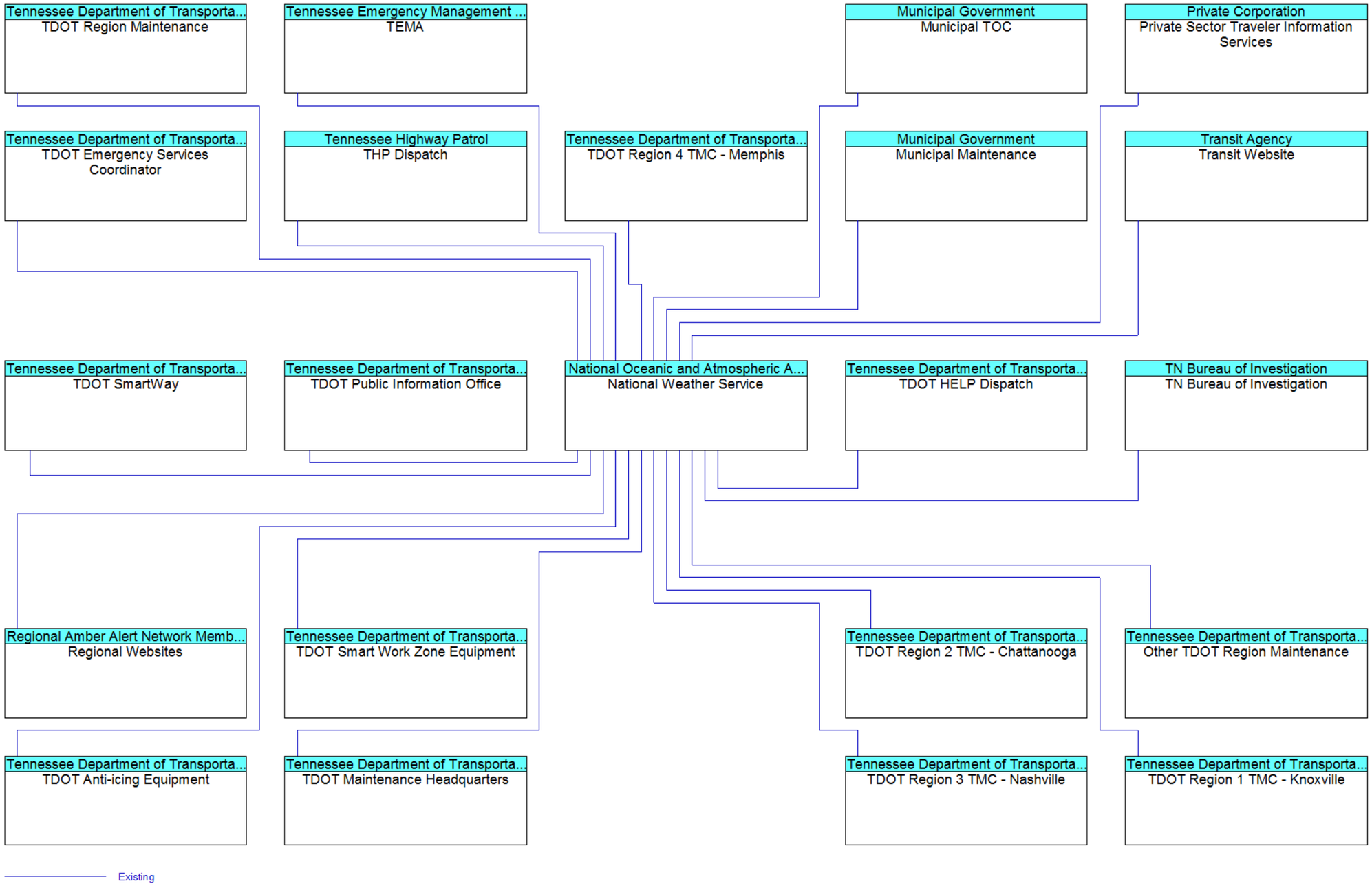


Figure 39: National Weather Service Interconnect Context Diagram

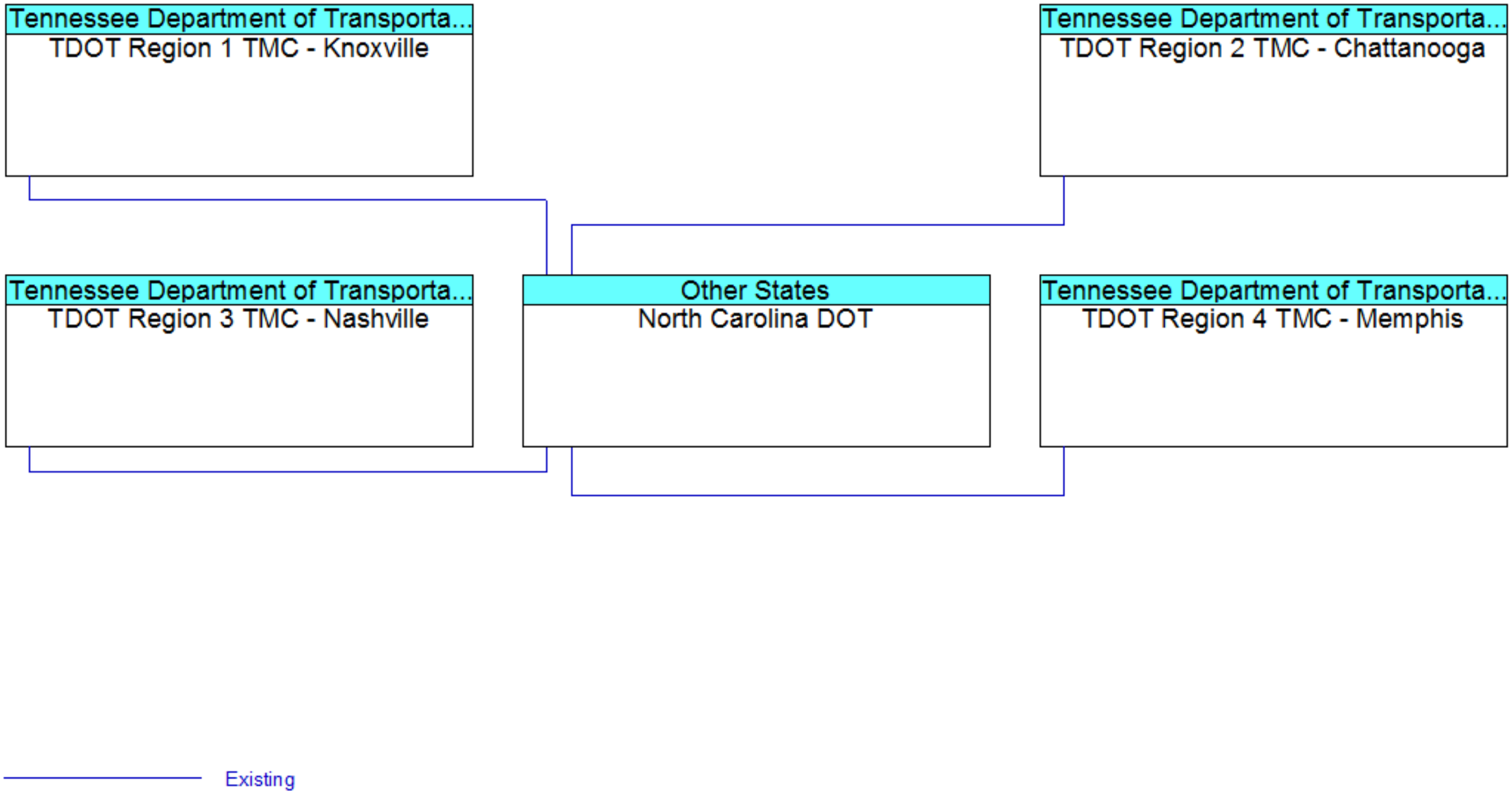


Figure 40: North Carolina DOT Interconnect Context Diagram

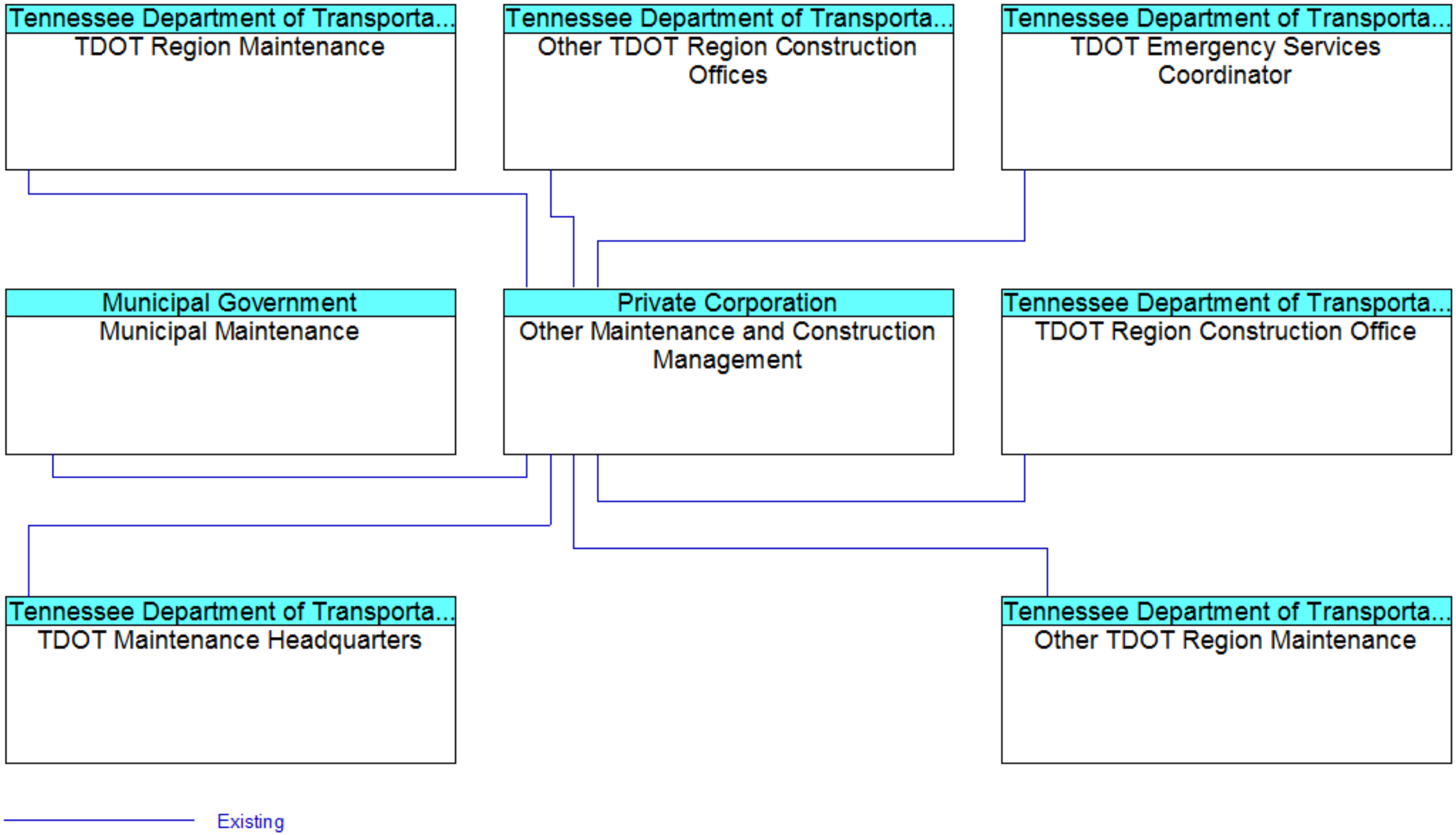


Figure 41: Other Maintenance and Construction Management Interconnect Context Diagram

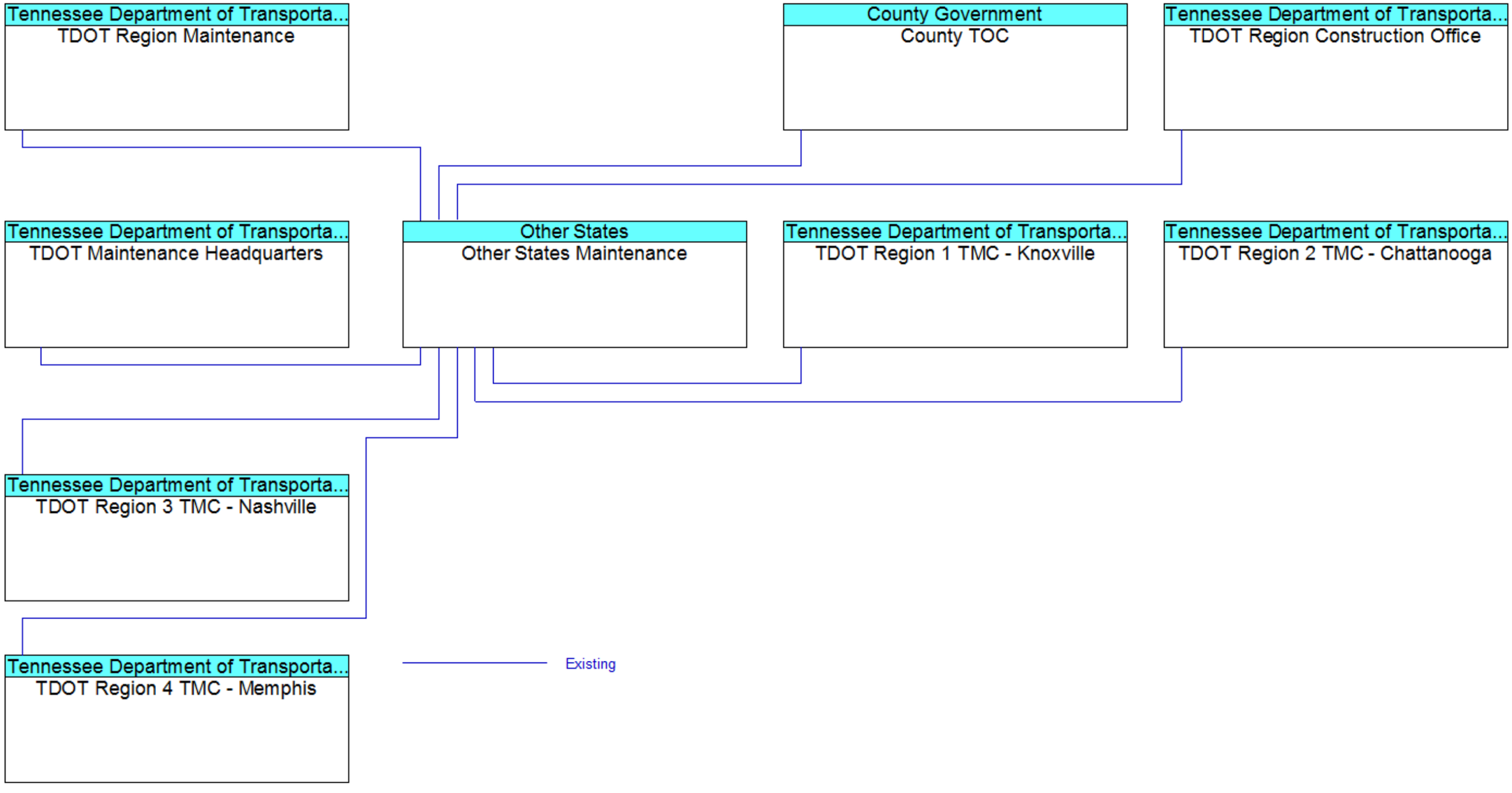


Figure 42: Other States Maintenance Interconnect Context Diagram

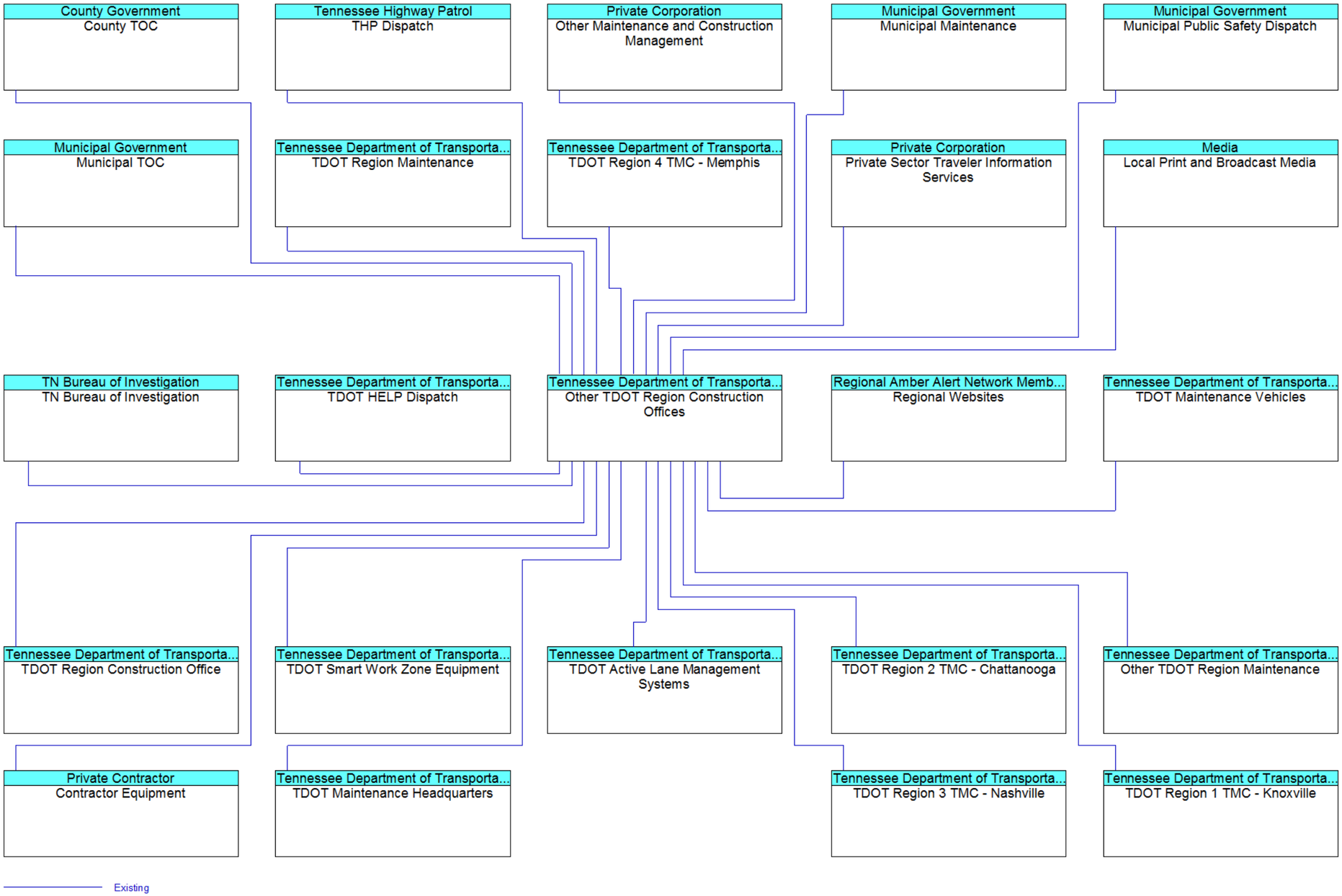


Figure 43: Other TDOT Region Construction Offices Interconnect Context Diagram

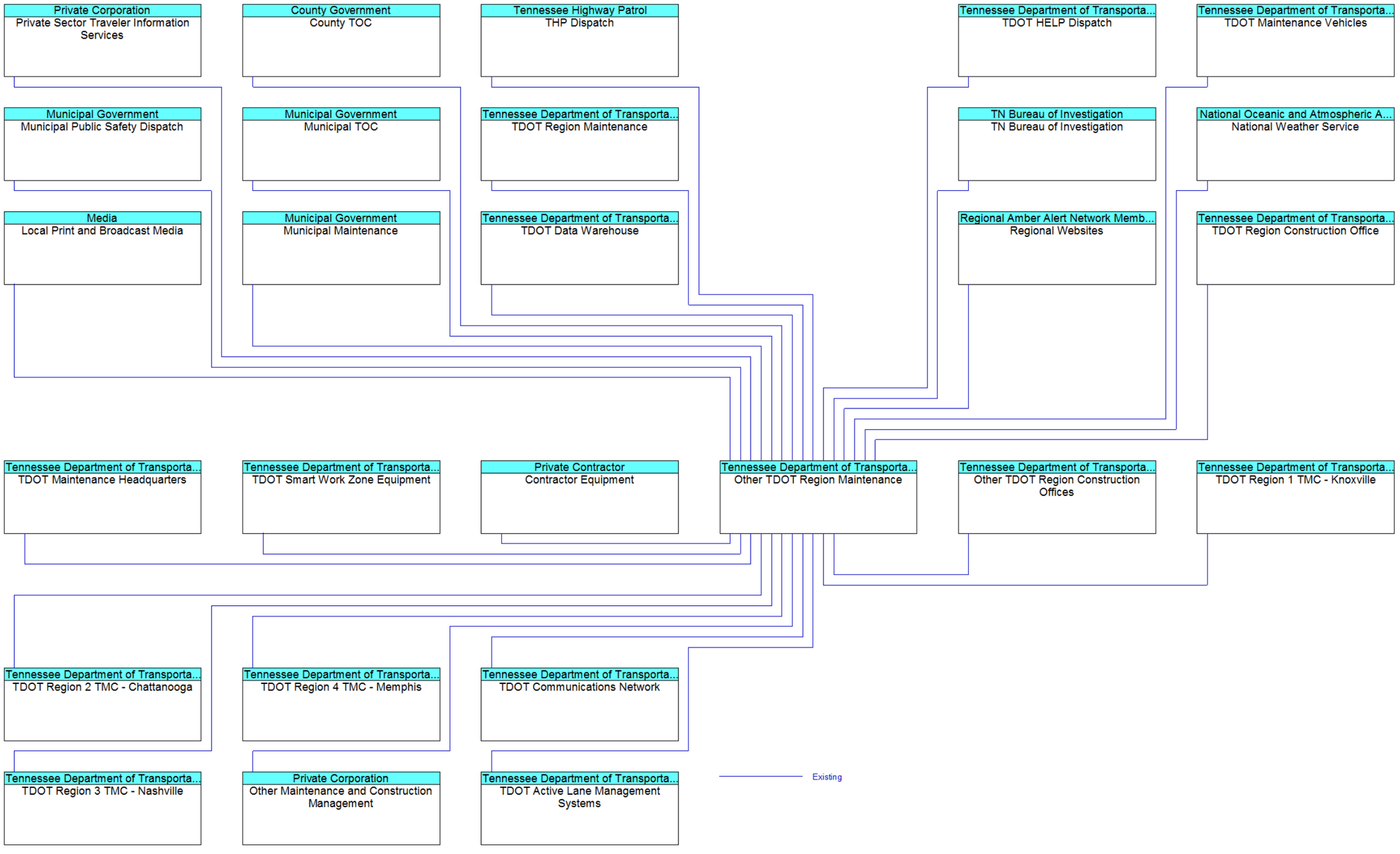


Figure 44: Other TDOT Region Maintenance Interconnect Context Diagram

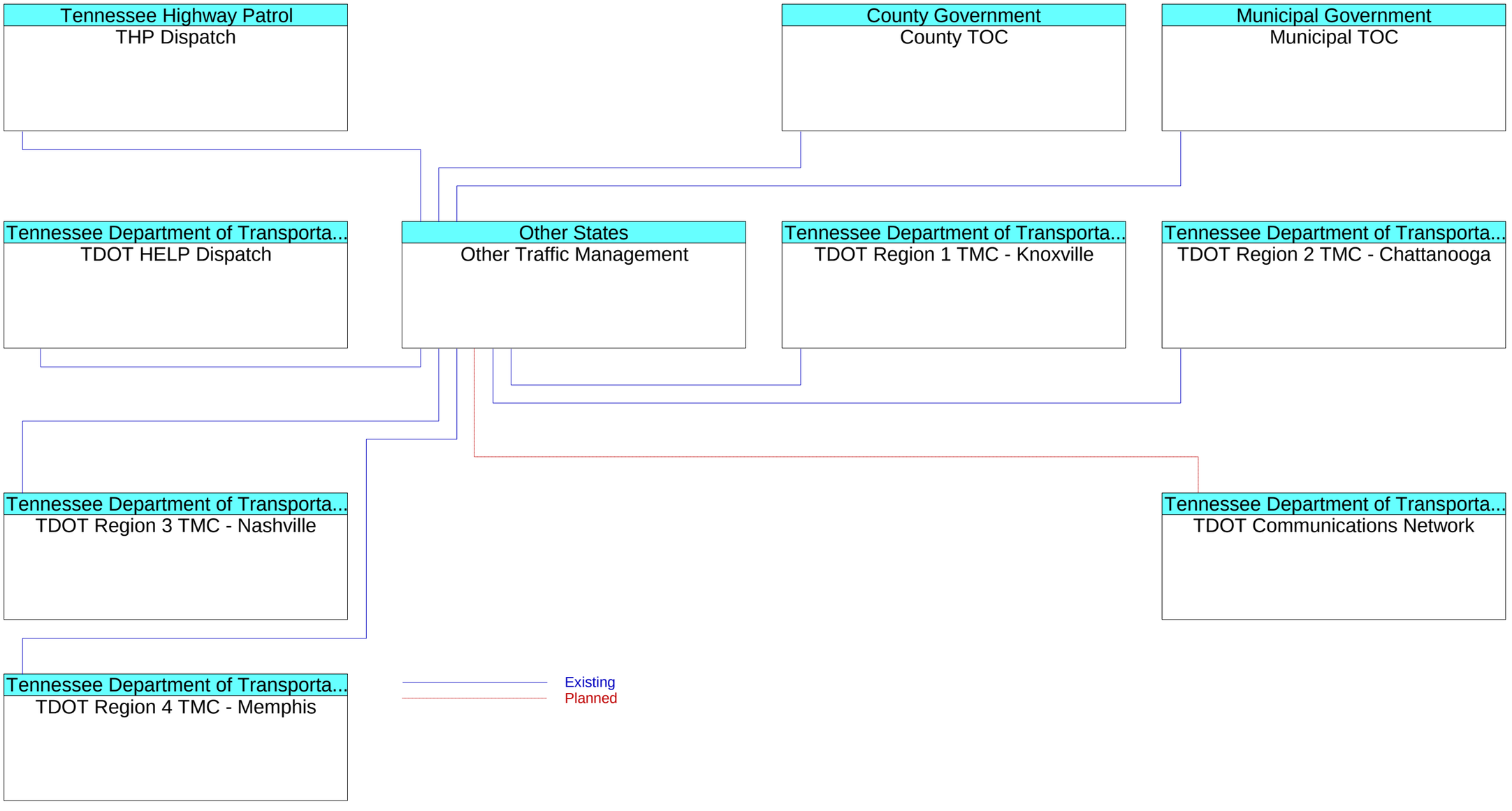


Figure 45: Other Traffic Management Interconnect Context Diagram

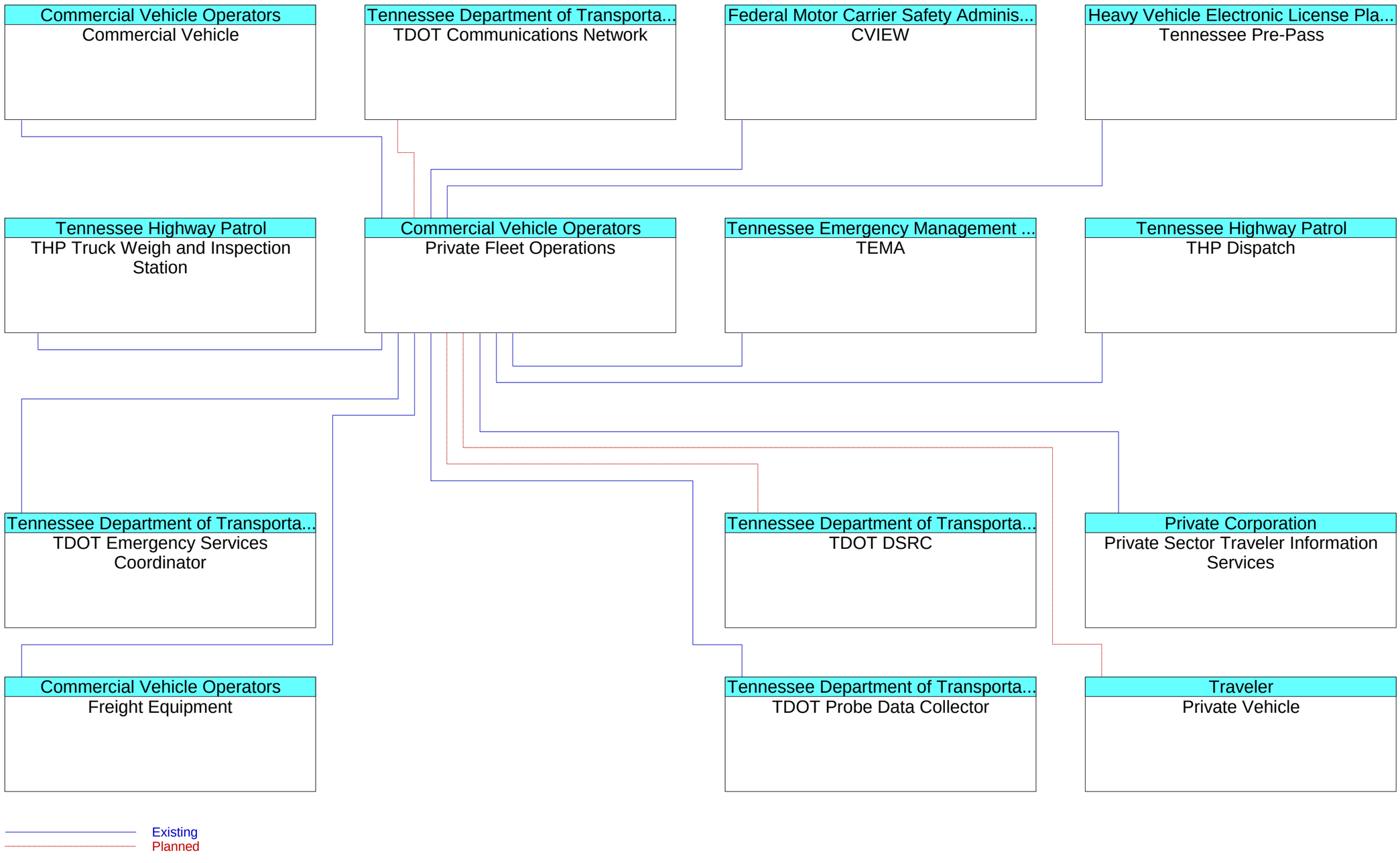


Figure 46: Private Fleet Operations Interconnect Context Diagram

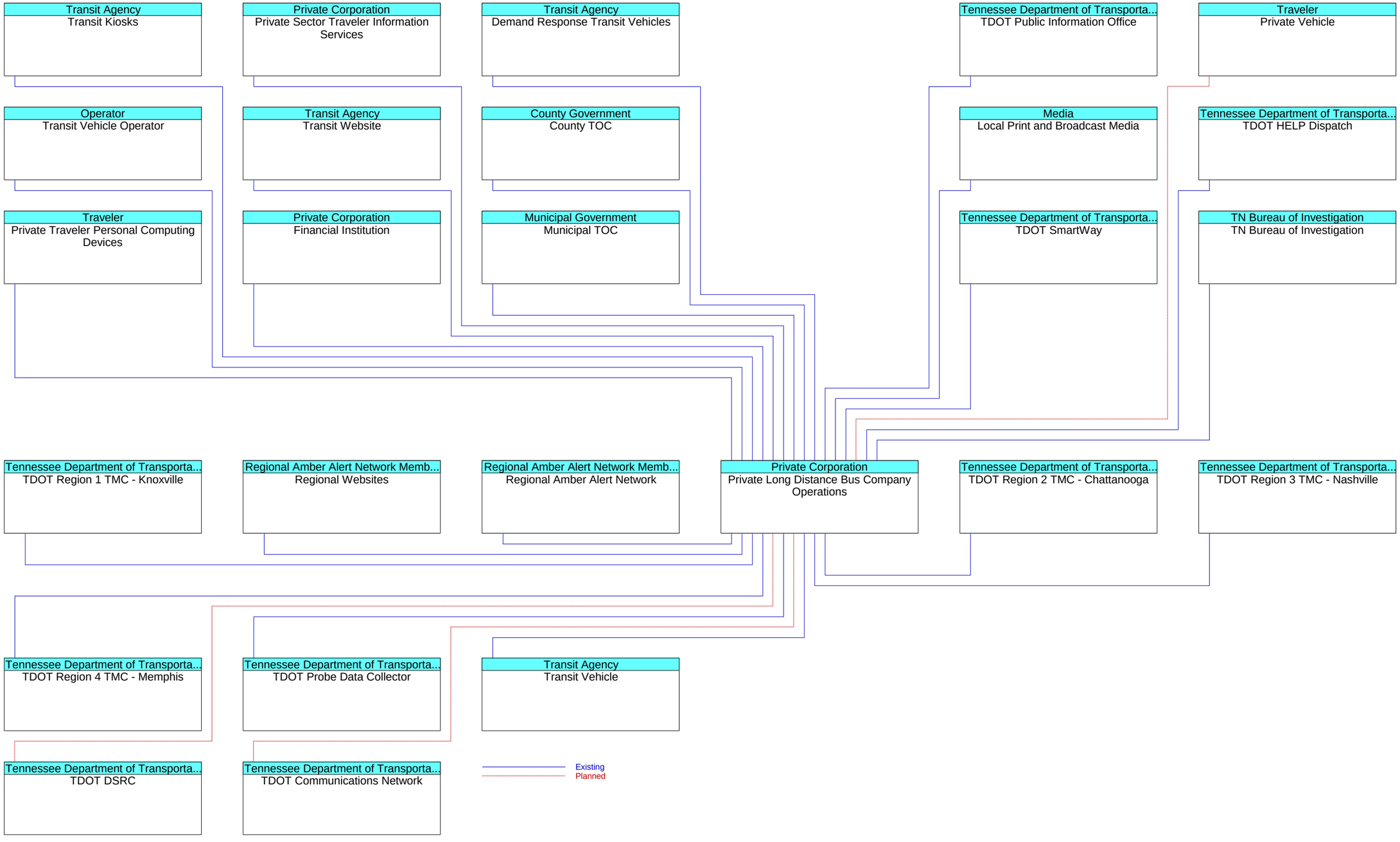


Figure 47: Private Long Distance Bus Company Operations Interconnect Context Diagram

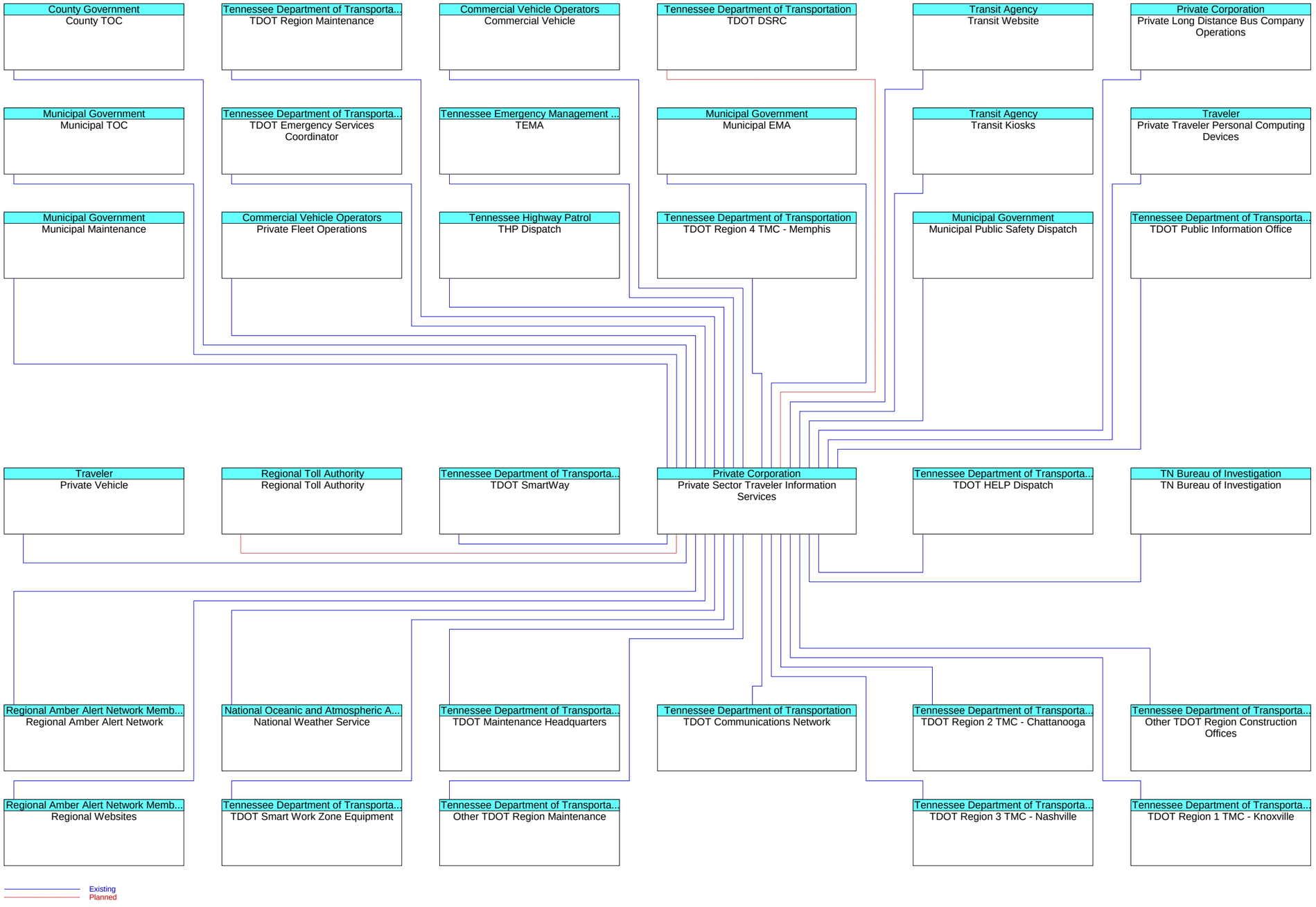


Figure 48: Private Sector Traveler Information Services Interconnect Context Diagram

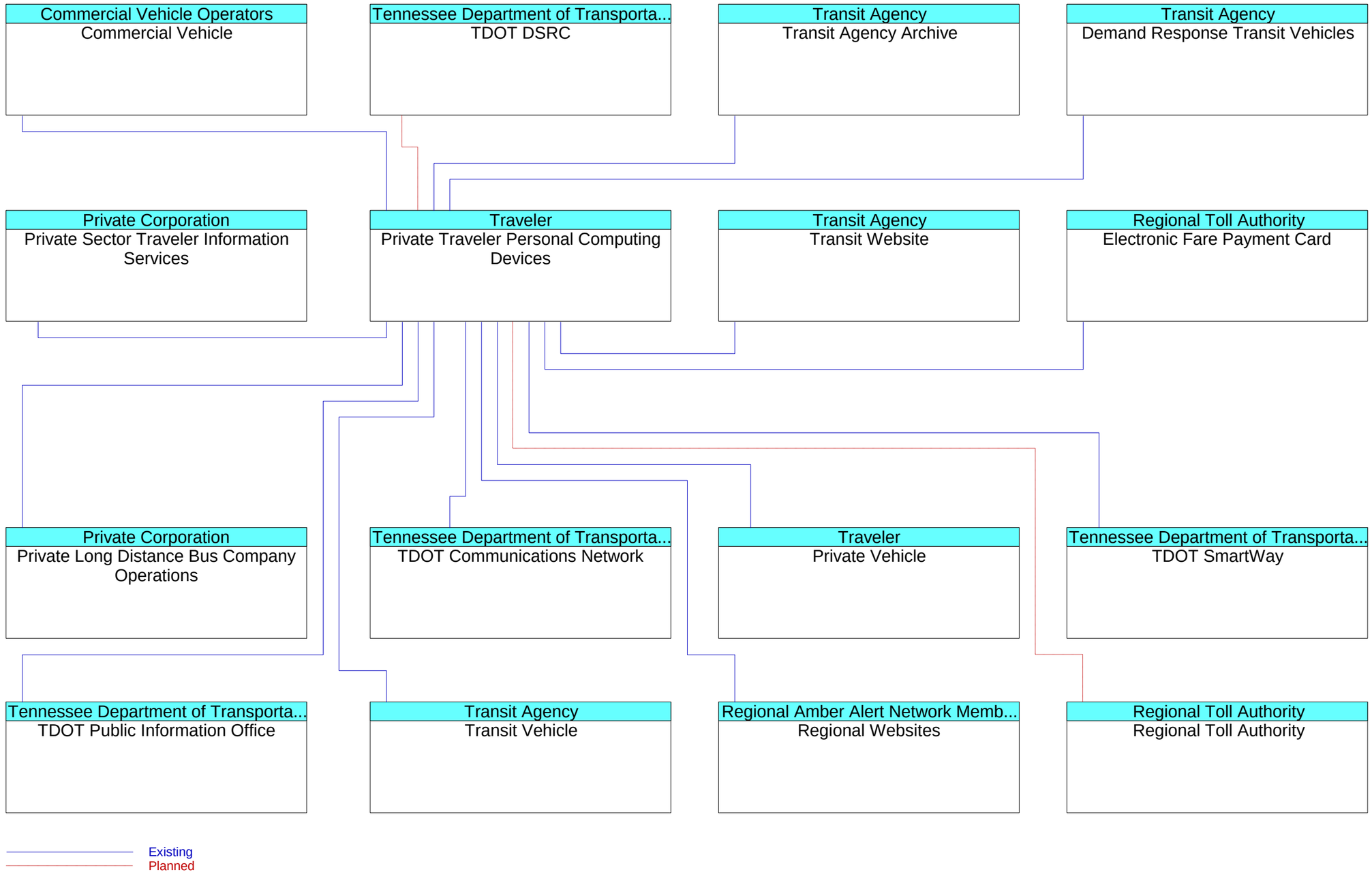


Figure 49: Private Traveler Personal Computing Device Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

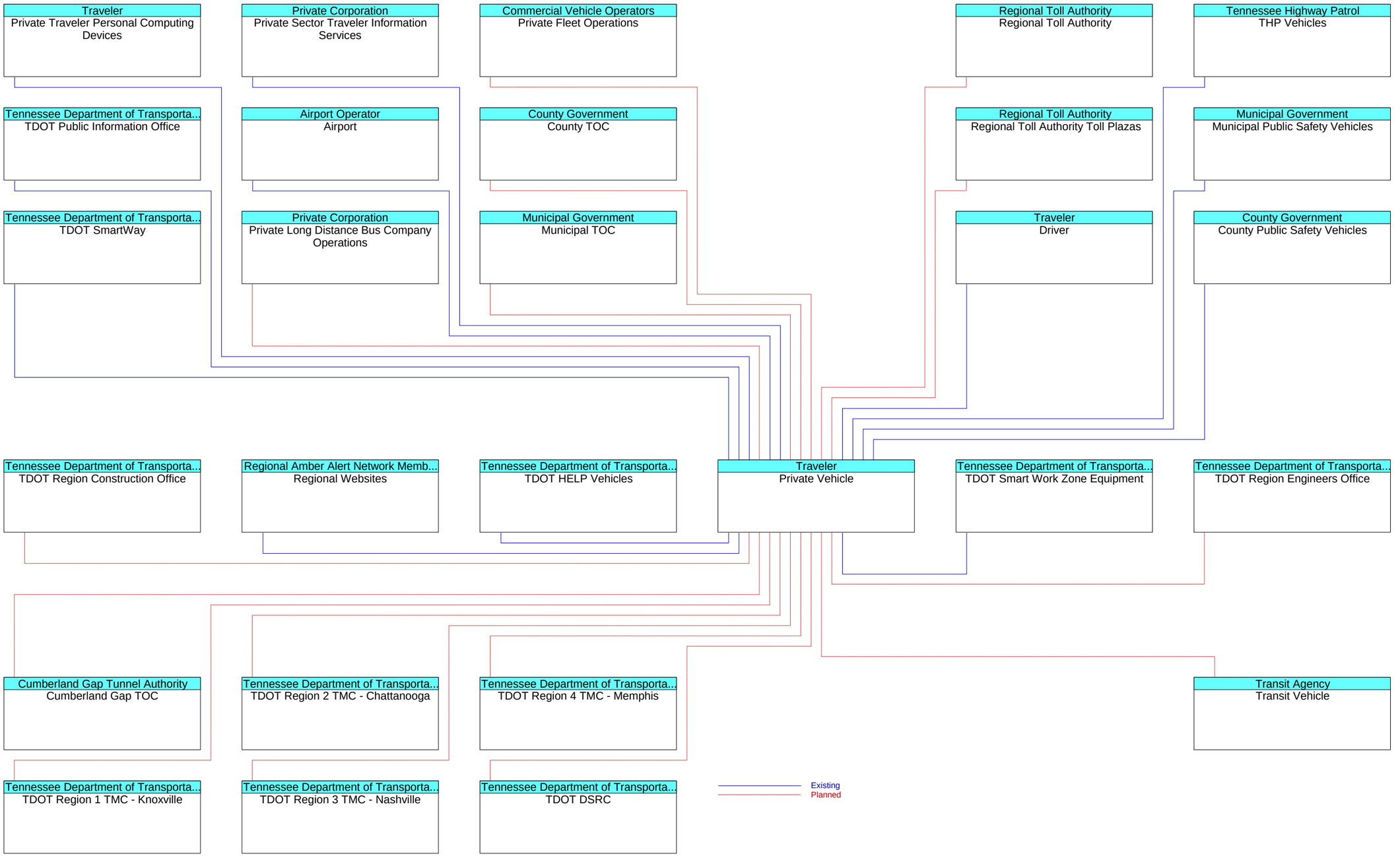


Figure 50: Private Vehicle Interconnect Context Diagram

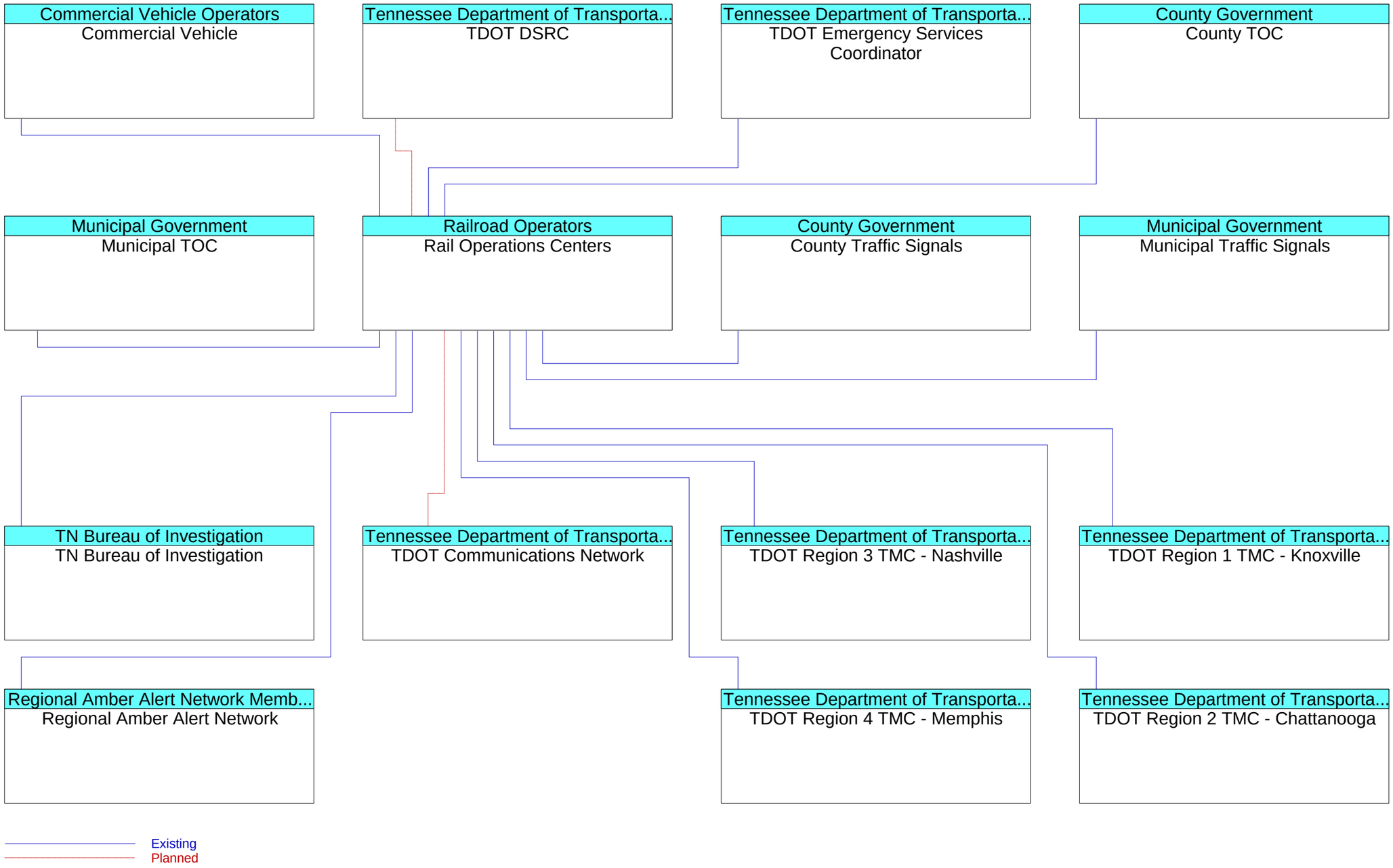


Figure 51: Rail Operations Centers Interconnect Context Diagram

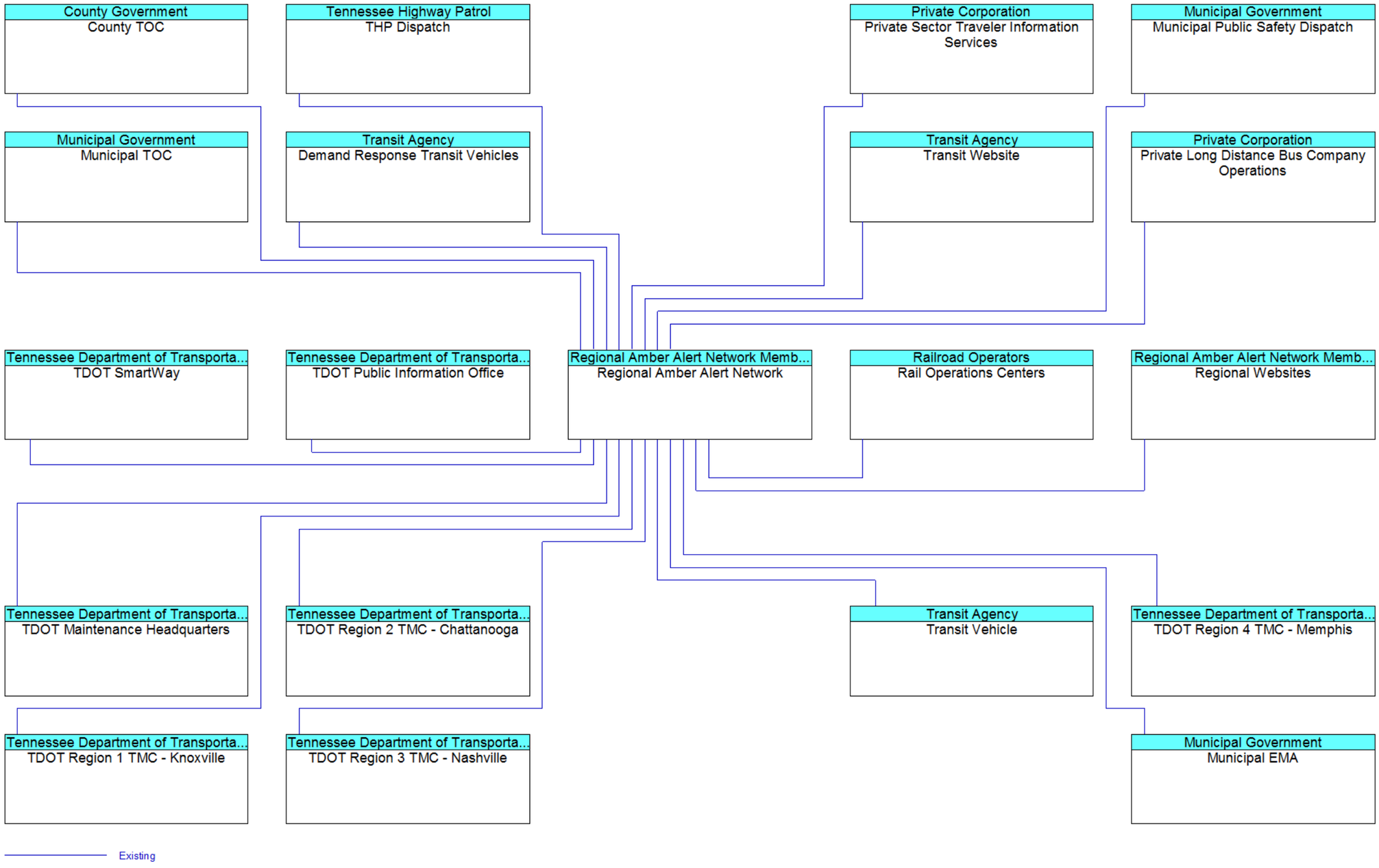


Figure 52: Regional Amber Alert Network Interconnect Context Diagram

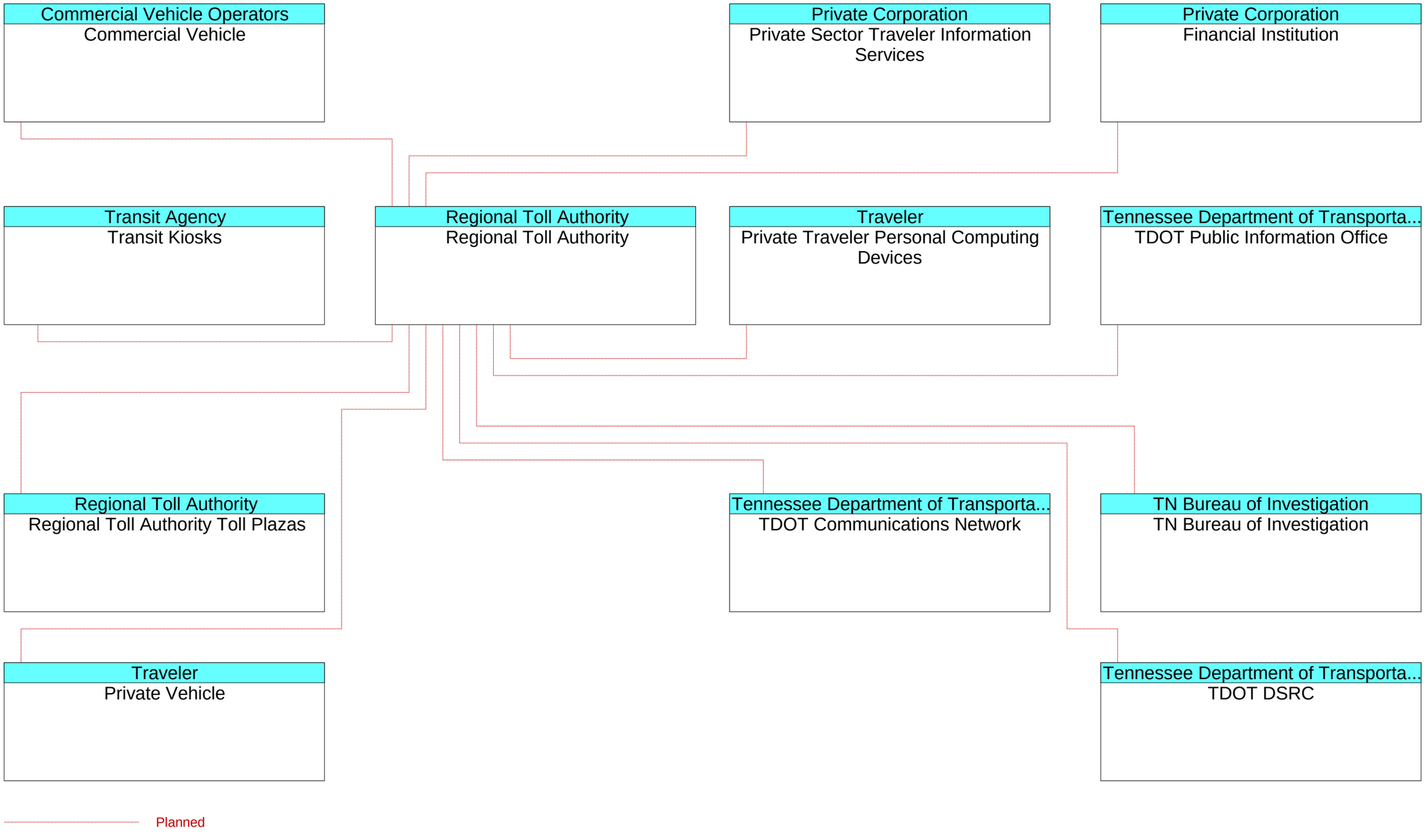


Figure 53: Regional Toll Authority Interconnect Context Diagram

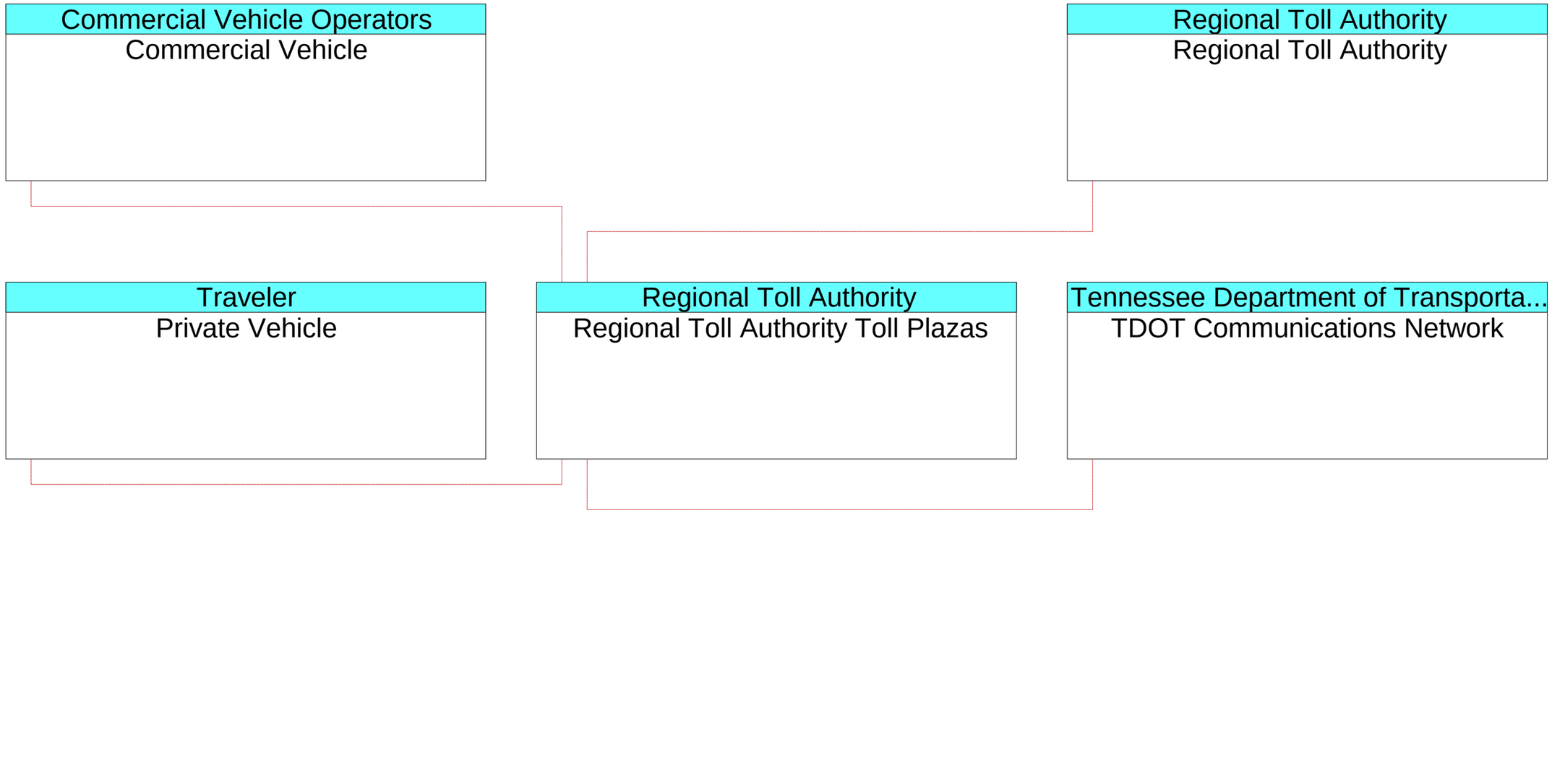


Figure 54: Regional Toll Authority Toll Plazas Interconnect Context Diagram

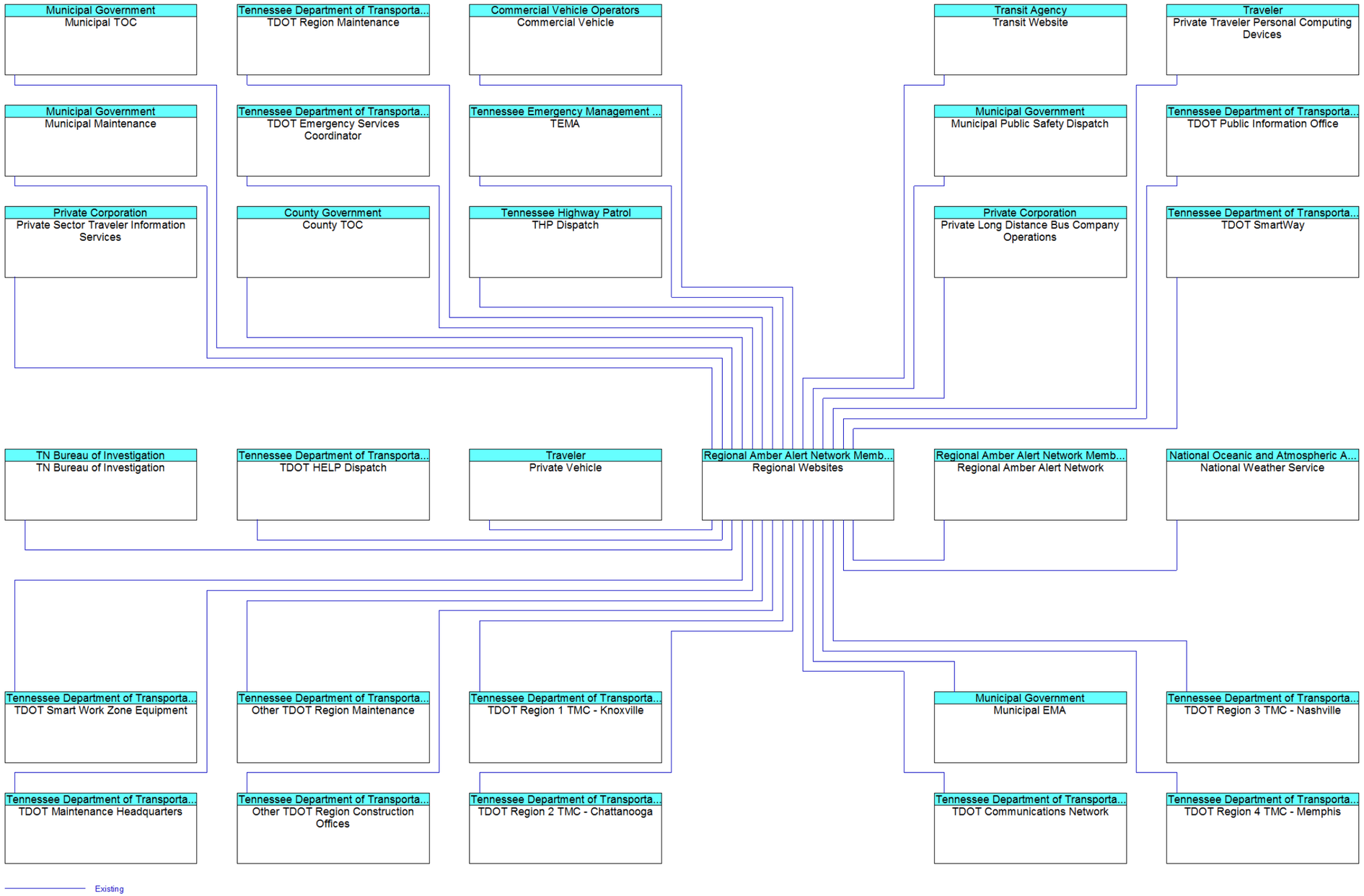


Figure 55: Regional Websites Interconnect Context Diagram

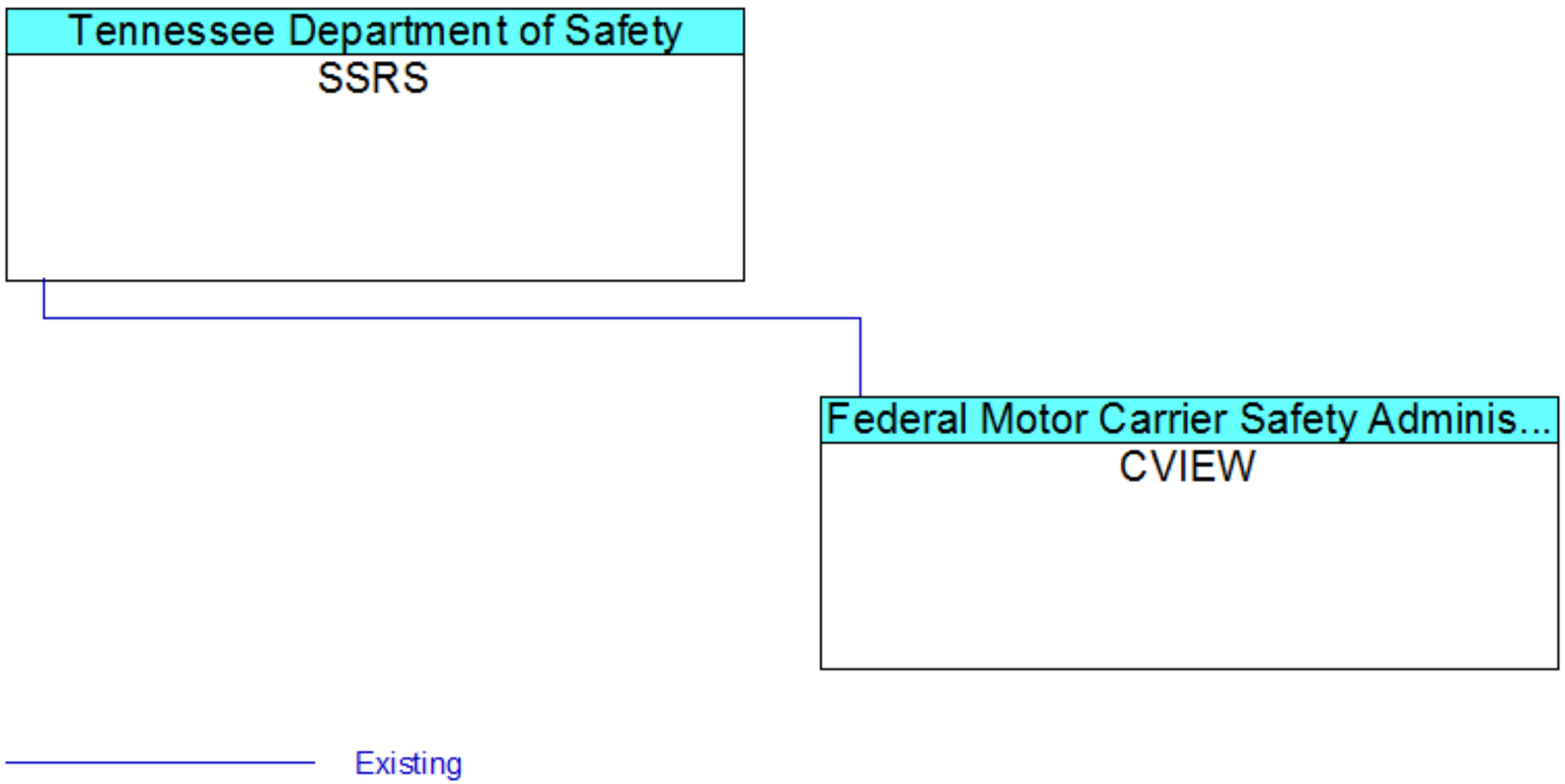


Figure 56: SSRS Interconnect Context Diagram

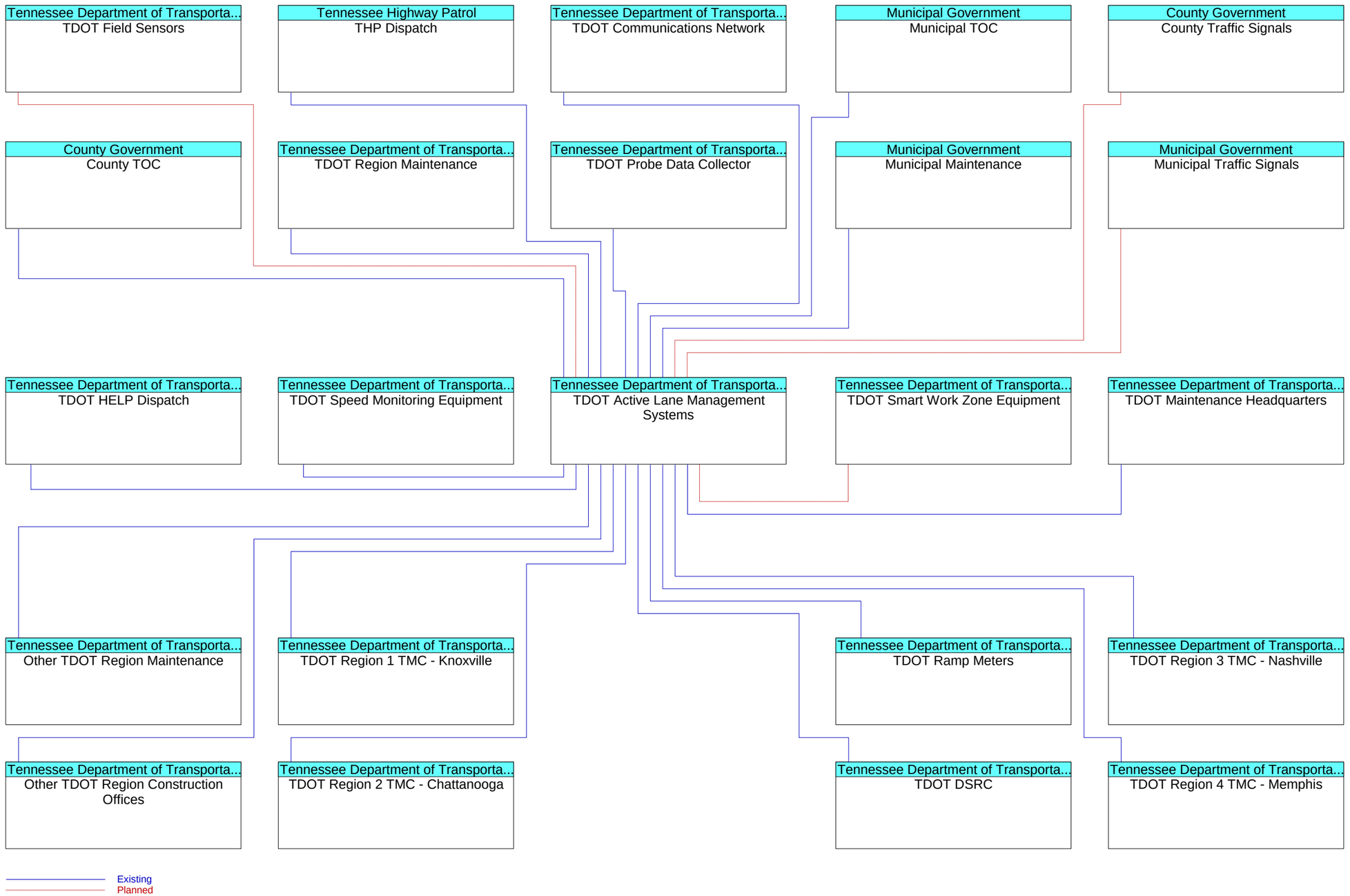


Figure 57: TDOT Active Lane Management System Interconnect Context Diagram

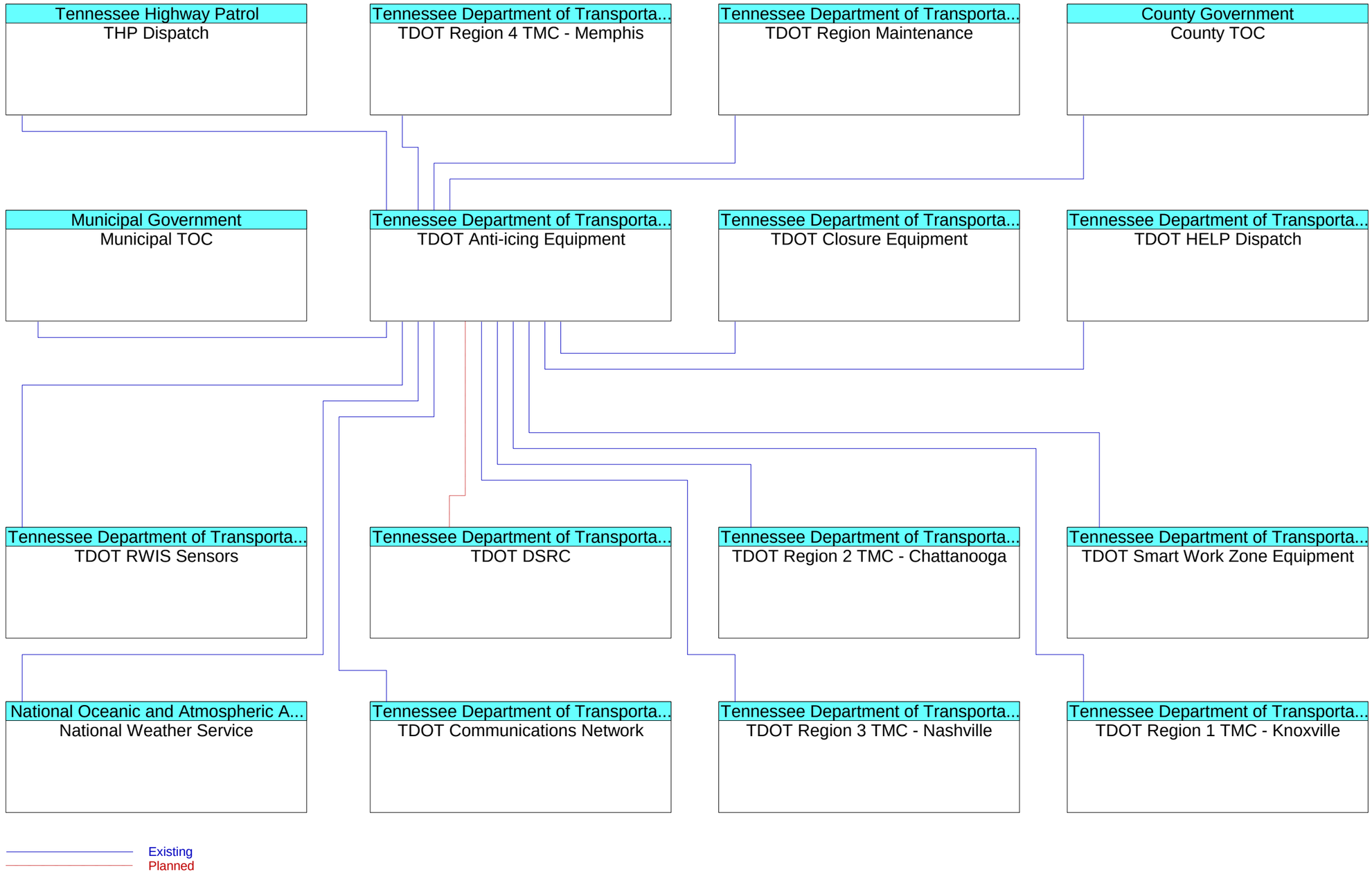


Figure 58: TDOT Anti-Icing Equipment Interconnect Context Diagram

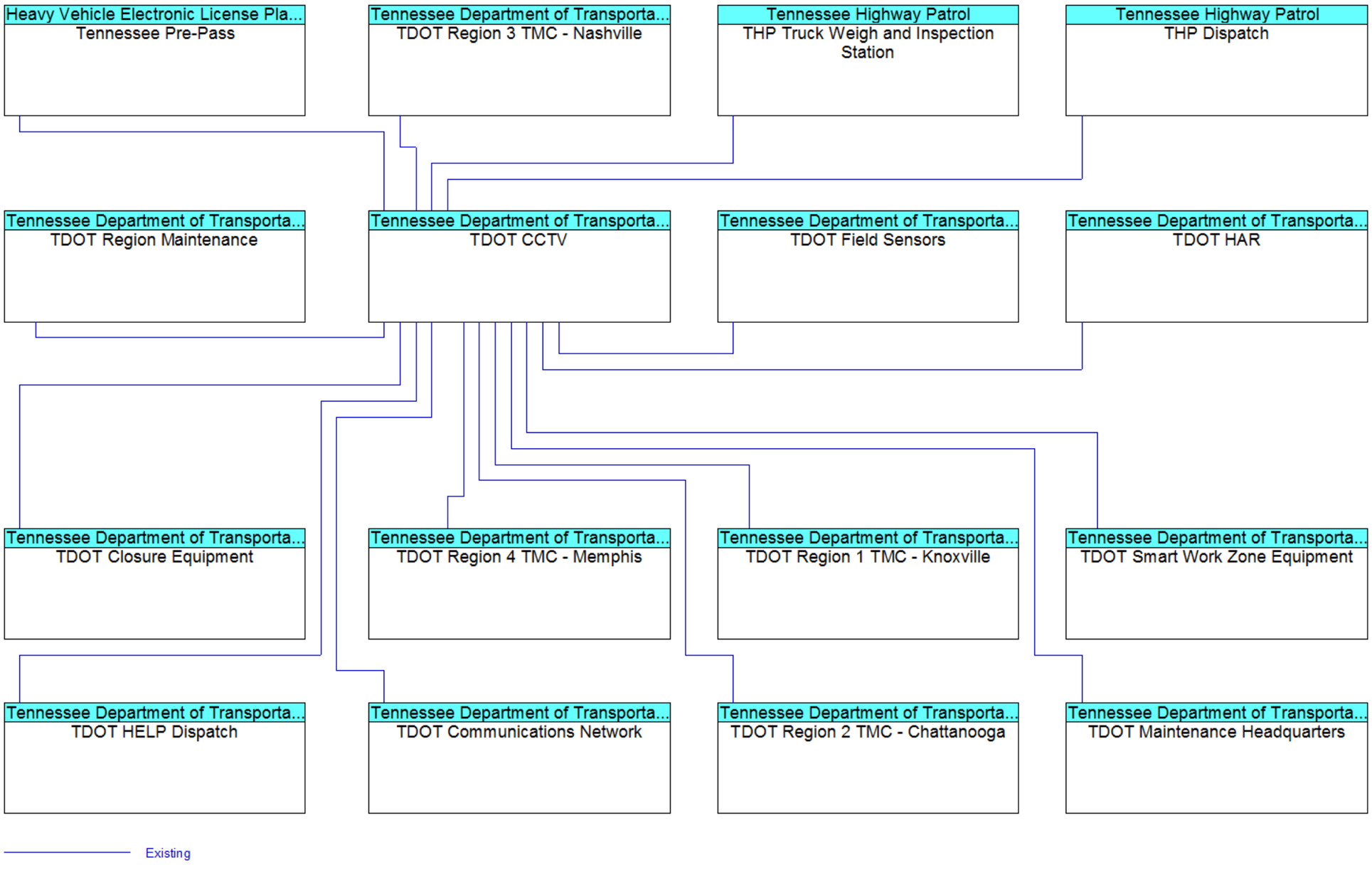


Figure 59: TDOT CCTV Interconnect Context Diagram

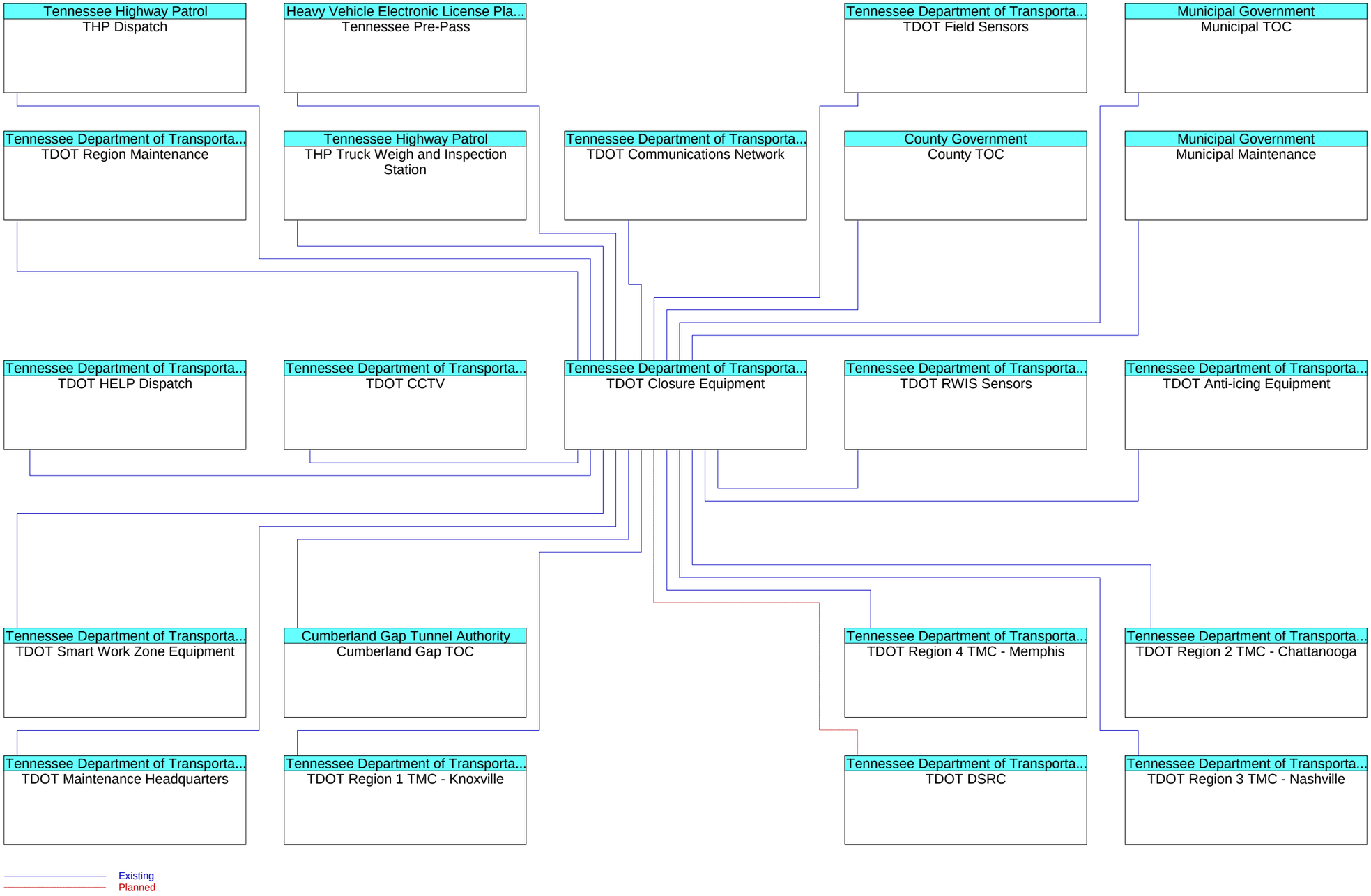


Figure 60: TDOT Closure Equipment Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

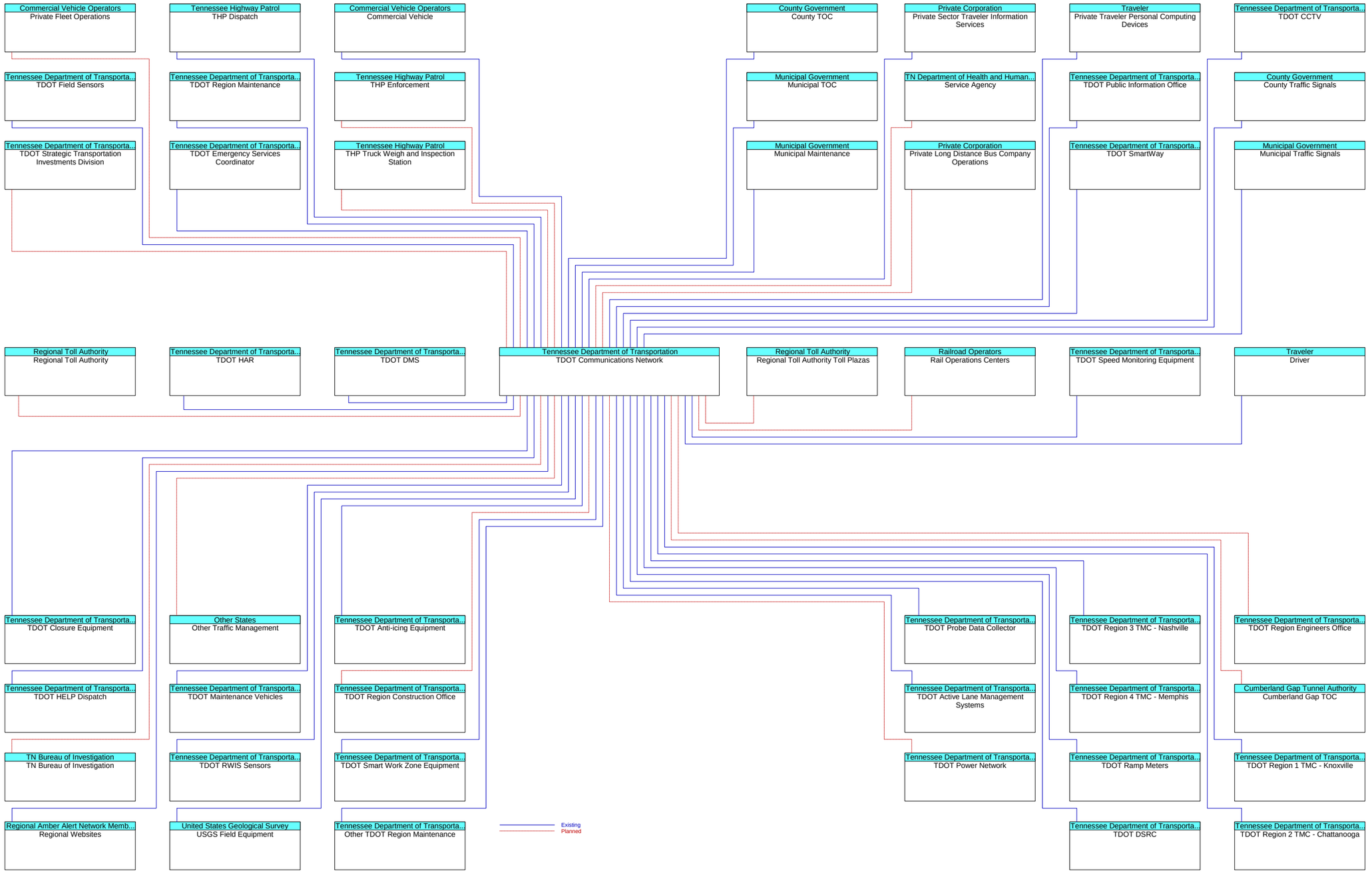


Figure 61: TDOT Communications Network Interconnect Context Diagram

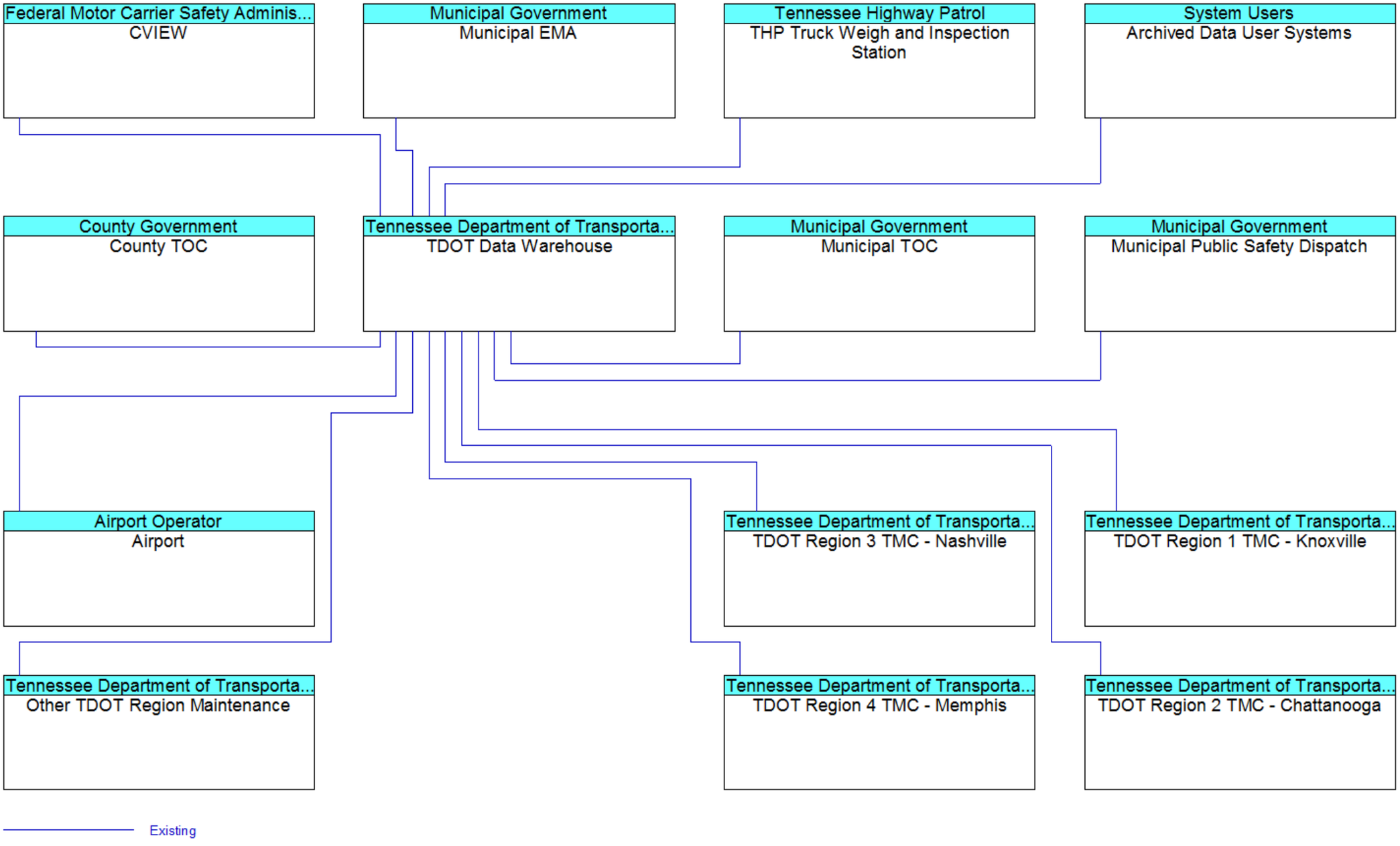


Figure 62: TDOT Data Warehouse Interconnect Context Diagram

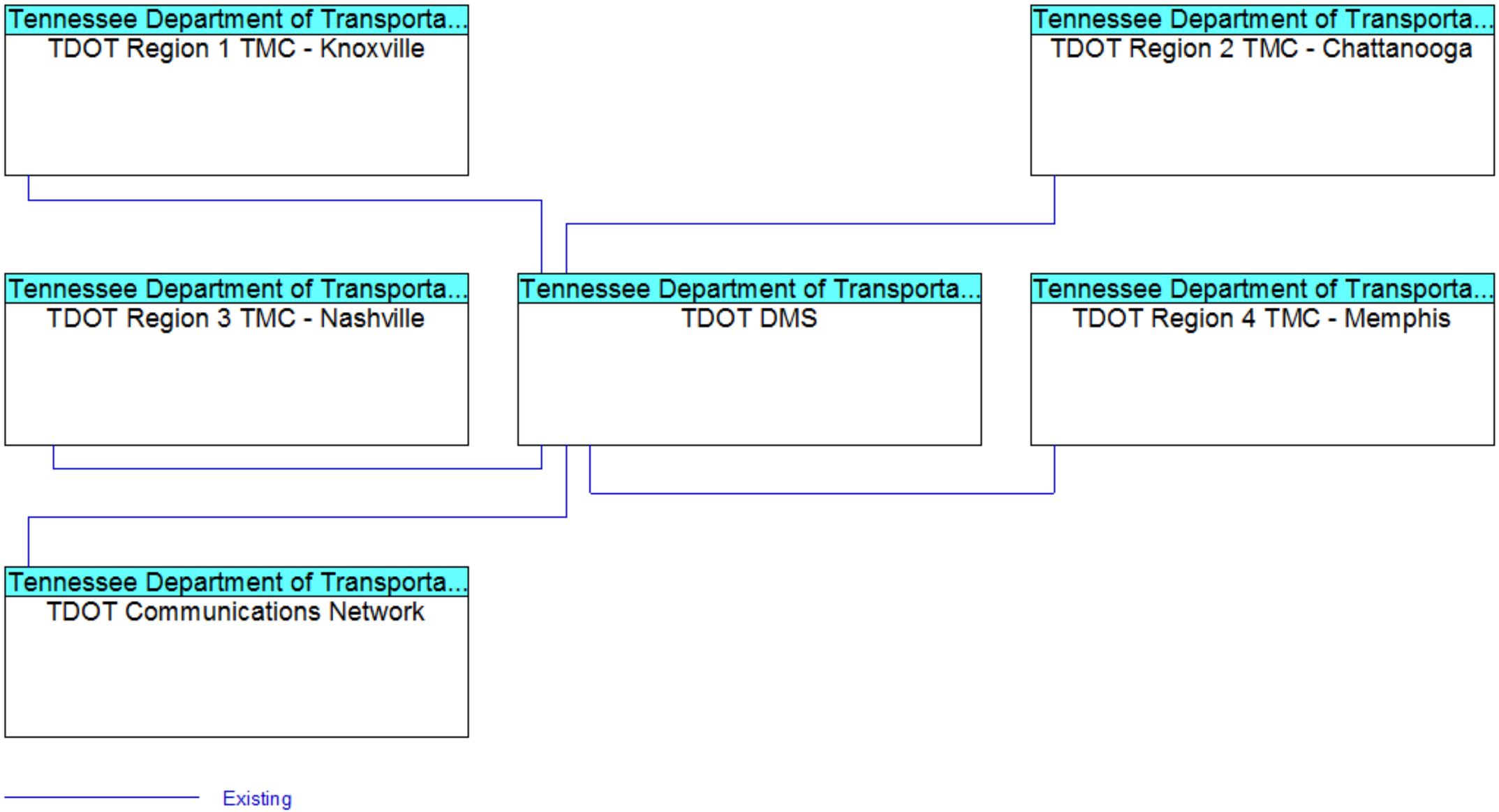


Figure 63: TDOT DMS Interconnect Context Diagram

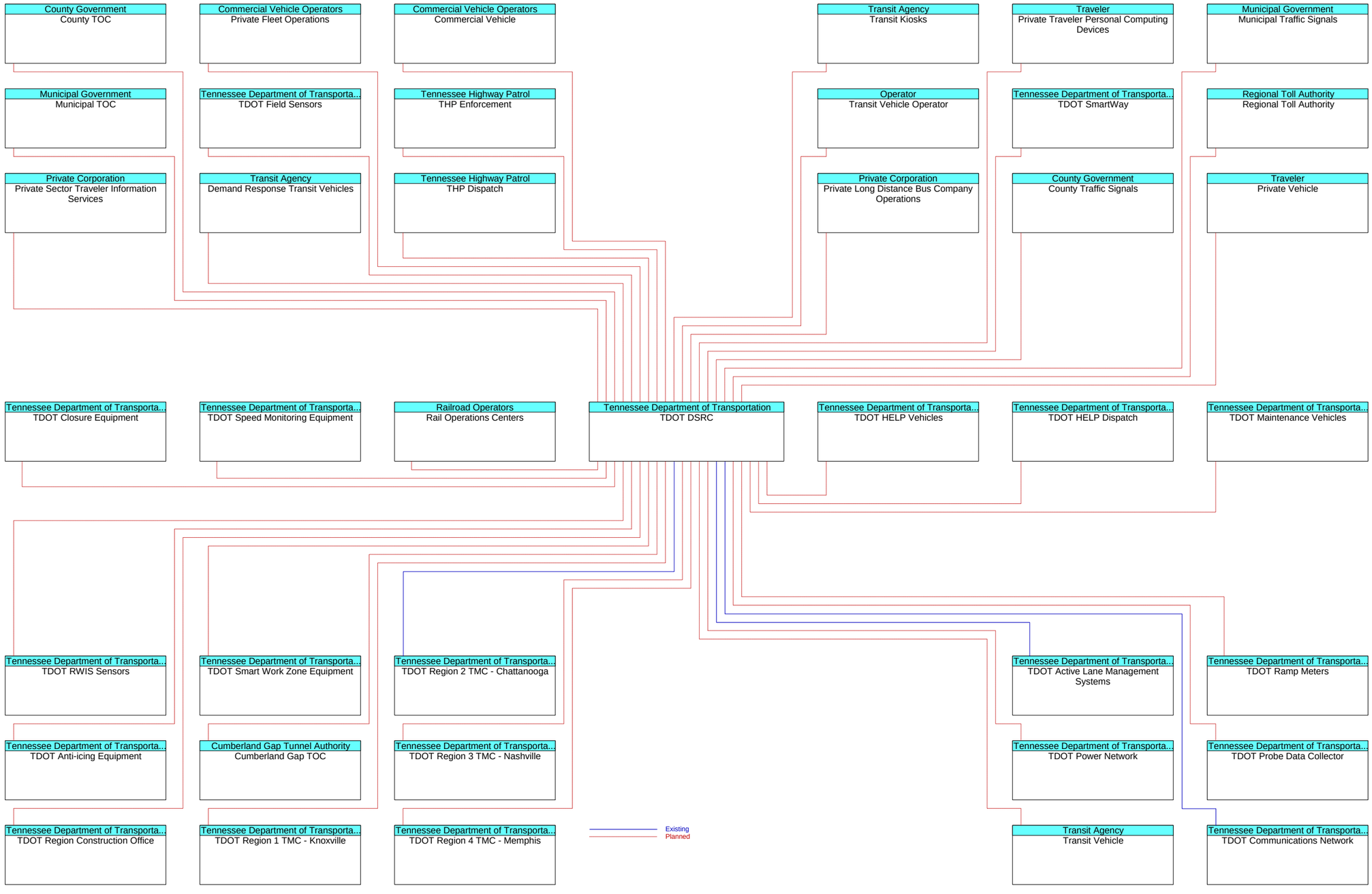


Figure 64: TDOT DSRC Interconnect Context Diagram

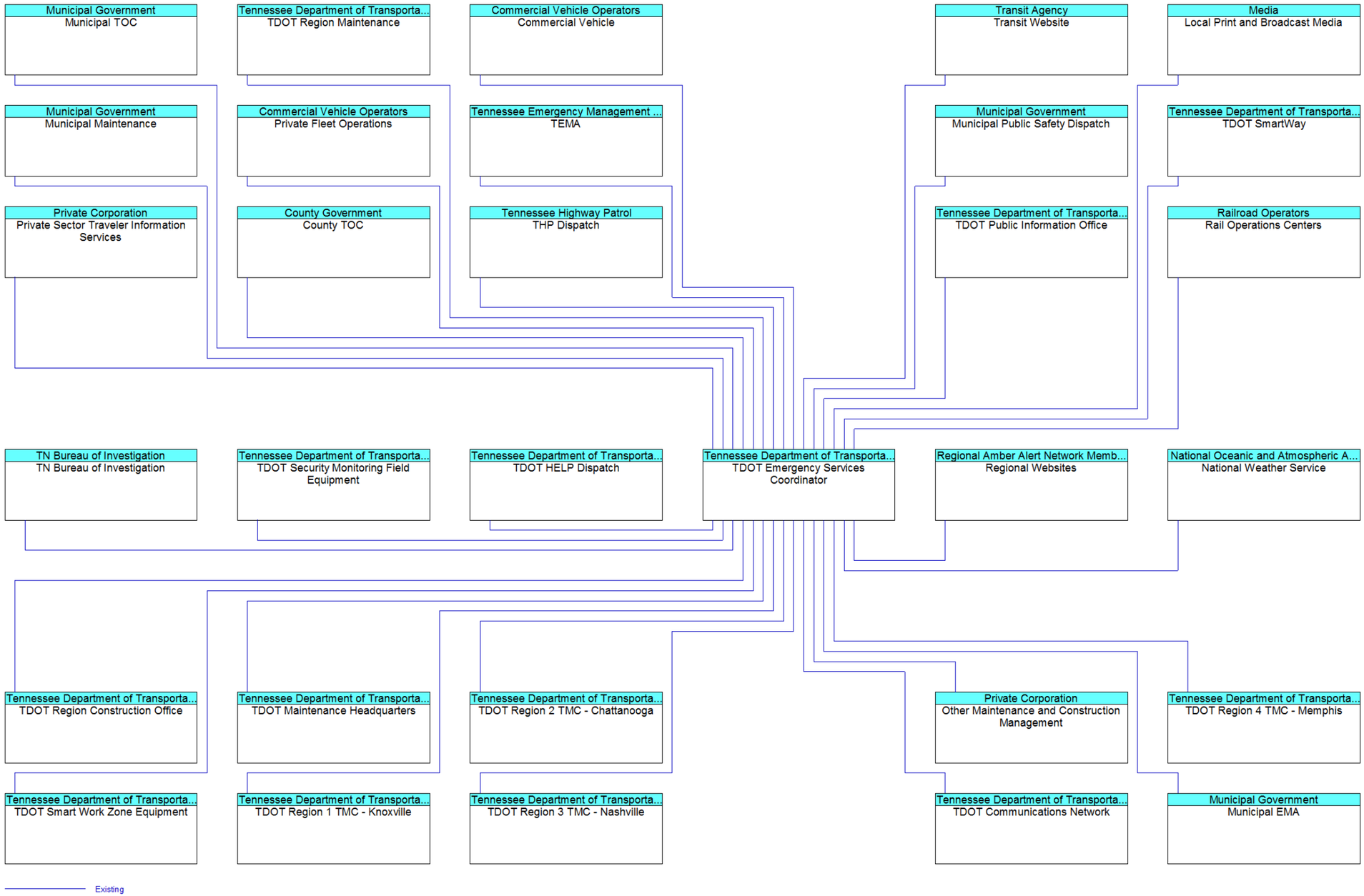


Figure 65: TDOT Emergency Services Coordinator Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

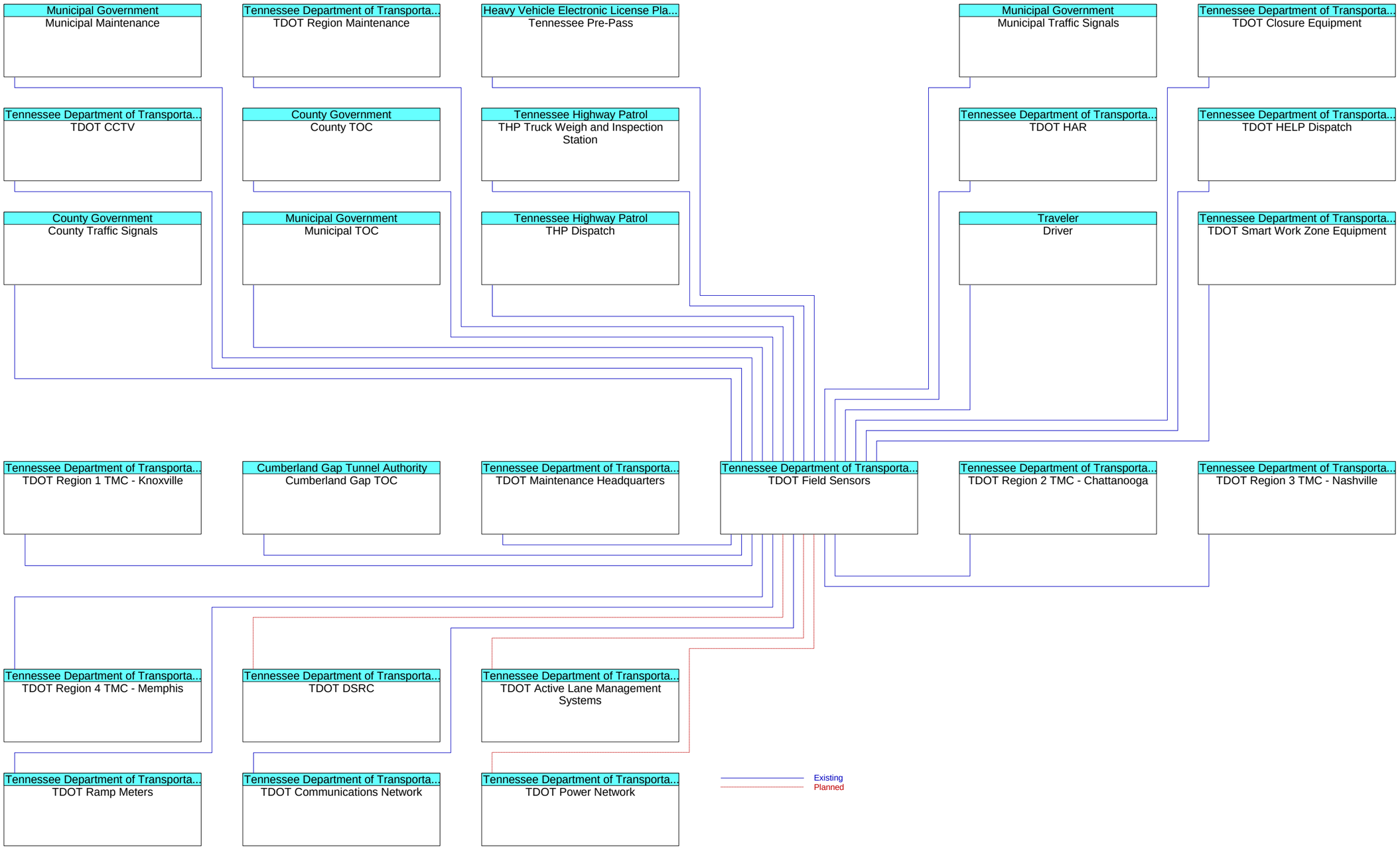


Figure 66: TDOT Field Sensors Interconnect Context Diagram

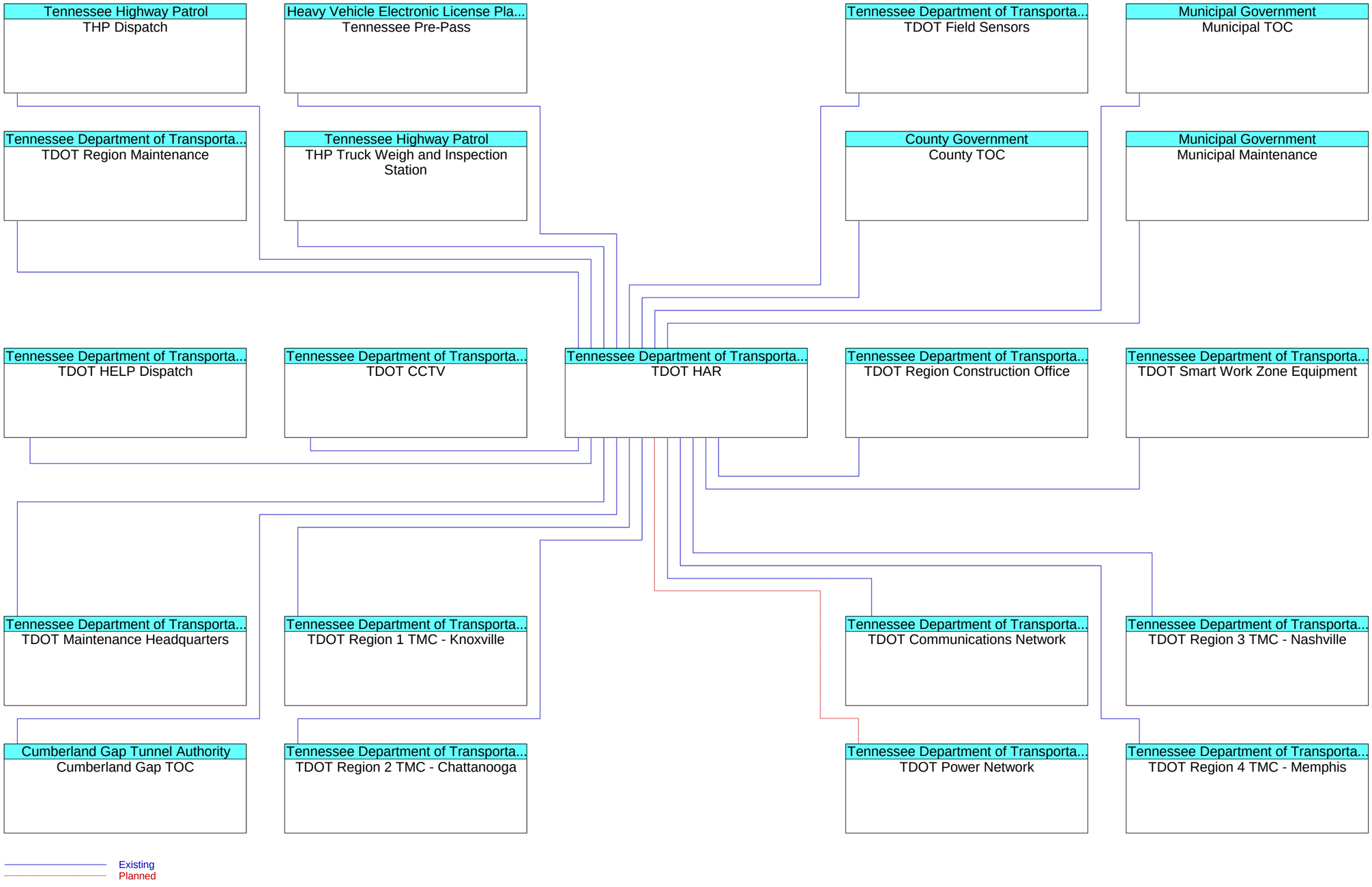


Figure 67: TDOT HAR Interconnect Context Diagram

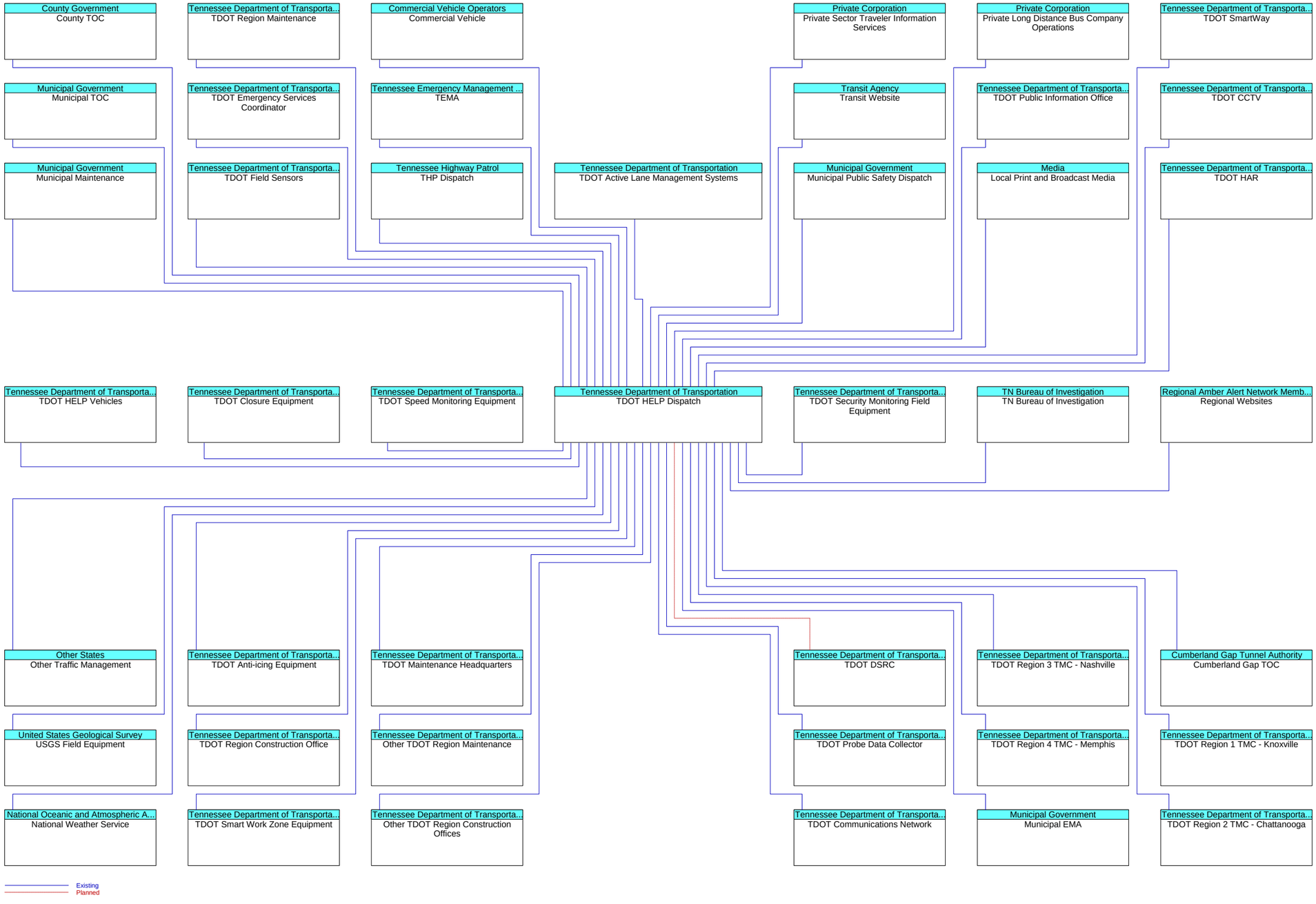


Figure 68: TDOT HELP Dispatch Interconnect Context Diagram

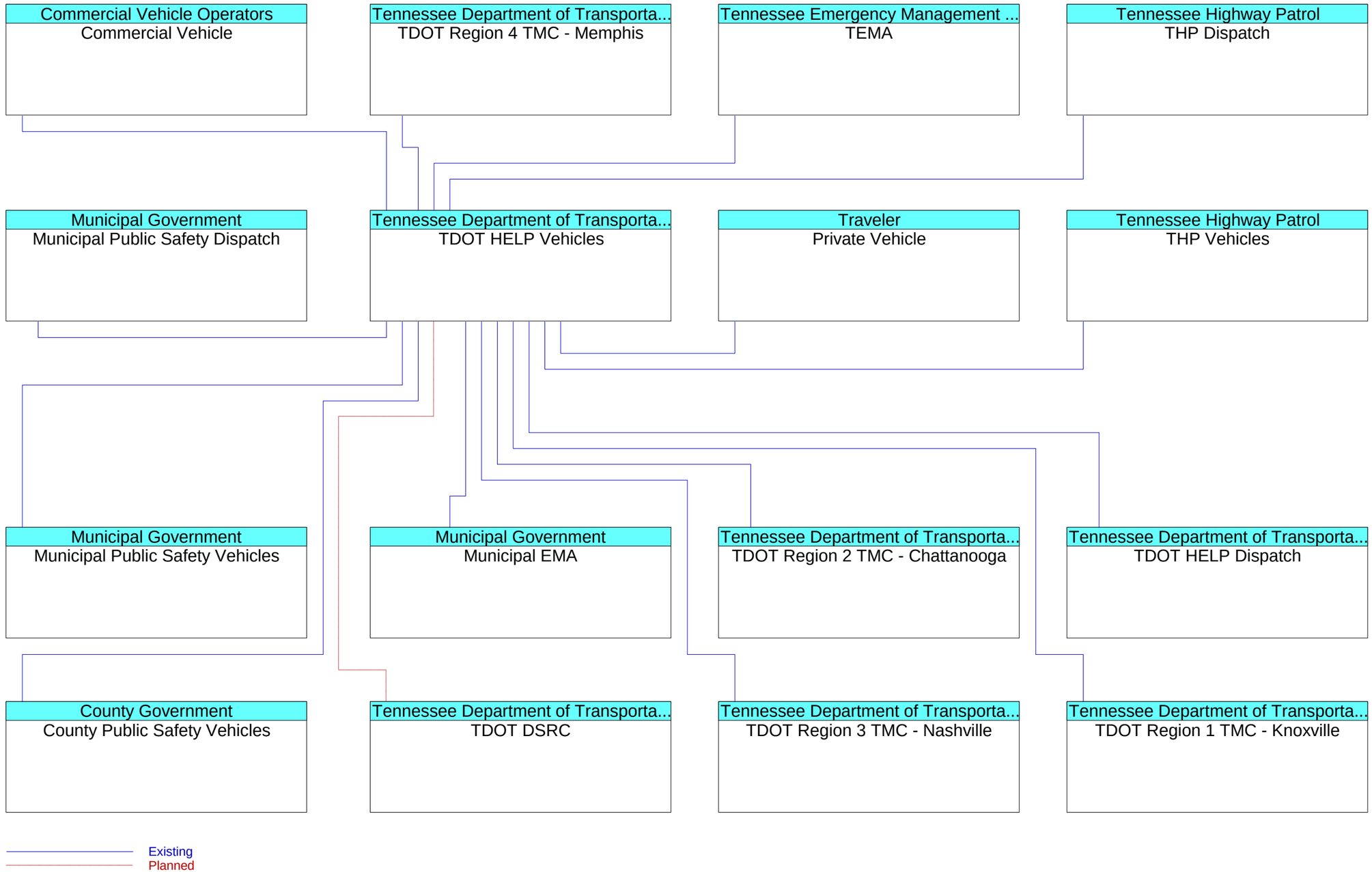


Figure 69: TDOT HELP Vehicles Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

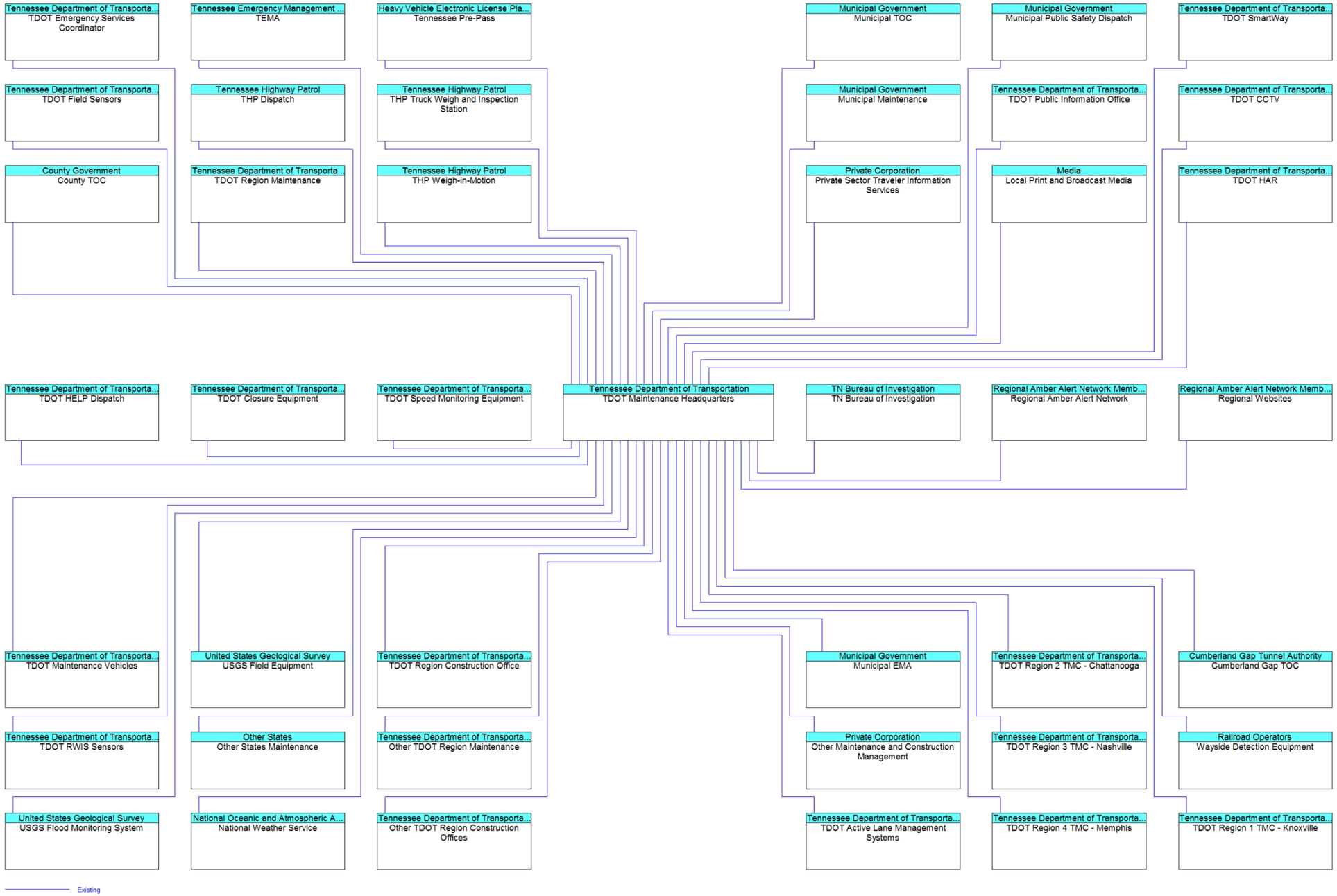


Figure 70: TDOT Maintenance Headquarters Interconnect Context Diagram

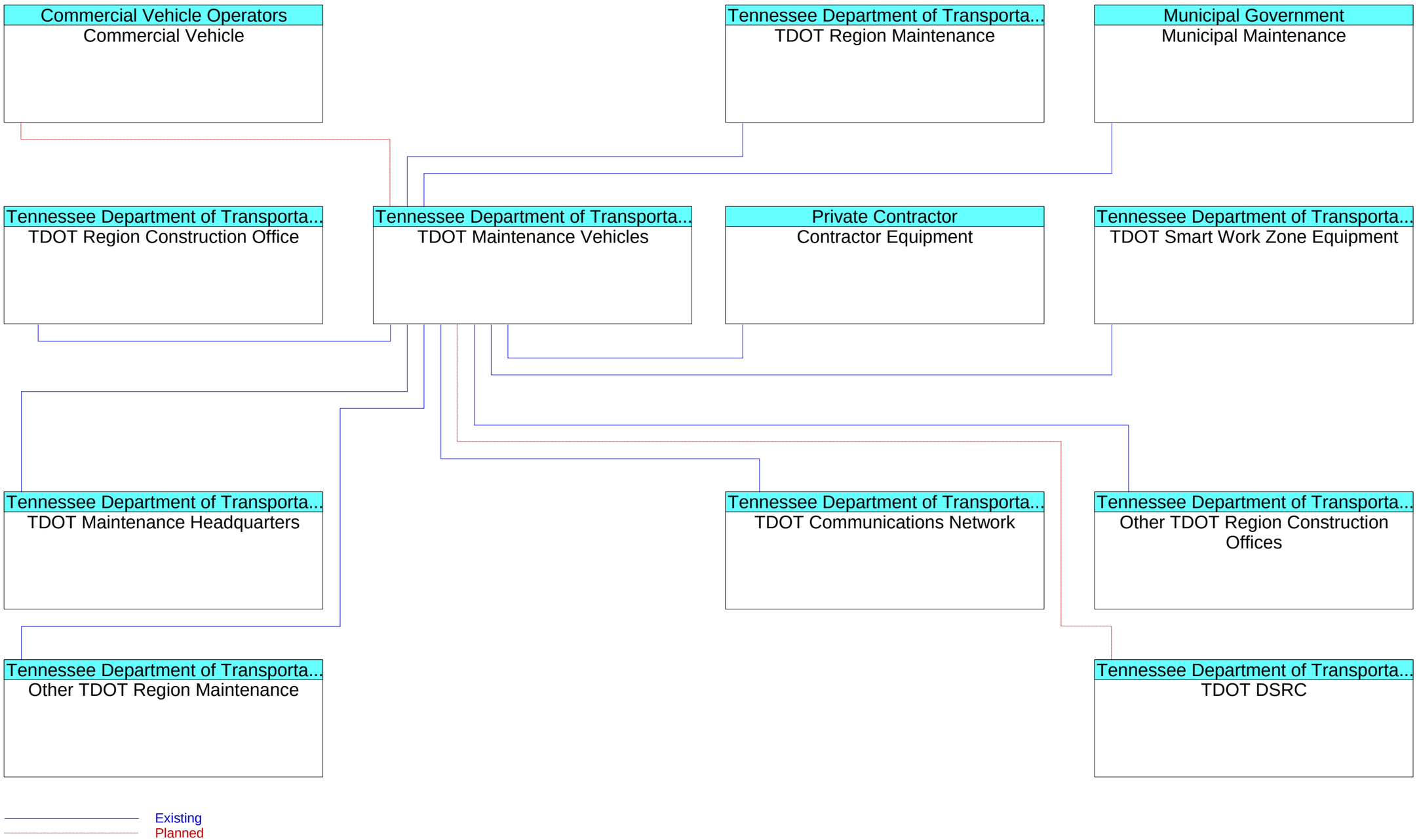


Figure 71: TDOT Maintenance Vehicles Interconnect Context Diagram

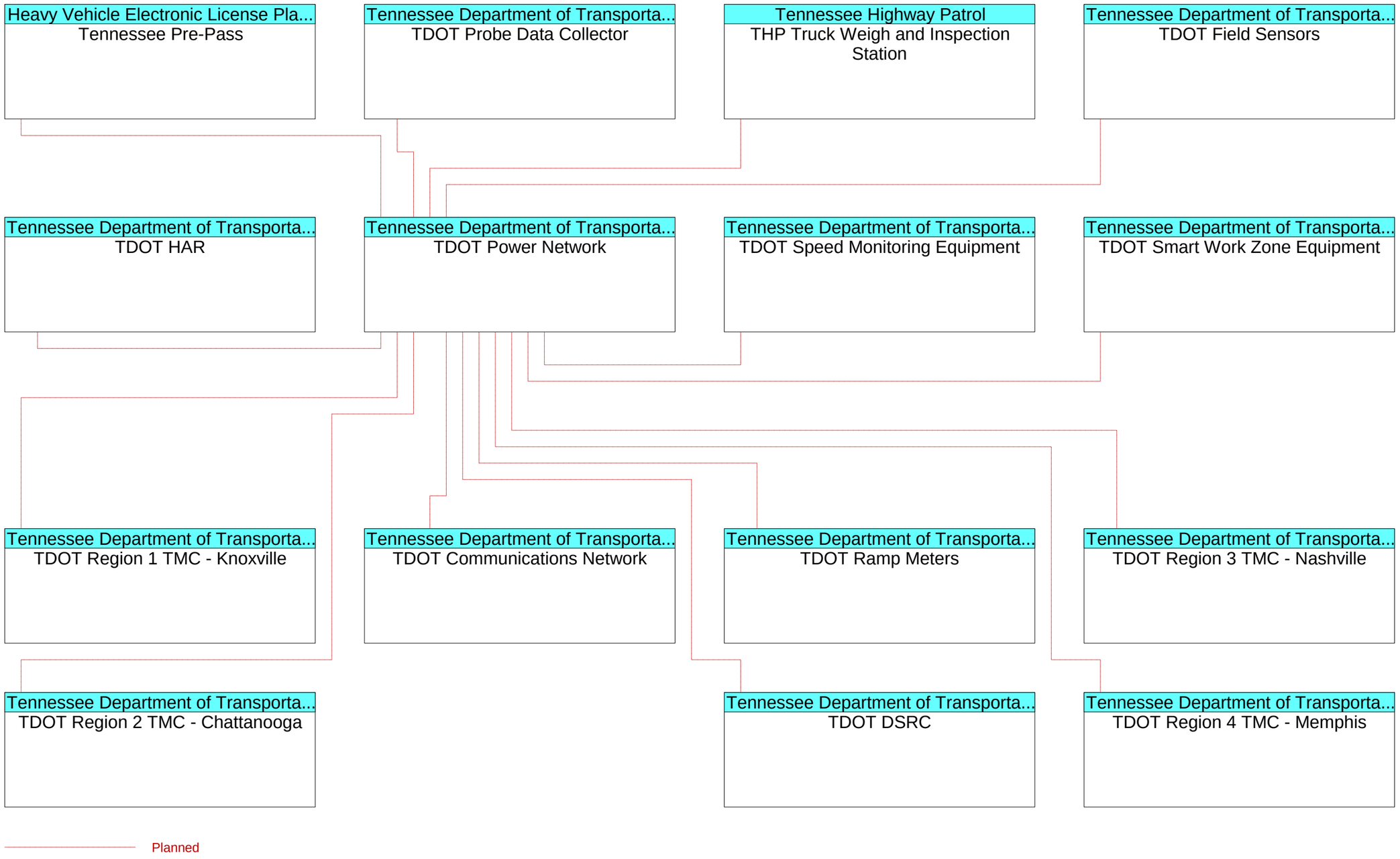


Figure 72: TDOT Power Network Interconnect Context Diagram

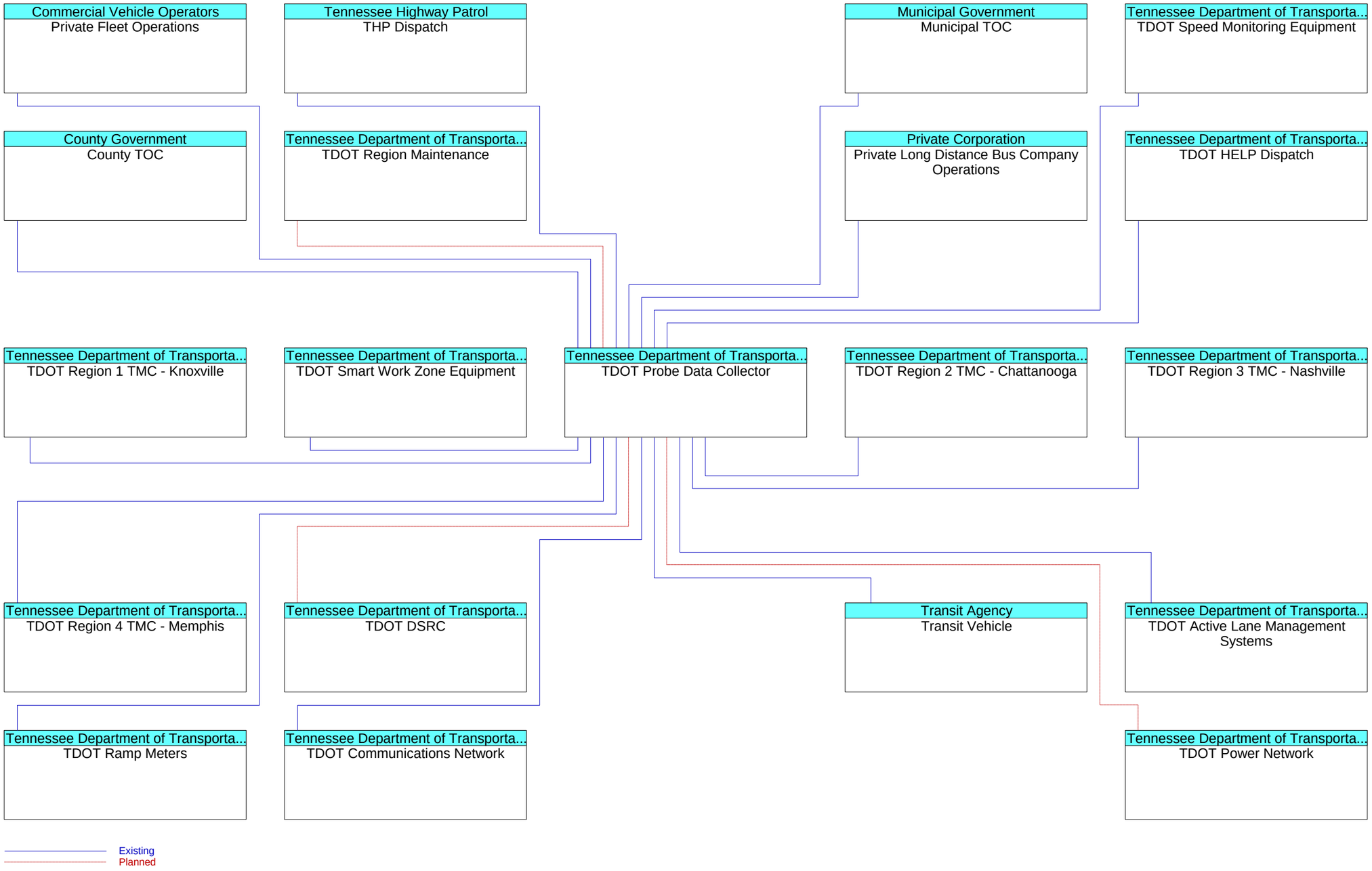


Figure 73: TDOT Probe Data Collector Interconnect Context Diagram

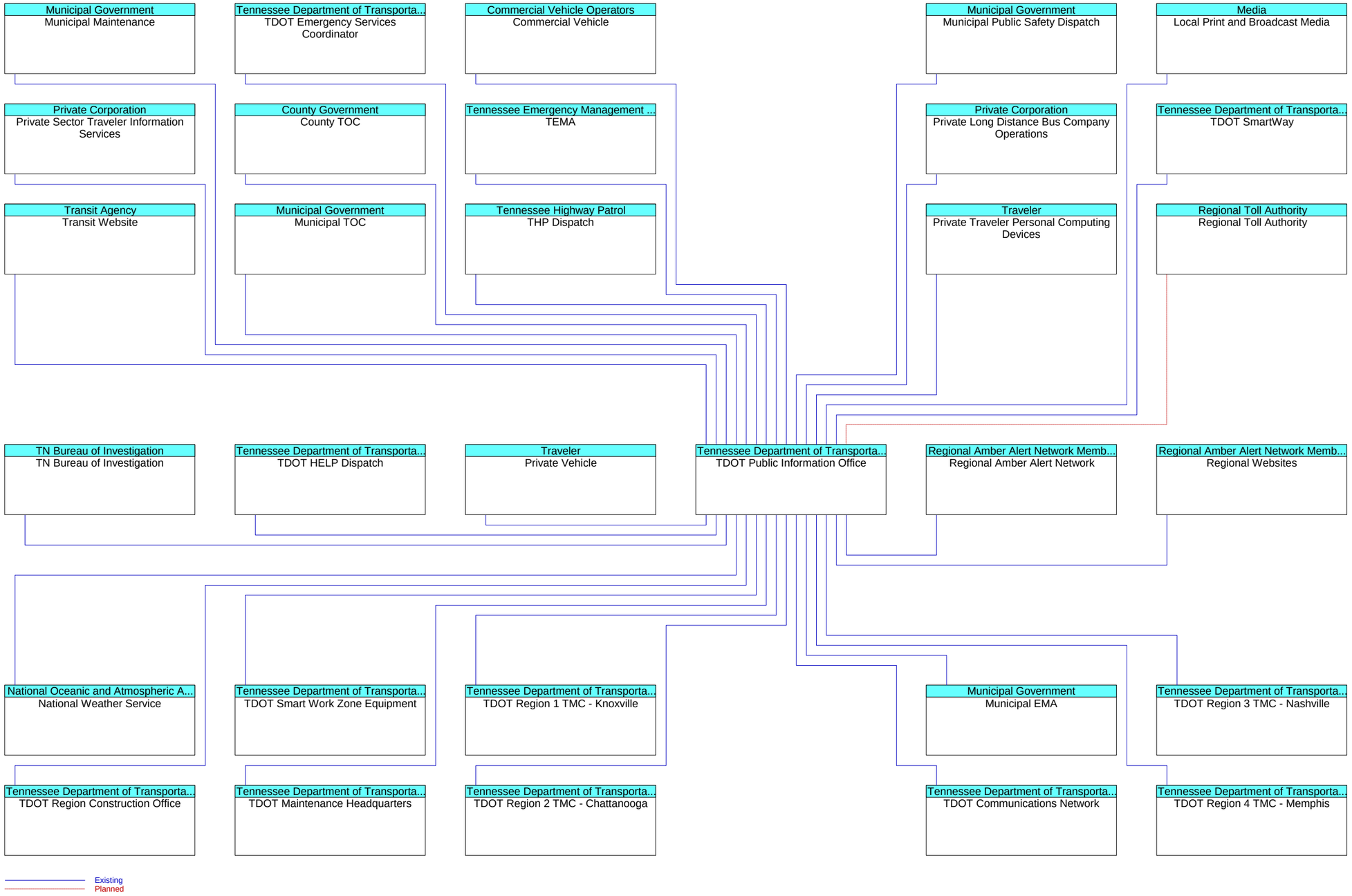


Figure 74: TDOT Public Information Office Interconnect Context Diagram

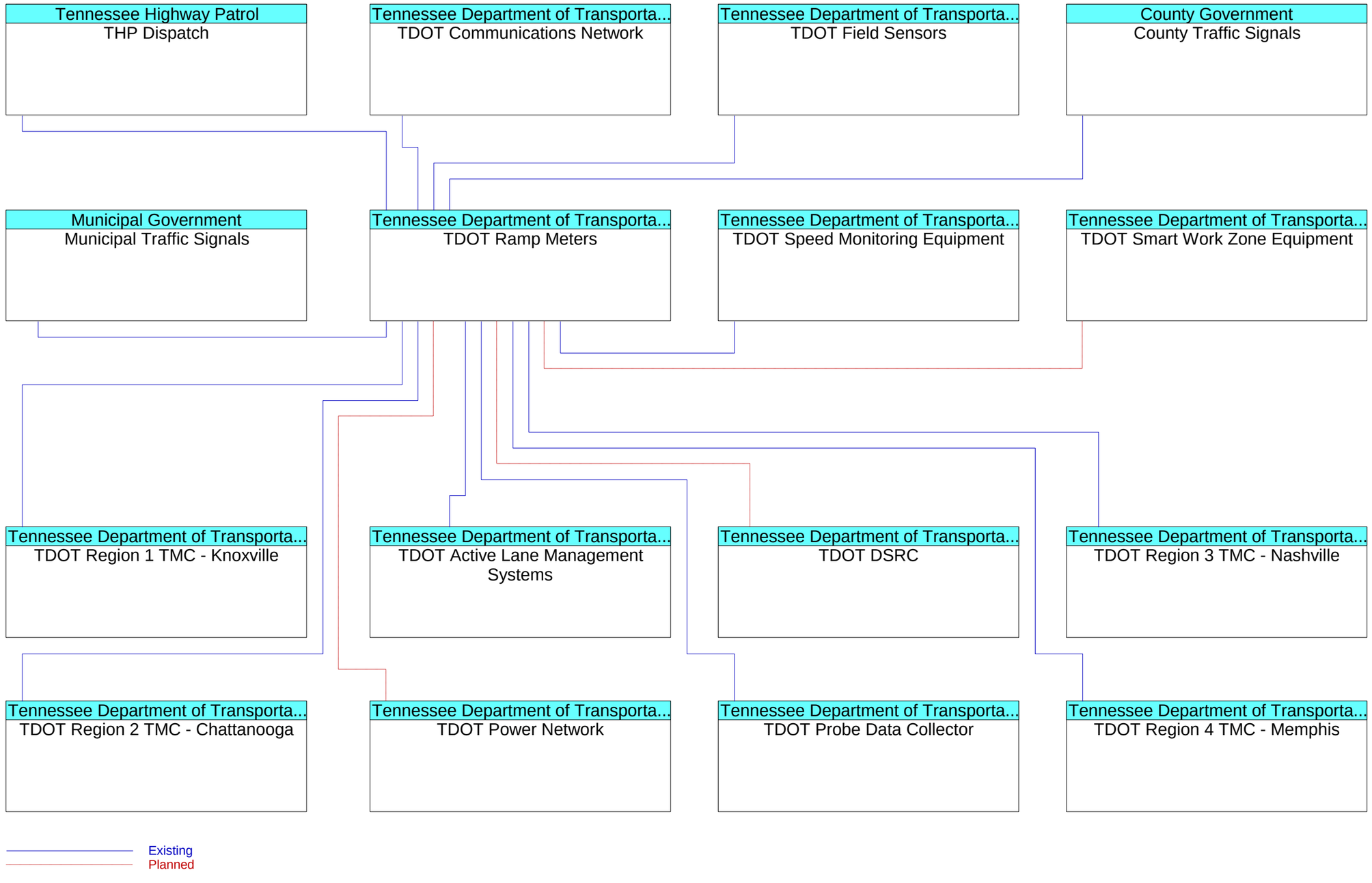


Figure 75: TDOT Ramp Meters Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

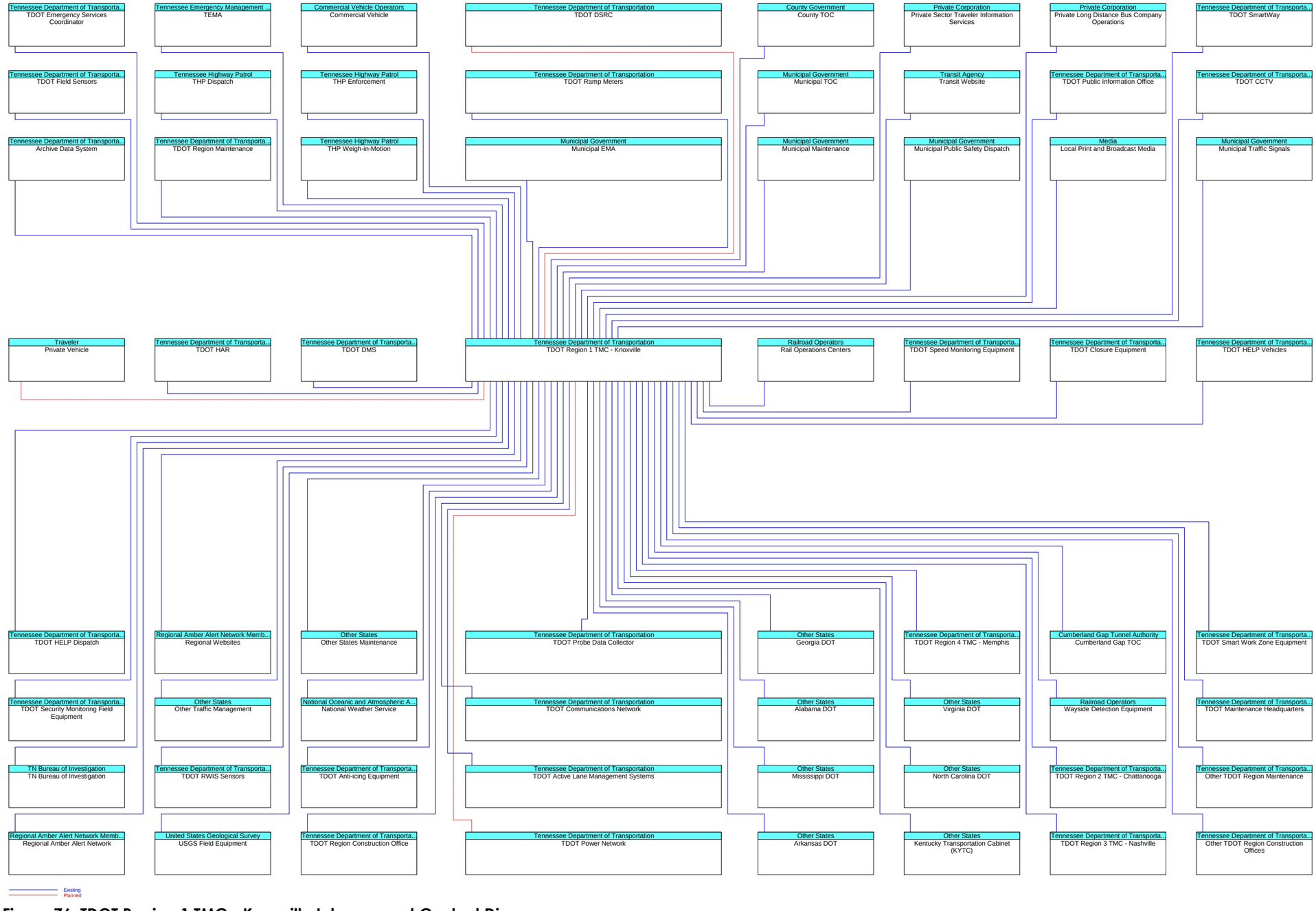


Figure 76: TDOT Region 1 TMC - Knoxville Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS



Figure 77: TDOT Region 2 TMC - Chattanooga Interconnect Context Diagram



Figure 78: TDOT Region 3 TMC - Nashville Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

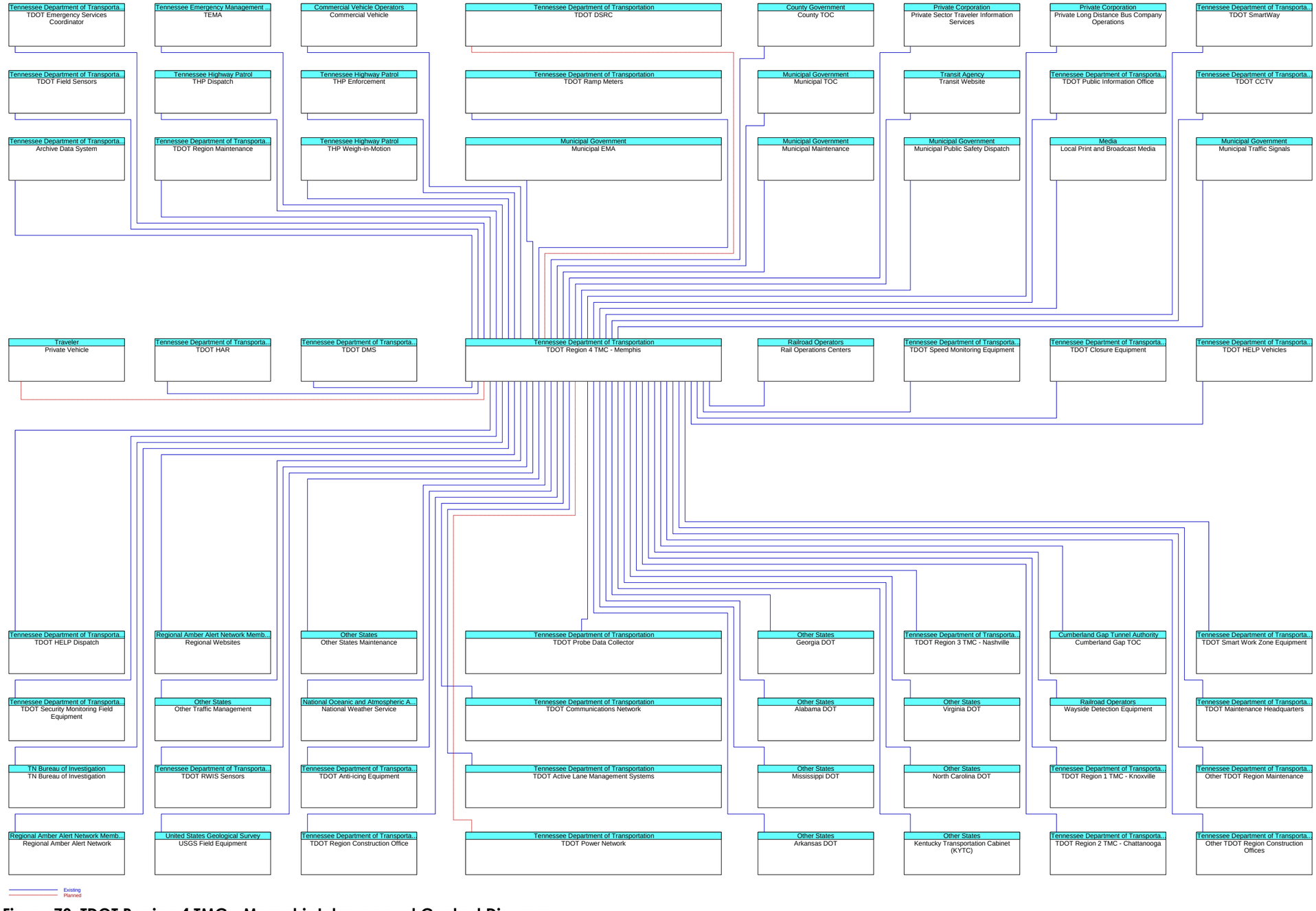


Figure 79: TDOT Region 4 TMC - Memphis Interconnect Context Diagram

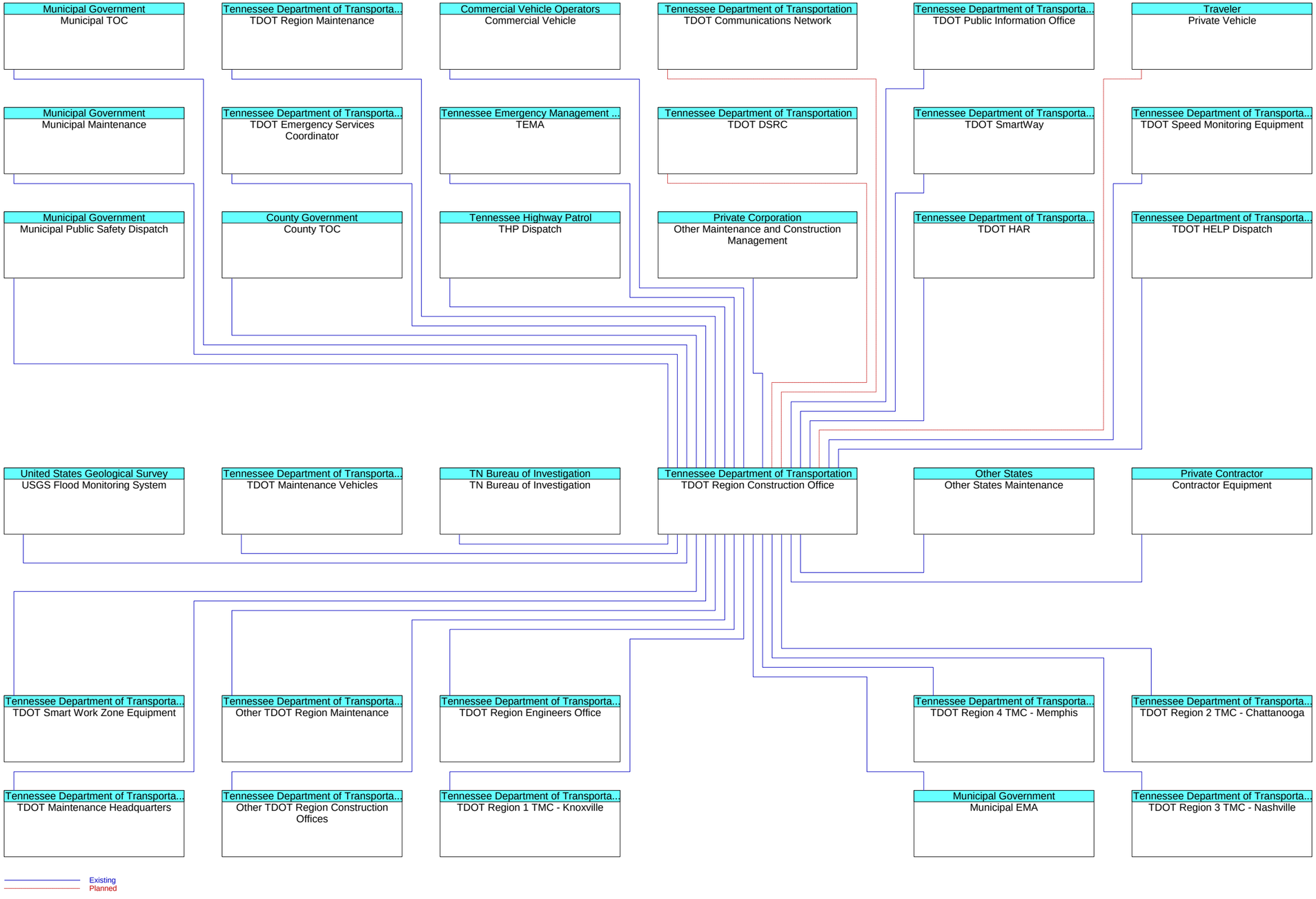


Figure 80: TDOT Region Construction Office Interconnect Context Diagram

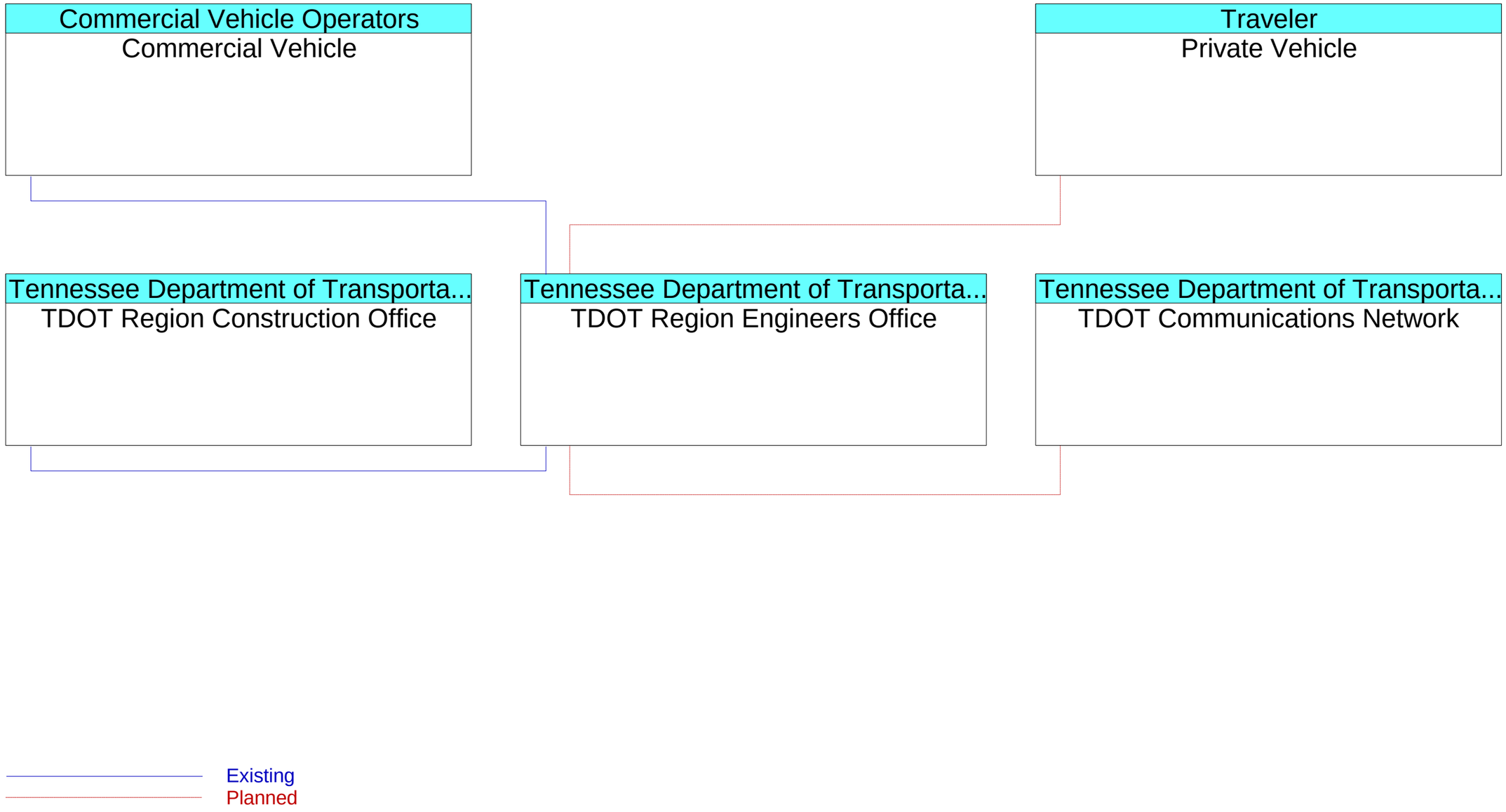


Figure 81: TDOT Region Engineers Office Interconnect Context Diagram

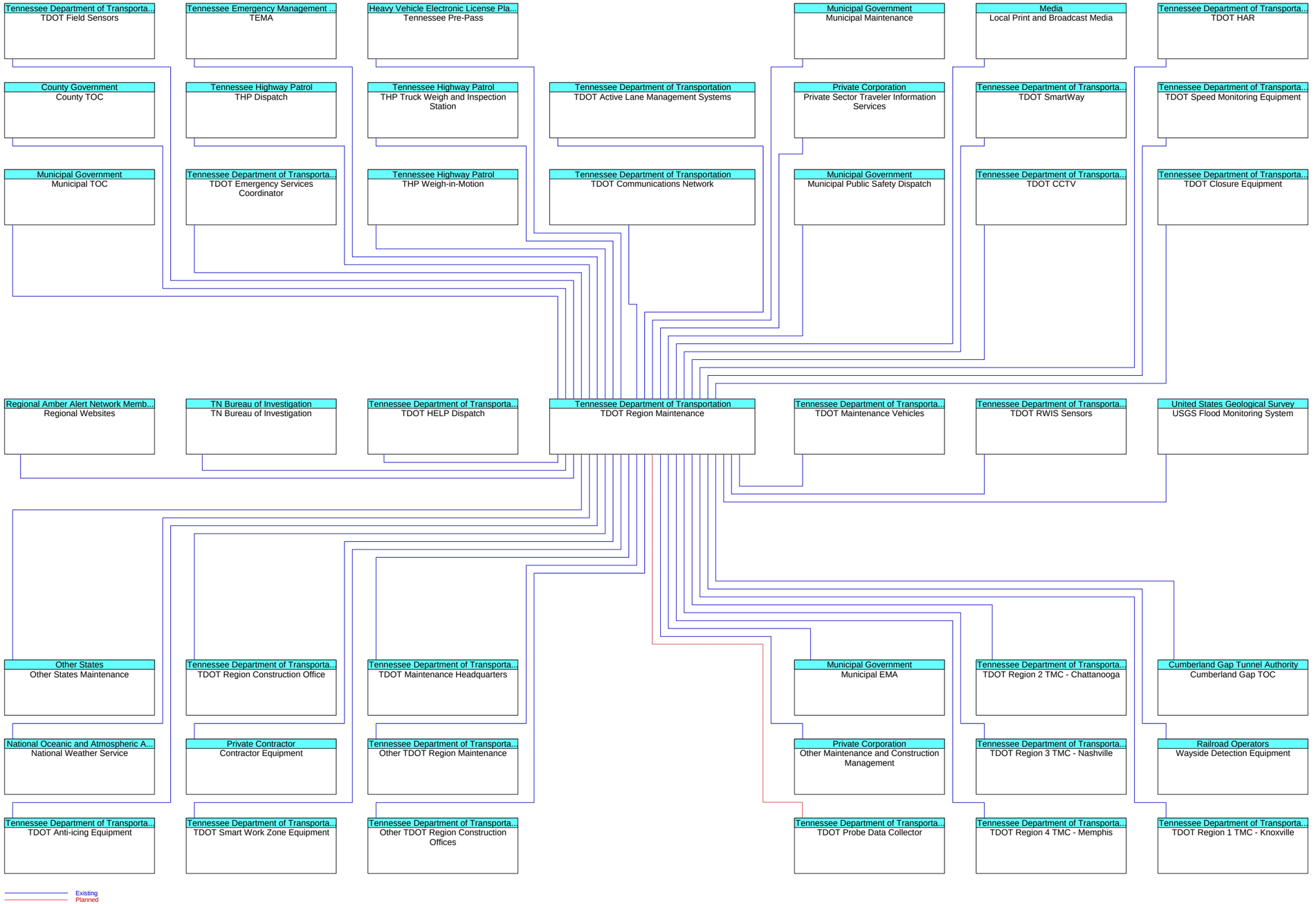


Figure 82: TDOT Region Maintenance Interconnect Context Diagram

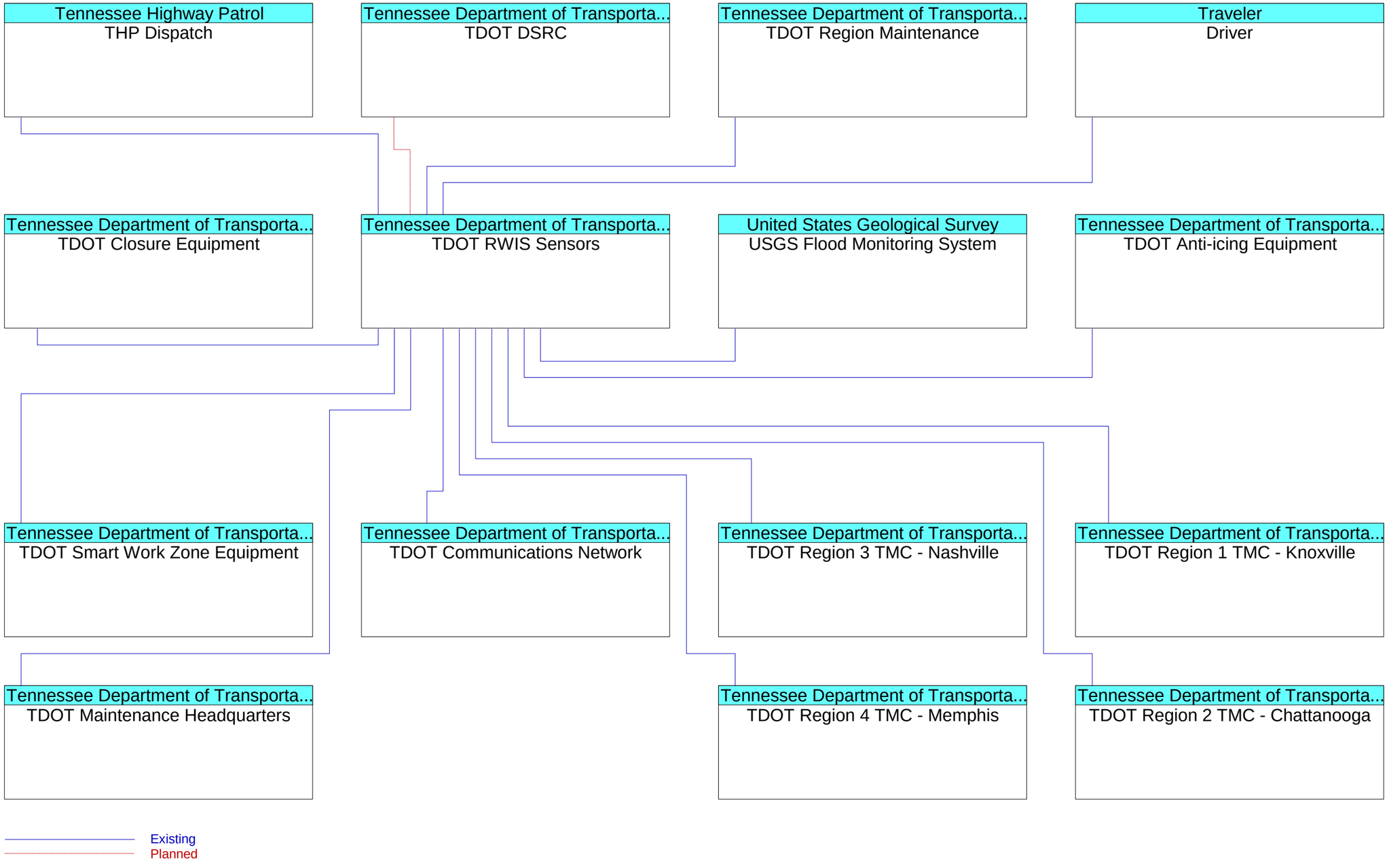


Figure 83: TDOT Road Weather Information System Interconnect Context Diagram

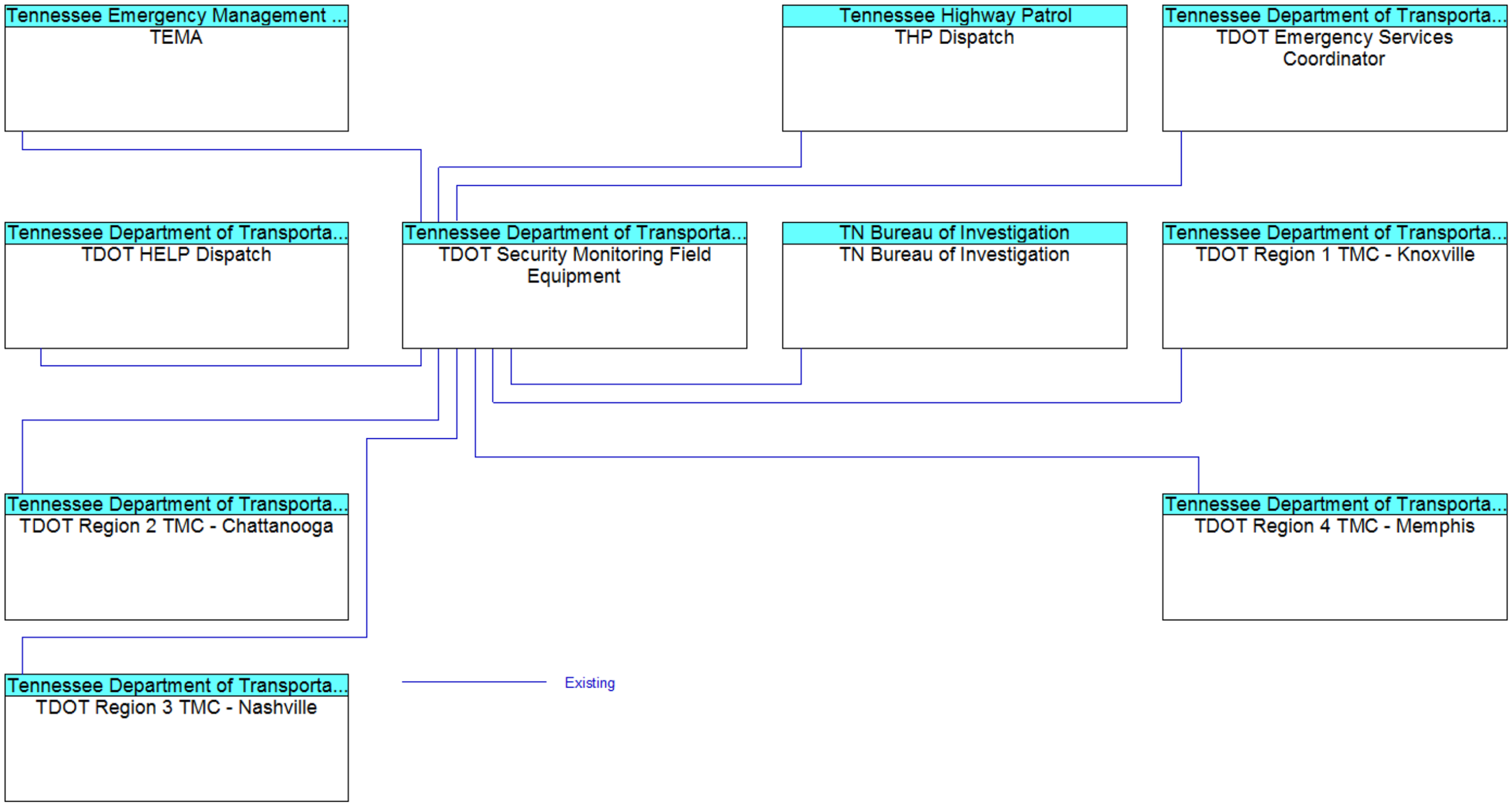


Figure 84: TDOT Security Monitoring Field Equipment Interconnect Context Diagram

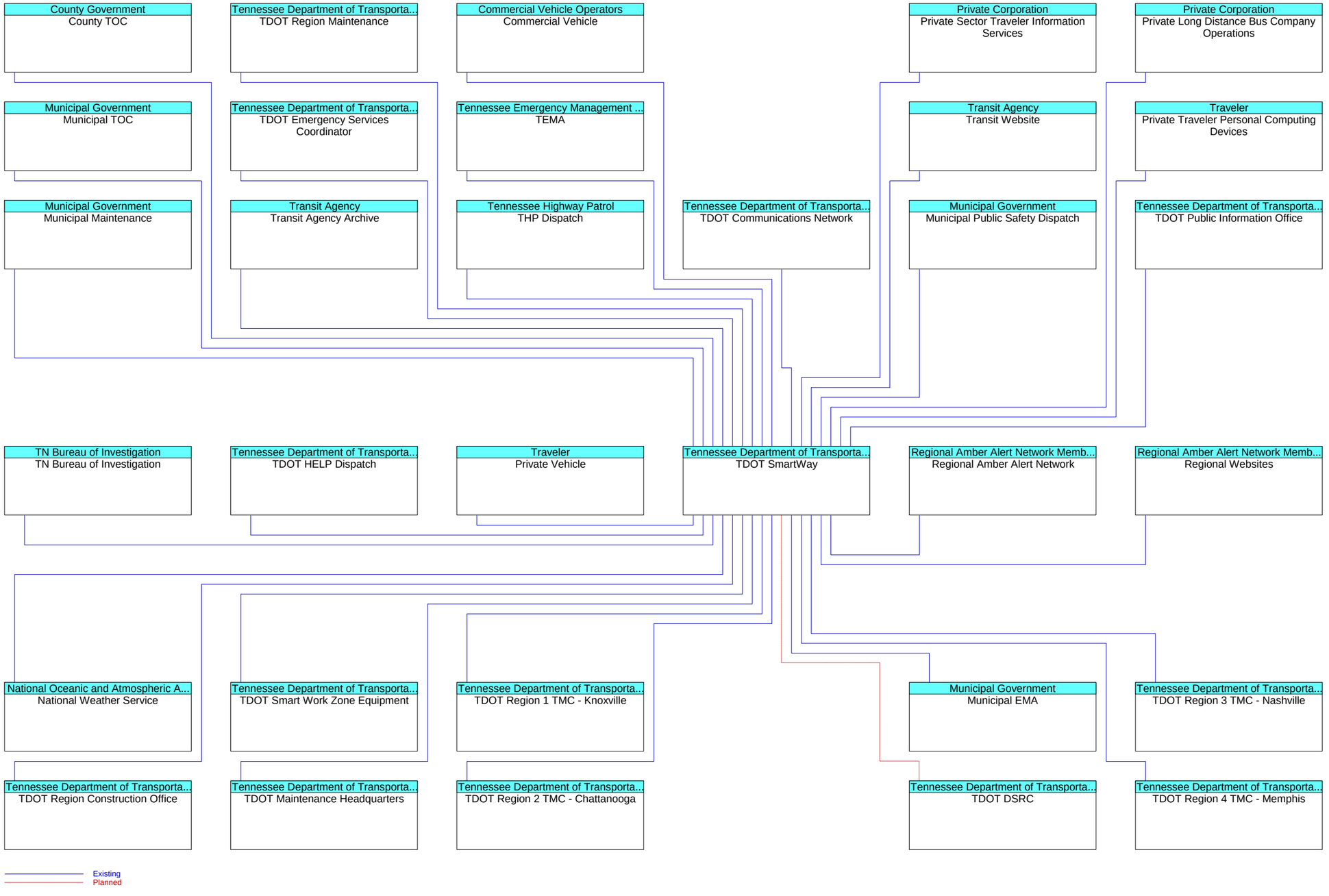


Figure 85: TDOT Smartway Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

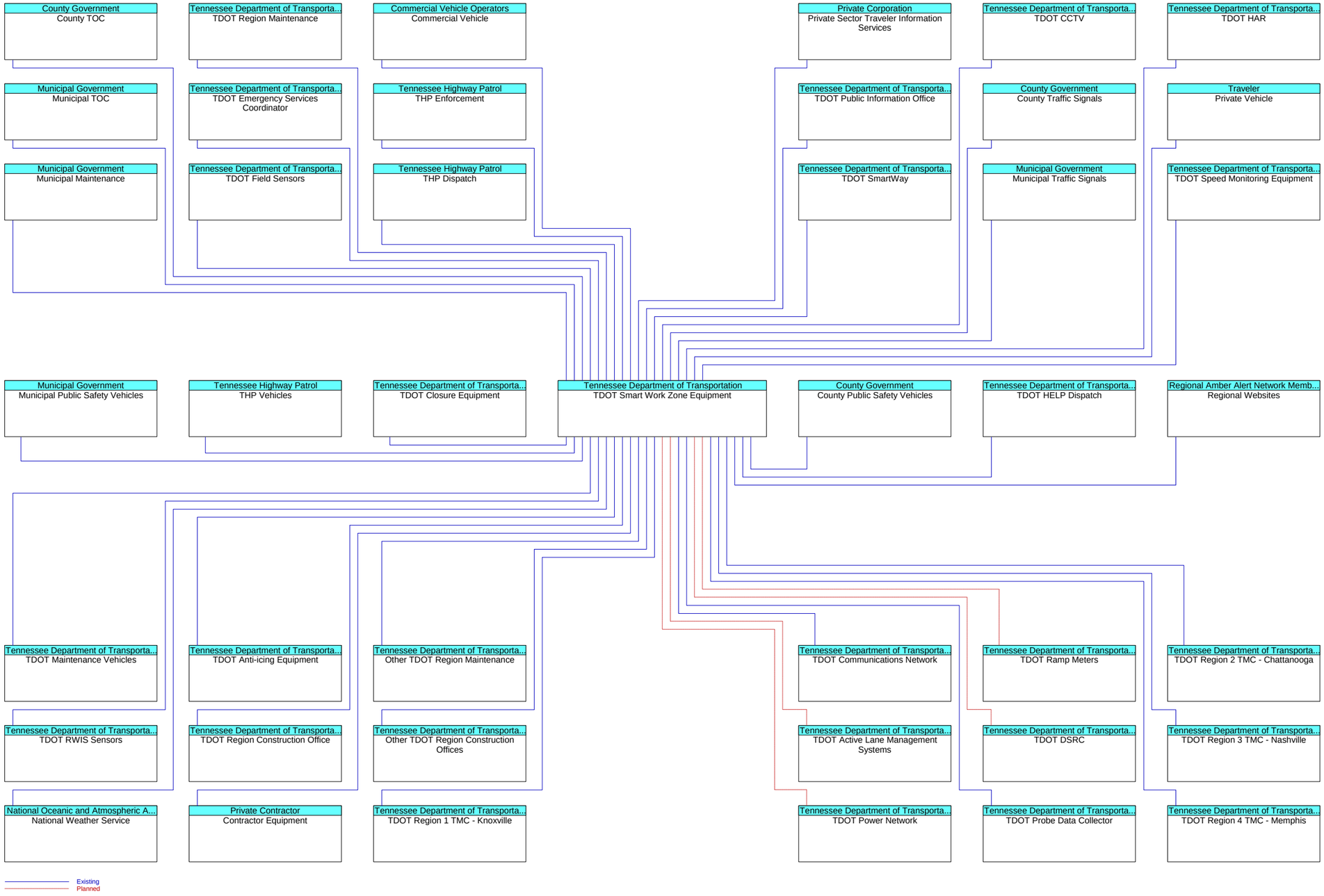


Figure 86: TDOT Smart Work Zone Equipment Interconnect Context Diagram

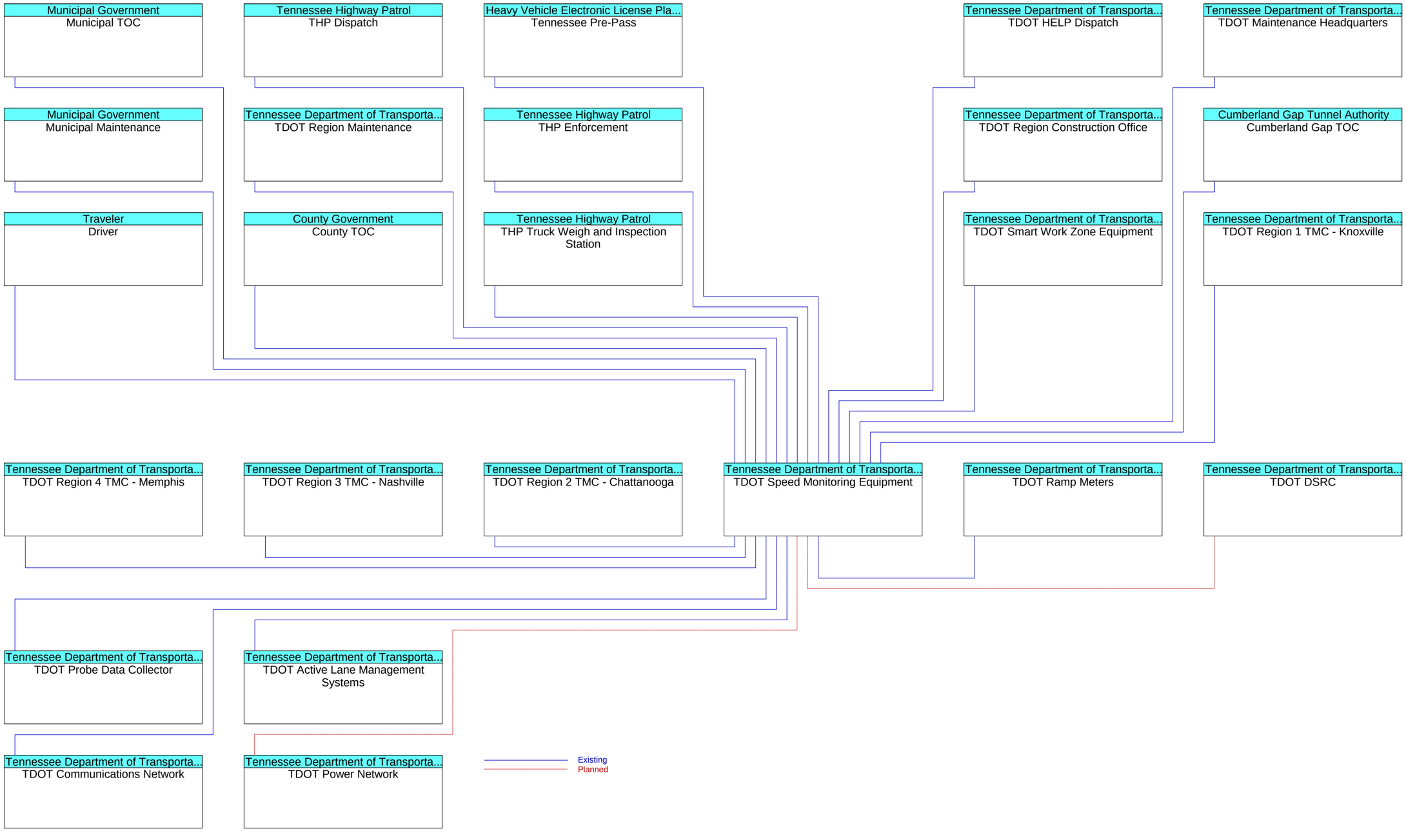


Figure 87: TDOT Speed Monitoring Equipment Interconnect Context Diagram

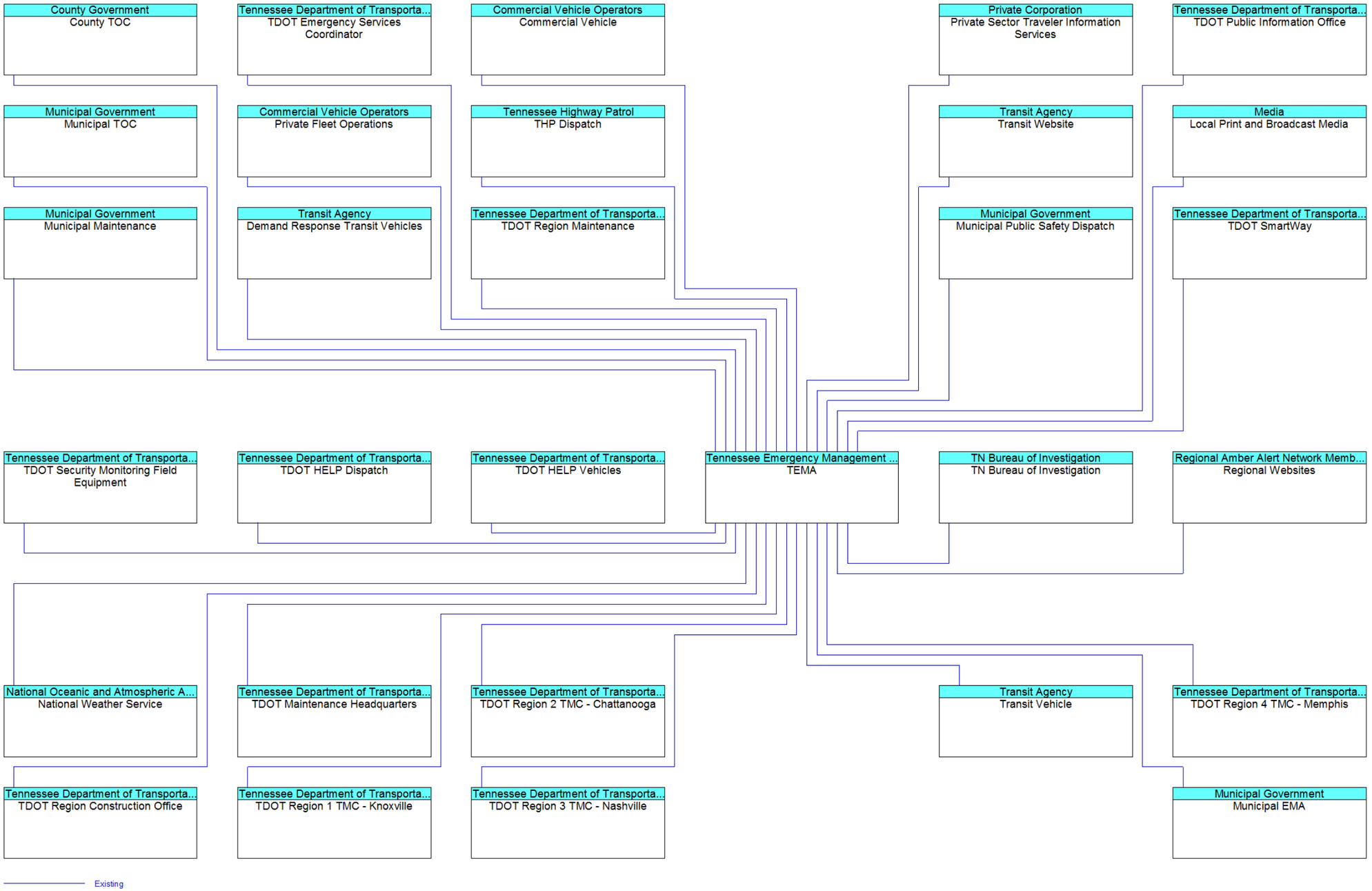


Figure 88: TEMA Interconnect Context Diagram

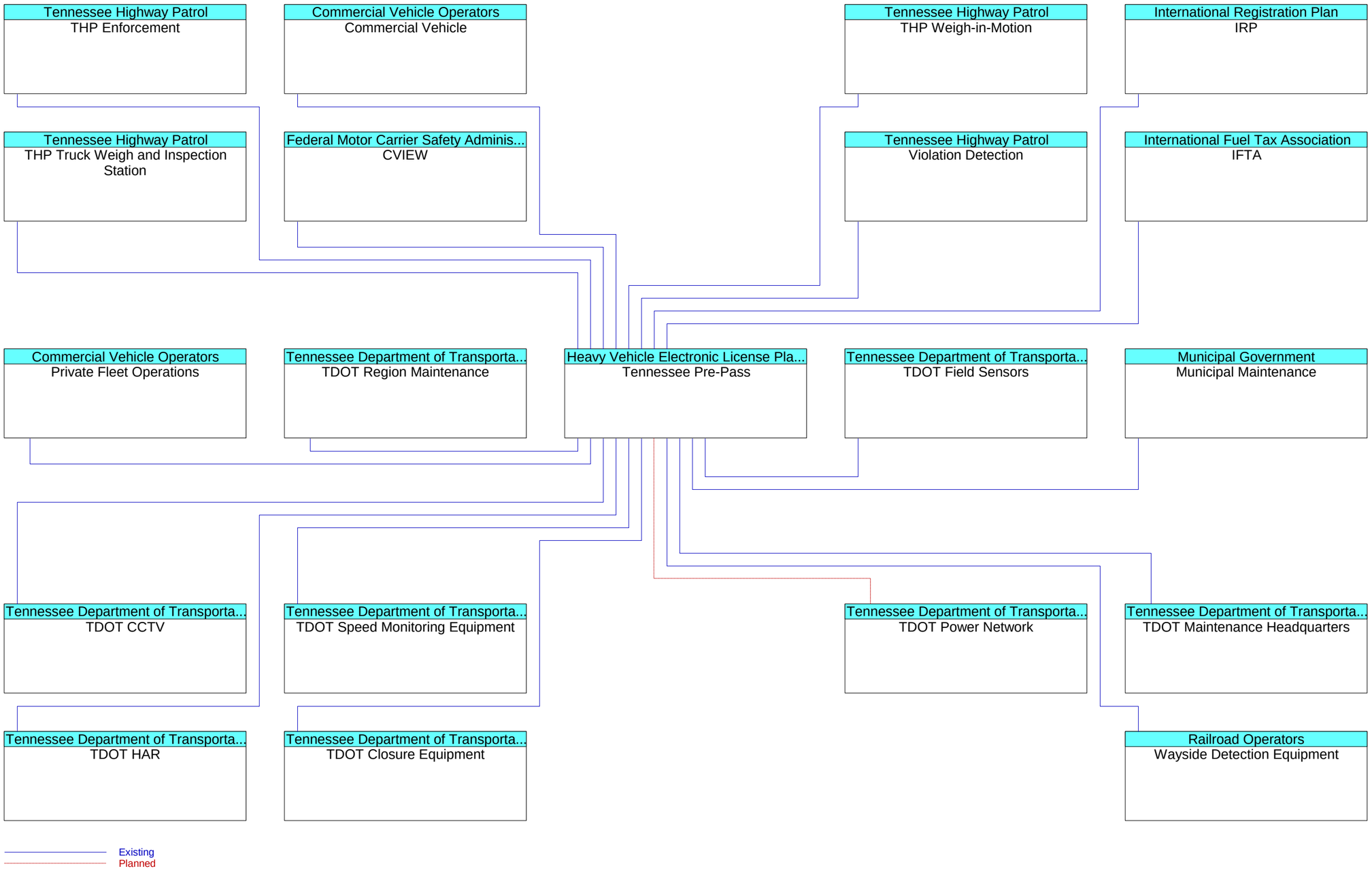


Figure 89: Tennessee Pre-Pass Interconnect Context Diagram

Appendix C INTERCONNECT CONTEXT DIAGRAMS

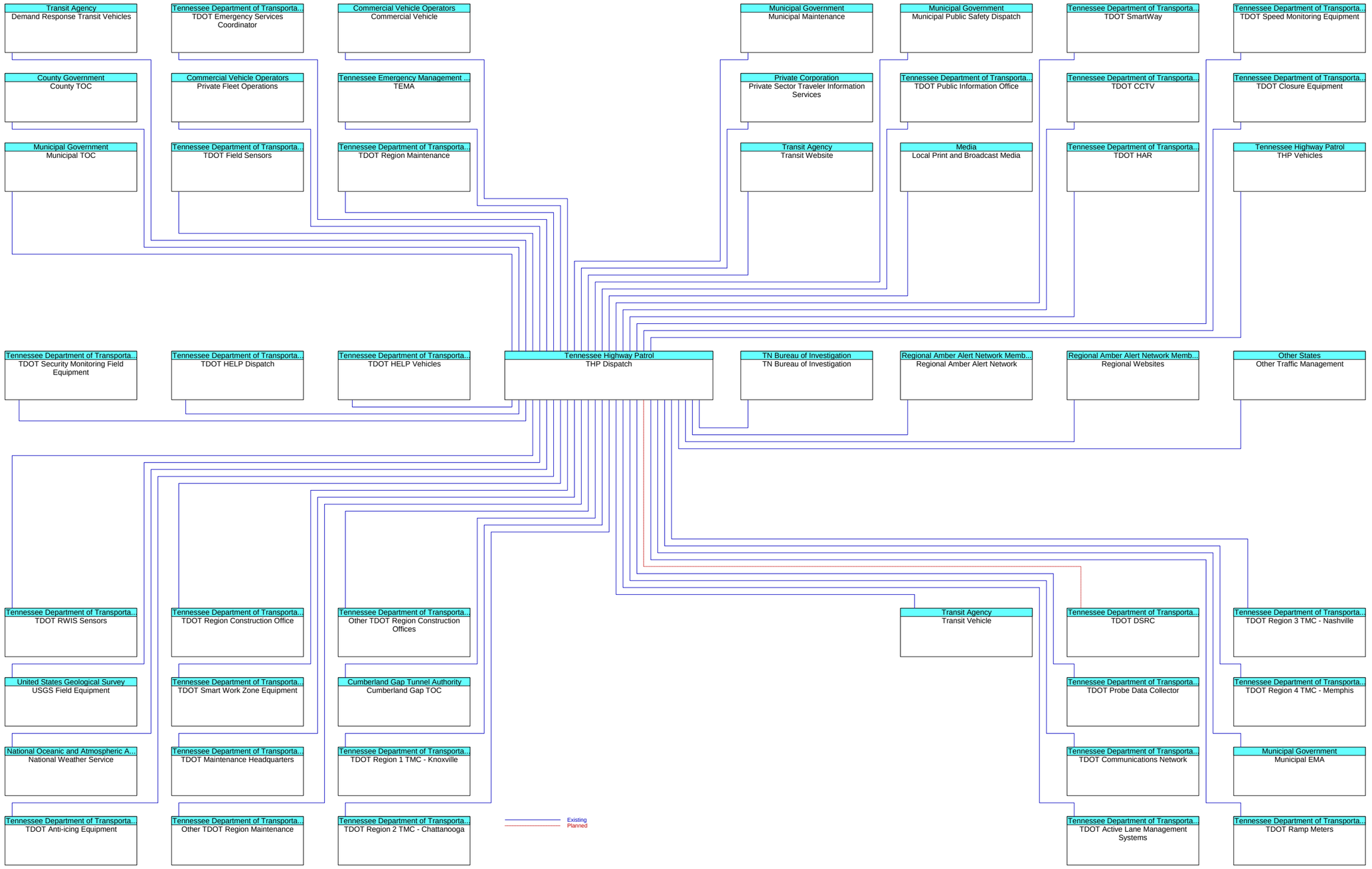


Figure 90: THP Dispatch Interconnect Context Diagram

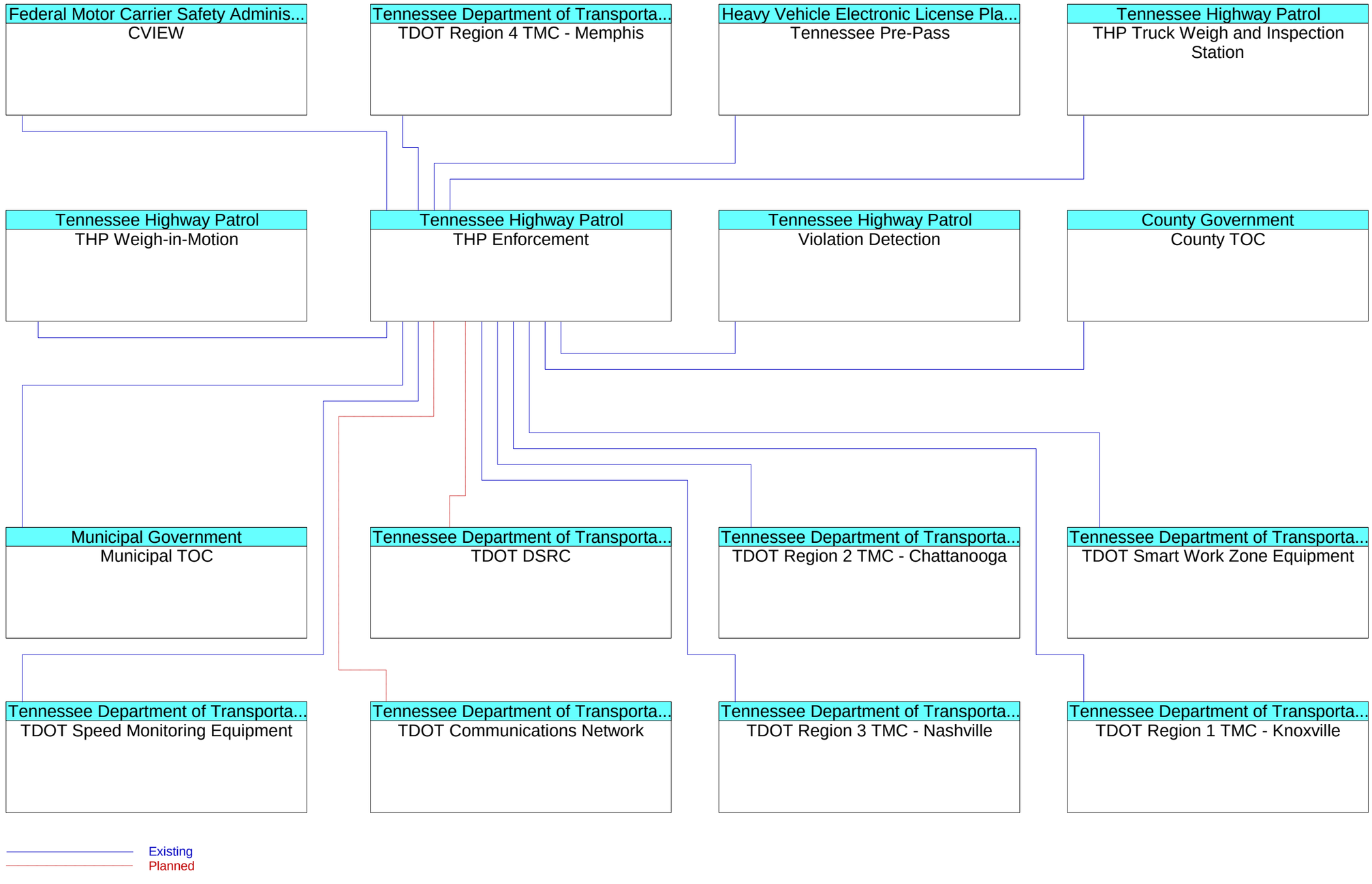


Figure 91: THP Enforcement Interconnect Context Diagram

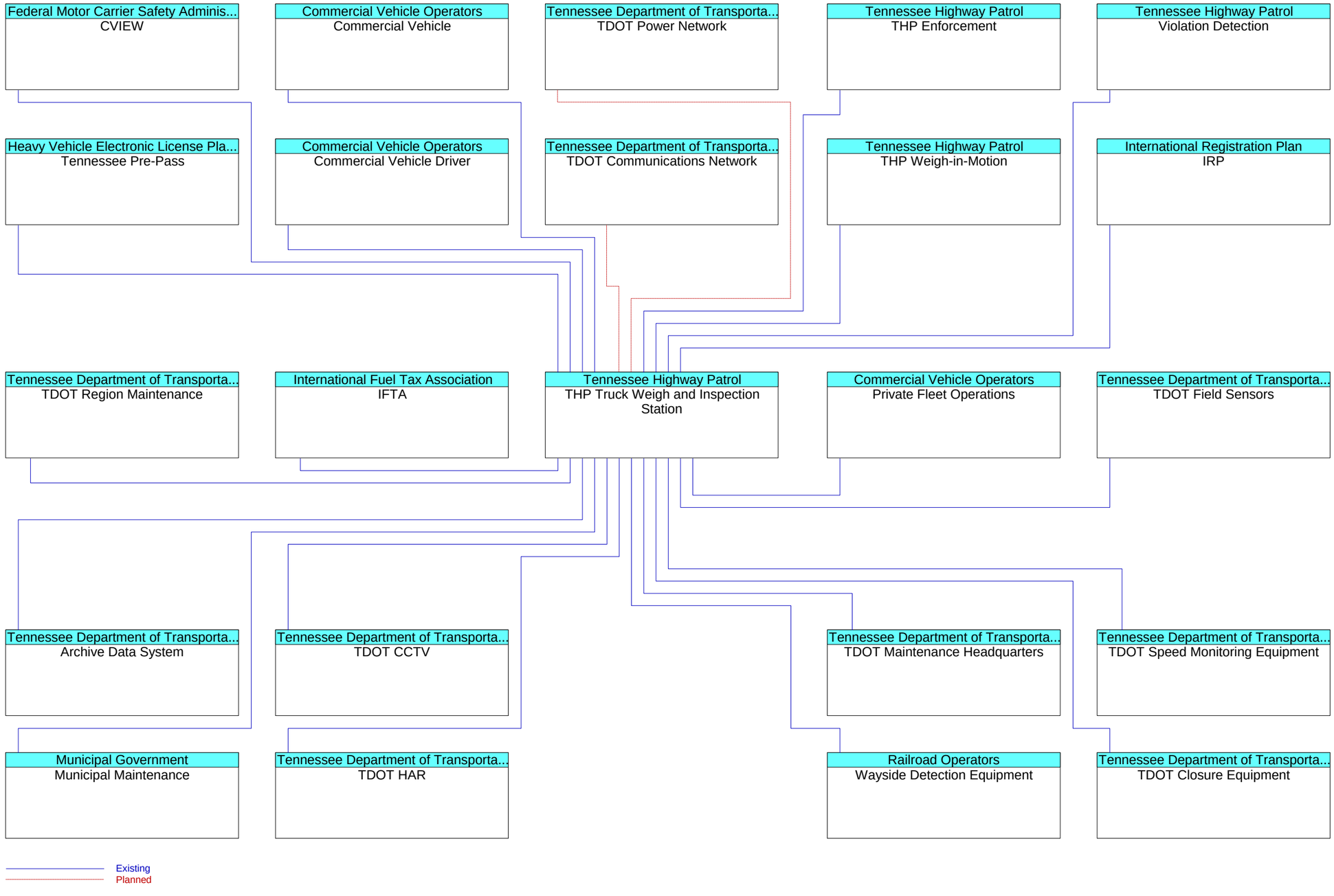


Figure 92: THP Truck Weigh and Inspection Station Interconnect Context Diagram

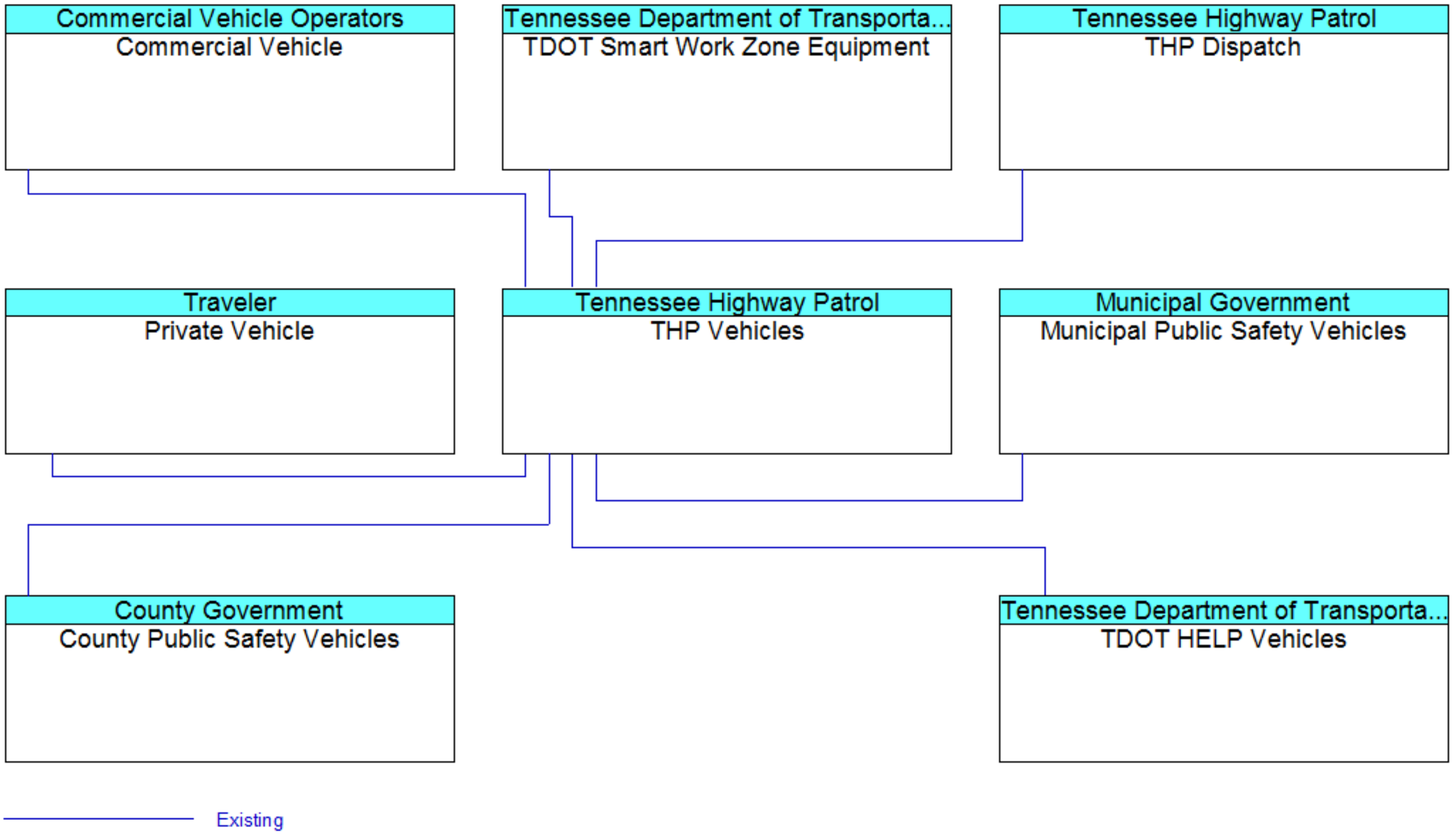


Figure 93: THP Vehicles Interconnect Context Diagram

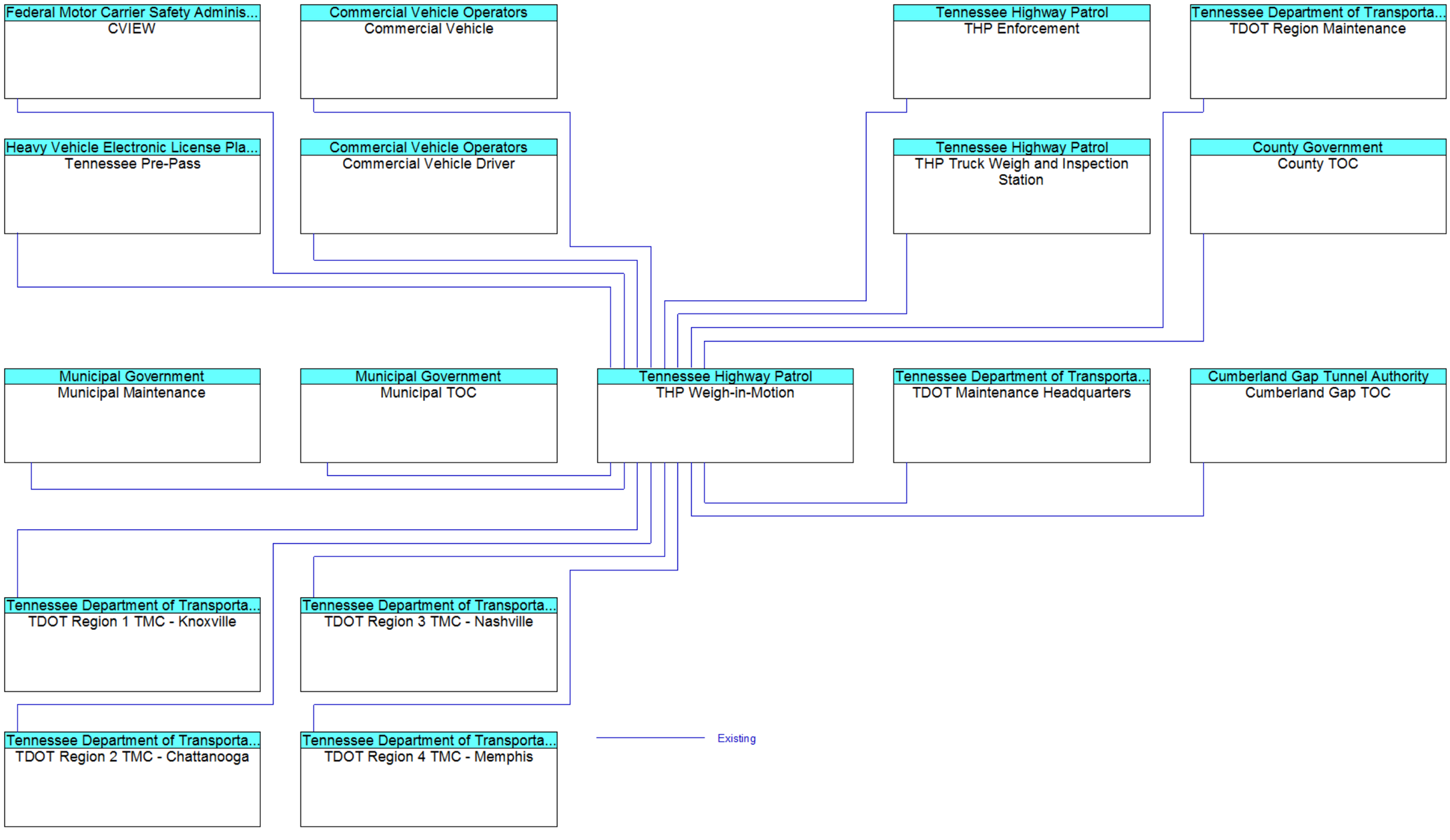


Figure 94: THP Weigh-in-Motion Interconnect Context Diagram

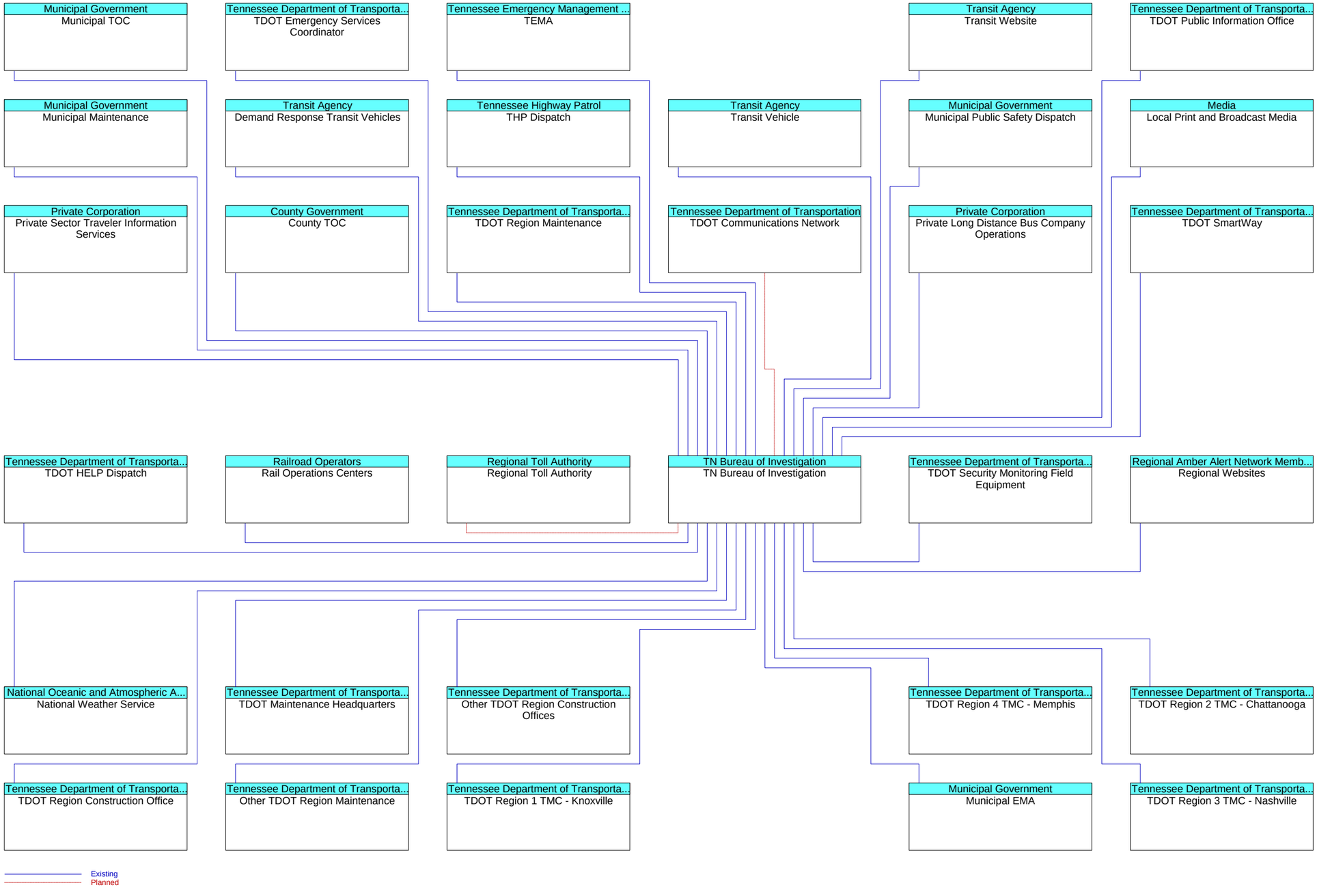


Figure 95: TN Bureau of Investigation Interconnect Context Diagram

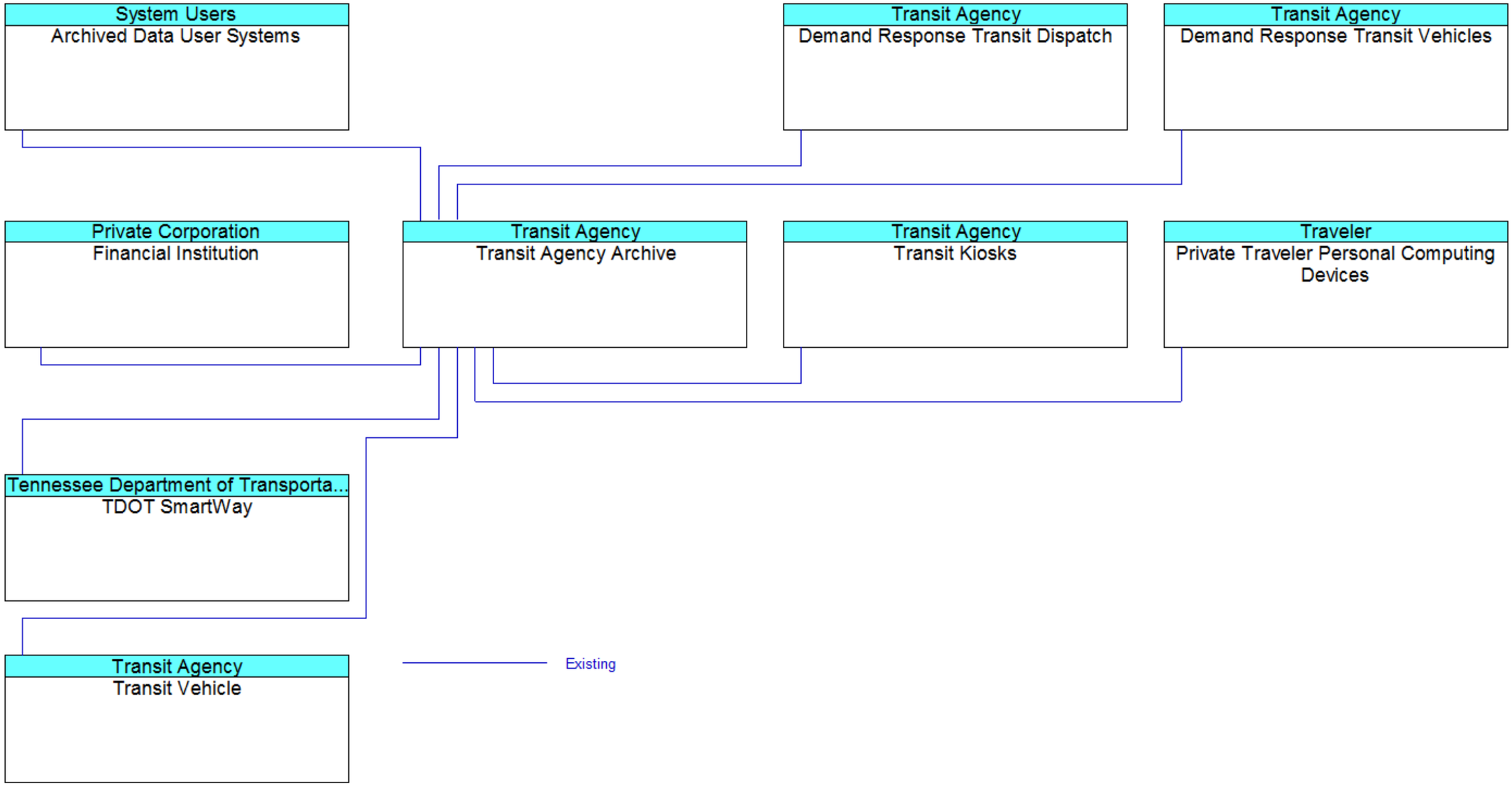


Figure 96: Transit Agency Archive Interconnect Context Diagram

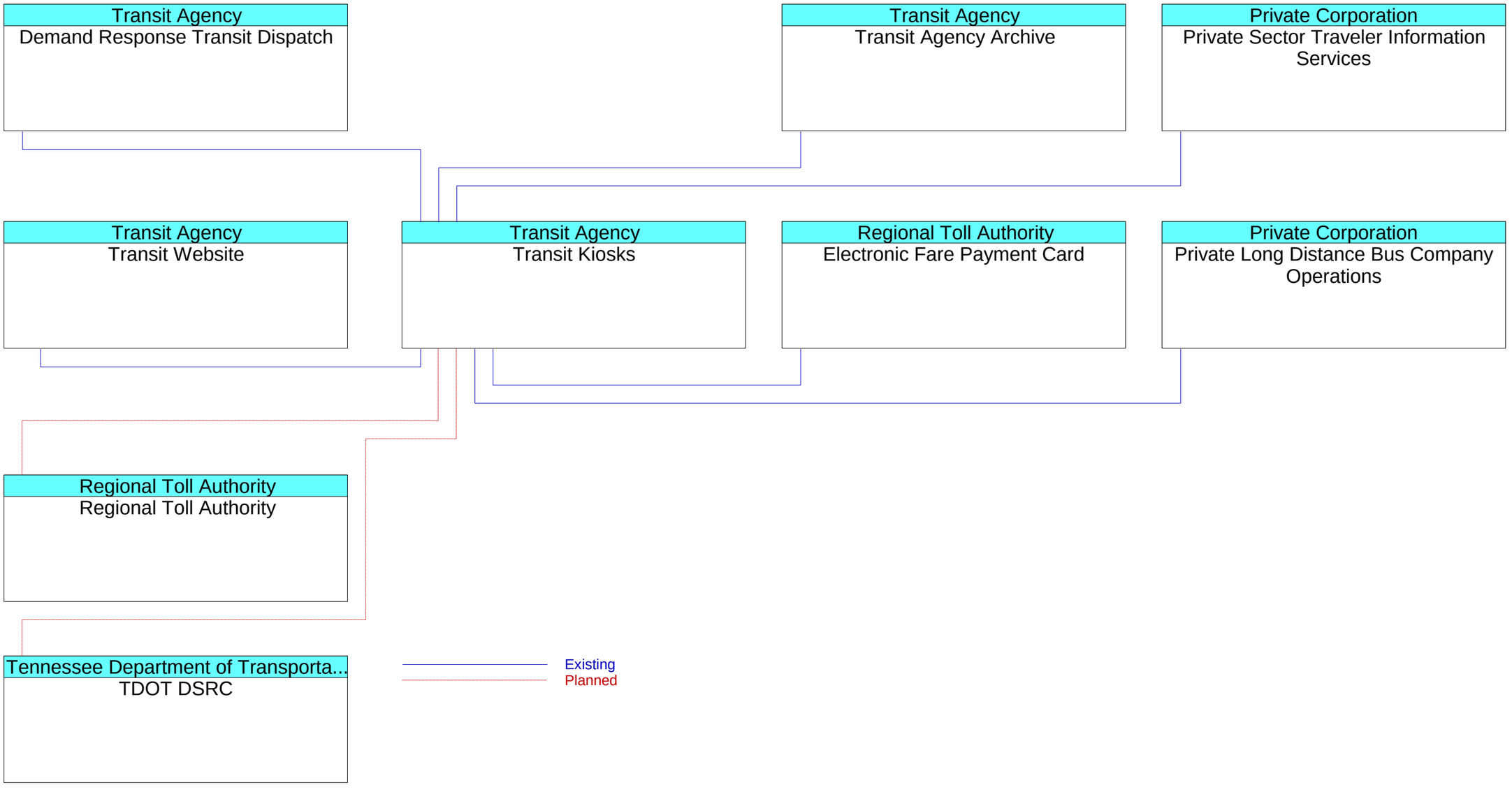


Figure 97: Transit Kiosk Interconnect Context Diagram

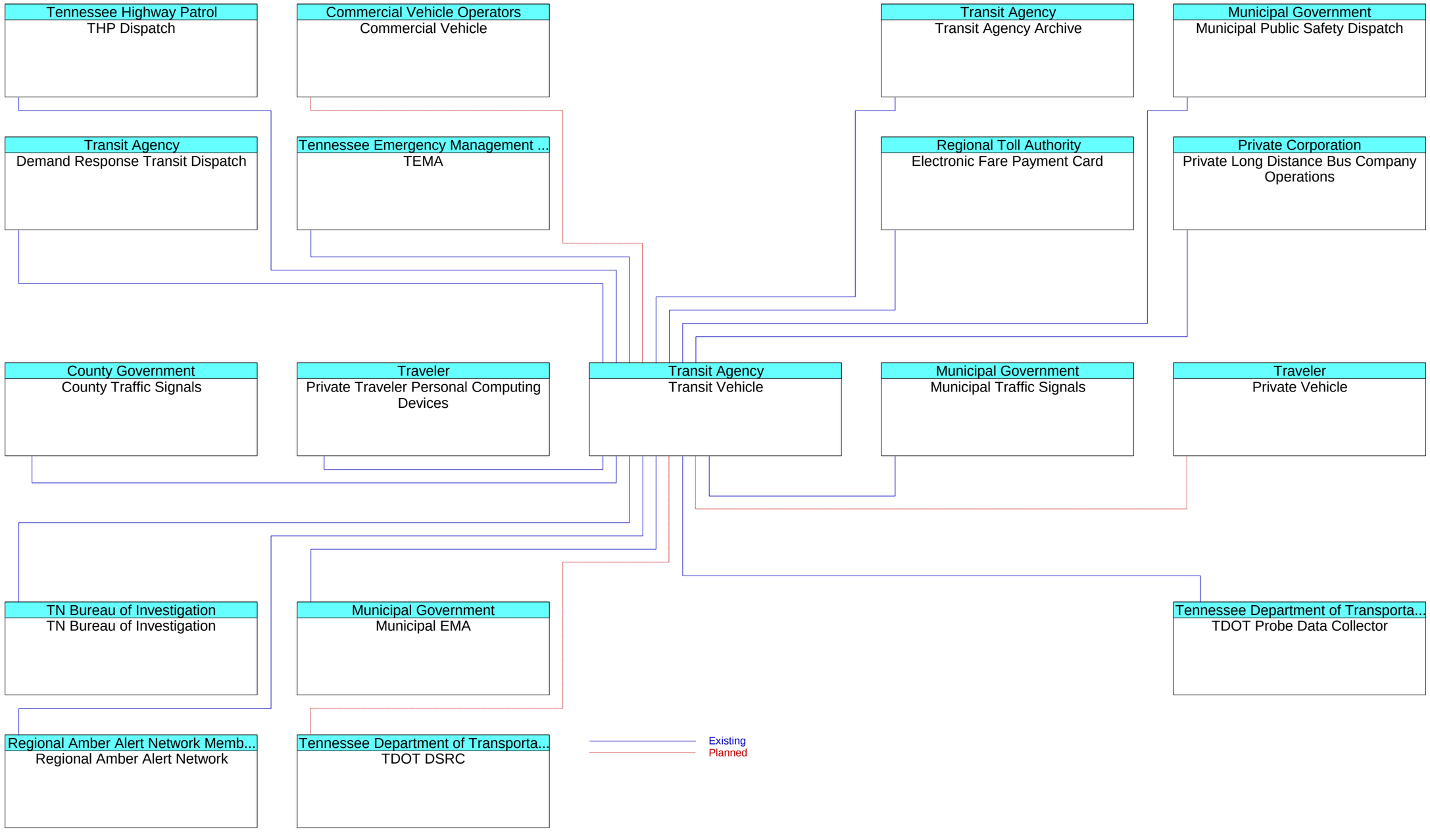


Figure 98: Transit Vehicle Interconnect Context Diagram

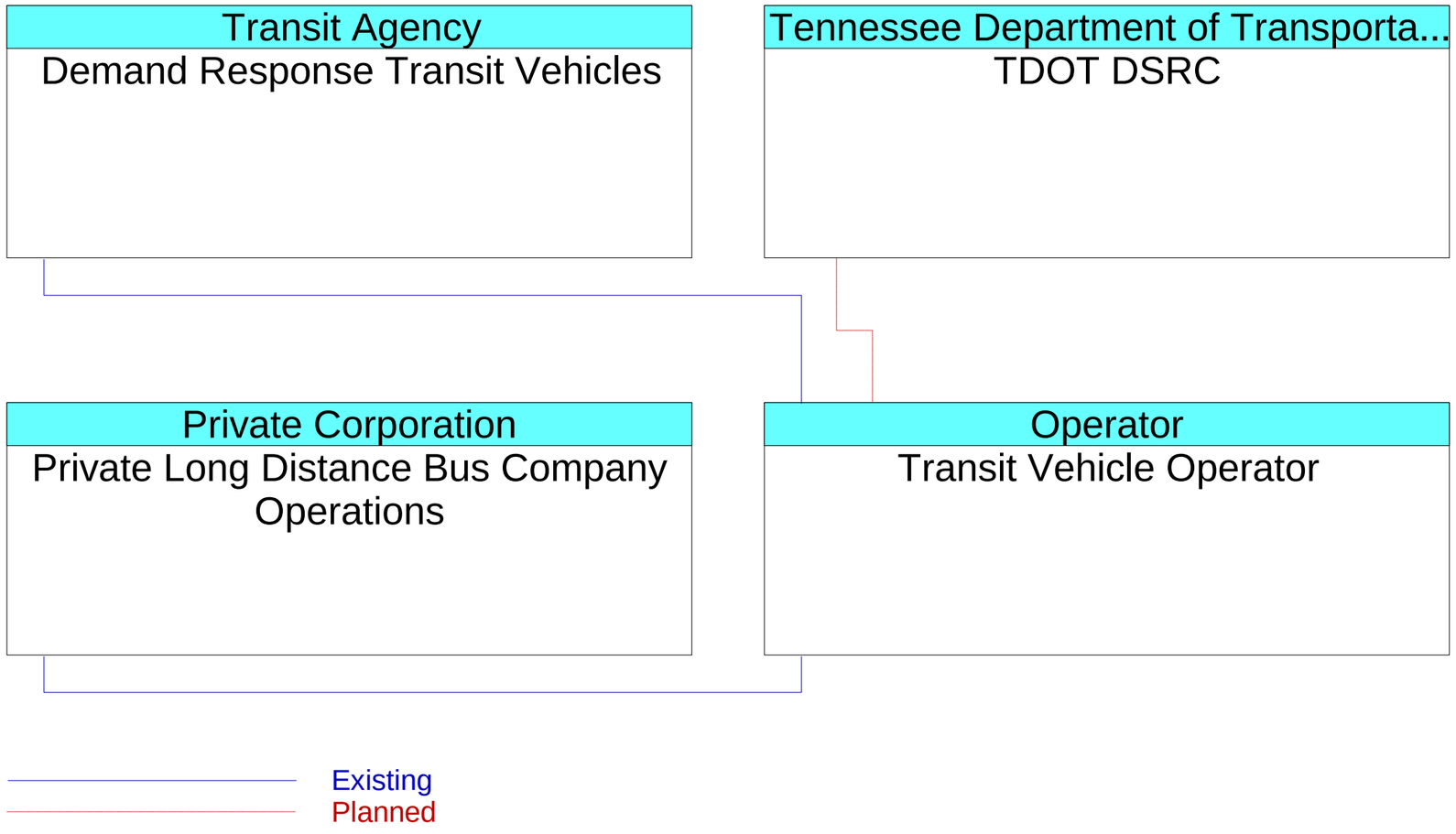


Figure 99: Transit Vehicle Operator Interconnect Context Diagram

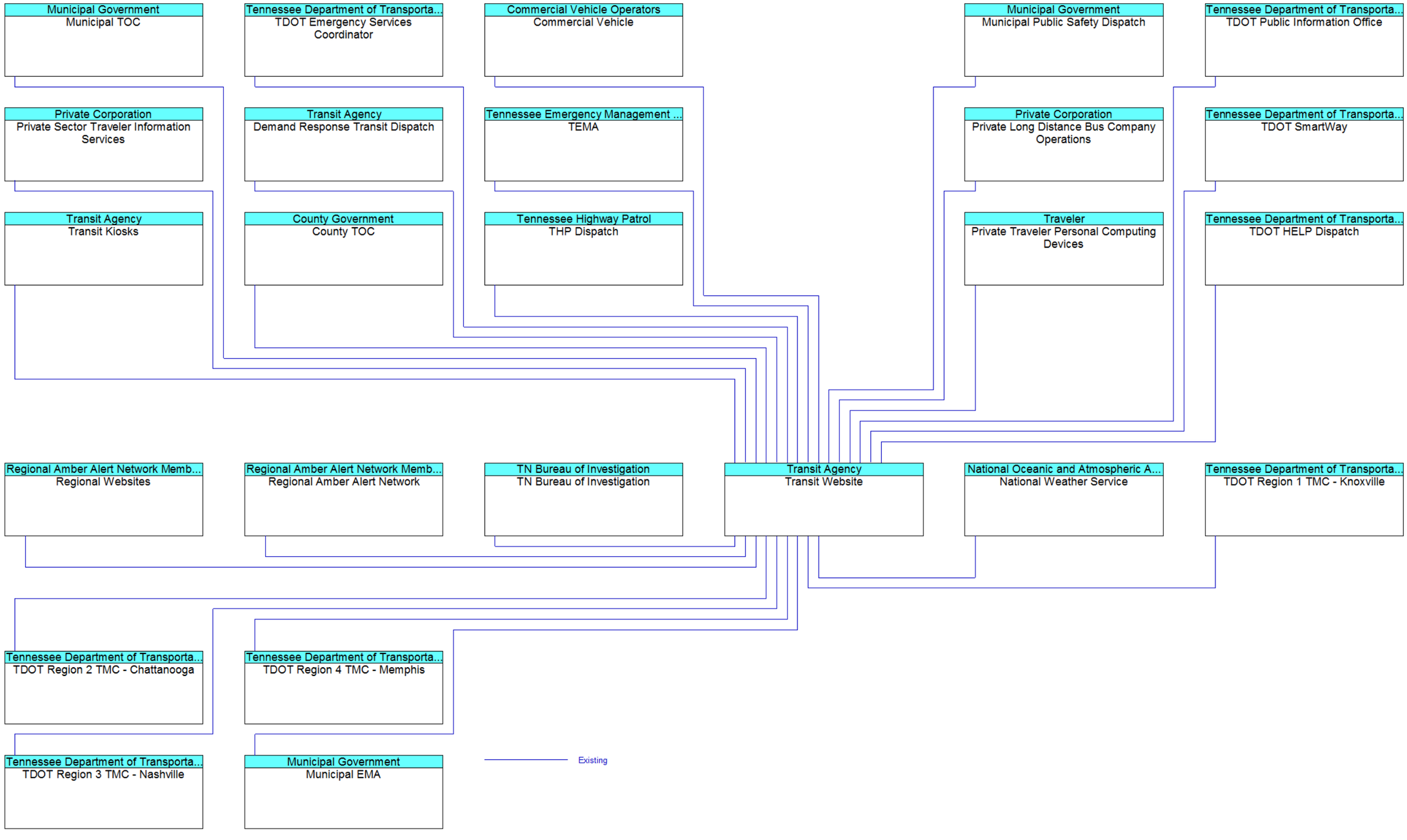


Figure 100: Transit Website Interconnect Context Diagram

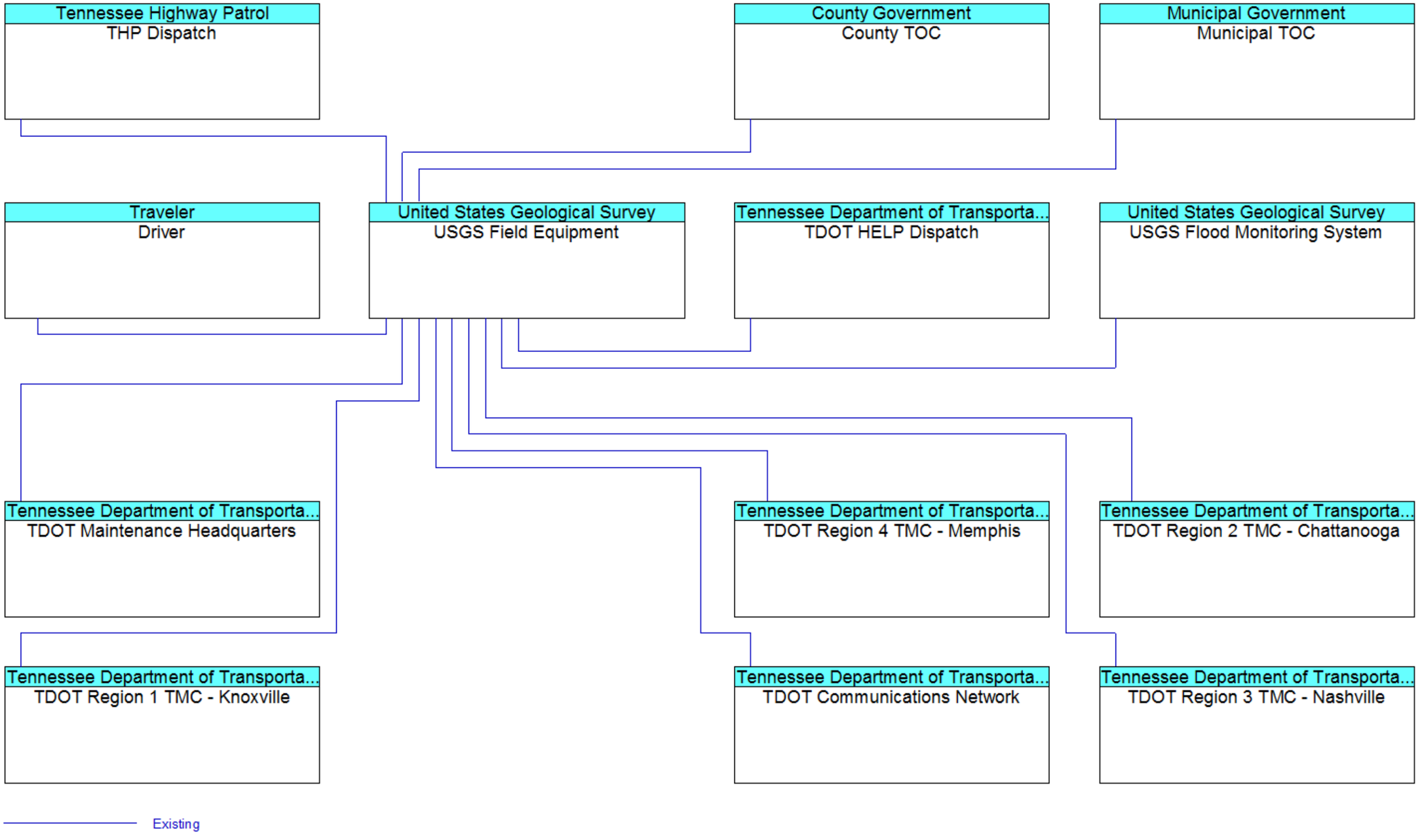


Figure 101: USGS Field Equipment Interconnect Context Diagram

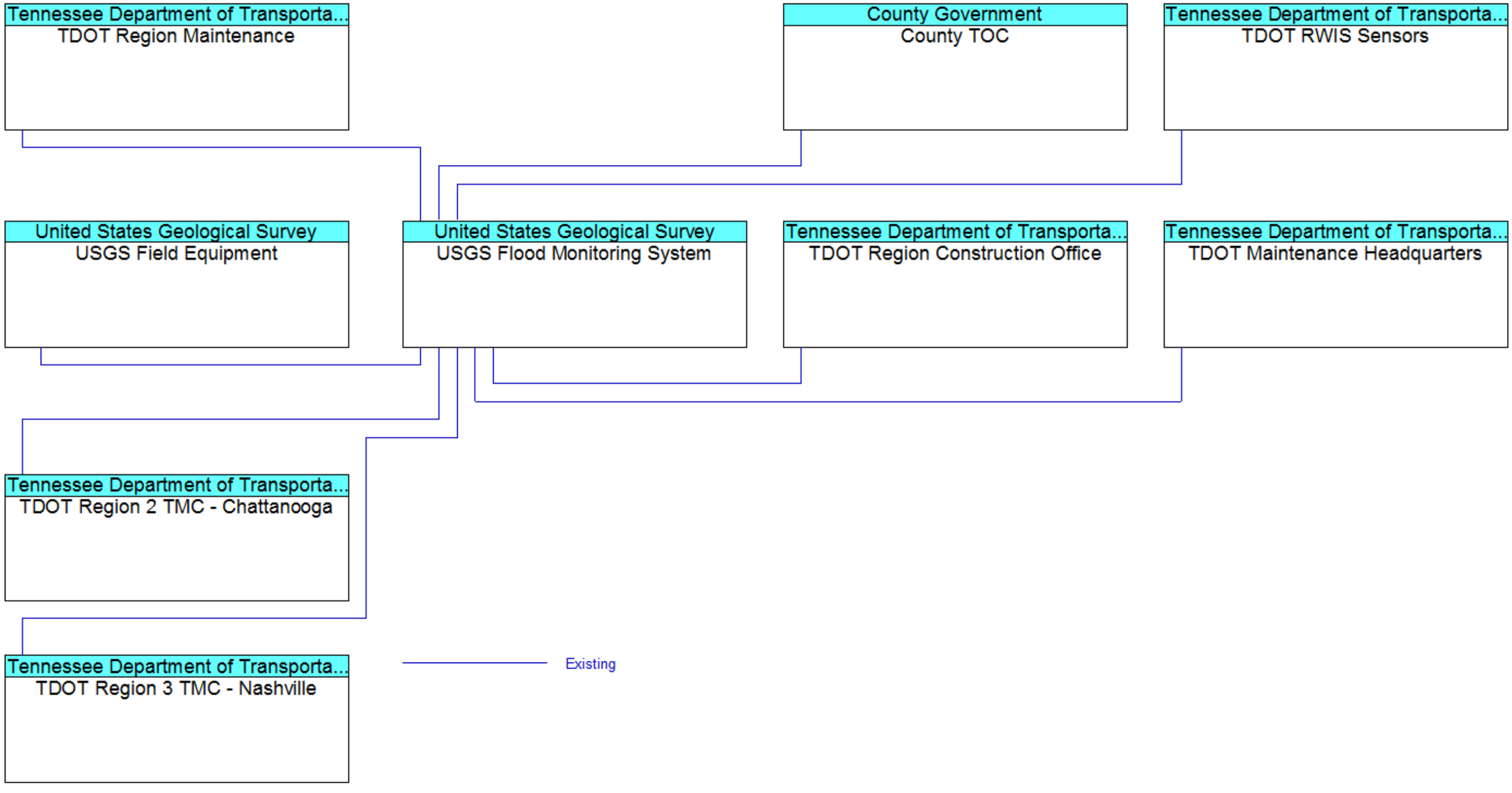


Figure 102: USGS Flood Monitoring Equipment Interconnect Context Diagram

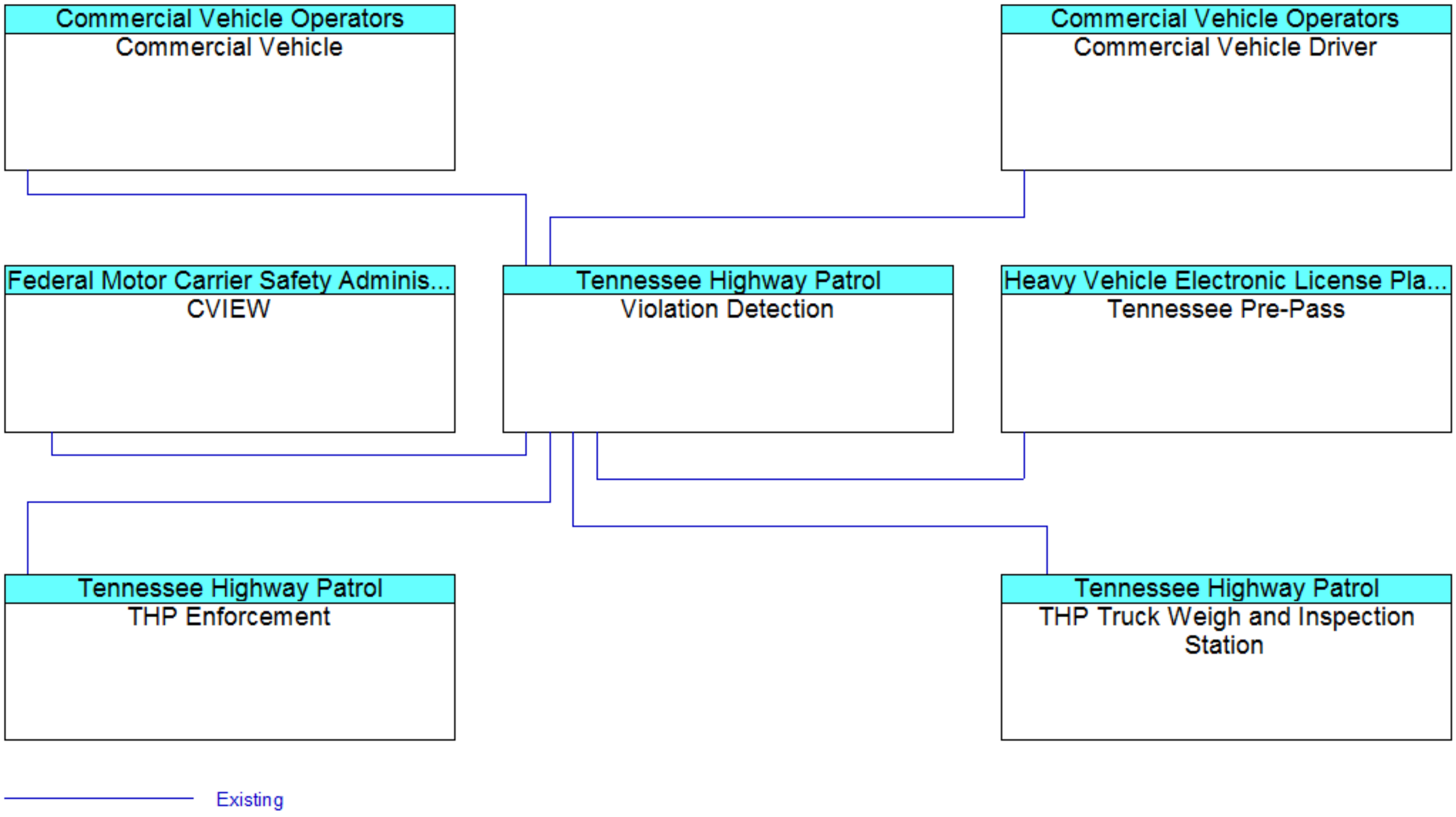


Figure 103: Violation Detection Interconnect Context Diagram

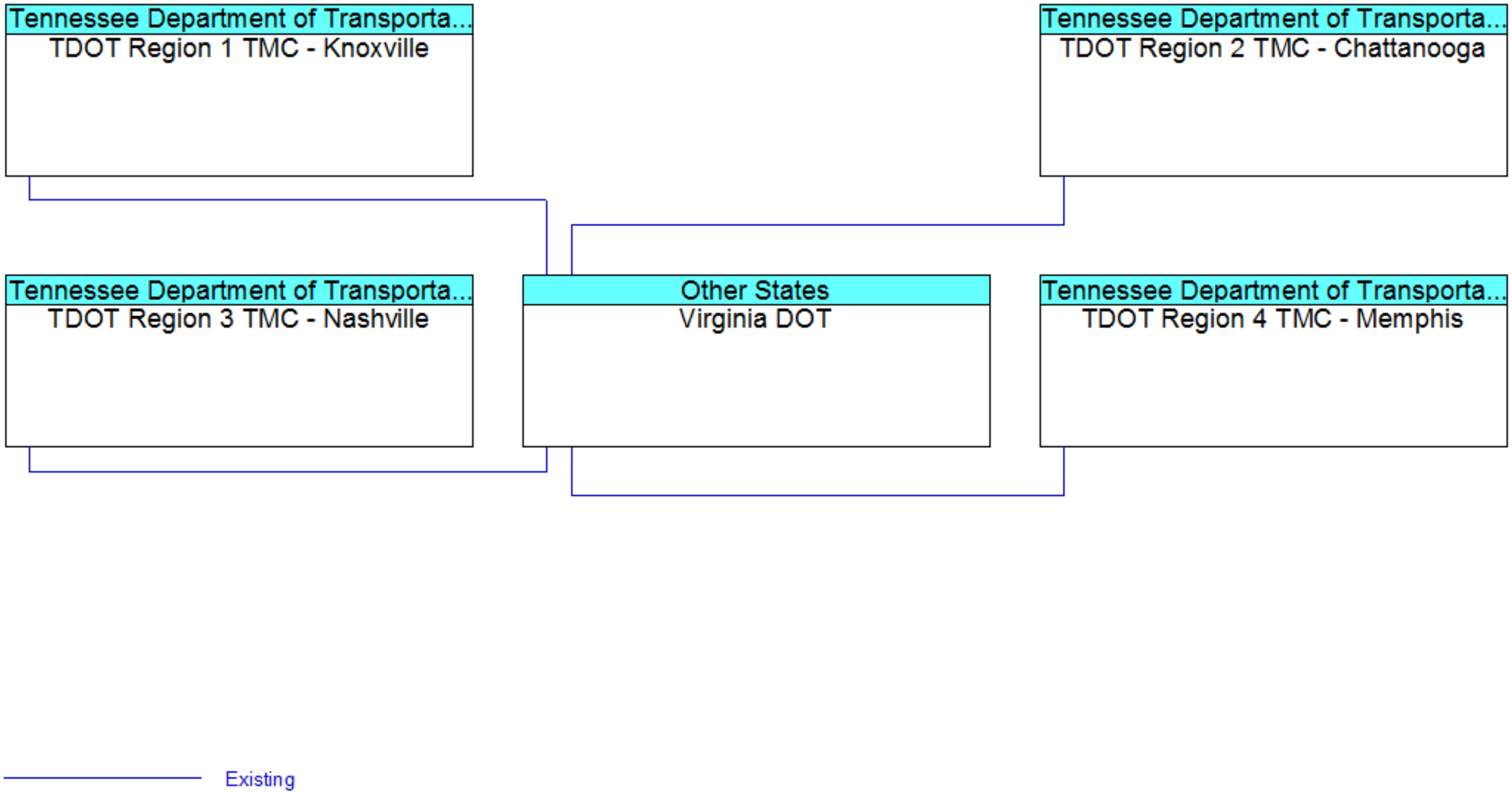


Figure 104: Virginia DOT Interconnect Context Diagram

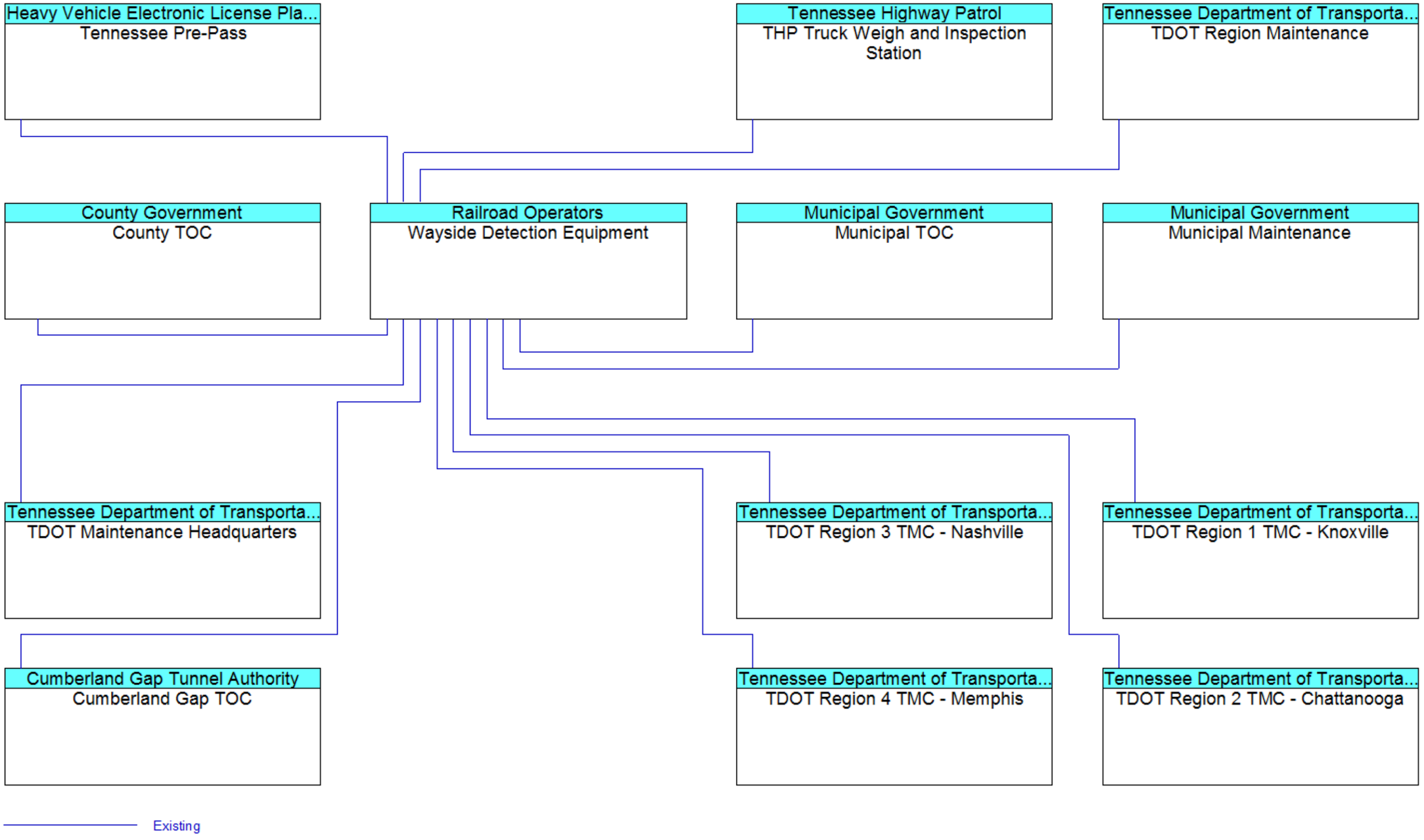


Figure 105: Wayside Detection Equipment Interconnect Context Diagram

Appendix D AGREEMENTS

- Tennessee Department of Transportation and Government Entity AGENCYs: Access Agreement for Live Traffic Data Sharing
- Tennessee Department of Transportation and Responder Entity USERs: Access Agreement for Live Video and Information Sharing
- Tennessee Department of Transportation and Government Entity USERs: Access Agreement for Live Video and Information Sharing
- Tennessee Department of Transportation and Private Entity USERs: Access Agreement for Live Video and Information Sharing
- Communications Resource License Agreement between the State of Tennessee Department of Transportation and The City of Franklin, TN
- Interagency Memorandum of Understanding Between Tennessee Department of Safety and Homeland Security and Tennessee Department of Transportation Relative to Urgent Clearance of Highway Incidents and Safety at Incident Scenes
- State of Tennessee “Open Roads Policy” Quick Clearance for Safety and Mobility Between the Tennessee Department of Transportation, the Tennessee Department of Safety and Homeland Security, and Tennessee Counties and Cities
- Interagency Memorandum of Understanding Between Tennessee Department of Safety and Homeland Security and Tennessee Department of Transportation Relative to Operation of Dynamic Message Signs, CCTVs and Fog Warning / Detection System

Appendix E CHANGE REQUEST FORM

Tennessee Statewide ITS Architecture Change Request Form
Submitter Information
Name
Agency
Description of change
Reason for Change
Change needed by (date)
Effect on Operations
References or Attachments
Date Submitted
Signature
Change Request Receiver (TDOT Traffic Operations Division)
Name
Date Received
Comments
Recommendation
Signature

Change Impact Evaluation (TDOT Traffic Operations)					
Name					
	Application	Hardware	Network	Database	Procedures
Change Type					
	Rejected	Approved	Approved with Conditions		
Decision					
Reason for Rejection					
	Urgent	High	Medium	Low	
Change Priority (for Approved Changes)					
Effect on Organization (TDOT Traffic Operations)					
Date					
Signature					