CLEVELAND

Regional Intelligent Transportation System Architecture and Deployment Plan

TN TDOT Department of Transportation

Cleveland Urban Area METROPOLITAN PLANNING ORGANIZATION

Prepared by:

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Final Report

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LIST OF ACRONYMS

AASHTO	American Association of State Highway and Transportation Officials
AD	Archived Data
AMBER	America's Missing: Broadcast Emergency Response
APTA	American Public Transportation Association
APTS	Advanced Public Transportation System
ASTM	American Society for Testing and Materials
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AVL	Automated Vehicle Location
CCTV	Closed Circuit Television
CVISN	Commercial Vehicle Information Systems and Networks
DMS	Dynamic Message Sign
EM	Emergency Management
EMA	Emergency Management Agency
EMS	Emergency Medical Services
EOC	Emergency Operations Center
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GPS	Global Positioning System
HAR	Highway Advisory Radio
HAWK	Pedestrian Hybrid Beacons
IEEE	Institute of Electrical and Electronics Engineers
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
IVR	Interactive Voice Response
MC	Maintenance and Construction
MDT	Mobile Data Terminal
MOU	Memorandum of Understanding
MPO	Metropolitan Planning Organization
NEMA	National Electrical Manufacturers Association

LIST OF ACRONYMS

NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
PSAP	Public Safety Answering Point
RTMS	Remote Traffic Microwave Sensor
RTP	Regional Transportation Plan
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible and Efficient Transportation Equity Act – A Legacy for Users
SDO	Standards Development Organization
SETHRA	Southeast Tennessee Human Resource Agency
SWIFT	TDOT Statewide Information for Travelers
TDOT	Tennessee Department of Transportation
TEA-21	Transportation Equity Act for the 21st Century
TEMA	Tennessee Management Emergency Agency
THP	Tennessee Highway Patrol
TIP	Transportation Improvement Program
TITAN	Tennessee Integrated Traffic Analysis Network
TMC	Transportation Management Center or Traffic Management Center
TOC	Traffic Operations Center
USDOT	United States Department of Transportation
VIVDS	Video Image Vehicle Detection Systems

1. INTRODUCTION

1.1 Project Overview

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

Regional ITS Architectures are living documents and should be updated as necessary to reflect a region's needs and current guidelines. The Cleveland Regional ITS Architecture was first developed in 2007 by the Tennessee Department of Transportation (TDOT), in coordination with the Cleveland Urban Area Metropolitan Planning Organization (MPO). Since that time, several ITS programs and projects have been implemented in the Cleveland Region Smart Park systems for truck parking at exits along I-75, improved transit security systems aboard SETHRA and Cleveland Transit vehicles, and an expansion of the City of Cleveland's emergency vehicle signal preemption program. Additionally, the National ITS Architecture, which served as the basis for the original Cleveland Regional ITS Architecture, was updated several times, with the most substantial update occurring in 2012. In order to incorporate these changes, the Tennessee Department of Transportation, in close coordination with the Cleveland MPO, completed an update of the Regional ITS Architecture in 2017.

The Regional ITS Architecture consists of several key components:

- ITS Needs – The needs describe the transportation related needs in the Region that could possibly be addressed by ITS.
- ITS Inventory – The inventory describes all of the ITS related elements that either exist or are planned for the Region.
- ITS Service Packages – The ITS service packages describe the services that stakeholders in the Region want ITS to provide. ITS service package diagrams have been developed to illustrate how each service will be deployed and operated by each agency in the Region that expressed interest in a particular service. In the previous version of the Cleveland Regional ITS Architecture, ITS service packages were referred to as ITS market packages. Terminology in this document has been updated to be consistent with the terminology that is now used in Version 7.1 of the National ITS Architecture.
- Use and Maintenance Plan – The use and maintenance plan describes how to use the Regional ITS Architecture for ITS planning and design efforts, such as the development of a Systems Engineering Analysis. It also describes how the Regional ITS Architecture should be maintained in the future.

A regional ITS architecture is necessary to satisfy the ITS conformity requirements first established in the Transportation Equity Act for the 21st Century (TEA-21) highway bill and continued in the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) bill passed in 2005; the Moving Ahead for Progress in the 21st Century (MAP-21) bill passed in 2012; and the Fixing America's Surface Transportation (FAST) Act bill passed in 2015. In response to Section 5206(e) of TEA-21, the Federal Highway Administration (FHWA) issued a final rule and the Federal Transit Administration (FTA) issued a final policy that required regions

implementing any ITS project to have an ITS architecture in place by April 2005. After this date, any ITS projects must show conformance with their regional or statewide ITS architecture in order to be eligible for funding from FHWA or FTA. In order to show this conformance, it is important that any region deploying ITS have an updated regional ITS architecture in place.

The Cleveland Regional ITS architecture update includes the geographic jurisdictions within the Cleveland MPO Planning Area as well as the remainder of Bradley County. The stakeholders developed the Regional ITS Architecture based on a vision of how they wanted to implement and operate ITS through the year 2040 in the Cleveland Region. Additionally, the Regional ITS Architecture includes an ITS Deployment Plan. The ITS Deployment Plan identifies projects that have been recommended by the stakeholders as priority projects for their agency that will help achieve the vision of the Regional ITS Architecture.

The Cleveland Regional ITS Architecture was developed with significant input from local, state, and federal officials. Two stakeholder workshops were held and individual interviews were conducted with many of the stakeholders outside of the workshops to gather input and help ensure that the plans reflected the unique needs of the Region. Copies of the draft reports were provided to all stakeholders for review during the update process. The Regional ITS Architecture and Deployment Plan both provide an accurate snapshot of existing ITS project deployments and future ITS plans in the Region. Needs and priorities of the Region will change over time and in order to remain effective this plan should be periodically reviewed and updated.

1.2 Cleveland Region

1.2.1 Geographic Boundaries

The Cleveland Region includes all of Bradley County and a small portion of southern McMinn County including the municipality of Calhoun, as shown in **Figure 1**. A portion of McMinn County to the north along the I-75 corridor was included in the 2007 Cleveland Regional ITS Architecture for continuity with planning for management of fog events that impact I-75, however this region is no longer included in the Cleveland Regional ITS Architecture boundary. The Cleveland MPO and Chattanooga-Hamilton County/North Georgia Transportation Planning Organization have a Memorandum of Understanding (MOU) in place that states the fog detection equipment in McMinn County should be included in the Chattanooga Regional ITS Architecture.

When developing the stakeholder group, the project team coordinated with the Cleveland MPO to include the appropriate city, county, regional, state and federal agencies. Stakeholders included both local representatives as well as representatives from TDOT headquarters and Region 2 in Chattanooga, THP, and FHWA from the Tennessee Division Office in Nashville.

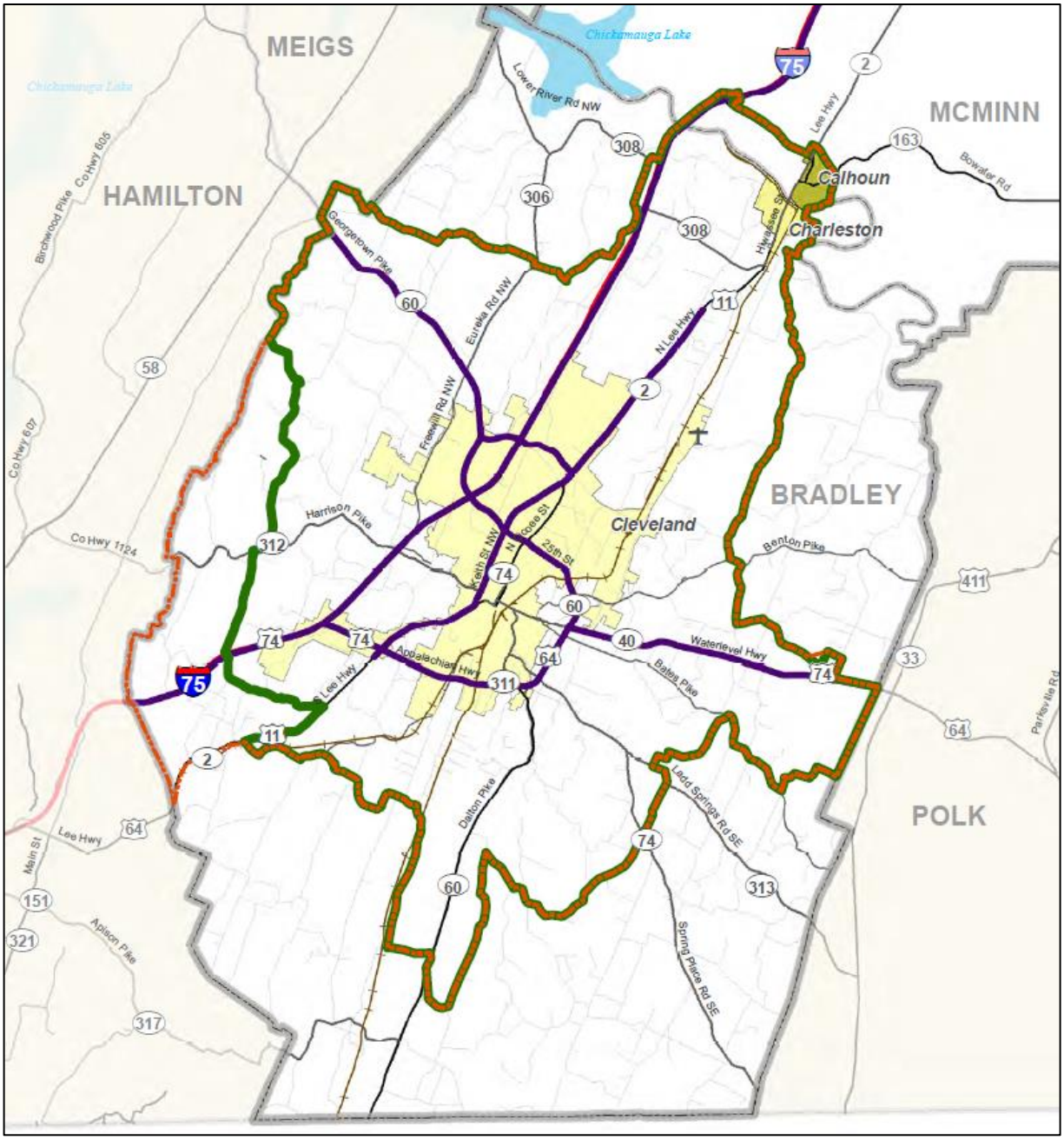


Figure 1 – Cleveland Regional Boundaries

1.2.2 Transportation Infrastructure

As illustrated previously in **Figure 1**, the Region is served by several State and Federal highways. The primary roadway facilities include I-75, US 11 and US 64.

I-75 is a divided north-south interstate highway that stretches between Miami, Florida and the Canadian border at Sault Ste. Marie, Michigan. US 11 also runs north-south through the Region and provides a valuable alternate route to I-75 between Chattanooga and Knoxville in the event of a large-scale incident on I-75. US 64 is an east-west facility connecting I-75 to the Cherokee National Forest and North Carolina.

Fixed-Route and paratransit services are provided in the City of Cleveland by Cleveland Transit, a separately branded transit service operated by the Southeast Tennessee Human Resource Agency (SETHRA). SETHRA also operates a demand response service in the portions of the Cleveland Region outside of the City of Cleveland.

The Cleveland Region is also served by one Class I railroad, operated by Norfolk Southern. Norfolk Southern's rail line traverses the western portion of the Region to connect to Knoxville to the north and Chattanooga to the south.

The Cleveland Region has undertaken several deployments of ITS programs. These programs are from multiple agencies and cover multiple transportation modes. Multi-agency participation has been present on some of these ITS initiatives, and it has been most important in the implementation of various aspects of the TDOT SmartWay Program. TDOT's SmartWay platform is predominately a freeway traffic management platform comprised of closed-circuit television (CCTV) cameras, dynamic message signs (DMS), radar detection systems (RDS), and highway advisory radio (HAR). CCTV cameras and DMS are located along I-75 within the Cleveland Region. The region also includes a Smart Park truck parking system that is currently in operation along I-75 northbound. Additionally, TDOT's SmartWay website provides congestion, incident, and construction information, as well as live video from CCTV cameras. TDOT has also created the SmartView software program that allows municipalities to view live video feeds with expanded capabilities compared to the SmartWay website. Active ITS, an Advanced Traffic Management System (ATMS) platform, is also being implemented at TDOT to upgrade their current SmartWay ATMS platform and improve TDOT's ability to share information with other partners.

1.2.3 Project Participation

Due to the fact that ITS often transcends traditional transportation infrastructure, it is important to involve a wide range of local, state and federal stakeholders in the ITS architecture development and visioning process. Input from these stakeholders, is a critical part of defining the interfaces, integration needs, and overall vision for ITS in a region.

Table 1 contains a listing of stakeholders in the Cleveland Region who participated in the project workshops or provided input through in-person or telephone interviews to the study team as to the needs and issues to be considered as part of the Regional ITS Architecture. Other stakeholders that were invited to participate but were not able to attend were provided the minutes from the workshops and notified when copies of the reports were available for review on the project website to encourage their participation as much as possible. A complete listing of stakeholders invited to participate in the project and workshop attendance records is included in the stakeholder database in **Appendix D**.

Table 1 – Cleveland Stakeholder Agencies and Contacts

Stakeholder Agency	Email	Contact
Bradley County	bthomas@bradleycountytn.gov	Bently Thomas
Chattanooga-Hamilton County/North Georgia Transportation Planning Organization	ylee@chattanooga.gov	Yuen Lee
Chattanooga-Hamilton County/North Georgia Transportation Planning Organization	krennich@chattanooga.gov	Karen Rennich
City of Cleveland	dsheely@clevelandtn.gov	David Sheely
City of Cleveland	gthomas@clevelandtn.gov	Greg Thomas
City of Cleveland	bbeck@clevelandtn.gov	Brian Beck
Cleveland City Schools	htaylor@clevelandschools.org	Hal Taylor
Cleveland/Bradley County Chamber of Commerce	dberry@clevelandchamber.com	Doug Berry
Cleveland Utilities	tbacon@clevelandutilities.com	Tad Bacon
Federal Highway Administration	nicholas.renna@dot.gov	Nick Renna
Southeast Tennessee Human Resource Agency	mbrown@sethra.us	Mary Lynn Brown
Southeast Tennessee Human Resource Agency	tsmith@sethra.us	Ted Smith
Southeast Tennessee Human Resource Agency	ckleehammer@sethra.us	Chris Kleehammer
Tennessee Department of Transportation	garris.bugg@tn.gov	Garris Bugg
Tennessee Department of Transportation	emily.carpenter@tn.gov	Emily Carpenter
Tennessee Department of Transportation	sara.elmore@tn.gov	Sara Elmore
Tennessee Department of Transportation	nikita.hemnani@tn.gov	Nikita Hemnani
Tennessee Department of Transportation	lacy.word@tn.gov	Lacy Word
Tennessee Department of Transportation	victor.weddle@tn.gov	Victor Weddle
Tennessee Department of Transportation	alan.wolfe@tn.gov	Alan Wolfe
Tennessee Department of Transportation	zach.johnson@tn.gov	Zach Johnson
Tennessee Department of Transportation	rashad.pinckney@tn.gov	Rashad Pinckney
Tennessee Department of Transportation	landon.t.castleberry@tn.gov	Landon Castleberry
Tennessee Department of Transportation	joseph.roach@tn.gov	Joe Roach
Tennessee Department of Transportation	eric.flora@tn.gov	Eric Flora
Tennessee Department of Transportation	khuzaima.mahdi@tn.gov	Khuzaima Mahdi
Tennessee Department of Transportation	stacy.morrison@tn.gov	Stacy Morrison

2. REGIONAL ITS ARCHITECTURE DEVELOPMENT PROCESS

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

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

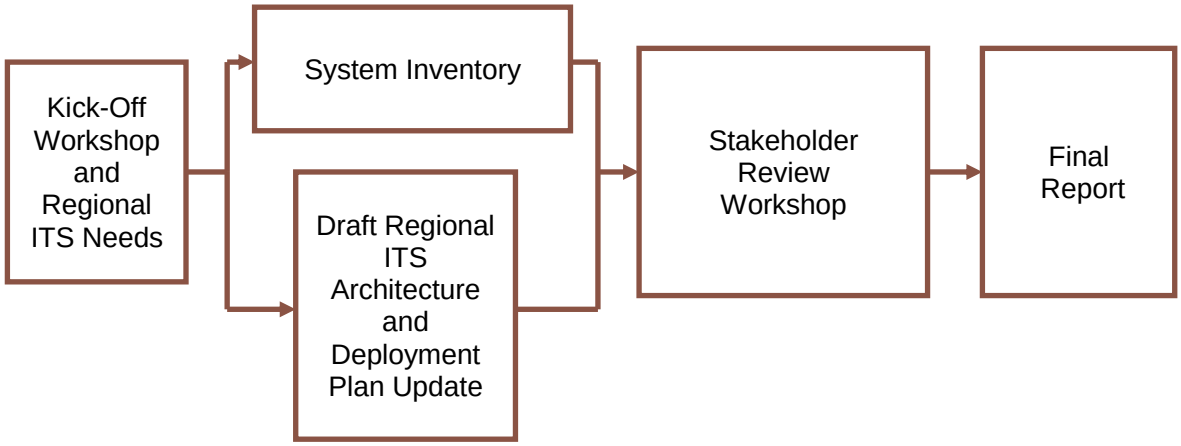


Figure 2 – Cleveland Regional ITS Architecture and Deployment Plan Development Process

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

- Kick-Off Workshop
- Stakeholder Review Workshop

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

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

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

Develop Draft Regional ITS Architecture and Deployment Plan Update: Following the stakeholder input, a draft report was developed which identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the ITS system, identifies projects for deployment, and establishes a maintenance plan. Additionally, a website was created to allow

stakeholders access to an interactive version of the ITS architecture and documents such as reports, meeting minutes, presentations, and the Turbo Architecture database.

Stakeholder Review Workshop: A second stakeholder workshop was conducted to review the Draft Regional ITS Architecture document as well as identify priorities for ITS service packages and confirm the list of potential ITS projects for the Cleveland Region. Use and maintenance of the Regional ITS Architecture was also discussed.

Final Report: The final Regional ITS Architecture and Deployment Plan was developed, which included an executive summary, project report, Turbo Architecture database, and project website with an interactive version of the Regional ITS Architecture.

Turbo Architecture

Turbo Architecture Version 7.1 was used to develop the Cleveland Regional ITS Architecture. Turbo Architecture is a software application that was developed by the United States Department of Transportation (USDOT) to be used as a tool for documenting and maintaining ITS architectures. Version 7.1 of Turbo Architecture was released in April 2015 and was developed to support Version 7.1 of the National ITS Architecture. Use of the Turbo Architecture software in development of the regional ITS architectures is recommended by both the FHWA and FTA.

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

Turbo Architecture saves data in Microsoft Access compatible data files. Turbo Architecture files can be accessed using Microsoft Access, although use of Access will not provide nearly the same amount of capabilities as accessing the files using the Turbo Architecture software. With the release of Version 4.1 of Turbo Architecture, the USDOT began offering the Turbo Architecture software free of charge and provides a link for downloading the software on the National ITS Architecture website. At the time this report was written, that site was located at http://local.iteris.com/itsarch/index.htm and Version 7.1 was the most recent version available.

Table 2 – Turbo Architecture Report and Diagrams

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

3. REGIONAL ITS NEEDS

Regional needs that could be addressed by ITS were identified by stakeholders in the Cleveland Regional ITS Architecture Kick-off Workshop and individual stakeholder interviews held in January and February 2017. In addition, the Cleveland MPO's *2040 Regional Transportation Plan* (RTP), adopted in May 2016, was reviewed to determine other regional needs that could possibly be addressed in some way through ITS.

Within the 2040 RTP, there are six regional goals that were identified to help direct future decisions regarding transportation for the Cleveland Region as those six goals correspond to eleven planning factors outlined in Fixing America's Surface Transportation (FAST) Act. Under those goals are objectives that ITS can directly support as described below. Note that the list of ITS strategies supporting each goal is not all-inclusive. Instead, for each goal several common ITS strategies are mentioned as examples.

Goal – Increase the availability of safe, convenient transportation choices that citizens can use to access jobs, essential services, and community activities.

Objectives:

- Expand and connect the existing pedestrian and bicycle network as part of new development and redevelopment.
- Expand transit hours and service, both in areas with existing ridership and in new areas with strong ridership potential
- Prioritize filling sidewalk gaps along routes with regular transit service and in other areas where people are frequently on foot.
- Create improved connectivity with Chattanooga and other parts of the greater metropolitan region.

The safety of various travel modes can be supported though ITS, for example by using mixed use warning systems that notify drivers that cyclists or pedestrians may be in the road or crossing the road. The availability of different transportation options can also be made known to travelers using real-time traveler information, another ITS tool.

Goal – Prioritize resources needed to maintain the existing system of roads, transit, and non-motorized transportation facilities.

Objectives:

- Work cooperatively at the local, regional, and state level to establish and maintain standards for the condition of various transportation assets.
- Track and report the condition of roads, sidewalks, and transit vehicles/infrastructure so that decision-makers have information and can anticipate needs before they become urgent.
- Adopt and maintain regular schedules and budgets for maintenance of storm drains, street sweeping, transit vehicle maintenance/replacement, trimming of sidewalk trees, and similar activities.

ITS can be used to monitor the condition of roadway infrastructure including pavement, bridges, and tunnels to improve maintenance of the roadway network. Additionally, ITS can help collect and maintain data regarding the condition and status of various elements of the transportation network to better guide resource planning and decision making.

Goal – Select transportation investments that maintain economic vitality by enhancing the character and goals of the areas they serve.

Objectives:

- In areas designated for infill and redevelopment, give priority to the creation/improvement of multimodal transportation facilities over adding roadway capacity.
- Maintain mobility by limiting new access points on major corridors such as Appalachian Highway (also known locally as APD 40) and SR 308, so that truck-dependent industries can continue to thrive. Encourage other types of growth to locate along corridors that emphasize access rather than speed.

ITS technologies such as traffic surveillance, real-time traveler information, and signal coordination reduce the need for additional roadway capacity. Mixed use warning systems provide added protection for cyclists and pedestrians. Providing considerations for all travel modes and limiting the construction of new road lanes through ITS will maintain economic vitality at the local level.

Goal – Improve the safety and security of all transportation system users.

Objectives:

- Focus on both near-term and long-term solutions to improve transportation safety along roads that are narrow or have no/limited shoulder width.
- Reduce the risks to motorists and road/utility workers by training local agencies and contractors on proper work zone management; ensure compliance through regular enforcement.
- Cooperate with local law enforcement agencies to enhance management and analysis of crash records, so that safety problems can be promptly identified and addressed.
- Emphasize projects that help reduce potential conflicts between modes of transportation, including roadway and rail, and motorized and non-motorized users.
- Continue to carry out emergency preparedness plans and update them regularly.

ITS can be used to implement measures to help improve safety such as early warning systems that notify officials of potential hazards, dynamic roadway warning systems that warn drivers, and roadway service patrols that help clear stalled vehicles or crashes. ITS also allows for surveillance of the transportation system which can improve security for its users, whether they are driving, using transit, or travelling via a non-motorized mode.

Goal – Promote efficient operation and management of the system, including the ability to maintain adequate operations when major incidents occur.

Objectives:

- Update and continue to implement the Regional ITS Architecture.
- Promote development policies and other initiatives that manage traffic congestion, without adding new road-miles if possible.
- Encourage an interconnected transportation network that minimizes the number of miles needed to complete a trip and provides multiple routes to reach the same destinations.

ITS can address this goal by improving transportation operations without adding additional capacity by using measures such as improved traffic signal coordination through connected and coordinated signals, real-time travel information for travelers, transit signal priority, traffic metering, and dynamic lane management. The use of DMS can divert traffic away from crashes, and the use of queue detection devices or other incidents that may introduce the potential for secondary crashes as a result of changing road conditions. ITS implementation also often allows for improved incident response times from emergency responders and roadway service patrols.

Goal – Make transportation decisions that are economically and environmentally sustainable and promote equitable access to community resources.

Objectives:

- Avoid impacts to environmentally sensitive resources and identified environmental justice communities if at all possible; minimize and mitigate impacts that cannot be avoided.
- When designing transportation facilities, purchasing transportation equipment, and providing transportation services, promote economic and environmental sustainability by considering factors such as:
- Life cycle costs,
- Energy efficiency,
- Opportunities to create redundancy (i.e. backup systems and alternate routes),
- Resistance to the potential impacts of climate change, and
- Potential benefits for other infrastructure, such as stormwater drainage.
- Continue to expand the number of people in the region who have safe and convenient access to multiple modes of transportation.

ITS technologies such as signal coordination, ramp metering, speed harmonization, and real-time traveler information are often used to reduce congestion experienced by users of the transportation system. Reduced congestion directly translates to reductions in fuel use and vehicle emissions. ITS technologies such as traffic surveillance, real-time traveler information, and signal coordination can all improve the quality of the transportation system using existing roadway facilities. The use of technology in place of additional pavement usually allows for a reduction in capital costs and maintenance costs for locations where ITS technologies have been used.

The investment needs identified through the Regional ITS Architecture development process as well as the 2040 RTP regional goals provided guidance for determining which service packages should be included in the architecture. Stakeholders identified ITS needs for the Cleveland Region in the following areas:

- Traffic Management
- Traveler Information;
- Emergency Management;
- Maintenance and Construction Management;
- Commercial Vehicle Operations;
- Public Transportation Management; and
- Archived Data Management.

In Section 5.1.4, a complete list of regional needs is presented along with the ITS service packages that have been recommended for the Region to consider implementing or expanding (if the service package currently exists) in order to address the needs.

4. REGIONAL ITS INVENTORY

The inventory and needs documented during the individual interviews were the starting point for updating the Regional ITS Architecture. These ITS systems and components are used to customize the National ITS Architecture and create the updated Regional ITS Architecture for the Cleveland Region.

The Cleveland Region stakeholder group agreed to create individual traffic, maintenance, and emergency management elements for the City of Cleveland and Bradley County. Other small cities, towns, and census-designated places in the Region were documented as part of the general municipal elements. This documentation allows the smaller cities, towns and census-designated places to be included in the Regional ITS Architecture, and therefore eligible to use federal funds for future ITS deployments, even if there are no specific plans for ITS implementation at this time.

4.1 Stakeholders

Each element included in the Cleveland Regional ITS Architecture is associated with a stakeholder agency. A listing of stakeholder agencies identified in the Cleveland Regional ITS Architecture can be found in **Table 3** along with a description of each stakeholder. Most stakeholder agencies are called out by name with the exception of smaller municipalities or counties. In the Regional ITS Architecture, the City of Cleveland and Bradley County are called out by name, but all other municipalities and census-designated places are covered under the general stakeholder name Municipal/County Government.

Table 3 – Cleveland Region Stakeholder Descriptions

Stakeholder	Stakeholder Description
Bradley County	County government for Bradley County. Includes all county departments including EMS, Fire, Sheriff and Highway Departments as well as the Cleveland-Bradley County Emergency Management Agency.
City of Cleveland	Municipal government for the City of Cleveland, Tennessee. Covers all city departments including those that deal with traffic and public safety.
Financial Institution	Handles exchange of money for transit electronic fare collection.
McMinn County	County government for McMinn County. Includes all county departments including EMS, Fire, Sheriff and Highway Departments as well as the McMinn County Emergency Management Agency.
Media	Local media outlets. This can include television stations, newspapers, radio stations and their associated websites.
Municipal Government	Government for various municipalities within the Region that are not specifically called out. Covers all city departments including those that deal with traffic and public safety.
NOAA	National Oceanic and Atmospheric Administration, agency that gathers weather information and issues severe weather warnings.
Other Agencies	This stakeholder represents a wide variety of agencies. The associated elements are groups of agencies or providers that do not have a primary stakeholder agency.
Other States	Emergency or traffic management agencies in other states adjacent to Tennessee. In the Cleveland Region this includes Georgia and North Carolina.
Private Information Provider	Private sector business responsible for the gathering and distribution of traveler information. This service is typically provided on a subscription basis.
Rail Operators	Companies that operate trains and/or are responsible for the maintenance and operations of railroad tracks.
Southeast Tennessee Human Resource Agency	Among other Regional social services, the human resource agency operates Southeast Tennessee HRA Transportation (SETHRA). SETHRA provides demand-response transit service in the Region and fixed-route service in the Cleveland urban area.
System Users	All of the users of the transportation system.
TDOT	The Tennessee Department of Transportation is responsible for the construction, maintenance, and operation of state roadways in Tennessee.
TEMA	Tennessee Emergency Management Agency. The agency is responsible for emergency operations during a disaster or large scale incident.
Tennessee Bureau of Investigation	Statewide law enforcement agency responsible for issuing statewide Amber Alerts in Tennessee.
Tennessee Department of Health and Human Services	State department that manages funding for medical transportation services.
Tennessee Valley Authority	The Tennessee Valley Authority (TVA) produces power for distribution by local power distributors in the Tennessee River Valley. The TVA operates several nuclear power plants in or near the Cleveland Region.
THP	The Tennessee Highway Patrol is the state law enforcement agency that enforces traffic safety laws as well as commercial vehicle regulations.

4.2 ITS Elements

The ITS inventory is documented in the Regional ITS Architecture as elements. **Table 4** sorts the inventory by stakeholder so that each stakeholder can easily identify and review all of the architecture elements associated with their agency. The table includes the status of the element. In many cases, an element classified as existing might still need to be enhanced to attain the service level desired by the Region.

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

Table 4 – Cleveland Region Inventory of ITS Elements

Stakeholder	Element Name	Element Description	Status
Bradley County	Bradley County 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	Bradley County EMS Vehicles	Vehicles operated by Bradley County EMS.	Existing
	Bradley County Fire Vehicles	Vehicles operated by the Bradley County Fire Department.	Existing
	Bradley County Flood Detection	Roadway equipment used to detect when there is water on the roadway.	Planned
	Bradley County Highway Department	County department that oversees the maintenance of county roadways within the region.	Existing
	Bradley County Highway Department Vehicles	Vehicles used in maintenance and construction activities.	Existing
	Bradley County Sheriff Department	Bradley County law enforcement agency. The emergency dispatch functions for the Sheriff's Department are included in the Bradley County 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
	Bradley County Sheriff Vehicles	Vehicles operated by the Bradley County Sheriff's Department.	Existing
	Bradley County Website	Website for Bradley County.	Planned
	Cleveland-Bradley County EMA	Emergency management agency for the City of Cleveland and Bradley County. Responsible for disaster planning for the County and operating the emergency operations center.	Existing
City of Cleveland	City of Cleveland Beacon Warning Signs	Flashing beacon signs that draw attention to low clearance underpass.	Existing
	City of Cleveland CCTV Cameras	Closed circuit television cameras operated by the City of Cleveland TOC for traffic condition monitoring and management of incidents.	Existing
	City of Cleveland DMS	Dynamic message signs for traffic information dissemination operated by the City of Cleveland.	Planned
	City of Cleveland Dynamic Overheight Vehicle Warning Signage	Warning signage with flashing beacons at low clearance bridge underpass that is activated when overheight vehicle is approaching.	Planned
	City of Cleveland Field Sensors	Roadway equipment used to detect vehicle volumes and/or speeds. This information is used in the operation of the traffic signal system and collected by the TOC. Cleveland field sensors include radar detectors and any other vehicle detection.	Existing
	DataDriven Watson Database	The crash and criminal record database maintained by the City of Cleveland for the collection of crash record information. TITAN interfaces with DataDriven Watson.	Existing

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

Stakeholder	Element Name	Element Description	Status
City of Cleveland (continued)	City of Cleveland Fire Vehicles	Vehicles from the City of Cleveland's Fire Department. Vehicles are equipped with GPS units that allow for vehicle preemption at signals.	Existing
	City of Cleveland Overheight Vehicle Detection	Sensors that detect overheight vehicles on the approach to a height restricted underpass. The sensors trigger Dynamic Overheight Vehicle Warning Signage to notify the driver.	Planned
	City of Cleveland Police Department	Police Department for the City of Cleveland. The emergency dispatch functions for the Police Department are included in the Bradley County 911 Dispatch. Non-emergency functions include the collection of crash data.	Existing
	City of Cleveland Police Vehicles	Police vehicles include City of Cleveland Police Department patrol cars and helicopters.	Existing
	City of Cleveland Portable DMS	Portable dynamic message signs for traffic information dissemination operated by the City of Cleveland.	Existing
	City of Cleveland Public Works Vehicles	Vehicles used by the City of Cleveland Public Works/TOC in maintenance and construction activities.	Existing
	City of Cleveland Rail Notification System	Rail notification system for city of Cleveland.	Planned
	City of Cleveland Rectangular Rapid Flash Beacons	Rectangular Rapid Flash Beacon signs at pedestrian crossings that require pedestrian activation.	Existing
	City of Cleveland School Zone Speed Monitoring Equipment	Field equipment used for monitoring vehicle speeds in school zones.	Existing
	City of Cleveland Speed Monitoring Equipment	Field equipment used for monitoring vehicle speeds.	Planned
	City of Cleveland TOC	Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way. The Department operates the Cleveland traffic signal system and CCTV cameras and DMS.	Existing
	City of Cleveland Traffic Data Archive	Archive that contains historical traffic data such as volume and speed information.	Planned
	City of Cleveland Traffic Signals	Traffic signal system operated by the City of Cleveland.	Existing
	City of Cleveland Website	Website for the City of Cleveland. Includes information on City departments and in the future it is envisioned that the website will have real-time information about roadway conditions.	Existing

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

Stakeholder	Element Name	Element Description	Status
City of Cleveland (continued)	Cleveland Area MPO Data Archive	Archive for transportation information such as traffic counts and transit ridership data for use in regional transportation planning.	Planned
Financial Institution	Financial Service Provider	Service provider that handles exchange of money for transit electronic payment collection.	Planned
McMinn County	McMinn County 911 Dispatch	911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders.	Existing
	McMinn County EMA	Emergency management agency for McMinn County. Responsible for disaster planning for the County and operating the emergency operations center.	Existing
Media	Local Print and Broadcast Media	Local media that provide traffic or incident information to the public.	Existing
Municipal Government	Municipal TOC	Traffic operations centers responsible for the operation of municipal or county signal systems and any other ITS infrastructure.	Existing
	Municipal Traffic Signals	Municipal traffic signal systems, including those operated by Bradley County.	Existing
	Municipal/County Maintenance	Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way.	Existing
	Municipal/County Public Safety Vehicles	Municipal/County law enforcement, fire, and emergency medical services (EMS) vehicles.	Existing
NOAA	National Weather Service	Provides official US weather, marine, fire and aviation forecasts, warnings, meteorological products, climate forecasts, and information about meteorology.	Existing
Other Agencies	GreenTrips Website	GreenTrips transportation demand management and ridematching website and application. This service is currently maintained by the Chattanooga-Hamilton County/North Georgia TPO (CHCNGA TPO) and is available to anyone age 18 or older who has a commuting origin or destination within the CHCNGA TPO Regional Planning Area.	Existing
	Local Utility Providers	Local utility providers including cable and telephone companies that may impact the roadway network with their operations, especially those lane closures that occur following a natural disaster or other large scale incident.	Existing
	Other Maintenance and Construction Agencies	Additional maintenance and construction operations agencies with which information is shared for coordination in an emergency situation.	Existing
	Other Traffic Management Agencies	Additional traffic management agencies with which information is shared for coordination in an emergency situation.	Existing
Other States	GDOT Maintenance	Maintenance operations in the State of Georgia.	Existing

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

Stakeholder	Element Name	Element Description	Status
Other States (continued)	Georgia NaviGAtor	System to consolidate real-time traffic, incident and construction road closure information. The information is used by agencies around the state and provides the data available on the NaviGAtor website and through 511.	Existing
Private Information Provider	Private Sector Traveler Information Services	Traveler information service operated by a private entity.	Existing
Rail Operators	Rail Operations Centers	Centers responsible for the operation and tracking of trains.	Planned
	Rail Operator Wayside Equipment	Equipment located along the tracks including railroad crossing gates, bells, and lights as well as the interface to the traffic signal controller indicating the presence of a train.	Existing
Southeast Tennessee Human Resource Agency	Bus Stop DMS	Bus Stop Dynamic Message Signs for SETHRA.	Existing
	Cleveland Transit CCTV Camera Surveillance	Surveillance cameras on Cleveland Transit demand-response and fixed-route vehicles, as well as at fixed-route transit stops.	Planned
	Cleveland Transit Data Archive	Archive of historical transit ridership statistics.	Planned
	Cleveland Transit Demand-Response Vehicles	Demand-response and paratransit vehicles used within the City of Cleveland. The Cleveland Transit system is operated by SETHRA.	Existing
	Cleveland Transit Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of Cleveland Transit demand response and fixed route services.	Existing
	Cleveland Transit Fixed-Route Vehicles	Fixed route transit vehicles used within the City of Cleveland. The Cleveland Transit system is operated by SETHRA.	Existing
	Cleveland Transit Website	Website with information about fares and schedules.	Existing
	Electronic Fare Payment Card	Medium for collection of transit fares electronically.	Planned
	SETHRA Transit CCTV Camera Surveillance	Surveillance cameras on SETHRA demand-response vehicles.	Planned
	SETHRA Transportation Data Archive	Archive of historical transit ridership statistics.	Planned
	SETHRA Transportation Dispatch Center	Transit dispatch center responsible for the tracking, scheduling and dispatching of SETHRA demand response services.	Existing
	SETHRA Transportation Vehicles	SETHRA demand response transit vehicles including those that provide paratransit services for disabled travelers.	Existing

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

Stakeholder	Element Name	Element Description	Status
Southeast Tennessee Human Resource Agency (continued)	SETHRA Transportation Website	Website with information about fares and schedules. At this time the website is static.	Existing
System Users	Archive Data User	Users that request information from the data archive systems.	Existing
	Commercial Vehicles	Privately owned commercial vehicles traveling within the Region.	Existing
	Pedestrians	Individuals afoot or using a motorized or non-motorized wheelchair.	Existing
	Private Fleet Management Systems	Fleet and freight management for private carriers.	Existing
	Private Traveler Personal Computing Devices	Computing devices that travelers use to access public information.	Existing
	Traveler	User of the transportation system.	Existing
TDOT	Other TDOT Region Construction Office	Other TDOT regional construction offices besides the Region 2 Construction Office.	Existing
	Other TDOT Regions District Operations	Other TDOT regional maintenance offices besides the Region 2 District Operations Office.	Existing
	TDOT CCTV Cameras	Closed circuit television cameras for traffic surveillance and incident management.	Existing
	TDOT Changeable Speed Limit Signs	TDOT roadway equipment that is used to lower speed limits on the affected roadway segment.	Existing
	TDOT DMS	TDOT dynamic message signs for traffic information dissemination.	Existing
	TDOT Emergency Services Coordinator	Coordinator responsible for managing the Tennessee Department of Transportation response in a large scale incident or disaster in which the Tennessee Emergency Management Agency (TEMA) activates the state emergency operations center (EOC).	Existing
	TDOT Field Sensors	TDOT roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as video image vehicle detection systems (VIVDS), remote traffic microwave sensors (RTMS), or traditional loops.	Existing
	TDOT HAR	Highway advisory radio for traffic information dissemination.	Existing
	TDOT HELP Vehicles	Roadway service patrol vehicles that operate in the Region for incidents and special events.	Existing

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

Stakeholder	Element Name	Element Description	Status
TDOT (continued)	TDOT Maintenance Headquarters	The Tennessee Department of Transportation's maintenance headquarters.	Existing
	TDOT Maintenance Vehicles	The Tennessee Department of Transportation vehicles used in maintenance operations.	Existing
	TDOT On-Ramp Closure Gates	TDOT roadway equipment that is part of the fog management system used to close freeway on-ramps during a fog event.	Existing
	TDOT Public Information Office	Tennessee Department of Transportation office responsible for the dissemination of traffic information to the media and the public.	Existing
	TDOT Ramp Queue Detection System	Queue detection system located along off-ramps along Interstate 75 in the Cleveland Region. System would detect when vehicle queues are extending onto freeway traveled lanes, with the capability to communicate with nearby frontage road traffic signals to dissipate queues more quickly.	Planned
	TDOT Region 1 TMC - Knoxville	Transportation management center for Region 1, located in Knoxville. Responsible for the operation of the ITS equipment located in Region 1. This includes the freeway management system in Knoxville as well as rural ITS deployments.	Existing
	TDOT Region 2 Construction Office	The Tennessee Department of Transportation office responsible for oversight of construction projects in Region 2.	Existing
	TDOT Region 2 District Operations	Region 2 maintenance headquarters. Responsible for maintenance operations in the Region, however most routine maintenance is handled by the district maintenance offices. There are several district maintenance offices within the Region.	Existing
	TDOT Region 2 HELP Dispatch	TDOT roadway service patrol dispatch. Currently service is limited to the Chattanooga area except in the case of a large scale incident.	Existing
	TDOT Region 2 TMC - Chattanooga	TDOT transportation management center for Region 2, located in Chattanooga. Responsible for the operation of the ITS equipment located in Region 2. This includes the freeway management system in Chattanooga as well as rural ITS deployments.	Existing
	TDOT Region 3 TMC - Nashville	Transportation management center for Region 3, located in Nashville. Responsible for the operation of the ITS equipment located in Region 3. This includes the freeway management system in Nashville as well as rural ITS deployments.	Existing

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

Stakeholder	Element Name	Element Description	Status
TDOT (continued)	TDOT Region 4 TMC - Memphis	Transportation management center for Region 4, located in Memphis. Responsible for the operation of the ITS equipment located in Region 4. This includes the freeway management system in Memphis as well as rural ITS deployments.	Existing
	TDOT RWIS Sensors	Road weather information system sensors to monitor weather conditions at the roadway.	Planned
	TDOT SmartPark Truck Parking Management	Management for TDOT SmartPark commercial vehicle Interstate parking system along I-75 within the Cleveland Region.	Existing
	TDOT Smart Work Zone Equipment	Portable ITS equipment that can be used in work zones to more efficiently manage traffic and provide traveler information. Includes portable closed circuit television (CCTV) cameras, vehicle detection, and dynamic message signs (DMS).	Existing
	TDOT SmartWay Website	TDOT SmartWay website providing road network conditions including incident and construction information and camera views. Much of the data for the website comes from SWIFT.	Existing
	TDOT Statewide Information for Travelers (SWIFT)	SWIFT is a statewide roadways conditions database. Currently information can be entered by District and Regional maintenance personnel as well as staff at any of the traffic management centers or the THP. SWIFT feeds the Statewide 511 system.	Existing
	TDOT Traffic Operations	Data archive for the Project Planning Division. The Division is responsible for traffic data collection and analysis and includes the Short Range Planning Office.	Existing
	Tennessee 511 IVR	Tennessee 511 Interactive Voice Response. TDOT contracts the IVR operation to a vendor. The IVR accepts callers' requests and provides responses to specific traveler information needs. This is the customer interface component of the 511 phone system.	Existing
	Tennessee 511 System	511 traveler information system central server.	Existing
TEMA	TEMA	Tennessee Emergency Management Agency responsible for managing emergency operations during a disaster or large scale incident.	Existing
Tennessee Bureau of Investigation	Tennessee Bureau of Investigation	Responsible for issuing statewide America's Missing: Broadcast Emergency Response (AMBER) Alerts in Tennessee.	Existing

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

Stakeholder	Element Name	Element Description	Status
Tennessee Department of Health and Human Services	Health and Human Services	Agency responsible for providing health related services including the subsidization of transportation to obtain medical services.	Existing
Tennessee Valley Authority	TVA Sequoyah Nuclear Power Plant Operations	Operations for the Sequoyah nuclear power plant. The Cleveland Region is within the area that could be impacted by an incident at the power plant.	Existing
	TVA Siren System	Emergency alerting siren system in case of an incident at the Sequoyah nuclear power plant.	Existing
THP	THP Dispatch	Tennessee Highway Patrol dispatch center. There are several THP dispatch centers around the state of Tennessee.	Existing
	THP District 2 Office	Tennessee Highway Patrol District 2 office. The District 2 Office has the ability to directly control the fog zone management system.	Existing
	THP Vehicles	Tennessee Highway Patrol vehicles.	Existing
	TITAN Database	Tennessee Integrated Traffic Analysis Network database. The Tennessee Department of Safety crash record database maintained by THP for the collection of crash record information. TITAN interfaces with the TraCS (Traffic and Criminal Software) system.	Existing

5. REGIONAL ITS ARCHITECTURE

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

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

Existing, planned, and future systems in the Region were considered in each of the service areas. Vehicle Safety was not included in the Cleveland Regional ITS Architecture because implementation of those service packages would primarily be by private sector automobile manufacturers and information service providers.

5.1 ITS Service Packages

In the National ITS Architecture, services that are provided by ITS are referred to as ITS service packages. ITS service packages can include several stakeholders and elements that work together to provide a service in the Region. Examples of ITS service packages from the National ITS Architecture include Network Surveillance, Traffic Information Dissemination, and Transit Vehicle Tracking. There are currently a total of 97 ITS service packages identified in the National ITS Architecture Version 7.1, which was the most recent version available of the National ITS Architecture at the time of the 2017 Cleveland Regional ITS Architecture update. As noted in Section 1.1, in the previous version of the Cleveland Regional ITS Architecture, ITS service packages were referred to as ITS market packages. The name change has been made to be consistent with the terminology that is now used in Version 7.1 of the National ITS Architecture.

5.1.1 Overview of ITS Service Package Structure

An ITS service package is made up of elements and information flows. Each identified system or component in the Cleveland regional ITS inventory, which is documented in the previous section, was mapped to a subsystem or terminator in the National ITS Architecture. Subsystems and terminators represent the various functional categories that define the role of an element in ITS and the regional architecture. The elements are connected together by

information flows that document the existing and planned flow of information. **Figure 3** depicts a sample service package with each of the components identified. Additional explanation of the terminology used can be found in text and in **Table 5** after the figure.

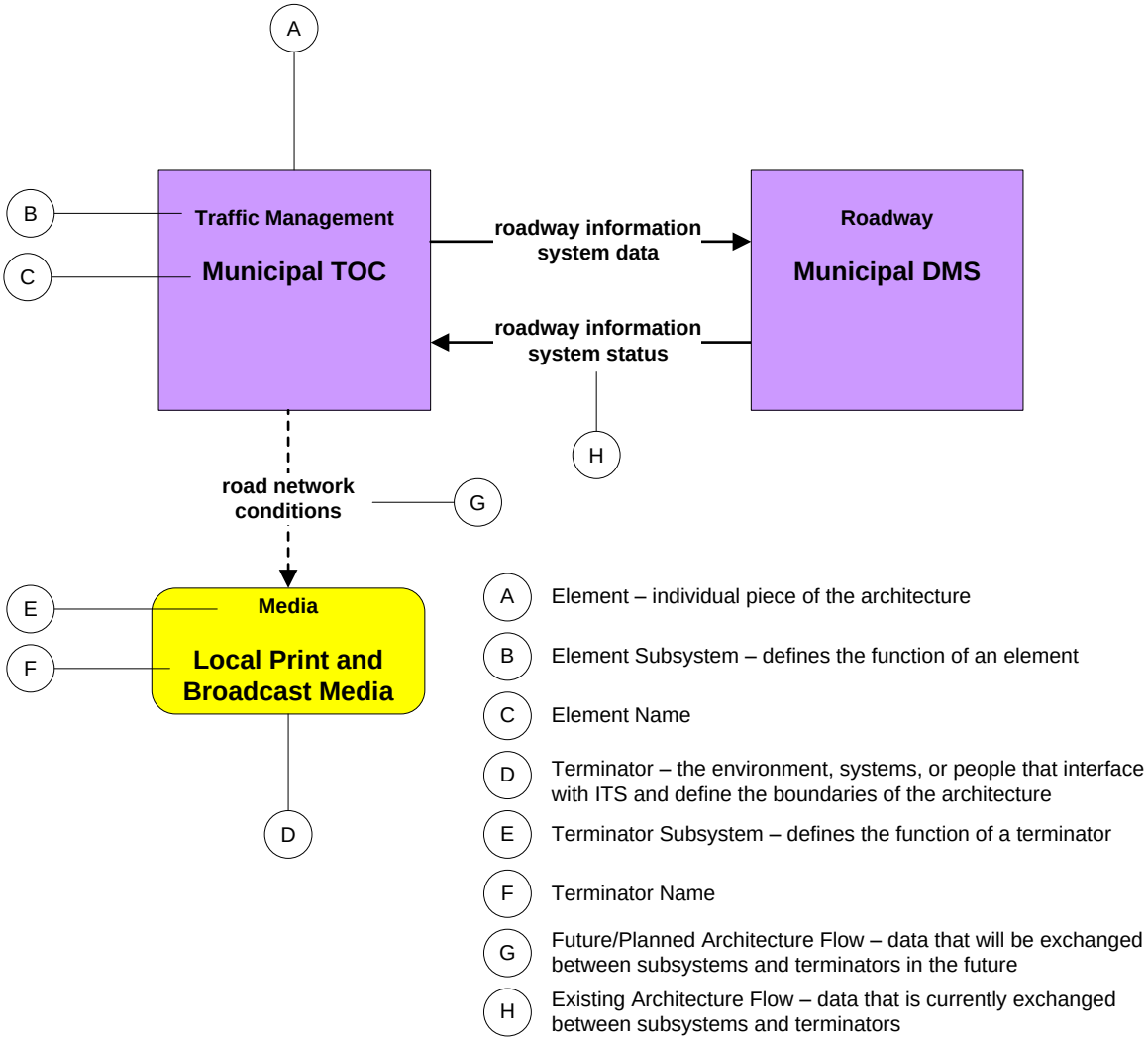


Figure 3 – Overview of ITS Service Package Structure

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

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

Terminators are the people, systems, other facilities, and environmental conditions outside of ITS that need to communicate or interface with ITS subsystems. Terminators help define the

boundaries of the National ITS Architecture as well as a regional system. Examples of terminators include drivers, weather services, and information service providers.

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

Table 5 – Summary of ITS Architecture Terminology

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

5.1.2 Selection and Prioritization of Regional ITS Service Packages

In the Cleveland Region, the National ITS Architecture service packages were reviewed by the stakeholders and selected based on the relevance of the functionality that the ITS service package could provide to the Region. Stakeholders selected 38 ITS service packages for implementation in the Region, and they are identified in **Table 6**. Stakeholders prioritized the selected service packages during the workshop, and the table organizes the service packages into service areas and priority groupings.

It should be noted that ITS related commercial vehicle operations including applications such as electronic clearance, safety enforcement, and registration should be conducted on a statewide level and outlined in the Tennessee Statewide ITS Architecture. Unless a specific need was identified in the Cleveland Region that could be addressed locally, the commercial vehicle operations service packages were not selected. After selecting the ITS service packages that were applicable for the Region, stakeholders reviewed each ITS service package and the elements that could be included to customize it for the Region. This customization is discussed further in the next section (Section 5.1.3).

Table 6 – Cleveland Region ITS Service Package Prioritization by Functional Area

High Priority ITS Service Packages	Medium Priority ITS Service Packages	Low Priority ITS Service Packages
Traffic Management		
ATMS01 Network Surveillance ATMS03 Traffic Signal Control ATMS06 Traffic Information Dissemination ATMS08 Traffic Incident Management System ATMS26 Mixed Use Warning Systems	ATMS07 Regional Traffic Management ATMS13 Standard Railroad Grade Crossing ATMS17 Regional Parking Management ATMS19 Speed Monitoring ATMS24 Dynamic Roadway Warning	ATMS15 Railroad Operations Coordination
Emergency Management		
EM01 Emergency Call-Taking and Dispatch EM02 Emergency Routing EM04 Roadway Service Patrols EM06 Wide-Area Alert	EM10 Disaster Traveler Information EM08 Disaster Response and Recovery EM09 Evacuation and Reentry Management	
Maintenance and Construction Management		
MC03 Road Weather Data Collection MC04 Weather Information Processing and Distribution MC08 Work Zone Management MC10 Maintenance and Construction Activity Coordination	MC01 Maintenance and Construction Vehicle and Equipment Tracking MC09 Work Zone Safety Monitoring	MC02 Maintenance and Construction Vehicle Maintenance
Public Transportation Management		
APTS01 Transit Vehicle Tracking APTS02 Transit Fixed-Route Operations APTS03 Demand Response Transit Operations APTS04 Transit Fare Collection Management APTS05 Transit Security APTS07 Multimodal Coordination APTS08 Transit Traveler Information APTS09 Transit Signal Priority APTS10 Transit Passenger Counting		APTS06 Transit Fleet Management
Commercial Vehicle Operations		
	CVO10 HAZMAT Management	
Traveler Information		
ATIS01 Broadcast Traveler Information ATIS02 Interactive Traveler Information		
Archived Data Management		
AD1 ITS Data Mart	AD2 ITS Data Warehouse	

5.1.3 Customization of Regional ITS Service Packages

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

Figure 4 is an example of an Advanced Traffic Management System (ATMS) service package for traffic incident management that has been customized for the Region. This instance focuses on the activities of the TDOT Region 2 TMC – Chattanooga. The ITS service package shows the distribution of traffic incident information from the TDOT Region 2 TMC to local and state emergency management dispatch and road maintenance authorities. Incident information is also shared between the Region 2 TMC and TDOT Region 2 District Operations, which spearheads road maintenance efforts within the region. Information flows between the subsystems indicate what information is being shared between each element. The remainder of the ITS service packages that were customized for the Cleveland Region are shown in **Appendix B**.

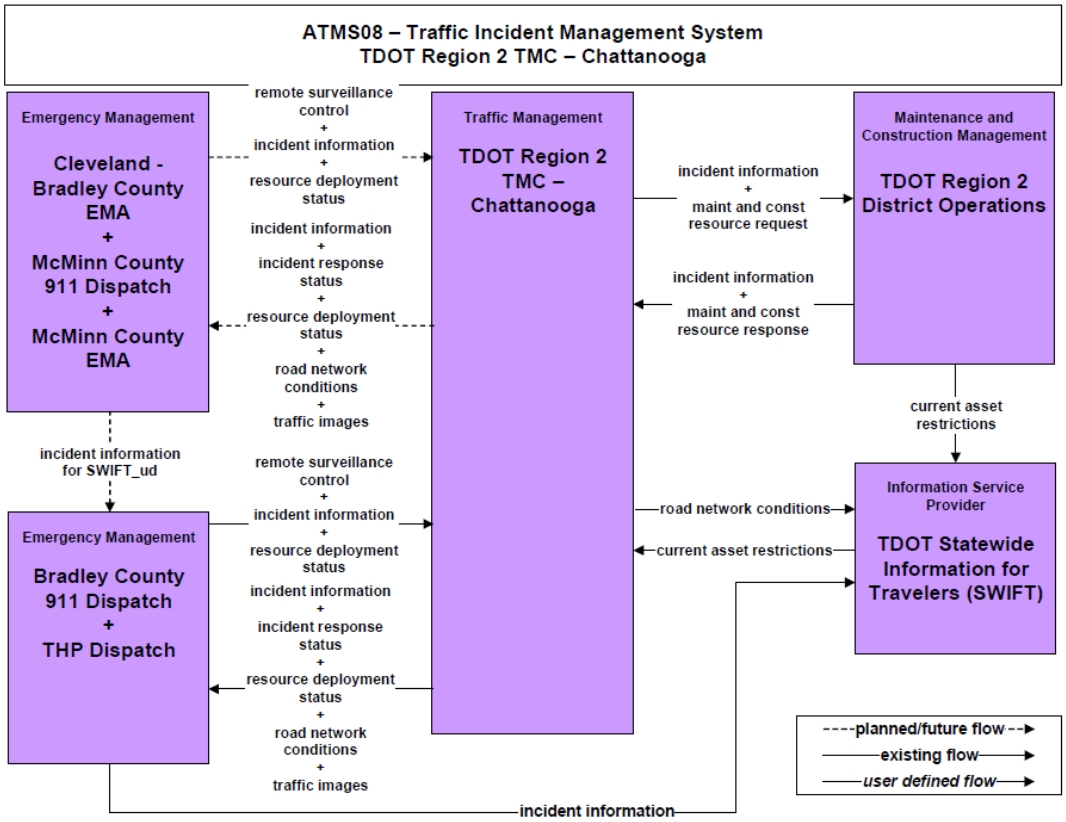


Figure 4 – Example ITS Service Package Diagram
ATMS08 – Traffic Incident Management System (TDOT Region 2 TMC – Chattanooga)

5.1.4 Regional Needs and Corresponding ITS Service Packages

Input received from stakeholders at the Cleveland Region ITS Architecture workshops provided valuable input for the ITS service package customization process. The needs identified by stakeholders in the ITS Architecture workshops are identified in **Table 7**. The table also identifies which ITS service packages could be implemented to address the particular need.

Table 7 – Regional Stakeholder ITS Needs and Related ITS Service Packages

ITS Need	ITS Service Package
Traffic Management	
Need an expanded and coordinated closed loop signal system for the City of Cleveland	ATMS03 – Traffic Signal Control
Need to upgrade traffic signal controllers	ATMS03 – Traffic Signal Control
Need DMS on I-75 prior to Exit 11 northbound and Exit 20 southbound to provide incident information pertaining to the isolated nine mile stretch between the exits and to provide information about detours	ATMS06 – Traffic Information Dissemination
Need DMS on US 411 primarily to provide information to those detouring from I-75	ATMS06 – Traffic Information Dissemination
Need CCTV cameras within the City and along TDOT roadways for DMS verification and to monitor traffic	ATMS01 – Network Surveillance
Need improved information dissemination of road conditions information on state and local routes	ATMS06 – Traffic Information Dissemination ATIS01 – Broadcast Traveler Information ATIS02 – Interactive Traveler Information
Need driver feedback signs and associated speed data archive to support targeted enforcement	ATMS19 – Speed Warning and Enforcement
Need overheight detection system on SR 40/US 64 at low railroad crossing	ATMS01 – Network Surveillance ATMS24 – Dynamic Roadway Warning
Need pedestrian crossing warning beacons in city	ATMS26 – Mixed Use Warning Systems
Public Transportation Management	
Need security monitoring systems on buses and at stops	APTS05 – Transit Security
Need automated passenger counting on fixed-route buses	APTS10 – Transit Passenger Counting
Need DMS units at key bus stops and transfer station	APTS08 – Transit Traveler Information
Need website and mobile app to inform riders of schedules and other updates	APTS02 – Transit Fixed-Route Operations APTS03 – Demand Response Transit Operations APTS08 – Transit Traveler Information
Need electronic fare collection system for fixed-route transit	APTS04 – Transit Fare Collection Management
Emergency Management	
Need to expand emergency vehicle traffic signal preemption system for the Fire Department and possibly add traffic signal preemption for EMS	EM02 – Emergency Routing
Need data and video transfer capabilities between 911 and traffic management	ATMS08 – Traffic Incident Management System
Need to be able to receive real-time traffic information to aid in emergency vehicle dispatch	ATMS06 – Traffic Information Dissemination EM02 – Emergency Routing
Need detection and notification system for railroad crossing blockages to support emergency vehicle dispatch	ATMS13 – Standard Railroad Grade Crossing EM02 – Emergency Routing
Need capability to monitor CCTV and control DMS from the EOC during evacuations	ATMS08 – Traffic Incident Management System
Maintenance and Construction Management	
Need improved communication and dissemination of information on lane closures to traffic management	MC10 – Maintenance and Construction Activity Coordination
Need additional weather detection on roads within the Region	MC03 – Road Weather Data Collection
Need flood detection for Bradley County	MC03 – Road Weather Data Collection

5.2 Architecture Interfaces

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

5.2.1 Top Level Regional System Interconnect Diagram

A system interconnect diagram, or "sausage diagram", shows the systems and primary interconnects in the Region. The National ITS Architecture interconnect diagram has been customized for the Cleveland Region based on the system inventory and information gathered from the stakeholders. **Figure 5** summarizes the existing and planned ITS elements for the Cleveland Region in the context of a physical interconnect. Subsystems and elements specific to the Region are called out in the boxes surrounding the main interconnect diagram, and these are color-coded to the subsystem with which they are associated.

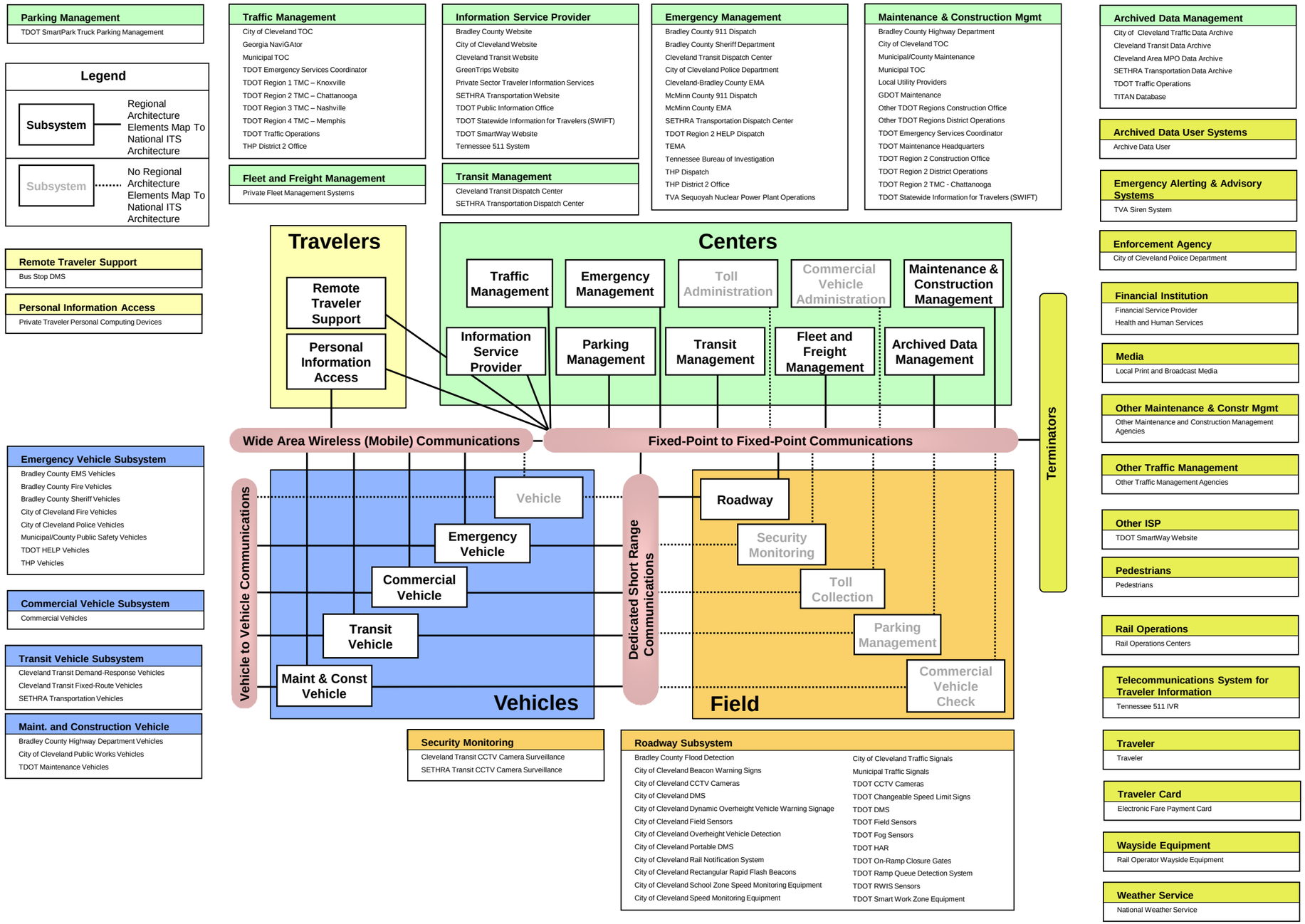


Figure 5 – Cleveland Regional System Interconnect Diagram

5.2.2 Element Connections

A number of different elements are identified as part of the Cleveland Regional ITS Architecture. These elements include transportation management centers, transit vehicles, dispatch systems, emergency management agencies, media outlets, and others—essentially, all of the existing and planned physical components that contribute to the regional ITS. Interfaces have been identified for each element in the Cleveland Regional ITS Architecture and each element has been mapped to those other elements with which it must interface. The Turbo Architecture software can generate interconnect diagrams for each element in the Region that show which elements are connected to one another. **Figure 6** is an example of an interconnect diagram from the Turbo database output. This interconnect diagram is for the City of Cleveland Police Department. The diagram shows existing connections in addition to connections that could be made in the future.

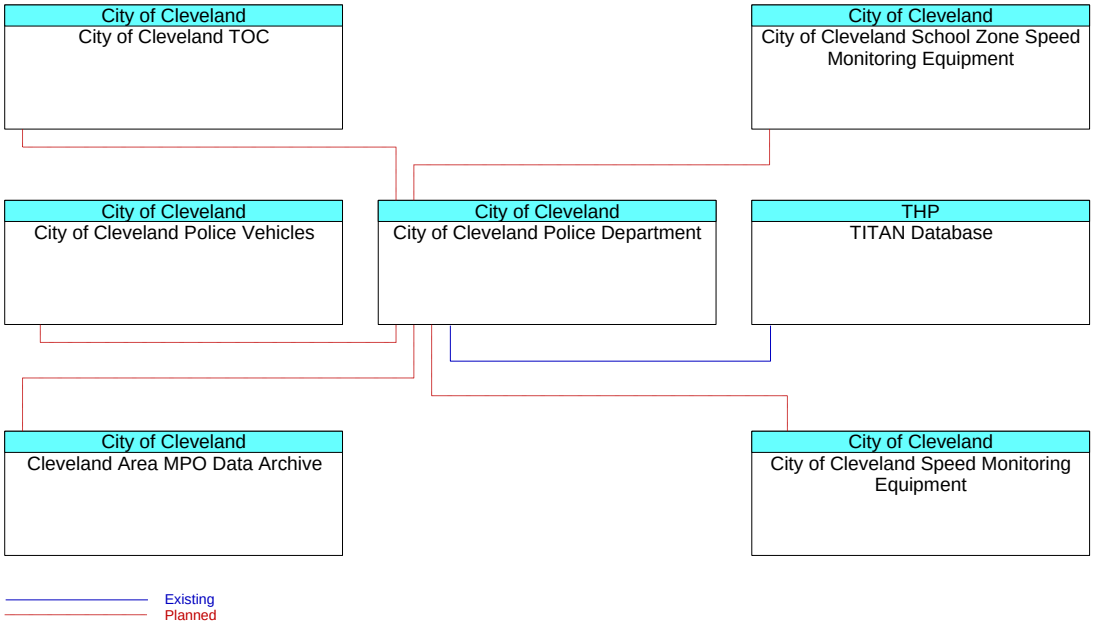


Figure 6 – Example Interconnect Diagram: City of Cleveland Police Department

5.2.3 Information flows Between Elements

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

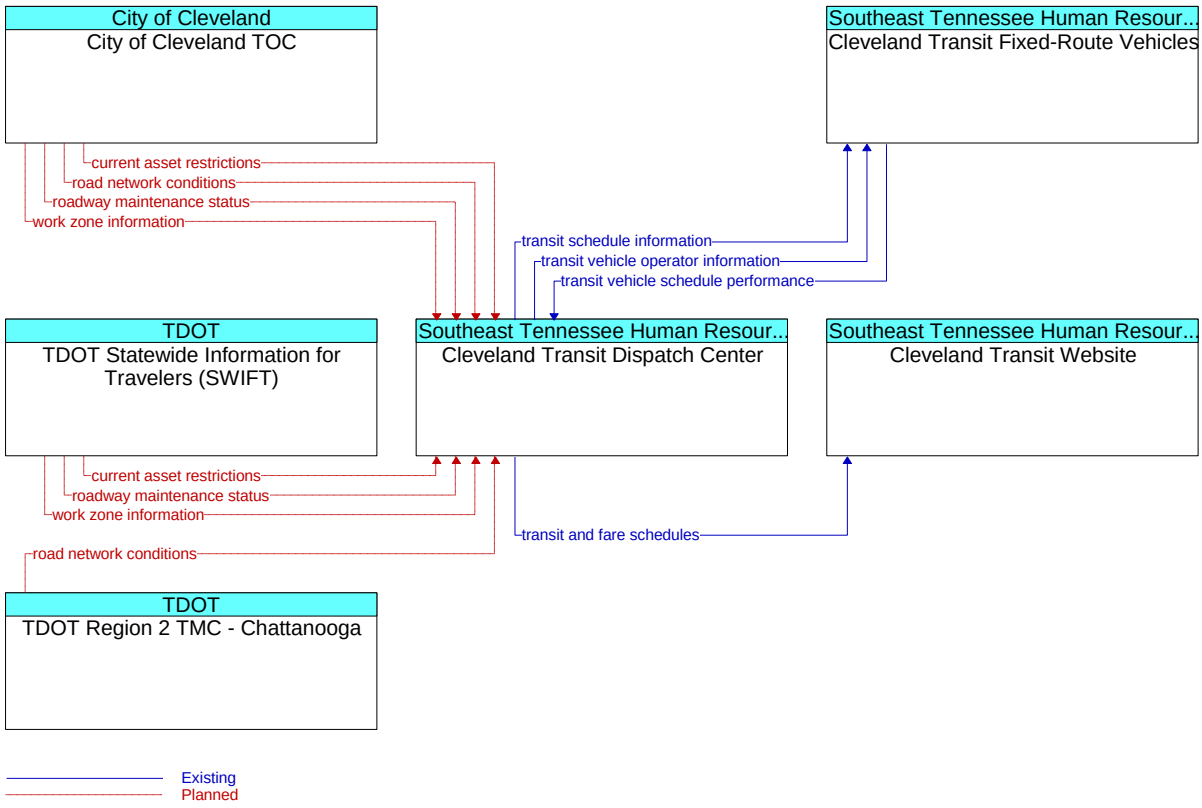


Figure 7 – Example Flow Diagram: APTS02 – Transit Fixed-Route Operations

5.3 Functional Requirements

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

For the Cleveland Regional ITS Architecture, functional requirements have been identified at two levels. The customized service packages, discussed previously in Section 5.1.3, describe the services that ITS needs to provide in the Region and the information flows between the elements. These service packages and information flows describe what ITS in the Cleveland Region has to do and the data that needs to be shared among elements.

At a more detailed level, functional requirements for the Cleveland Region are described in terms of functions that each element in the architecture performs or will perform in the future. **Appendix C** contains a table that summarizes the functions by element excluding terminators. In addition to Appendix C, the requirements tab within the Turbo Architecture database also includes the functional requirements that have been identified for each of the elements in the Cleveland Region. These functional requirements include the "shall" statements that describe what the system does. The "shall" statements should be reviewed during future project level planning and design phases, and stakeholders should determine which of the "shall" statements are existing, which need to be

implemented, and which are not needed based on their specific project needs. Section 7.2 contains additional information on the use of functional requirements when performing a systems engineering analysis on a project.

5.4 Standards

Standards are an important tool that will allow efficient implementation of the elements in the Cleveland Regional ITS Architecture over time. Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances, vendors change, and as new approaches evolve. The USDOT's ITS Joint Program Office is supporting Standards Development Organizations (SDOs) with an extensive, multi-year program of accelerated, consensus-based standards development to facilitate successful ITS deployment in the United States. **Table 8** identifies each of the ITS standards that could apply to the Cleveland Regional ITS Architecture. These standards are based on the physical subsystem information flows previously identified in Section 5.2.3 and shown in the service package diagrams in **Appendix B**.

While **Table 8** does not match the standards to specific information flows, that information is available through the National ITS Architecture website and Turbo Architecture. Since the website is updated more frequently than the software and links directly to additional information about the applicable standard, the website is the preferred method for determining which standards apply to a particular information flow. When a stakeholder agency within the region begins deployment of an ITS project, the agency should ensure that the technology being deployed conforms to standards that are relevant to the applicable project service packages. To locate this information, take the following steps:

- Go to the main page (http://local.iteris.com/itsarch/index.htm) of the National Architecture website;
- In the menu bar on the left hand side select the tab for Physical Architecture;
- Select the architecture flows (information flows) link embedded in the descriptive paragraph about the Physical Architecture;
- From the alphabetical list of flows that appears, locate and select the desired flow;
- Information flows are often used between multiple subsystems so scrolling may be required to find the appropriate information associated with the particular use of the flow, in the descriptive information any applicable standards will be identified; and
- For additional information on the applicable standards the standard name is a link that when selected leads to a more detailed description of the standard.

Table 8 – Cleveland Region Applicable ITS Standards

SDO	Document ID	Title
AASHTO/ITE	ITE TMDD	Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)
AASHTO/ITE/NEMA	NTCIP 1201	Global Object Definitions
	NTCIP 1202	Object Definitions for Actuated Traffic Signal Controller (ASC) Units
	NTCIP 1203	Object Definitions for Dynamic Message Signs (DMS)
	NTCIP 1204	Object Definitions for Environmental Sensor Stations (ESS)
	NTCIP 1205	Object Definitions for Closed Circuit Television (CCTV) Camera Control
	NTCIP 1208	Object Definitions for Closed Circuit Television (CCTV) Switching
	NTCIP 1209	Data Element Definitions for Transportation Sensor Systems (TSS)
	NTCIP 1210	Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters
	NTCIP 1211	Object Definitions for Signal Control and Prioritization (SCP)
	NTCIP 1214	Object Definitions for Conflict Monitor Units (CMU)
	NTCIP C2C	NTCIP Center-to-Center Standards Group
	NTCIP C2F	NTCIP Center-to-Field Standards Group
APTA	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles
ASTM	ASTM E2468-05	Standard Practice for Metadata to Support Archived Data Management Systems
	ASTM E2665-08	Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data
	DSRC 915MHz	Dedicated Short Range Communication at 915 MHz Standards Group
ASTM/IEEE/SAE	DSRC 5GHz	Dedicated Short Range Communication at 5.9 GHz Standards Group
IEEE	IEEE 1570-2002	Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection
	IEEE IM	Incident Management Standards Group
SAE	ATIS General Use	Advanced Traveler Information Systems (ATIS) General Use Standards Group

5.5 Operational Concepts

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

- **Traffic Signal Control** – The development of signal systems that react to changing traffic conditions and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions.
- **Freeway Traffic Metering Management** – The development of systems to monitor freeway traffic flow and roadway conditions, and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. Includes systems to provide information to travelers on the roadway.

- **Incident Management** – The development of systems to provide rapid and effective response to incidents. Includes systems to detect and verify incidents, along with coordinated agency response to the incidents.
- **Emergency Management** – The development of systems to provide emergency call taking, public safety dispatch, and EOC operations.
- **Maintenance and Construction Management** – The development of systems to manage the maintenance of roadways in the Region, including winter snow and ice clearance. Includes management of construction operations and coordination of construction activities.
- **Transit Management** – The development of systems to more efficiently manage fleets of transit vehicles or transit rail. Includes systems to provide transit traveler information both pre-trip and during the trip.
- **Traveler Information** – The development of systems to provide static and real-time transportation information to travelers.
- **Archived Data Management** – The development of systems to collect transportation data for use in non-operational purposes (e.g., planning and research).

Table 9 identifies the roles and responsibilities of key stakeholders for a range of transportation services.

Table 9 – Cleveland Region Stakeholder Roles and Responsibilities

Transportation Service	Stakeholder	Roles/Responsibilities
Traffic Signal Control	City of Cleveland	Operate and maintain traffic signal systems within the City.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on roadways within the City to facilitate traffic signal operations.
		Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle preemptions.
		Provide traffic signal preemption for emergency vehicles.
		Operate DMS for the distribution of traffic information and roadway conditions to travelers on the roadway.
	Municipal Government	Operate and maintain traffic signal systems within the municipality.
		Remotely operate traffic signal controllers to implement traffic management strategies at signalized intersections based on traffic conditions, incidents, and emergency vehicle preemption requests.
Freeway Traffic Metering Management	TDOT	Operate DMS and HAR to distribute traffic information and roadway conditions to travelers on the roadway.
		Operate network surveillance equipment including CCTV cameras and vehicle detection on state roadways.
		Operate motorist assistance patrol (HELP) to facilitate special event traffic control and incident management.
		Operate TDOT SmartPark truck parking systems along freeways within the Region.

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

Transportation Service	Stakeholder	Roles/Responsibilities
Incident Management	City of Cleveland	Remotely control traffic and video sensors to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate DMS to distribute incident information to travelers on the roadway.
		Responsible for coordination with other traffic operations centers and emergency management agencies for coordinated incident management.
		Coordinate maintenance resources for incident response.
	TDOT	Remotely control traffic and video sensors from the SmartWay TMC to support incident detection and verification.
		Responsible for the dissemination of traffic related data to other centers and the media.
		Operate DMS and HAR to distribute incident information to travelers on the roadway.
		Responsible for coordination with other TOCs and emergency management agencies for coordinated incident management.
		Responsible for the development, coordination, and execution of special traffic management strategies during an evacuation.
	Bradley County 911 Dispatch	Dispatch public safety vehicles to incidents.
		Coordinate incident response with emergency dispatch agencies, the City of Cleveland TOC, and the TDOT SmartWay Center in Chattanooga for incidents on state facilities.
	McMinn County 911 Dispatch	Dispatch public safety vehicles to incidents.
		Coordinate incident response with emergency dispatch agencies, the City of Cleveland TOC, and the TDOT SmartWay Center in Chattanooga for incidents on state facilities.
	THP Dispatch	Dispatch public safety vehicles for incidents.
		Coordinate incident response with other public safety and traffic management agencies as well as the TDOT SmartWay Center in Chattanooga for incidents on state facilities.
Emergency Management	Bradley County 911 Dispatch	Responsible for emergency call-taking for Bradley County, including the City of Cleveland, as the 911 PSAP.
		Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.

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

Transportation Service	Stakeholder	Roles/Responsibilities
Emergency Management (continued)	Bradley County 911 Dispatch (continued)	Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Cleveland – Bradley County EMA	Operates the EOC for Bradley County including the City of Cleveland in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the County.
		Lead regional efforts for emergency planning to support large-scale incidents and disasters.
		Lead evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	TEMA	Operates the EOC for the State of Tennessee in the event of a disaster or other large-scale emergency situation.
		Responsible for tactical decision support, resource coordination, and communications integration among emergency management agencies in the State.
		Lead statewide efforts for emergency planning to support large-scale incidents and disasters.
		Lead evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	THP	Responsible for the dispatch of emergency vehicles to incidents and tracking of their location and status.
		Responsible for the routing of emergency vehicles to facilitate the safest/quickest arrival at an incident.
		Participate in regional emergency planning to support large-scale incidents and disasters.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
	Tennessee Bureau of Investigation	Responsible for the initiation of AMBER Alerts.
Maintenance and Construction Management	Bradley County Highway Department	Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.
	City of Cleveland Street Department	Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.

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

Transportation Service	Stakeholder	Roles/Responsibilities
Maintenance and Construction Management (continued)	City of Cleveland Street Department (continued)	Supports work zone activities including the dissemination of work zone information through portable DMS and sharing of information with other groups.
		Disseminates work zone activity schedules and current asset restrictions to other agencies.
	TDOT	Monitors environmental sensors and distributes information about road weather conditions.
		Responsible for the tracking and dispatch of maintenance vehicles.
		Supports coordinated response to incidents.
		Supports work zone activities including the dissemination of work zone information through portable DMS, HAR, and sharing of information with other groups.
		Responsible for entering and updating work zone information in SWIFT.
		Disseminates work activity schedules and current asset restrictions to other agencies.
		Operates work zone traffic control equipment including portable surveillance equipment, DMS, and HAR transmitters.
Transit Management	SETHRA	Operates fixed route and paratransit services from a central dispatch facility responsible for tracking their location and status.
		Provide transit passenger electronic fare payment on fixed route and demand response transit vehicles.
		Provide transit security on transit vehicles and at transit terminals through silent alarms and surveillance systems.
		Provide transit traveler information to the agency website, local private sector traveler information services, and the Tennessee 511 system.
		Operate on-board systems to provide next stop annunciation.
		Participate in evacuation planning and coordination to manage evacuation and reentry in the vicinity of a disaster or other emergency situation.
Traveler Information	City of Cleveland	Responsible for the collection and distribution of traveler information including incident information and maintenance and construction closure information.
		Responsible for the collection and distribution of emergency information to the traveling public, including evacuation information and wide-area alerts.
	TDOT	Collection, processing, storage, and broadcast dissemination of traffic, transit, maintenance and construction, event and weather information to travelers via the SmartWay Website and the Tennessee 511 system.

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

Transportation Service	Stakeholder	Roles/Responsibilities
Traveler Information (continued)	TDOT (continued)	Provide transportation network condition data to private sector information service providers.
Archived Data Management	Cleveland Urban Area MPO	Collect and maintain data from regional traffic and transit management agencies.

5.6 Potential Agreements

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

With the implementation of ITS technologies, integrating systems from one or more agencies, and the anticipated level of information exchange identified in the architecture, it is likely that formal agreements between agencies will be needed in the future. These agreements, while perhaps not requiring a financial commitment from agencies in the Region, should outline specific roles, responsibilities, data exchanges, levels of authority, and other facets of regional operations. Some agreements will also outline specific funding responsibilities, where appropriate and applicable.

Agreements should avoid being specific with regards to technology when possible. Technology is likely to change, and changes to technology could require an update of the agreement if the agreement was not technology neutral. The focus of the agreement should be on the responsibilities of the agencies and the high level information that needs to be exchanged. Depending on the type of agreement being used, agencies need to be prepared for the process to complete an agreement to take several months to years. Agencies must first reach consensus on the content of an agreement and then proceed through the approval process. The approval process for formal agreements varies by agency. The process often is lengthy; agencies should plan ahead to ensure that the agreement does not delay the project.

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

Common agreement types and potential applications include:

- *Handshake Agreement:* Handshake agreements are often used in the early stages of a project. This type of informal agreement depends on relationships between agencies and may not be appropriate for long-term operations where staff is likely to change.
- *Memorandum of Understanding (MOU):* A MOU demonstrates general consensus but is not typically very detailed. MOUs often identify high-level goals and partnerships.

- *Interagency and Intergovernmental Agreements:* These agreements between public agencies can be used for operation, maintenance, or funding projects and systems. They can include documentation on the responsibility of each agency, functions each will provide, and liability.
- *Funding Agreements:* Funding agreements document the funding arrangements for ITS projects. At a minimum, funding agreements include a detailed scope, services to be performed, and a detailed project budget. Agency funding expectations or funding sources are also typically identified.
- *Master Agreements:* Master agreements include standard contract language for an agency and serve as the main agreement between two entities that guides all business transactions. Use of a master agreement can allow an agency to do business with another agency or private entity without having to go through the often lengthy development of a formal agreement each time.

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

In **Appendix E**, copies of any existing agreements that were available have been included. Future agreements included in **Table 10** will be implemented as needed on a project-by-project basis. Existing agreements include:

- Memorandum of Agreement between the Cleveland Urban Area MPO and the CHCNGA TPO regarding the development and maintenance of the Regional ITS Architecture in each region;
- Agreement developed by TDOT for live CCTV video access for governmental agency users;
- Agreement developed by TDOT for live CCTV video access for private entity users; and,
- Open Roads Policy Agreement between TDOT, THP, and local agencies that establish guidelines for removal of vehicles or debris from the state highway system.

Table 10 – Cleveland Region Existing and Potential Agreements

Status	Agreement and Agencies	Agreement Description	Sample Relevant Projects
Existing	**ITS Architecture Development** – (Cleveland Urban Area MPO, Chattanooga-Hamilton County/North Georgia TPO)	Existing MOU that defines the relationship between the Cleveland Regional ITS Architecture and Chattanooga Regional ITS Architecture. The agreement states that separate ITS architectures will be developed, the MPOs will actively coordinate and cooperate in the development and maintenance of each others respective Regional ITS Architecture, and clearly defines how certain projects will be covered within each Regional ITS Architecture.	Cleveland MPO GreenTrips Program
Existing/ Future	**Data Sharing and Usage (Public-Private)** Existing – TDOT, Future – Media and City of Cleveland	Agreement would allow private sector media and information service providers to access and broadcast public sector transportation agency CCTV camera video feeds, real time traffic speed and volume data, and incident data. Agreements should specify the control priority to allow traffic agencies first priority to control cameras during incidents or other events. The ability of the traffic agency to deny access to video and data feeds if a situation warrants such action should also be part of the agreement.	Regional Media Coordination
Existing/ Future	**Data Sharing and Usage (Public-Public)** Existing – TDOT and Bradley County, Future – City of Cleveland	Agreement would define the parameters, guidelines, and policies for inter-agency ITS data sharing between public sector agencies including CCTV camera feeds. Similar to data sharing and usage agreements for public-private agencies, the agency that owns the equipment should have first priority of the equipment and the ability to discontinue data sharing if a situation warrants such action.	City of Cleveland Coordination with TDOT SmartWay Center TDOT Queue Detection at Freeway Off Ramps
Existing	**Open Roads Policy (Public-Public)** – TDOT, THP (TDOSHS), and Municipalities/Counties	Memorandum of Understanding among TDOT, THP (TDOSHS), and local governments that establishes guidelines to accelerate the removal of vehicles or debris on the State Highway System to restore the flow of traffic following an incident.	TDOT HELP Vehicle Service Area Expansion to Bradley and McMinn Counties
Future	**Traffic Signal Timing Data Sharing and Usage** – (City of Cleveland, Bradley County)	Agreement would define the parameters, guidelines, and policies for inter-agency traffic signal timing, including sharing of timing plans and joint operations of signals, between cities and counties.	Cleveland Signal System Upgrade and Traffic Management Enhancements Cleveland Vehicle Detection
Future	**Incident Data Sharing and Usage** – (TDOT, City of Cleveland, THP, Bradley County 911 Dispatch)	Agreement would define the parameters, guidelines, and policies for inter-agency sharing of incident data between transportation and emergency management agencies in the Region. Incident information could be sent directly to computer-aided dispatch systems and include information on lane closures, travel delays, and weather.	Bradley County 911 Dispatch CCTV Camera Image Sharing Cleveland-Bradley County EMA CCTV Camera Image Sharing

Table 10 – Cleveland Region Existing and Potential Agreements (Continued)

Status	Agreement and Agencies	Agreement Description	Sample Relevant Projects
Future	**Shared Maintenance Agreements** – (TDOT, City of Cleveland, Bradley County, McMinn County, Other Agencies)	Agreement that would allow multiple public agencies to pool their funding together for the purposes of ITS-related projects on a regional level. For example, pooled funding could be used to hire a single maintenance contractor to maintain ITS devices throughout the Region. This type of agreement may reduce the cost of maintenance particularly for agencies with a limited number of ITS devices deployed. By combining all maintenance into a single contract the need for each agency to provide specialized training and equipment to staff is eliminated. Pooled funding could also be used to solicit engineering services for design of regional ITS architecture or traffic management software to be used in TOCs throughout the region.	Cleveland Urban Area MPO Archive Data Warehouse
Future	**Fog Event Incident Data Sharing and Usage** – (City of Cleveland, THP)	Agreement would define the parameters, guidelines, and policies for inter-agency sharing of fog incident data between THP and the City of Cleveland; this could also include the sharing of video images.	City of Cleveland Coordination with TDOT SmartWay Center I-75 Detour Route DMS
Future	**Joint Operations Agreements –** (TDOT, City of Cleveland, Bradley County)	Agreement to operate the system from a shared control facility that could include traffic, transit, and emergency management. Examples could include a regional TMC or a combined TMC and EOC. Agreement will need to identify such issues as sharing of data and control of devices, cost sharing of the facilities, and standard operating procedures. Shared field equipment, such as a CCTV camera that can be accessed by multiple agencies could also be covered under this type of agreement.	N/A
Future	**Joint Management of GreenTrips Program** – (CHCNGA TPO, Cleveland MPO)	Agreement would define the funding mechanisms, available programs, and operating responsibilities for inter-agency maintenance of the GreenTrips Transportation Demand Management (TDM) and ride matching website. The agreement could also outline guidelines for interested corporate partners.	Cleveland MPO GreenTrips Program

5.7 Phases of Implementation

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

A sequence of projects and their respective timeframes were identified in the Cleveland Regional ITS Deployment Plan presented in Section 6. These projects were sequenced over a time period that coincides with the Cleveland Region 2040 RTP, with projects identified for deployment in the short-term (0 to 5 years), mid-term (5 to 10 years), and long-term (beyond 10 years.)

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

- ATMS01 – Network Surveillance;
- ATMS03 – Traffic Signal Control;
- ATMS06 – Traffic Information Dissemination;
- ATMS08 – Traffic Incident Management System;
- ATMS26 – Mixed Use Warning Systems;
- EM02 – Emergency Routing;
- MC10 – Maintenance and Construction Activity Coordination;
- APTS01 – Transit Vehicle Tracking;
- APTS02 – Transit Fixed-Route Operations;
- APTS03 – Demand Response Transit Operations;
- APTS04 – Transit Fare Collection Management;
- APTS05 – Transit Security;
- APTS08 – Transit Traveler Information;
- APTS10 – Transit Passenger Counting; and
- AD1 – ITS Data Mart.

6. REGIONAL ITS DEPLOYMENT PLAN

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

The Regional ITS Deployment Plan also shows the correlation between each project and the Regional ITS Architecture by identifying the ITS service packages that correspond to each project. If projects were identified that did not correspond to an ITS service package, the ITS service packages in the Regional ITS Architecture were revised while the Regional ITS Architecture was still in draft format; therefore, the resulting ITS deployment projects are supported by the Regional ITS Architecture.

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

6.1 Project Development and Selection

An overview of the process used to develop the Regional ITS Deployment Plan is provided in **Figure 8**. This figure demonstrates that a variety of inputs were used to gather information and develop a set of ITS projects for selection by stakeholders, including a review of the regional needs, ITS service package priorities, and regional and local plans.

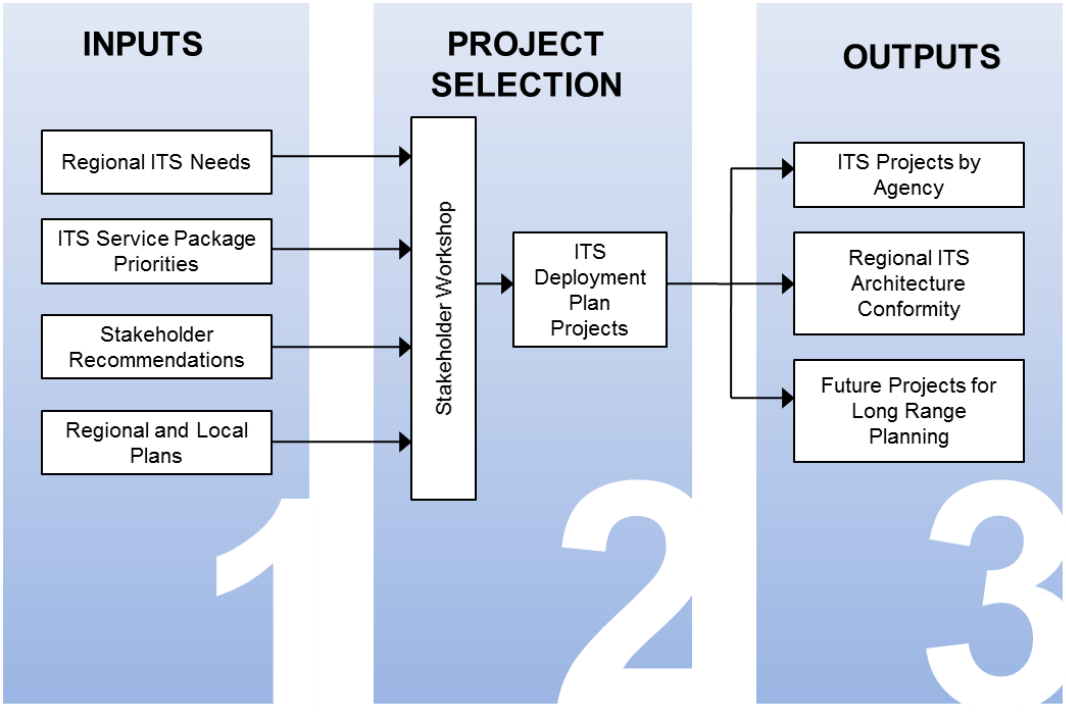


Figure 8 – Project Development and Selection Process

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

The inputs in Step 1 led to the project selection in Step 2. Project selection was completed through a combination of a stakeholder workshop held in March 2017 as well as stakeholder review of the Regional ITS Architecture Report.

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

6.2 ITS Project Recommendations

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

Input from all stakeholders is required for stakeholders to have ownership of the ITS Deployment Plan and to ensure that the plan has realistically identified projects and timeframes for deployment. Cost is another important factor—cost can vary a great deal for many ITS elements, depending on the level of deployment, maturity of the technology, type of communications, etc. For example, freeway network surveillance could be adequately achieved for one region by the deployment of still frame CCTV cameras only at freeway interchanges. In another region, full motion cameras may be deployed at one-mile intervals to provide complete coverage of the freeway. The infrastructure and telecommunications costs for these two projects would vary a great deal, yet either one could be suitable for a particular region.

Regional projects are identified in **Table 11** through **Table 17**. The tables are divided by the primary responsible agency as follows:

- **Table 11** – Bradley County 911 Dispatch;
- **Table 12** – City of Cleveland;
- **Table 13** – Cleveland-Bradley County Emergency Management Agency;
- **Table 14** – Cleveland Urban Area MPO;
- **Table 15** – Southeast Tennessee Human Resource Agency;
- **Table 16** – TDOT; and
- **Table 17** – Cleveland Region.

The projects identified in the tables represent priority projects for each agency that are needed in order to implement the ITS services that were identified as part of the Regional ITS Architecture development. Projects that have been funded using federal transportation funds will be included in the Regional Transportation Improvement Plan (TIP). Projects that are funded with non-federal funding may also be included in the TIP, but are not required to be included. Many of the projects

identified in the plan do not yet have funding. Identification of a funding source will likely be the most significant challenge in getting the projects implemented.

For each project, the following categories are discussed:

- **Project** – Identifies the project name including the agency responsible for implementation where applicable.
- **Description** – Provides a description of the project including notes on time-frames for deployment and costs if applicable. The level of detail in the project descriptions varies depending on the implementing agency and how much detail they wanted to include regarding a project. In some cases, projects had not been discussed beyond a very high conceptual level and there was limited or no information available on cost and scale of the potential project.
- **Deployment Timeframe and Responsible Agency** – Provides a recommended timeframe for deployment for each project. Timeframes have been identified as short-term (deployment recommended in 0-5 years), mid-term (deployment recommended in 5-10 years), and long-term (deployment recommended beyond 10 years). Recommendations for deployment timeframes were based on input from each agency, and each one considered the project's priority, possibility of funding, and dependency on other project deployments.
- **Funding Status** – Indicates whether funding has been identified or is still needed for the project.
- **Applicable ITS Service Packages** – Identifies the ITS service packages from the Regional ITS Architecture that each project will assist in implementing. Knowing which ITS service packages each project identifies is an important part of an ITS architecture conformance review.

Table 11 – Bradley County 911 Dispatch Project Recommendations

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
Bradley County 911 Dispatch CCTV Camera Image Sharing	Establish a connection to share TDOT and City of Cleveland CCTV camera images with the Bradley County 911 Dispatch. Connecting to the City of Cleveland Public Works Department would allow the Bradley County 911 Dispatch access to TDOT video once the Public Works Department was connected to TDOT. Additional Responsible Agencies: City of Cleveland, TDOT	Funding Identified: No	Mid-term	ATMS08
Bradley County 911 Dispatch CAD Connection to City of Cleveland Public Works	Implement a connection from the Bradley County 911 Dispatch to the City of Cleveland Public Works Department to allow automated sharing of incident and road closure information between traffic and public safety departments. Additional Responsible Agency: City of Cleveland	Funding Identified: No	Mid-term	ATMS08 EM02 MC10

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

Table 12 – City of Cleveland Project Recommendations

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
Cleveland Signal System Upgrade and Traffic Management Enhancements	Continue upgrading the traffic signal system and expand the traffic management capabilities of the Cleveland signal system. Add additional signals onto Ethernet communication network rather than radio communication and monitor signals from the TOC. Continue to upgrade traffic signal controllers and add battery back-up to all signals as needed.	Funding Identified: No	Short-term	ATMS01 ATMS03 ATMS08
Cleveland CCTV Camera Implementation	Implement additional CCTV cameras at key sections of roadway within the City of Cleveland. CCTV cameras can be used to monitor traffic conditions and to aid in incident management. Video feeds should be shareable between emergency management agencies to facilitate emergency response. Eight CCTV cameras are already in place throughout the city, and additional deployments are desired.	Funding Identified: No	Short-term	ATMS01
Cleveland Overheight Detection and Warning System on SR 40/US 64	Implement an overheight detection and warning system on SR 40/US 64 at the railroad overpass in downtown Cleveland. Current static signage is not effective for some recreational vehicles drivers that are not aware that their vehicle is over height. The system would include detection to determine whether a vehicle was too tall for the underpass and a lighted blank out sign or a static sign with beacons to indicate to the driver that they need to detour to avoid striking the overpass.	Funding Identified: No	Short-term	ATMS01
Cleveland HAWK Beacon Implementation	Implement Pedestrian Hybrid Beacons (HAWK) near Cleveland Community College and at any other priority locations identified by the city. HAWK beacons are activated by crossing pedestrians and provide motorists with added visual warnings near crosswalk locations.	Funding Identified: No	Short-term	ATMS26
Cleveland Emergency Vehicle Signal Preemption Expansion	Expand the emergency vehicle signal preemption system by adding preemption capabilities to additional traffic signals in the City of Cleveland to improve incident response times and emergency responder safety. Preemption capability is currently available at 21 signals for the Fire Department only, but should be considered for EMS as part of the expansion.	Funding Identified: No	Short-term	ATMS03 EM02

Table 12 – City of Cleveland Project Recommendations (continued)

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
City of Cleveland Coordination with TDOT Region 2 TMC - Chattanooga	Establish a communications connection between the City of Cleveland TOC and the Chattanooga SmartWay Center for the coordination of traffic information. This sharing will facilitate the inclusion of regional information in the Tennessee 511 System as well as the sharing of weather information and video feeds. With the fog system upgrades coming on line, this project should occur within the next year. Additional Responsible Agency: TDOT	Funding Identified: No	Short-term	ATMS07 ATMS08
Cleveland DMS	Implement DMS on the US 64 Bypass to provide traveler information for detours from I-75 onto US 11. Signs would be located on North Lee Highway and on APD 40.	Funding Identified: No	Mid-term	ATMS06
Cleveland Vehicle Detection	Implement vehicle detection technologies on roadways in the City of Cleveland so that traffic management staff can monitor speeds and volumes. The information could be used in the management of the transportation system or to detect incidents. In addition to use for real time traffic condition monitoring, in some locations the count data will be archived for use in signal timing and transportation planning.	Funding Identified: No	Mid-term	ATMS01
Cleveland Speed and Volume Monitoring System	Implement additional vehicle detection locations or add capabilities to vehicle detection implemented as part of other projects to monitor roadway speeds, intersection turning volumes, and mainline traffic volumes. From this data, determine locations for targeted speed limit enforcement. In select locations, such as school zones, the detection will also include driver feedback signs to inform drivers of their travel speed.	Funding Identified: No	Mid-term	ATMS01 ATMS19
Cleveland Public Works Department Real-Time Traveler Information Website	Add real-time traveler information, such as incident locations, speed, and CCTV camera images to the City of Cleveland Public Works Department website. Automatically notify city school system of pertinent traveler information.	Funding Identified: No	Mid-term	ATIS01 ATIS02

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

Table 13 – Cleveland-Bradley County Emergency Management Agency Project Recommendations

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
Cleveland-Bradley County EMA CCTV Camera Image Sharing	Establish a connection to share TDOT and the City of Cleveland CCTV camera images with the Cleveland-Bradley County EMA. Connecting to the City of Cleveland would allow the Cleveland-Bradley County EMA access to TDOT video once the City of Cleveland was connected to TDOT. Responsible Agencies: Bradley County EMA, City of Cleveland, TDOT	Funding Identified: No	Mid-term	EM08 EM09

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

Table 14 – Cleveland Urban Area MPO Project Recommendations

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
Cleveland Urban Area MPO GreenTrips Program	Facilitate an expansion of the CHCNGA TPO GreenTrips ride-matching and transportation demand management program. The program was created with the goal of encouraging alternatives to single occupancy vehicle trips, including carpooling, telecommuting, and biking or walking to work. The program includes several corporate partners and a ride-matching database. CHCNGA TPO has approved the extension of these services to the Cleveland region, and the Cleveland City Council has committed matching funding to allow the community to participate in the program. Responsible Agencies: Cleveland Urban Area MPO, CHCNGA TPO	Funding Identified: No**	Short-term	ATIS02
Cleveland Urban Area MPO Archive Data Warehouse	Establish a data warehouse to archive data from cities and transit agencies in the MPO service area for use in regional planning. Cost could vary widely depending on the level of detail and functionality of the system as well as the amount of development that is done in-house by the Cleveland Urban Area MPO.	Funding Identified: No	Long-term	AD2

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

** During the stakeholder review workshop, CHCNGA TPO stakeholders identified this program as one that had interested the City of Cleveland and the Cleveland MPO. While the project is not included in Cleveland's most recent TIP (November 2016), CHCNGA TPO staff noted that the Cleveland City Council had expressed interest in helping to fund the program.

Table 15 – Southeast Tennessee Human Resource Agency Project Recommendations

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
Cleveland Transit System Stop Annunciation	Implement stop annunciation technology to improve traveler information and accessibility by the sight impaired. Stop annunciation uses GPS to determine what the next stop is and makes an announcement to travelers. This information is also frequently displayed on a dynamic sign within the vehicle so that hearing impaired patrons can also benefit from the information.	Funding Identified: No	Short-term	APTS08
Cleveland Transit Automatic Passenger Counting	Implement automatic passenger counting technology on Cleveland Transit fixed-route buses. Ridership data will be forwarded to a transit data archive.	Funding Identified: No	Short-term	APTS10
Cleveland Transit DMS	Install DMS at select bus stops and the Cleveland Transit central transfer station. DMS will display expected arrival times, closure or detour information, and other custom messages as determined by the Cleveland Transit Dispatch Center.	Funding Identified: No	Short-term	APTS08
Cleveland Transit Website and App Development	Develop a Cleveland Transit website and mobile app to share traveler information and provide other services to riders.	Funding Identified: No	Short-term	APTS02 APTS03 APTS08
Cleveland Transit Transfer Station CCTV Surveillance	Install CCTV surveillance cameras at the Cleveland Transit central transfer station. CCTV will feed back to Cleveland Transit Dispatch Center.	Funding Identified: No	Short-term	APTS05
Cleveland Transit System Electronic Fare Collection	Implement electronic fare collection capabilities on Cleveland Urban Area Transit System buses.	Funding Identified: No	Short-term	APTS04

Table 15 – Southeast Tennessee Human Resource Agency Project Recommendations (continued)

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
SETHRA/Cleveland Transit Data Archive	Develop a data archive to store, organize, and access data that is automatically collected from Cleveland Transit and SETHRA vehicles.	Funding Identified: No	Short-term	AD1
Transit Signal Priority for Cleveland Transit Fixed-Route Buses	Implement transit signal priority infrastructure on priority corridors within Cleveland. Transit signal priority would allow Cleveland Transit fixed-route buses that are operating behind schedule to move more quickly through enabled traffic signals within the city.	Funding Identified: No	Medium-term	APTS09

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

Table 16 – TDOT Project Recommendations

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
TDOT HELP Vehicle Service Area Expansion to Bradley and McMinn Counties	Expand the TDOT Region 2 HELP service area to include the Cleveland Region. HELP vehicles stationed in the area would facilitate incident management as well as special event management.	Funding Identified: No	Short-term	EM04
TDOT Queue Detection at Freeway Off Ramps	Install queue detection systems at freeway off ramps that are located near arterial signals. Detection systems would communicate with nearby signals and would activate when queues spill back to the ramp, modifying the signal timing to clear queues before they extend back to the freeway. Project would require close coordination with the City of Cleveland. Responsible Agencies: TDOT, City of Cleveland	Funding Identified: No	Short-term	ATMS03
I-75 Detour Route DMS	Implement a DMS on US 64 in advance of US 411 that could be used to support detours during long-term closures on I-75, such as a full-scale activation of the fog system.	Funding Identified: No	Mid-term	ATMS06
TDOT Additional CCTV Cameras	Implement closed circuit television (CCTV) cameras on APD 40, US 411, and US 64. CCTV cameras can be used to monitor traffic conditions and to aid in incident management. Video feeds can be shared with emergency management agencies to facilitate emergency response.	Funding Identified: No	Mid-term	ATMS01

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

Table 17 – Cleveland Regional Project Recommendations

Project	Description	Funding Status	Deployment Timeframe *	Applicable ITS Service Packages
Regional Media Coordination	Develop agreements and enhanced coordination with local media to improve information sharing and dissemination. If the media desires to gather data, such as closed circuit television (CCTV) camera video feeds, from the transportation agencies in the Region, then it is expected that the media would be responsible for any costs. Responsible Agencies: City of Cleveland, TDOT	Note: Funding not applicable	Mid-term	ATIS01

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

7. USE AND MAINTENANCE PLAN

The Cleveland Regional ITS Architecture is one of several documents that address transportation plans for the region. These documents should be compatible with one another and guided by similar overarching goals and objectives related to the regional transportation network. Federal agencies require that ITS projects using federal funding from the Highway Trust Fund conform to the Regional ITS Architecture, so it is important that ITS elements, which are going to be incorporated into other regional plans, are incorporated according to the Regional ITS Architecture. Section 7.1 describes how the Regional ITS Architecture can be used to guide the incorporation of ITS elements into the Long Range Transportation Plan (LRTP) and Transportation Improvement Programs (TIP). Section 7.2 provides insights into how the Regional ITS Architecture can be used to improve or streamline efforts for transportation operations project selection and implementation throughout the Region.

7.1 Incorporation into the Regional Planning Process

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

Although no formal process is in place in the Cleveland Region, many other MPOs require that as projects are submitted for inclusion in the TIP, each project be evaluated by the submitting agency to determine if the project includes any ITS elements. If the project contains ITS elements, a determination needs to be made if those elements are in conformance with the Regional ITS Architecture. The submitting agency should perform this evaluation as part of the planning process using the procedure outlined in Section 7.3. LAMTPO would review each project to confirm that it does conform to the Regional ITS Architecture and assist agencies as they perform this evaluation as part of the project application process.

An additional tool that could be utilized by LAMTPO in evaluating ITS projects is TDOT's "ITS Project Development Guidelines," which requires all agencies with projects related to ITS (including certain non-ITS traffic operations improvements) complete the Tennessee ITS Project Identification Form. TDOT will then validate whether a project is considered an ITS project and the risk associated with implementing the project, which will determine the next steps to be taken. LAMTPO could require stakeholder agencies to complete TDOT's form when submitting projects for inclusion in the TIP.

Figure 9 provides a diagram that details the proposed steps for consideration of the Regional ITS Architecture in Cleveland's regional planning process. In this figure, the TIP project selection process includes a review of the Regional ITS Architecture to ensure that projects containing ITS elements are in conformity with the regional ITS needs identified by the architecture. In this system, the TIP project selection process includes a review of the Regional ITS Architecture to ensure that projects containing ITS elements are in conformity with the regional ITS needs identified by the architecture.

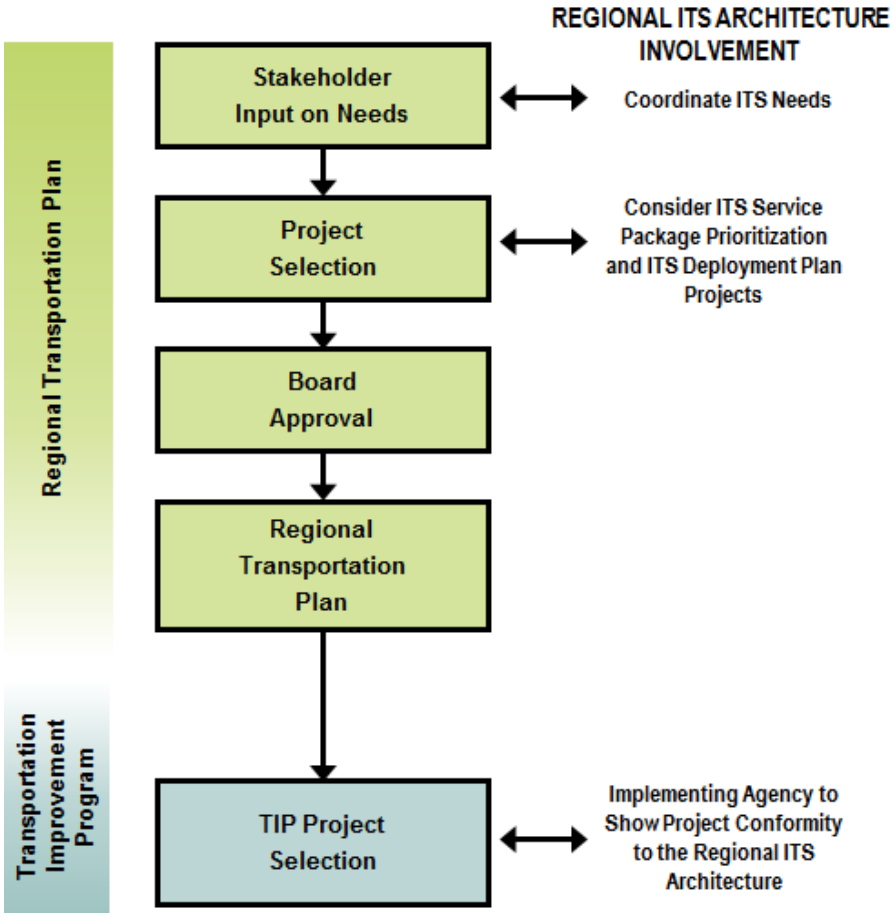


Figure 9 – Proposed Regional Planning Process and ITS Architecture Involvement

7.2 Systems Engineering Analysis

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

The goal of performing a systems engineering analysis is to systematically think through the project deployment process, and show that thorough, upfront planning has been shown to help control costs and ensure schedule adherence. A project's level of risk will determine if a simplified systems engineering analysis form (SSEAF) is sufficient, or if a more detailed systems engineering analysis report (SEAR) is necessary.

The Tennessee requirements indicate that the following should be included in a systems engineering analysis:

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

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

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

Many projects are categorically excluded from the systems engineering analysis requirements. Categorically excluded projects are those that do not utilize a centralized control, do not share data with another agency, or are expansions or enhancements to existing systems that do not add any new functionality. For example, installation of an isolated traffic signal or upgrades to an existing signal that does not introduce new functional capabilities would be categorically excluded. Other projects are subject to the systems engineering analysis, either in an abbreviated sense through the use of a form, or in a detailed sense through the preparation of a full report. TDOT and the FHWA Tennessee Division have established a method for determining the necessary documentation for each project, based on the project's risk factors and complexity. This method is shown in the flow chart in **Figure 10** and is described in detail in the *TDOT ITS Development Guidelines* developed by the TDOT Traffic Operations Division (https://tn.gov/tdot/topic/its-project-development).

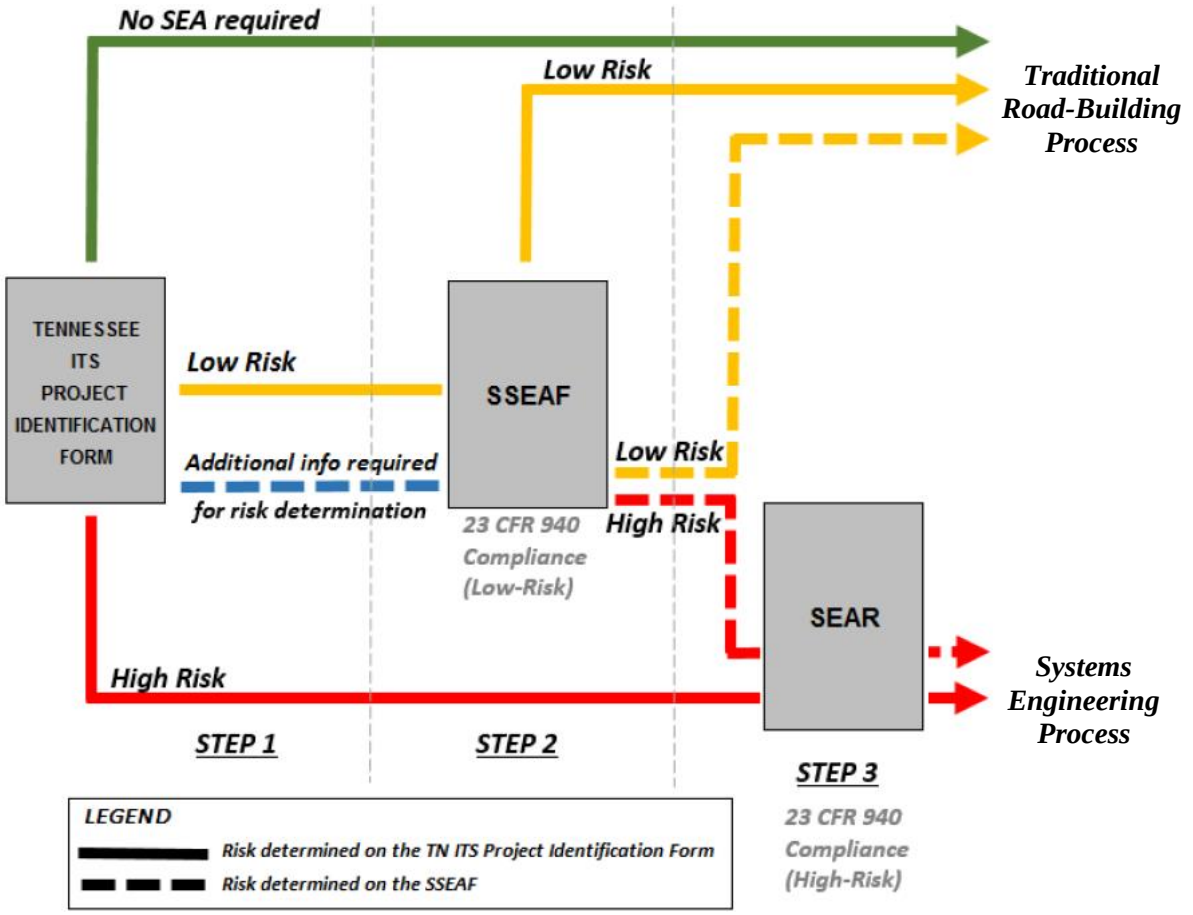


Figure 10 – Systems Engineering Analysis Project Flow Chart

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

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

Projects which are identified as "High-Risk" on the Project Identification Form will require a systems engineering analysis report (SEAR). Projects which are identified as "Low Risk" or as requiring more information to determine risk on the Project Identification Form are subject to an

abbreviated analysis. In these cases, contracting agencies must fill out a Simplified Systems Engineering Analysis Form (SSEAF). This form is submitted to TDOT, which reviews the form and informs the agency and project sponsor of risk determination. If TDOT determines the project to be "High Risk", a SEAR is required. If TDOT determines the project to be "Low Risk", the project can follow the traditional road building project process for other non-ITS projects.

The Vee Diagram, shown in **Figure 11**, is frequently used in systems engineering discussions to demonstrate where the Regional ITS Architecture and systems engineering process fits into the life cycle of an ITS project. The Regional ITS Architecture is shown unattached from the rest of the diagram because it is not specifically project related and an undetermined amount of time can pass between the architecture development and the beginning of project implementation. Moving from left to right along the diagram, the systems engineering process addresses concept exploration, the systems engineering management plan framework, concept of operations, and systems requirements.

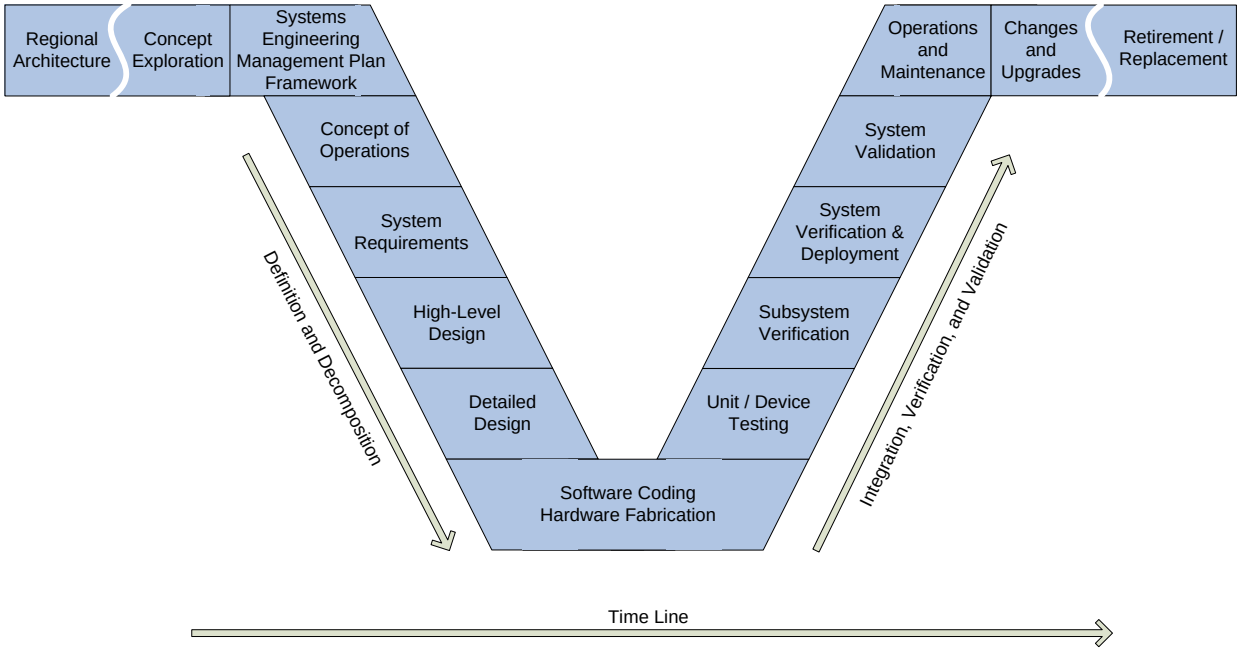


Figure 11 – Systems Engineering Vee Diagram

The Tennessee guidance document contains reference material to aid in the preparation of a systems engineering analysis. During the process, if it is determined that a project is not adequately addressed in the Regional ITS Architecture, the Regional ITS Architecture maintenance process (described in Section 7.4) should be used to document the necessary changes.

7.3 Process for Determining ITS Architecture Conformity

The Cleveland Regional ITS Architecture documents the customized service packages that were developed as part of the ITS architecture process. To satisfy FHWA and FTA requirements and remain eligible to use Federal funds, a project must be accurately documented. TDOT's "ITS Project Development Guidelines" specify that ITS projects need to be reviewed by MPOs to determine if the proposed ITS elements are in conformance with the regional ITS architecture. The steps of determining regional architecture conformity are as follows:

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

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

Step 1 – Identify the ITS Components

ITS components can be fairly apparent in an ITS focused project such as CCTV or DMS deployments, but could also be included in other types of projects where they are not as apparent. For example, an arterial widening project could include the installation of signal system interconnect, signal upgrades, and the incorporation of the signals in the project limits into a city's closed loop signal system. These are all ITS functions and should be included in the ITS Architecture. As mentioned in Section 7.1, stakeholders can make use of the TDOT ITS Project Identification Form that was filled out upon project submission to the TIP to help identify ITS components of a given project.

Step 2 – Identify the Corresponding Service Packages

If a project was included in the list of projects identified in the Cleveland Regional ITS Deployment Plan, then the applicable service package(s) for that project were also identified. However, ITS projects are not required to be included in the ITS Deployment Plan in order to be eligible for federal funding; therefore, service packages might need to be identified for projects that have not been covered in the ITS Deployment Plan. In that case, the service packages selected and customized for the Cleveland Region should be reviewed to determine if they adequately cover the project. Service packages selected for the Cleveland Region are identified in **Table 6** of this document and detailed service package definitions are located in **Appendix A**.

Step 3 – Identify the Component within the Service Package

The customized service packages for the Cleveland Region are located in **Appendix B**. Once the element is located within the appropriate service package, the evaluator should determine if the element name used in the service package is accurate or if a change to the name is needed. For example, a future element called Municipal TOC was included in the Cleveland Regional ITS Architecture. Detailed planning for this center has not begun and it would not be unusual for the city or county to select a different name for the TOC once planning and implementation is underway. Such a name change should be documented using the process outlined in Section 7.5.

Step 4 – Evaluate the Connections and Flows

The connections and information flows documented in the service package diagrams were selected based on the information available at the time the Regional ITS Architecture was developed. As the projects are designed, decisions will be made on the system layout that might differ from what is shown in the service package. These changes in the project should be documented in the ITS service packages using the process outlined in Section 7.5.

Step 5 – Document Required Changes

If any changes are needed to accommodate the project under review, Section 7.5 describes how those changes should be documented. Any changes will be incorporated during the next Regional

ITS Architecture update. Conformance will be accomplished by documenting how the service package(s) should be modified so that the connections and information flows are consistent with the project.

7.4 Regional ITS Architecture Maintenance Process

The Cleveland MPO will be responsible for leading the process to update the Cleveland Regional ITS Architecture in coordination with the TDOT Traffic Operations Division. **Table 18** summarizes the maintenance process agreed upon by stakeholders in the Region.

Table 18 – Cleveland Regional ITS Architecture Maintenance Summary

Maintenance Details	Regional ITS Architecture and Deployment Plan	
	Minor Update	**Full Update**
Timeframe for Updates	As needed	Review in coordination with the update to the Regional Transportation Plan
Scope of Update	Review and update service packages to satisfy architecture compliance requirements of projects or to document other changes that impact the Regional ITS Architecture.	Entire Regional ITS Architecture and Deployment Plan
Lead Agency	Cleveland MPO in Coordination with TDOT	
Participants	Stakeholders impacted by service package modifications	Entire stakeholder group
Results	ITS service package or other change(s) documented for next complete update	Updated Regional ITS Architecture and Deployment Plan document, Appendices, and Turbo Architecture database

It was agreed that, in the future, a review of the Regional ITS Architecture should occur in the same cycle as the Regional Transportation Plan (RTP) update to determine if a full update of the Regional ITS Architecture is necessary. The Cleveland MPO most recently updated their RTP in 2016, so the content in this document will help to shape future iterations. The RTP is updated every five years if the Cleveland Region is designated in attainment; however, the update occurs every four years if the Region is designated non-attainment. The need for an update will depend on the extent of ITS deployment in the Region since the previous update as well as changes that may have occurred in the National ITS Architecture. The Cleveland MPO will coordinate with TDOT to determine if an update is required.

By completing a full update of the Regional ITS Architecture in coordination with an RTP update (if an update is needed), stakeholders will be able to determine the ITS needs and projects that are most important to the Region and document those needs and projects for consideration when developing the RTP. The Cleveland MPO, in coordination with the TDOT Traffic Operations Division, will be responsible for completing the full update. During the update process, all of the stakeholder agencies that participated in the original development of the Regional ITS Architecture and Deployment Plan should be included as well as any other agencies in the Region that are deploying or may be impacted by ITS projects.

Minor changes to the Regional ITS Architecture and Deployment Plan should occur as needed between full updates of the plan. In Section 7.5 of this document, the procedure for submitting a change to the Regional ITS Architecture is documented. Documentation of changes to the Regional

ITS Architecture is particularly important if a project is being deployed and requires a change to the Regional ITS Architecture in order to establish conformity.

7.5 Procedure for Submitting ITS Architecture Changes between Major Updates

Updates to the Cleveland Regional ITS Architecture will occur on a regular basis as described in Section 7.4 to maintain the architecture as a useful planning tool. Between major plan updates, smaller modifications will likely be required to accommodate ITS projects in the Region. Section 7.3 contains step by step guidance for determining whether a project requires modifications to the Regional ITS Architecture.

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

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

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

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

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

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

The Cleveland MPO will review and accept the proposed changes and forward the form to the TDOT Traffic Operations Division for their records. When a major update is performed, all of the documented changes should be incorporated into the Regional ITS Architecture.

APPENDIX A – SERVICE PACKAGE DEFINITIONS

Service Package	Service Package Name	Description
Traffic Management Service Area		
ATMS01	Network Surveillance	Includes traffic detectors, CCTV cameras, other surveillance equipment, supporting field equipment and fixed point to point communications to transmit the collected data back to a traffic management center.
ATMS02	Traffic Probe Surveillance	Provides an alternative approach for surveillance of the roadway network. Probe vehicles are tracked, and the vehicle's position and speed information are utilized to determine road network conditions such as average speed and congestion conditions.
ATMS03	Traffic Signal Control	Provides the central control and monitoring equipment, communication links, and the signal control equipment that support traffic control at signalized intersections. This service package is consistent with typical traffic signal control systems.
ATMS04	Traffic Metering	Includes 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.
ATMS05	HOV Lane Management	Manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals.
ATMS06	Traffic Information Dissemination	Provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. Information can include traffic and road conditions, closure and detour information, incident information, emergency alerts and driver advisories.
ATMS07	Regional Traffic Management	Sharing of traffic information and control among traffic management centers to support a regional management strategy. The nature of optimization and extent of information and control sharing is determined through working arrangements between jurisdictions.
ATMS08	Traffic Incident Management System	Manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. This service package includes incident detection capabilities and coordination with other agencies. It supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel.
ATMS09	Traffic Decision Support and Demand Management	Recommends courses of action to traffic operations personnel based on an assessment of current and forecast road network performance. All recommendations 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 TDM, where applicable.
ATMS10	Electronic Toll Collection	Provides toll operators with the ability to collect tolls electronically and detect and process violations.
ATMS11	Emissions Monitoring and Management	Monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data.
ATMS12	Roadside Lighting System Control	Manages electrical lighting systems by monitoring operational conditions and using the lighting controls to vary the amount of light provided along the roadside.
ATMS13	Standard Railroad Grade Crossing	Manages highway traffic at highway-rail intersections (HRIs) where rail operational speeds are less than 80 mph.
ATMS14	Advanced Railroad Grade Crossing	Manages highway traffic at highway-rail intersections (HRIs) where operational speeds are greater than 80 mph. Augments Standard Railroad Grade Crossing service package with additional safety features to mitigate the risks associated with higher rail speeds.
ATMS15	Railroad Operations Coordination	Provides an additional level of strategic coordination between freight rail operations and traffic management centers. Could include train schedules, maintenance schedules or any other anticipated HRI closures.

Service Package	Service Package Name	Description
Traffic Management Service Area (continued)		
ATMS16	Parking Facility Management	Provides enhanced monitoring and management of parking facilities. Service package assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees.
ATMS17	Regional Parking Management	Supports communication and coordination between parking facilities as well as coordination between parking facilities and traffic and transit management systems.
ATMS18	Reversible Lane Management	Provides for the management of reversible lane facilities and includes the field equipment, physical lane access controls, and associated control electronics.
ATMS19	Speed Warning and Enforcement	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.
ATMS20	Drawbridge Management	Supports systems that manage drawbridges at rivers and canals and other multimodal crossings. Includes control devices as well as traveler information systems.
ATMS21	Roadway Closure Management	Closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, or other situations. Service package covers general road closures applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other service packages.
ATMS22	Variable Speed Limits	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.
ATMS23	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 along a roadway. 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.
ATMS24	Dynamic Roadway Warning	Includes systems that dynamically warn drivers approaching hazards on a roadway. 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.
ATMS25	VMT Road User Payment	Facilitates charging 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).
ATMS26	Mixed Use Warning Systems	Supports the sensing and warning systems used to interact with pedestrians, bicyclists, and other vehicles that operate on the main vehicle roadways, or on pathways which intersect the main vehicle roadways. These systems could allow automated warning or active protection for this class of users.
Emergency Management Service Area		
EM01	Emergency Call-Taking and Dispatch	Provides basic public safety call-taking and dispatch services. Includes emergency vehicle equipment, equipment used to receive and route emergency calls, wireless communications and coordination between emergency management agencies.
EM02	Emergency Routing	Supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions and suggested routing information are provided to enhance emergency vehicle routing. Includes signal preemption and priority applications.

Service Package	Service Package Name	Description
Emergency Management Service Area (continued)		
EM03	Mayday and Alarms Support	Allows the user to initiate a request for emergency assistance and enables the emergency management subsystem to locate the user, gather information about the incident and determine the appropriate response.
EM04	Roadway Service Patrols	Supports the roadway service patrol vehicles that aid motorists, offering rapid response to minor incidents (flat tire, crashes, out of gas) to minimize disruption to the traffic stream. This service package monitors service patrol vehicle locations and supports vehicle dispatch.
EM05	Transportation Infrastructure Protection	Includes the monitoring of transportation infrastructure (e.g. bridges, tunnels and management centers) for potential threats using sensors, surveillance equipment, barriers and safeguard systems to preclude an incident, control access during and after an incident or mitigate the impact of an incident. Threats can be acts of nature, terrorist attacks or other incidents causing damage to the infrastructure.
EM06	Wide-Area Alert	Uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather, civil emergencies or other situations that pose a threat to life and property.
EM07	Early Warning System	Monitors and detects potential, looming and actual disasters including natural, technological and man-made disasters.
EM08	Disaster Response and Recovery	Enhances the ability of the surface transportation system to respond to and recover from disasters. Supports coordination of emergency response plans, provides enhanced access to the scene and better information about the transportation system in the vicinity of the disaster, and maintains situation awareness.
EM09	Evacuation and Reentry Management	Supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. This service package supports both anticipated, well-planned and orderly evacuations such as for a hurricane, as well as sudden evacuations with little or no time for preparation or public warning such as a terrorist act. Employs a number of strategies to maximize capacity along an evacuation route including coordination with transit.
EM10	Disaster Traveler Information	Use of 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.
Maintenance and Construction Management Service Area		
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities.
MC02	Maintenance and Construction Vehicle Maintenance	Performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities. Includes on-board sensors capable of automatically performing diagnostics.
MC03	Road Weather Data Collection	Collects current road weather conditions using data collected from environmental sensors deployed on and about the roadway.
MC04	Weather Information Processing and Distribution	Processes and distributes the environmental information collected from the Road 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 system operators can make decisions on corrective actions to take.
MC05	Roadway Automated Treatment	Automatically treats a roadway section based on environmental or atmospheric conditions. Includes the sensors that detect adverse conditions, automated treatment (such as anti-icing chemicals), and driver information systems.
MC06	Winter Maintenance	Supports winter road maintenance. Monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities.

Service Package	Service Package Name	Description
Maintenance and Construction Management Service Area (continued)		
MC07	Roadway Maintenance and Construction	Supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.
MC08	Work Zone Management	Directs activity in work zones, controlling traffic through portable dynamic message signs and informing other groups of activity for better coordination management. Also provides speed and delay information to motorists prior to the work zone.
MC09	Work Zone Safety Monitoring	Includes systems that improve work crew safety and reduce collisions between the motoring public and maintenance and construction vehicles. Detects vehicle intrusions in work zones and warns workers and drivers of safety hazards when encroachment occurs.
MC10	Maintenance and Construction Activity Coordination	Supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations. (i.e., traffic management, transit, emergency management)
MC11	Environmental Probe Surveillance	Collects data from vehicles in the road network that can be used to directly measure on infer current environmental conditions.
MC12	Infrastructure Monitoring	Monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure using both fixed and vehicle-based infrastructure monitoring sensors. Monitors vehicle probes used to determine current pavement conditions.
Public Transportation Service Area		
APTS01	Transit Vehicle Tracking	Monitors current transit vehicle location using an automated vehicle location system. Location data may be used to determine real time schedule adherence and update the transit system's schedule in real time.
APTS02	Transit Fixed-Route Operations	Performs vehicle routing and scheduling, as well as operator assignment and system monitoring for fixed-route and flexible-route transit services.
APTS03	Demand Response Transit Operations	Performs vehicle routing and scheduling, as well as operator assignment and system monitoring for demand responsive transit services.
APTS04	Transit Fare Collection Management	Manages transit fare collection on-board transit vehicles and at transit stops using electronic means. Allows the use of a traveler card or other electronic payment device.
APTS05	Transit Security	Provides for the physical security of transit passengers and transit vehicle operators. Includes on-board security cameras and panic buttons.
APTS06	Transit Fleet Management	Supports automatic transit maintenance scheduling and monitoring for both routine and corrective maintenance.
APTS07	Multi-modal Coordination	Establishes two way communications between multiple transit and traffic agencies to improve service coordination.
APTS08	Transit Traveler Information	Provides transit users at transit stops and on board transit vehicles with ready access to transit information. Services include stop annunciation, imminent arrival signs and real-time transit schedule displays. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this service package.
APTS09	Transit Signal Priority	Determines the need for transit priority on routes and at certain intersections and requests transit vehicle priority at these locations to improve on-time performance of the transit system.
APTS10	Transit Passenger Counting	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.
APTS11	Multi-modal Connection Protection	Supports the coordination of multimodal services to optimize the travel time of travelers as they move from mode to mode (or to different routes within a single mode).

Service Package	Service Package Name	Description
Commercial Vehicle Operations Service Area		
CVO01	Carrier Operations and Fleet Management	Provides the capabilities to manage a fleet of commercial vehicles. Vehicle routing and tracking as well as notification of emergency management of any troublesome route deviations (such as a HAZMAT vehicle) are part of this service package.
CVO02	Freight Administration	Tracks the movement of cargo and monitors the cargo condition.
CVO03	Electronic Clearance	Provides for automatic clearance at roadside check facilities. Allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and dedicated short range communications to the roadside.
CVO04	CV Administrative Processes	Provides for electronic application, processing, fee collection, issuance and distribution of CVO credentials and tax filing.
CVO05	International Border Electronic Clearance	Provides for automated clearance at international border crossings.
CVO06	Weigh-In-Motion	Provides for high speed weigh-in-motion with or without automated vehicle identification capabilities.
CVO07	Roadside CVO Safety	Provides for automated roadside safety monitoring and reporting. Automates commercial vehicle safety inspections at the roadside check facilities.
CVO08	On-board CVO Safety	Provides for on-board commercial vehicle safety monitoring and reporting, and includes support for collecting on-board safety data via transceivers or other means. The on-board safety data are assessed by an off-board system. In some cases the monitoring and safety assessment may occur remotely (i.e., not at a roadside site).
CVO09	CVO Fleet Maintenance	Supports maintenance of CVO fleet vehicles with on-board monitoring equipment and automated vehicle location capabilities.
CVO10	HAZMAT Management	Integrates incident management capabilities with commercial vehicle tracking to assure effective treatment of HAZMAT material and incidents.
CVO11	Roadside HAZMAT Security Detection and Mitigation	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.
CVO12	CV Driver Security Authentication	Provides the ability for fleet and freight management to detect when an unauthorized commercial vehicle driver attempts to drive a vehicle based on stored identity information. If an unauthorized driver has been detected the commercial vehicle can be disabled.
CVO13	Freight Assignment Tracking	Provides for the planning and tracking of the commercial vehicle, freight equipment and the commercial vehicle driver.
Traveler Information Service Area		
ATIS01	Broadcast Traveler Information	Collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadly disseminates this information through existing infrastructures (radio, cell phones, etc.).
ATIS02	Interactive Traveler Information	Provides tailored information in response to a traveler request. 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.
ATIS03	Autonomous Route Guidance	Using vehicle location and other information, this service package enables route planning and detailed route guidance based on static, stored information.
ATIS04	Dynamic Route Guidance	Offers advanced route planning and guidance that is responsive to current conditions.
ATIS05	ISP Based Trip Planning and Route Guidance	Offers the user pre-trip route planning and en-route guidance services. Routes may be based on static or real time network conditions.

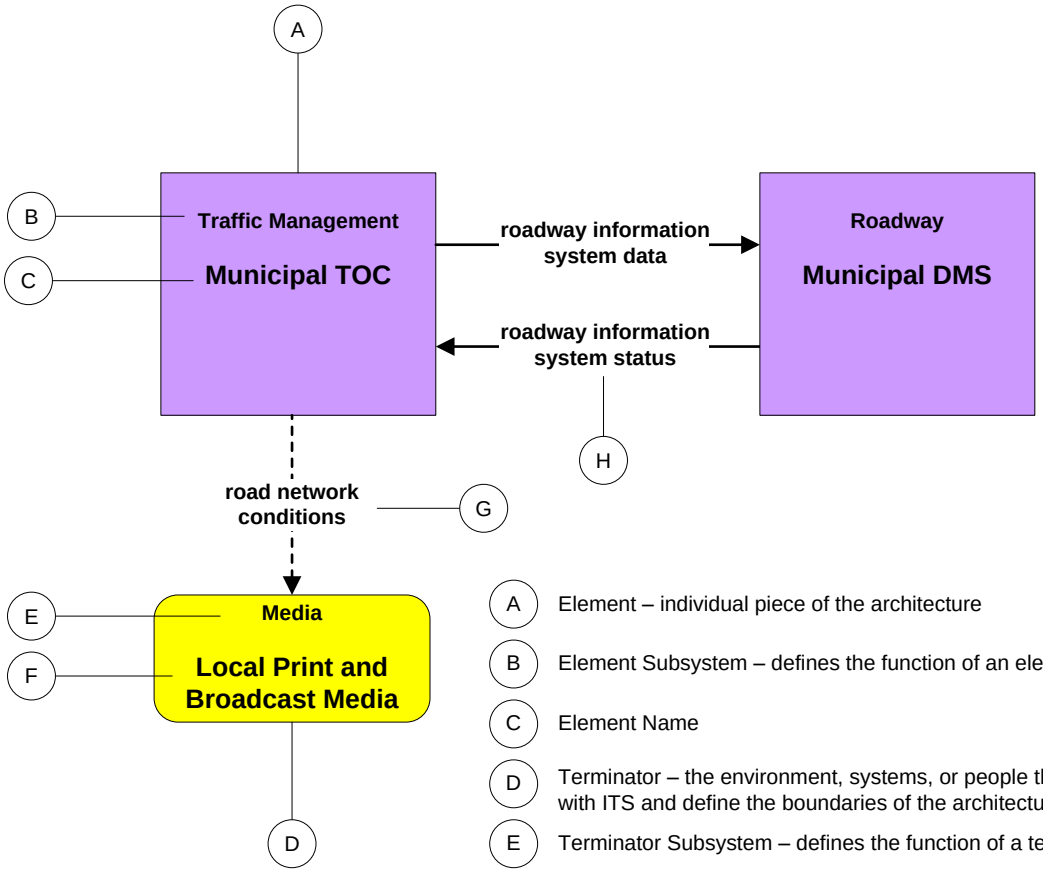
Service Package	Service Package Name	Description
Traveler Information Service Area		
ATIS06	Transportation Operations Data Sharing	Collects, processes, and stores current information on traffic and travel conditions and other information about the current state of the transportation network and makes the information available to transportation system operators.
ATIS07	Travel Service Information and Reservation	Provides travel information and reservation services to the user. This service package provides multiple ways for accessing information either while en route in a vehicle using wide-area wireless communications or pre-trip via fixed-point to fixed-point connections.
ATIS08	Dynamic Ridesharing	Provides dynamic ridesharing/ride matching services to travelers.
ATIS09	In Vehicle Signing	Supports the distribution of traffic and travel advisory information to drivers through in-vehicle devices.
ATIS10	Short Range Communications Traveler Information	Provides location-specific or situation-relevant information to travelers in vehicles using Dedicated Short Range Communications (DSRC) infrastructure supporting mobility applications for connected vehicles. Delivers real-time traveler information including travel times, incident information, road conditions, and emergency traveler information to vehicles as they pass DSRC roadside equipment along their route.
Archived Data Management Service Area		
AD1	ITS Data Mart	Provides a focused archive that houses data collected and owned by a single agency or other organization. Focused archive typically covers a single transportation mode and one jurisdiction.
AD2	ITS Data Warehouse	Includes all the data collection and management capabilities of the ITS Data Mart. Adds the functionality to allow collection of data from multiple agencies and data sources across modal and jurisdictional boundaries.
AD3	ITS Virtual Data Warehouse	Provides the same broad access to multimodal, multidimensional data from varied sources as in the ITS Data Warehouse Service Package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed.
Vehicle Safety Service Area		
AVSS01	Vehicle Safety Monitoring	Diagnoses critical components of the vehicle and warns the driver of potential dangers. On-board sensors will determine the vehicle's condition, performance, and on-board safety data and display that information to the driver.
AVSS02	Driver Safety Monitoring	Determines the driver's condition and warns the driver of potential dangers. On-board sensors will determine the driver's condition, performance, and on-board safety data and display that information to the driver.
AVSS03	Longitudinal Safety Monitoring	Uses on-board safety sensors and collision sensors to monitor the areas in front of and behind the vehicle and present warnings to the driver about potential hazards.
AVSS04	Lateral Safety Warning	Uses on-board safety sensors and collision sensors to monitor the areas to the sides of the vehicle and present warnings to the driver about potential hazards.
AVSS05	Intersection Safety Warning	Determines the probability of a collision in an equipped intersection (either highway-highway or highway-rail) and provides timely warnings to drivers in response to hazardous conditions. Monitors in the roadway infrastructure assess vehicle locations and speeds near an intersection. Using this information, a warning is determined and communicated to the approaching vehicle using a short range communications system. Information can be provided to the driver through the ATIS09 – In-Vehicle Signing service package.
AVSS06	Pre-Crash Restraint Deployment	Provides in-vehicle sensors to monitor the vehicle's local environment (lateral and longitudinal gaps, weather, and roadway conditions), determine collision probability, and deploy a pre-crash safety system.

Service Package	Service Package Name	Description
Vehicle Safety Service Area (continued)		
AVSS07	Driver Visibility Improvement	Enhances the driver visibility using an enhanced vision system. On-board display hardware is needed.
AVSS08	Advanced Vehicle Longitudinal Control	Automates the speed and headway control functions on board the vehicle utilizing safety sensors and collision sensors combined with vehicle dynamics processing to control the throttle and brakes. Requires on-board sensors to measure longitudinal gaps and a processor for controlling the vehicle speed.
AVSS09	Advanced Vehicle Lateral Control	Automates the steering control on board the vehicle utilizing safety sensors and collision sensors combined with vehicle dynamics processing to control the steering. Requires on-board sensors to measure lane position and lateral deviations and a processor for controlling the vehicle steering.
AVSS10	Intersection Collision Avoidance	Determines the probability of an intersection collision and provides timely warnings to approaching vehicles so that avoidance actions can be taken. This service package builds on the intersection collision warning infrastructure and in-vehicle equipment and adds equipment in the vehicle that can take control of the vehicle in emergency situations.
AVSS11	Automated Vehicle Operations	Enables “hands-off” operation of the vehicle on the automated portion of the highway system. Implementation requires lateral lane holding, vehicle speed and steering control, and automated highway system check-in and check-out.
AVSS12	Cooperative Vehicle Safety Systems	Enhances the on-board longitudinal and lateral warning stand-alone systems by exchanging messages wirelessly with other surrounding vehicles. Vehicles send out information concerning their location, speed, and direction to any surrounding vehicles. Special messages from approaching emergency vehicles may also be received and processed.

APPENDIX B – CUSTOMIZED ITS SERVICE PACKAGES

APPENDIX B

ITS SERVICE PACKAGE DIAGRAM COMPONENT AND TERMINOLOGY KEY



A – Element – individual piece of the architecture

B – Element Subsystem – defines the function of an element

C – Element Name

D – Terminator – the environment, systems, or people that interface with ITS and define the boundaries of the architecture

E – Terminator Subsystem – defines the function of a terminator

F – Terminator Name

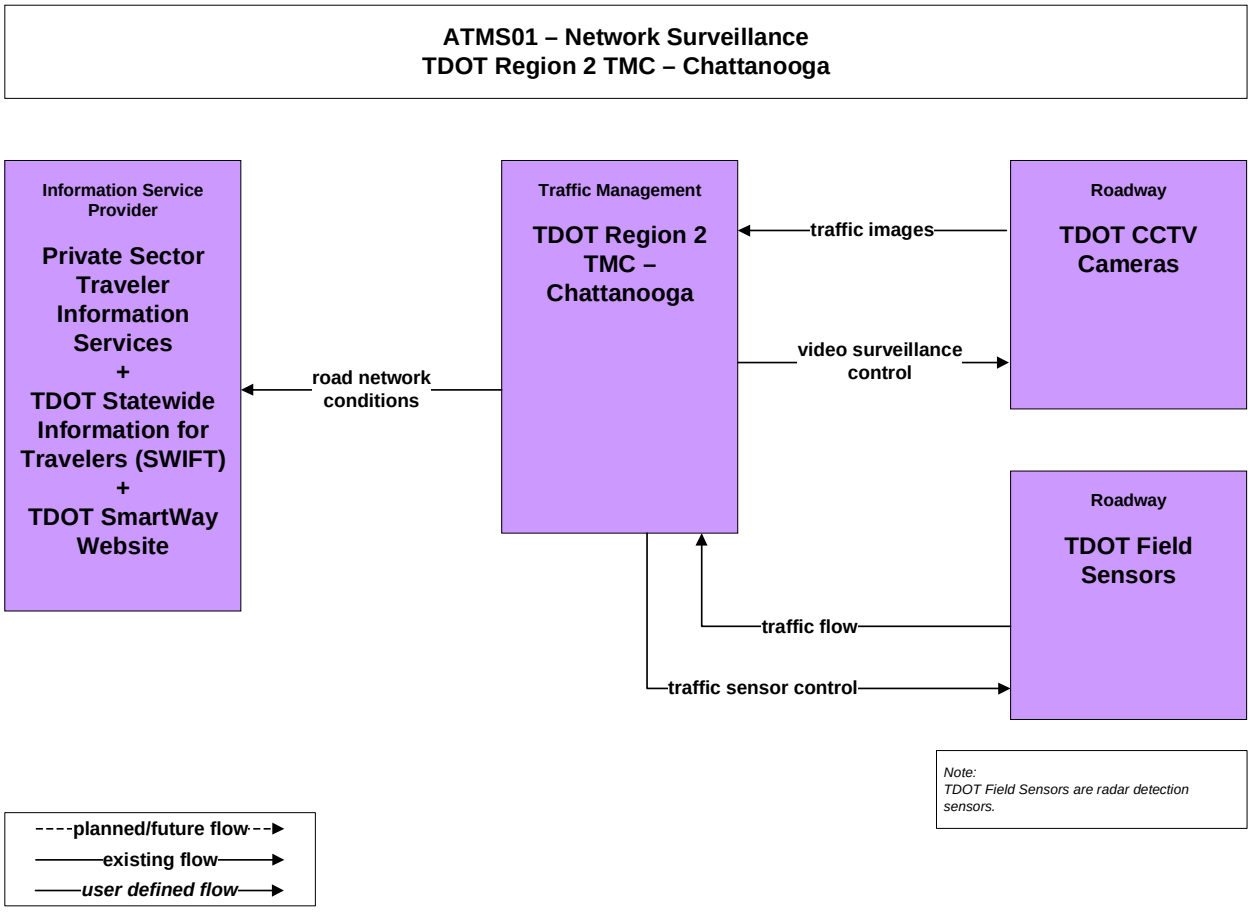
G – Future/Planned Architecture Flow – data that will be exchanged between subsystems and terminators in the future

H – Existing Architecture Flow – data that is currently exchanged between subsystems and terminators

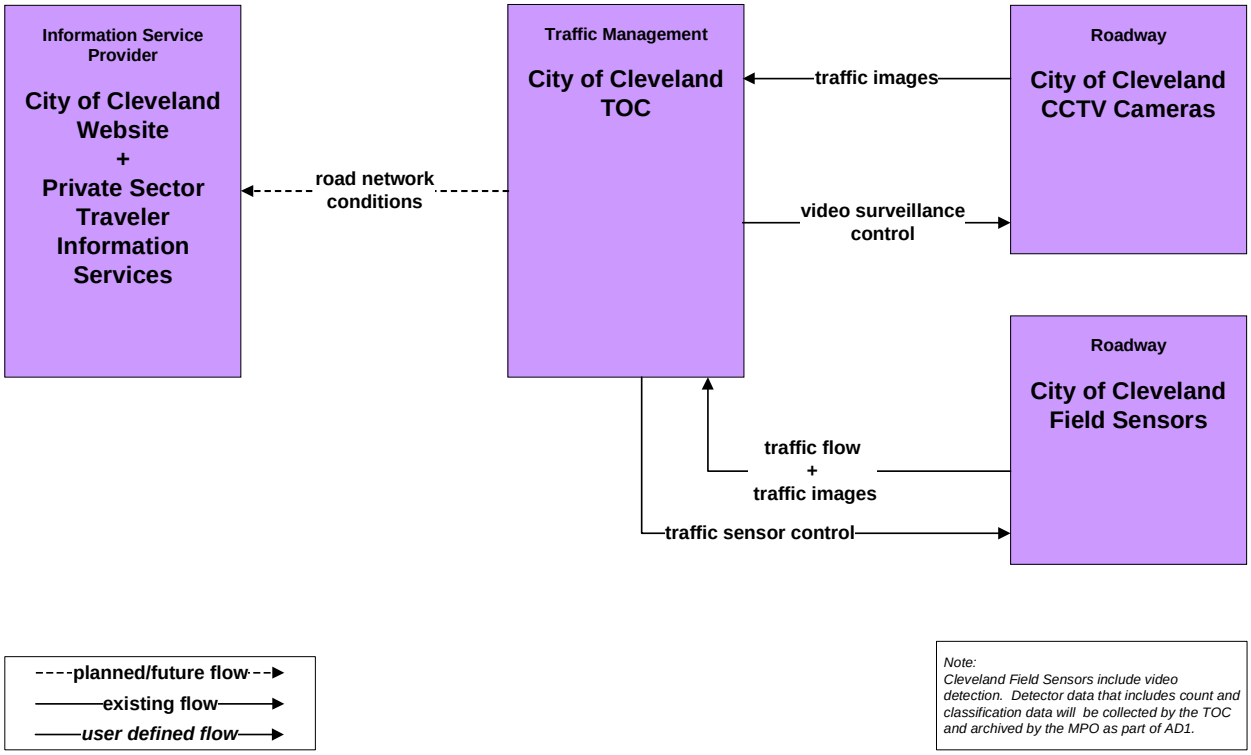
Cleveland Regional ITS Architecture
Service Packages

April 2017

Advanced Traffic Management System



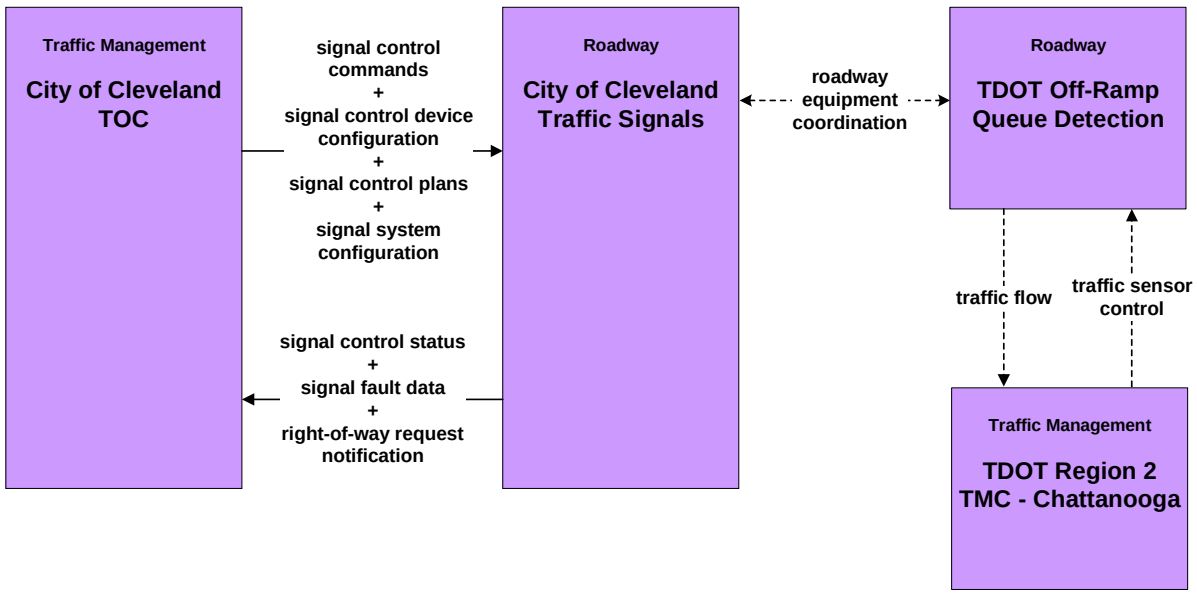
ATMS01 – Network Surveillance
City of Cleveland



planned/future flow
existing flow
user defined flow

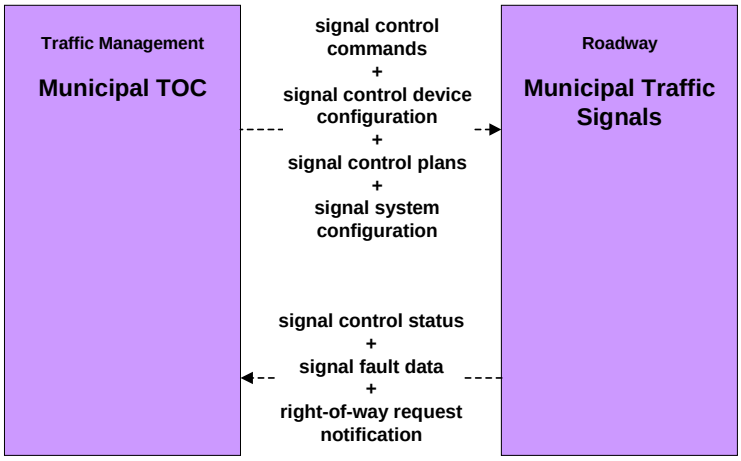
Note:
Cleveland Field Sensors include video detection. Detector data that includes count and classification data will be collected by the TOC and archived by the MPO as part of AD1.

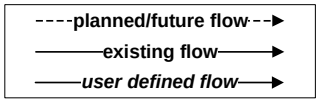
ATMS03 – Traffic Signal Control
City of Cleveland Signal System



planned/future flow
existing flow
user defined flow

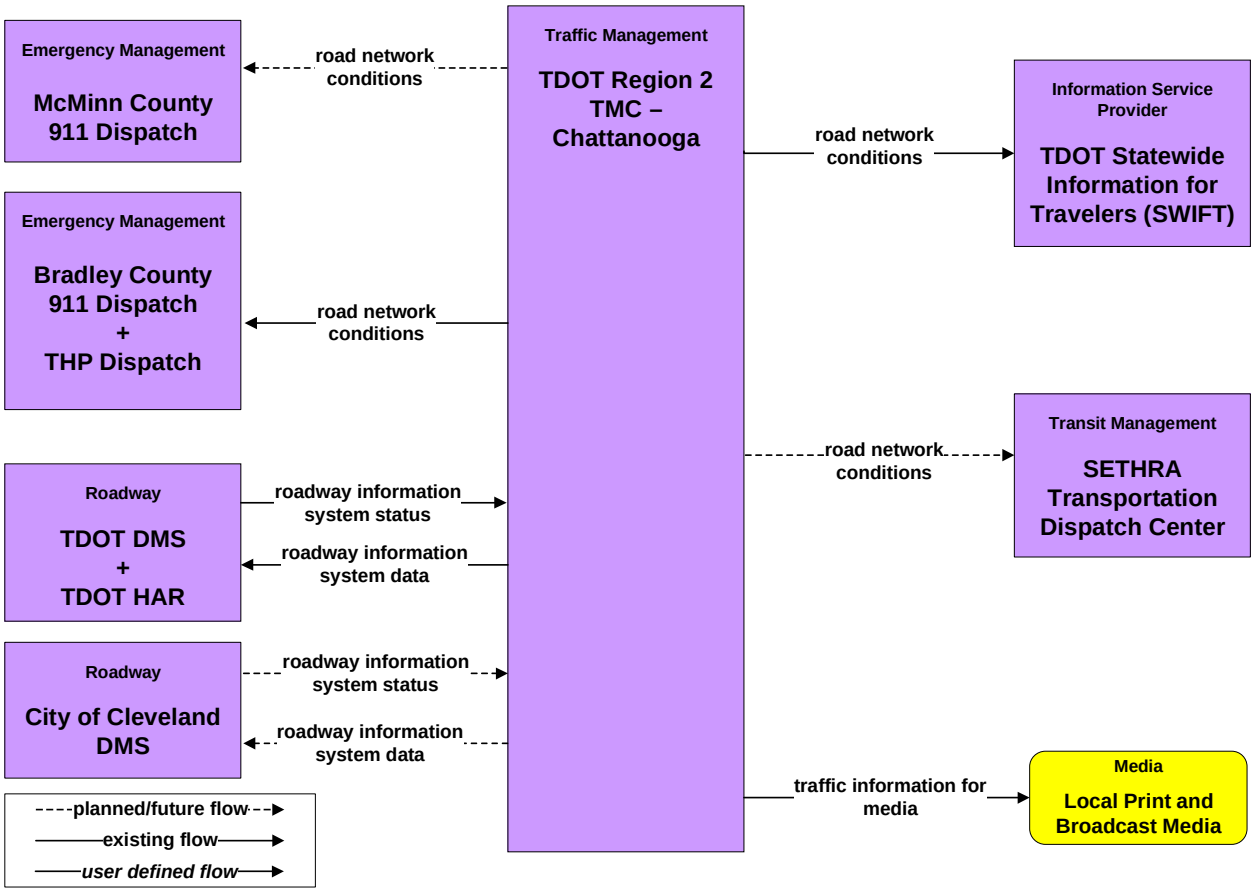
ATMS03 – Traffic Signal Control
Municipal Signal System



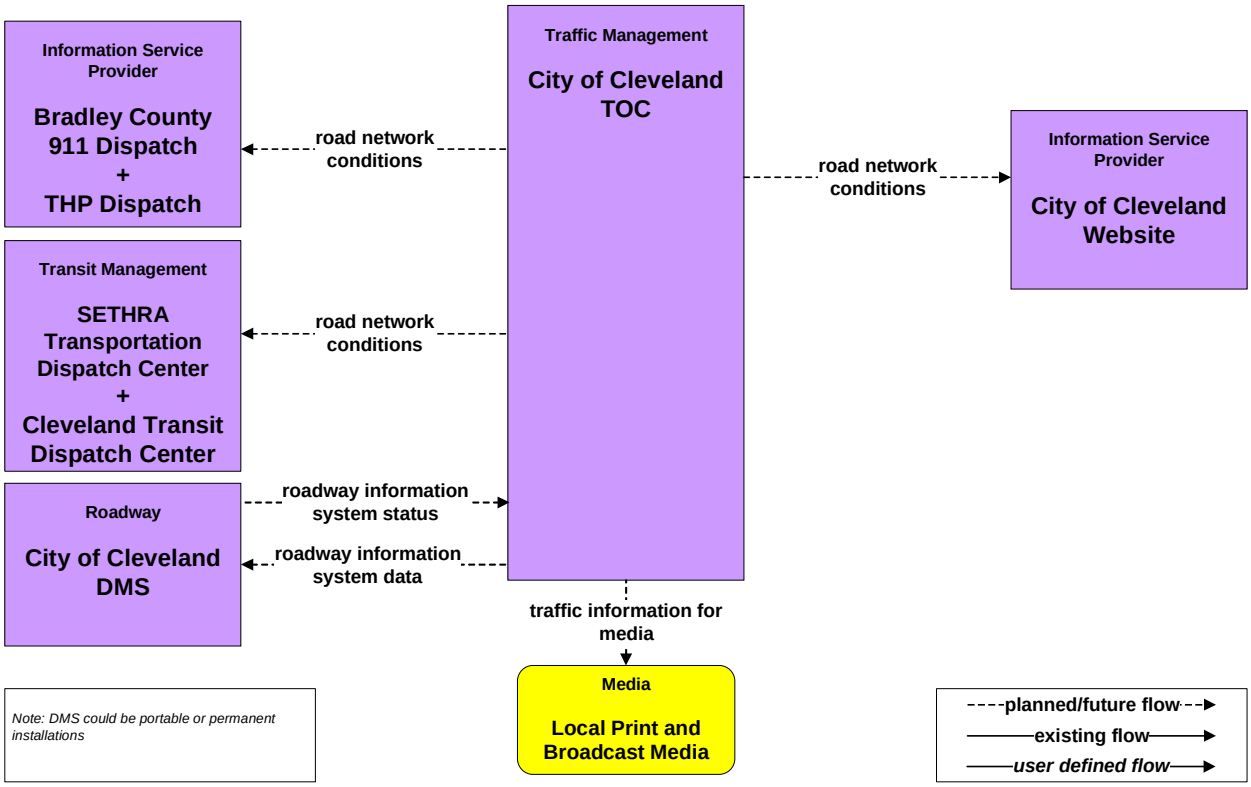


Note:
Municipal includes Bradley County, McMinn County, and the City of Charleston.

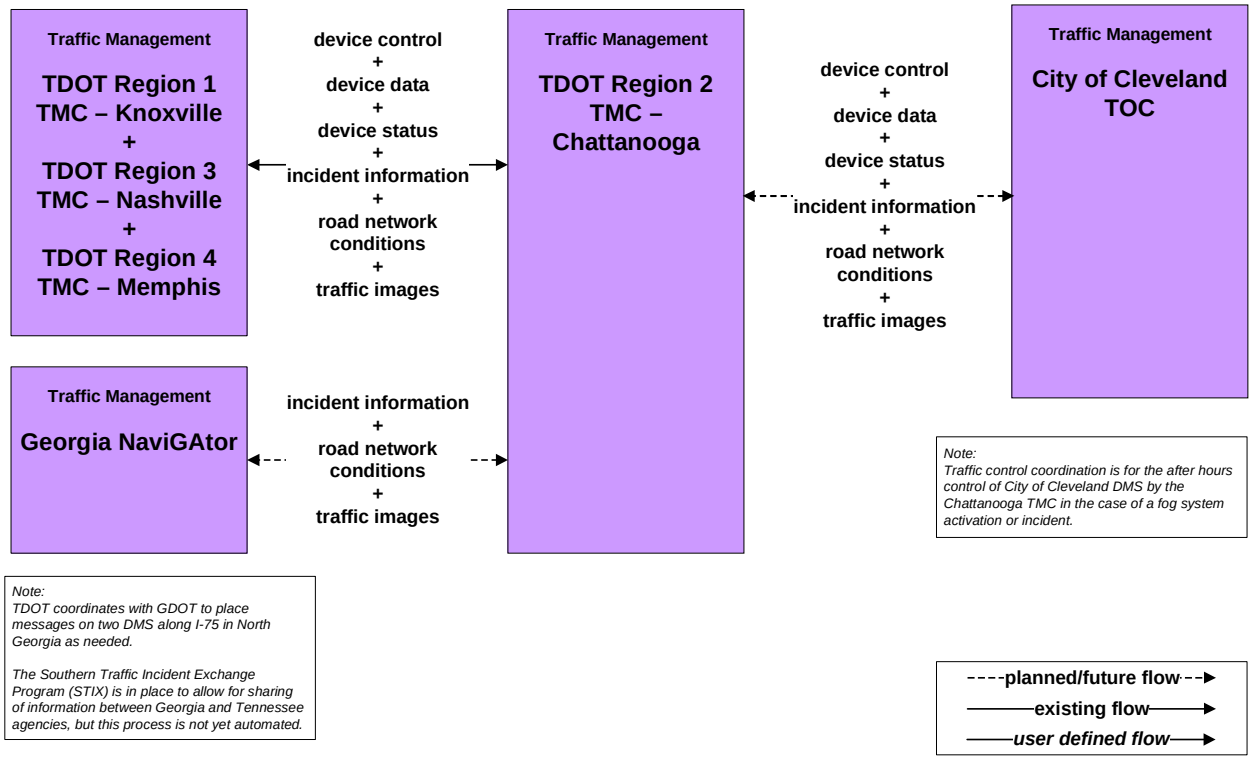
ATMS06 – Traffic Information Dissemination
TDOT Region 2 TMC – Chattanooga



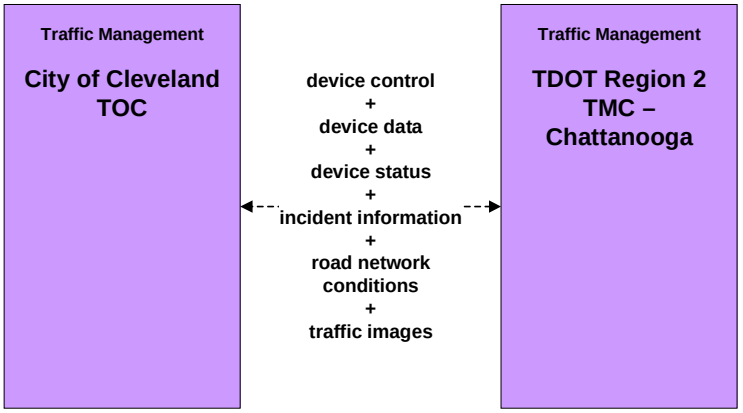
ATMS06 – Traffic Information Dissemination
City of Cleveland



ATMS07 – Regional Traffic Management
TDOT Region 2 TMC – Chattanooga



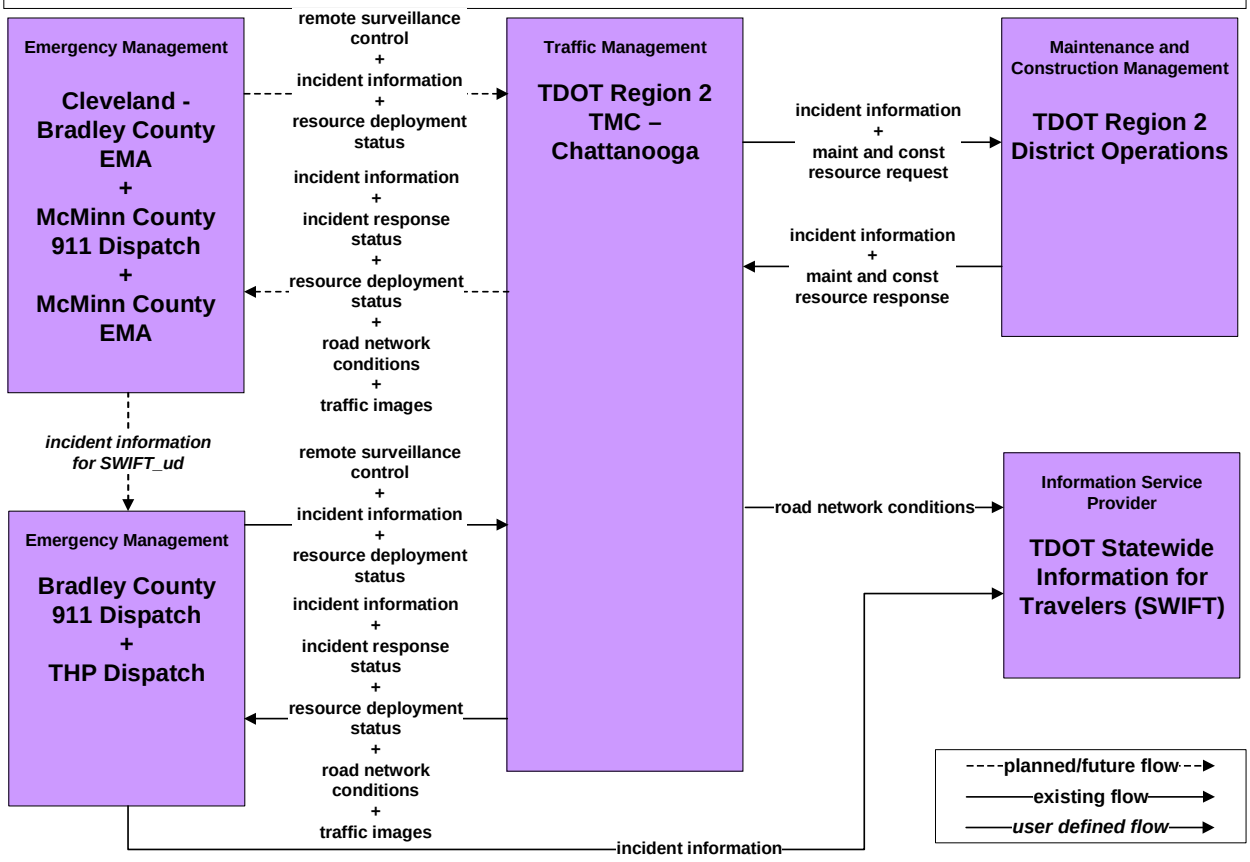
ATMS07 – Regional Traffic Management
City of Cleveland



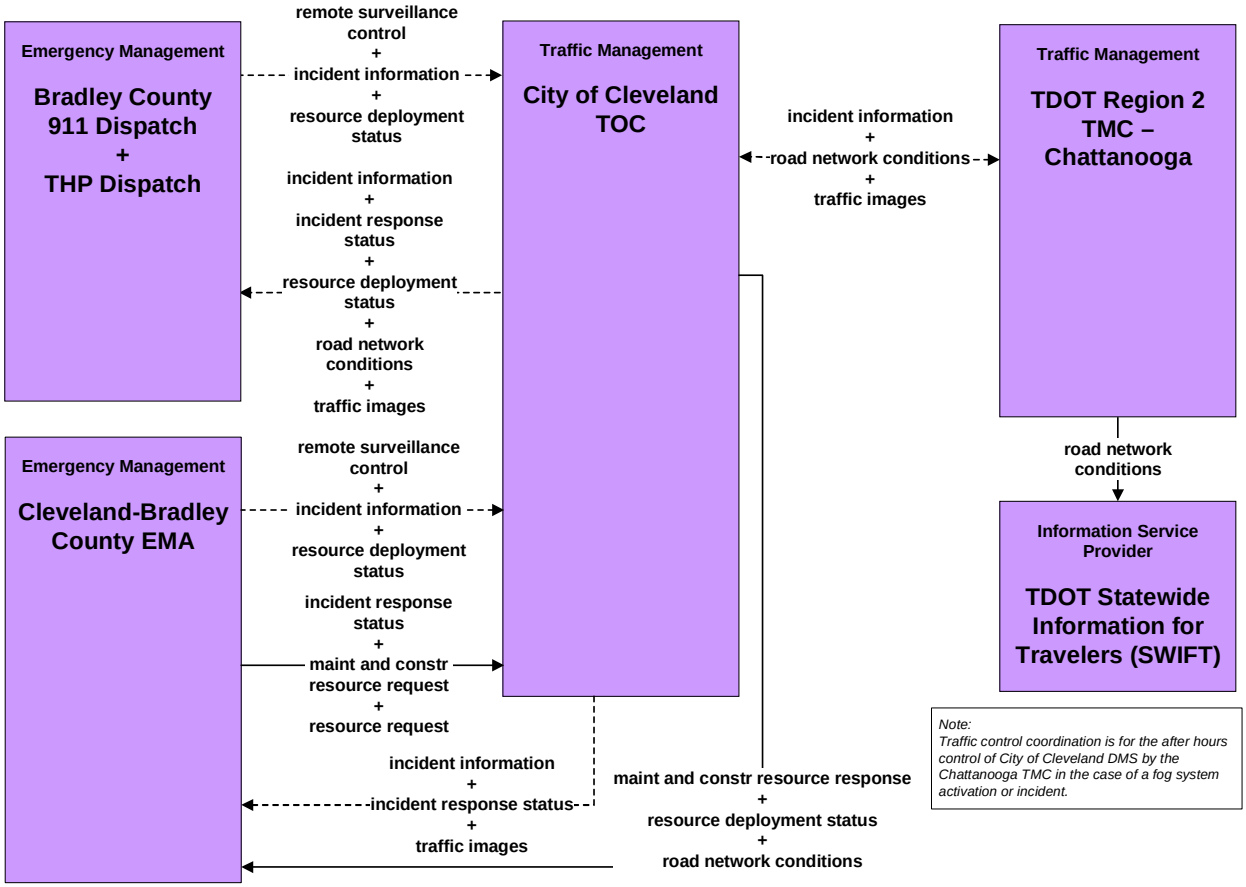
Note:
Traffic control coordination could be used for after hours control of City of Cleveland DMS by the TDOT Region 2 TMC in the case of a fog system activation or incident.

planned/future flow
existing flow
user defined flow

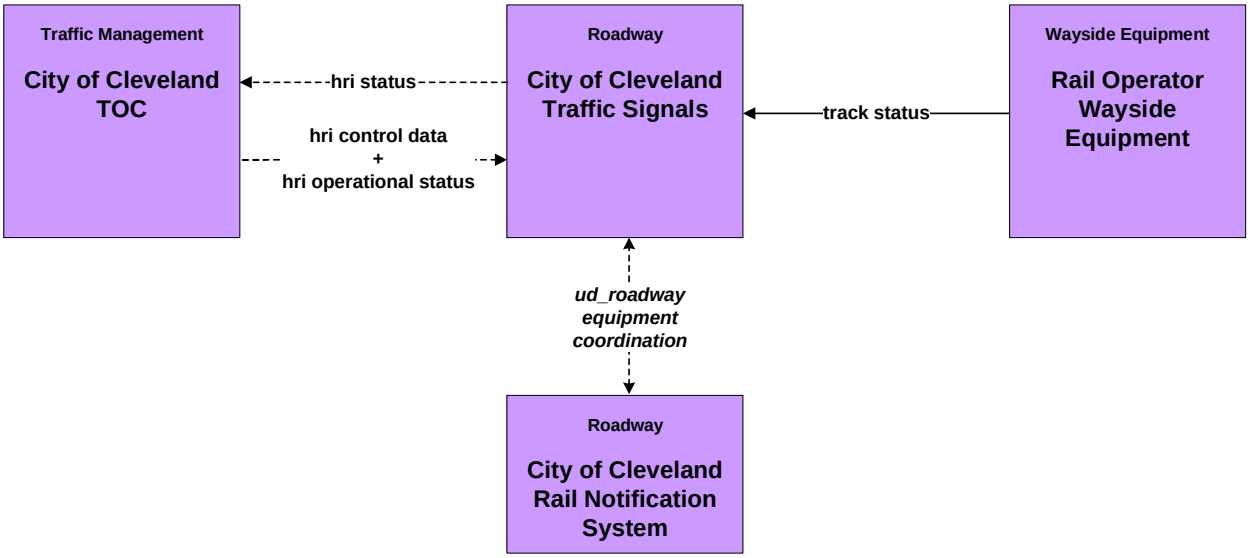
ATMS08 – Traffic Incident Management System
TDOT Region 2 TMC – Chattanooga



ATMS08 – Traffic Incident Management System
City of Cleveland

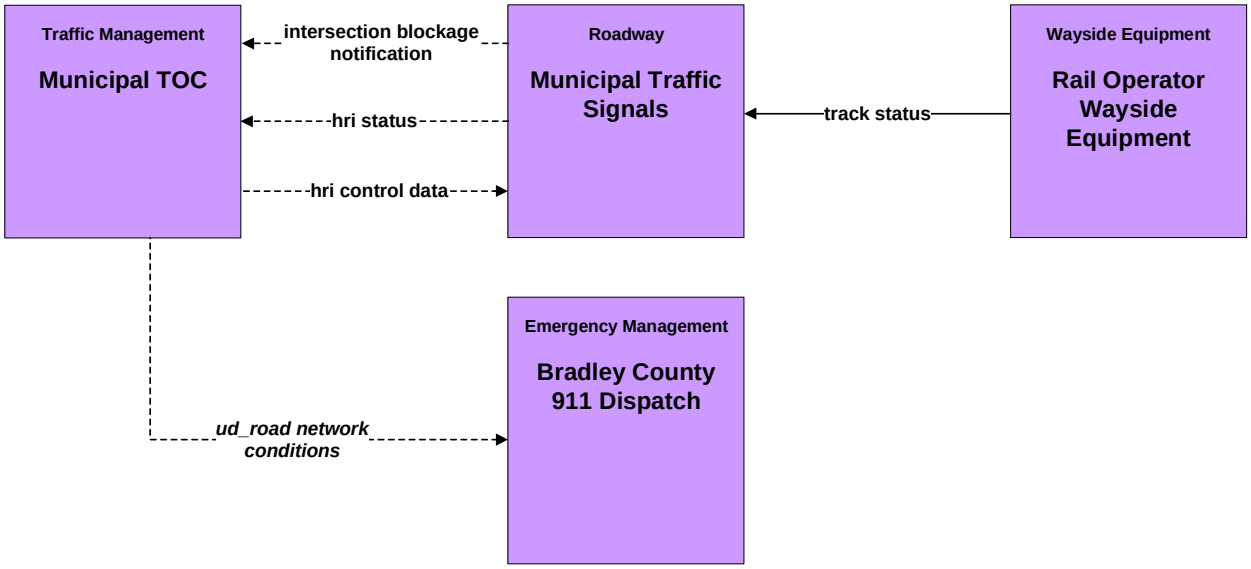


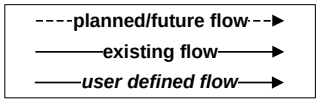
ATMS13 – Standard Railroad Grade Crossing
City of Cleveland



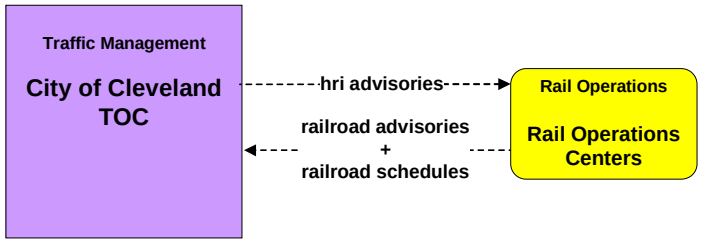
planned/future flow
existing flow
user defined flow

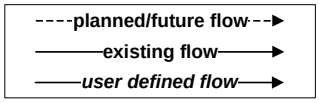
ATMS13 – Standard Railroad Grade Crossing
Municipal



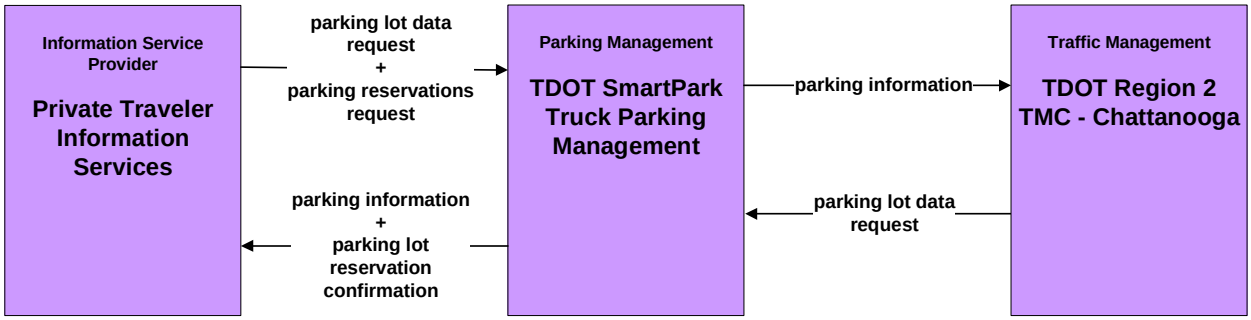


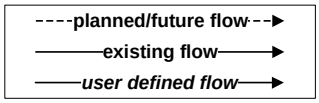
ATMS15 – Railroad Operations Coordination
City of Cleveland



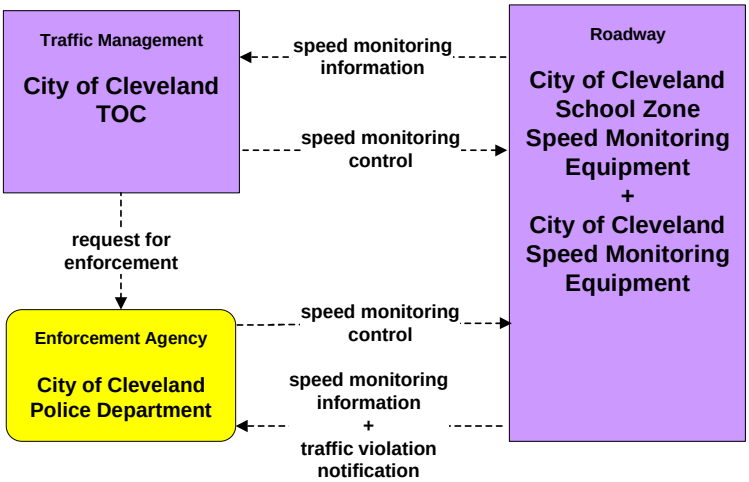


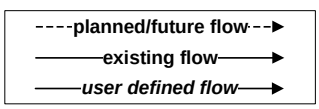
ATMS17 – Regional Parking Management
TDOT SmartPark



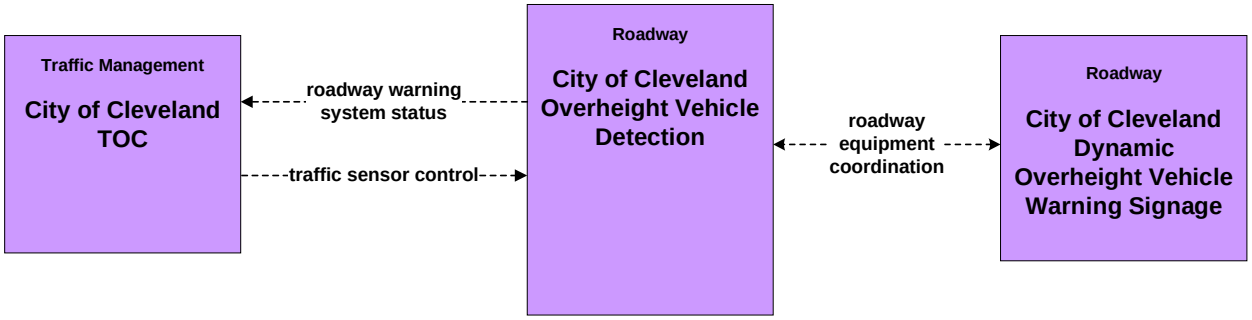


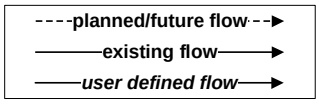
ATMS19 – Speed Warning and Enforcement
City of Cleveland



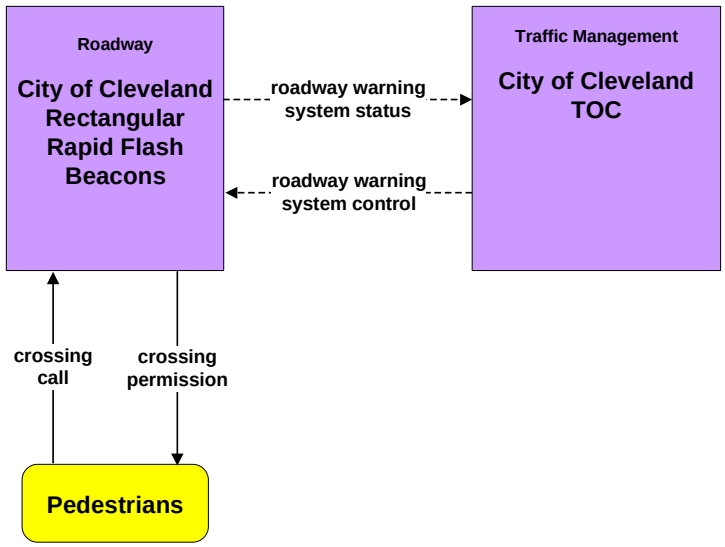


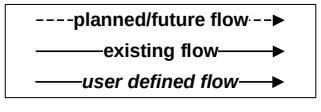
ATMS24 – Dynamic Roadway Warning
City of Cleveland





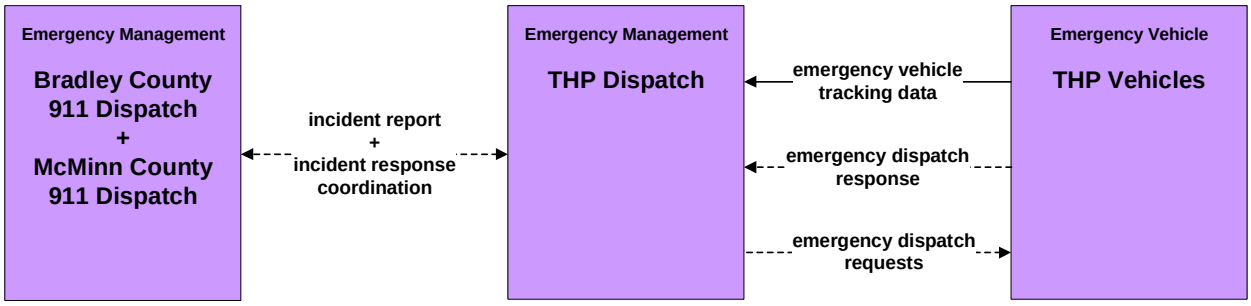
ATMS26 – Mixed Use Warning Systems
City of Cleveland

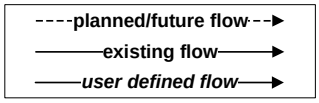




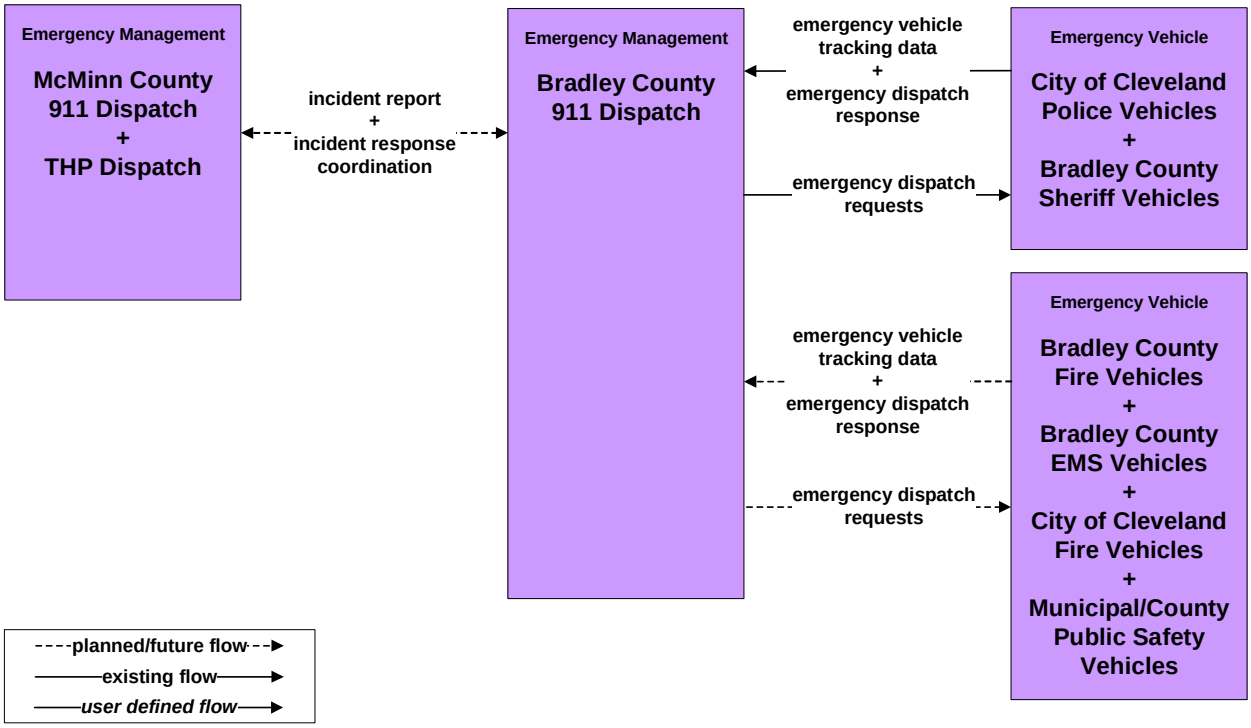
Emergency Management

EM01 – Emergency Call-Taking and Dispatch
Tennessee Highway Patrol

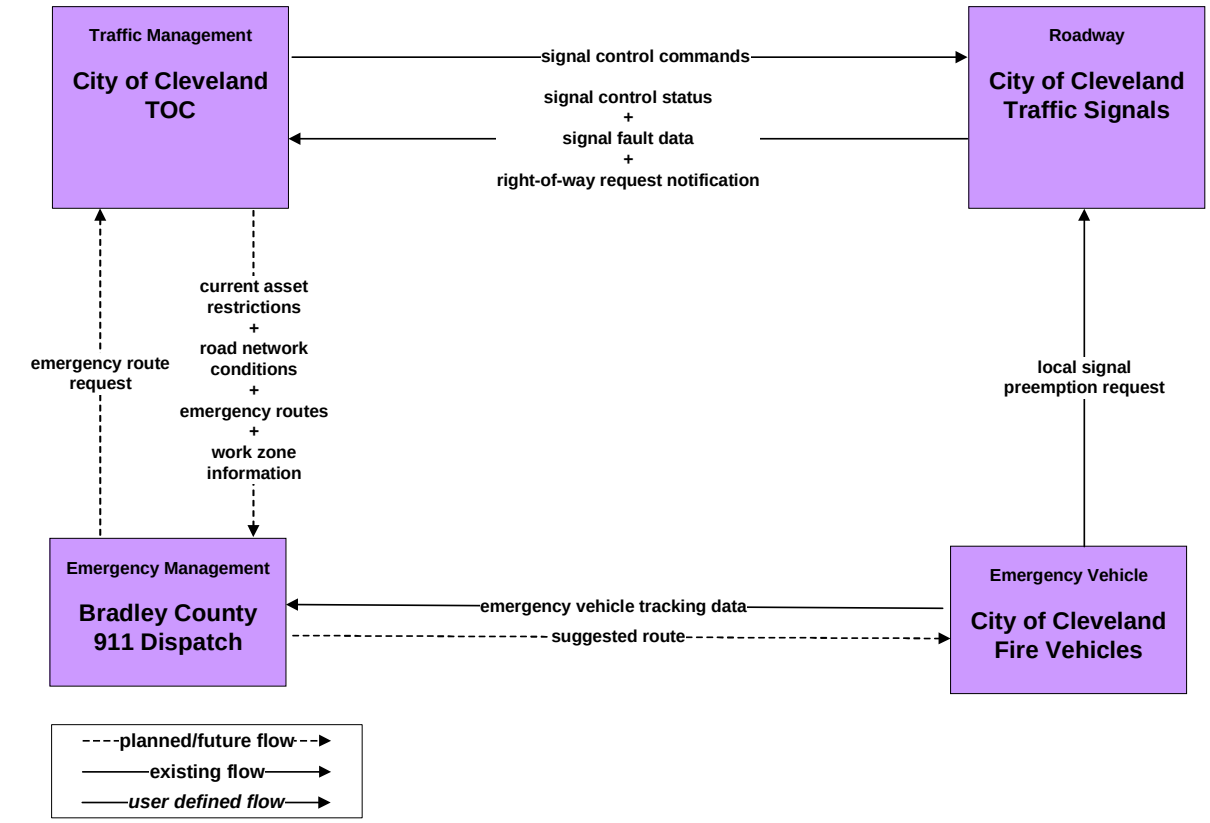




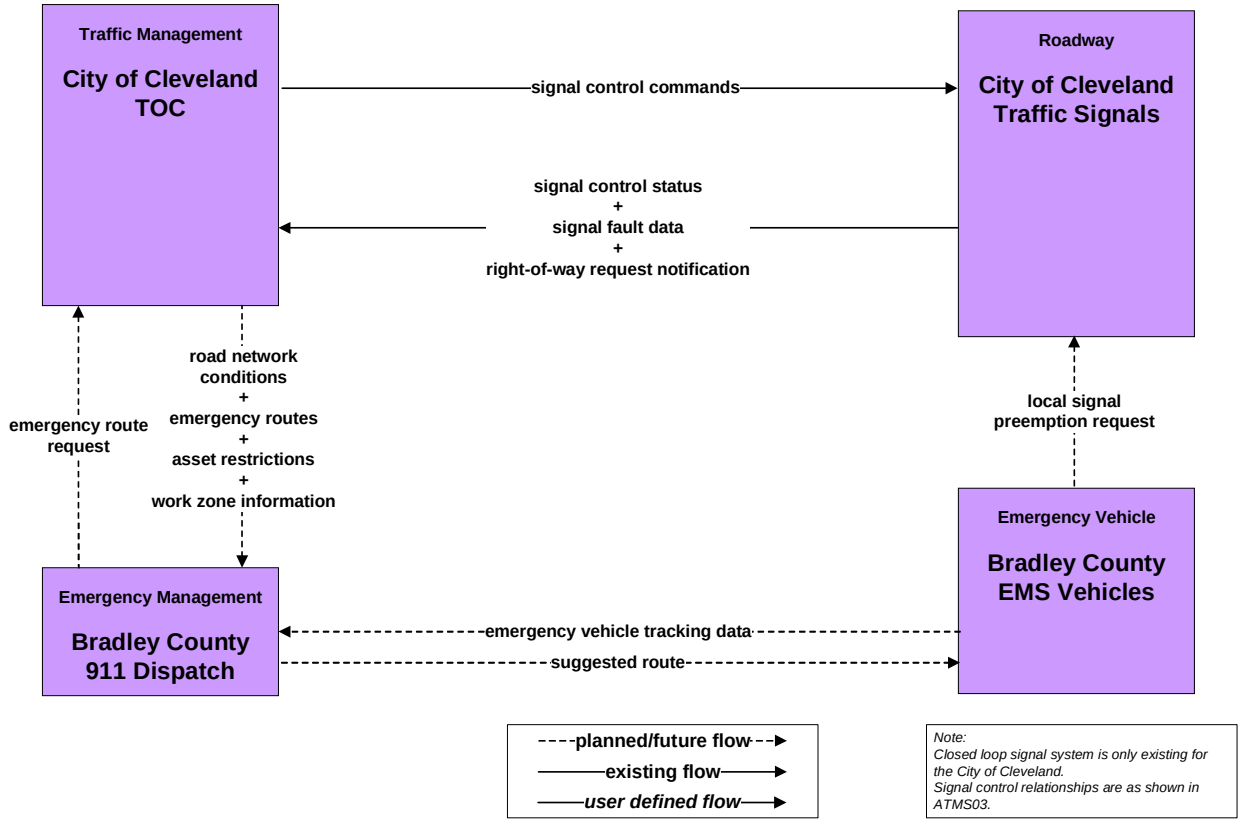
EM01 – Emergency Call-Taking and Dispatch
Bradley County 911 Dispatch



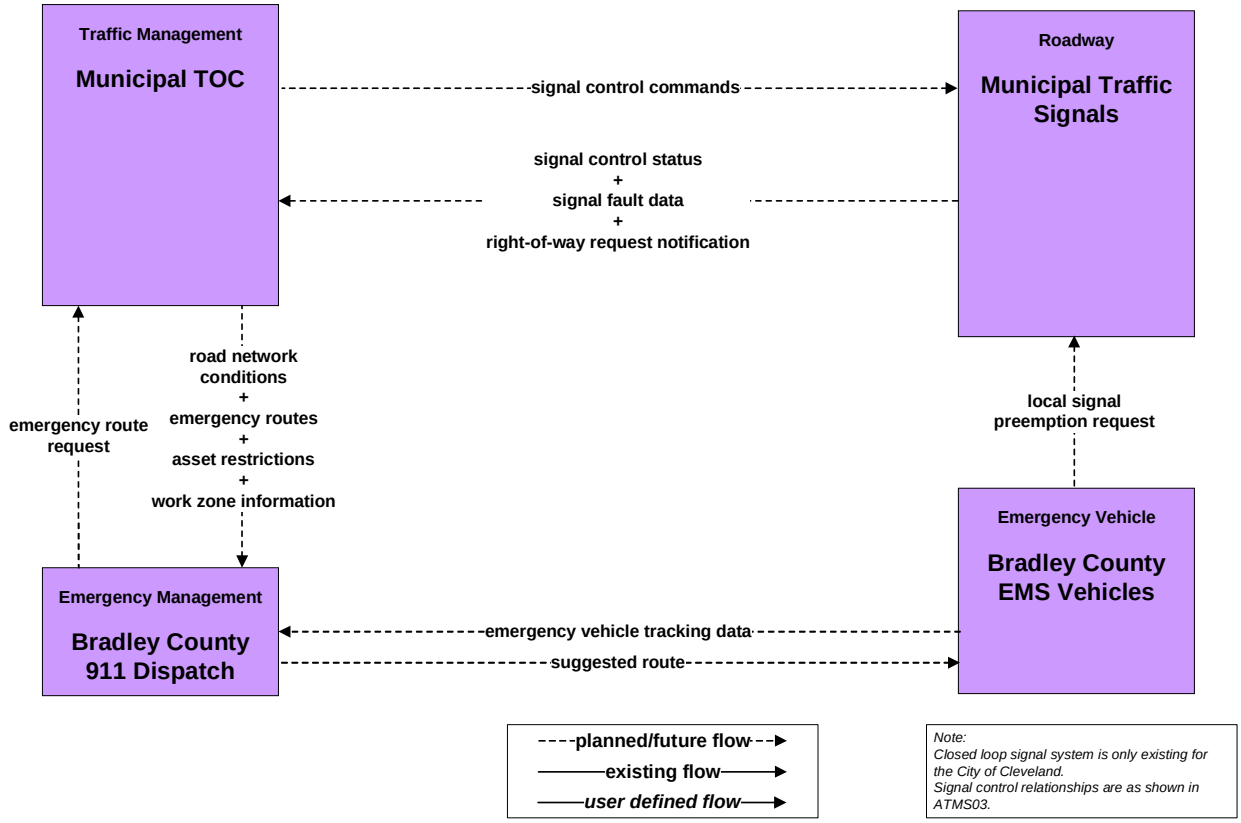
EM02 – Emergency Routing
City of Cleveland Fire Department



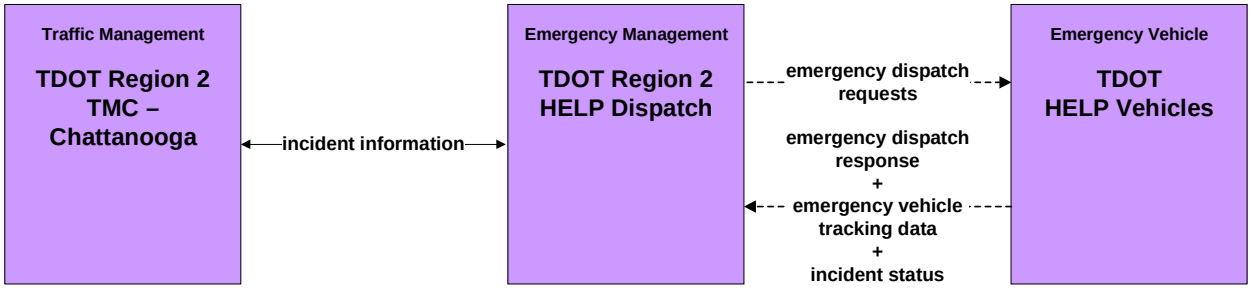
EM02 – Emergency Routing
Bradley County EMS (1 of 2)

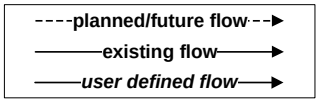


EM02 – Emergency Routing
Bradley County EMS (2 of 2)

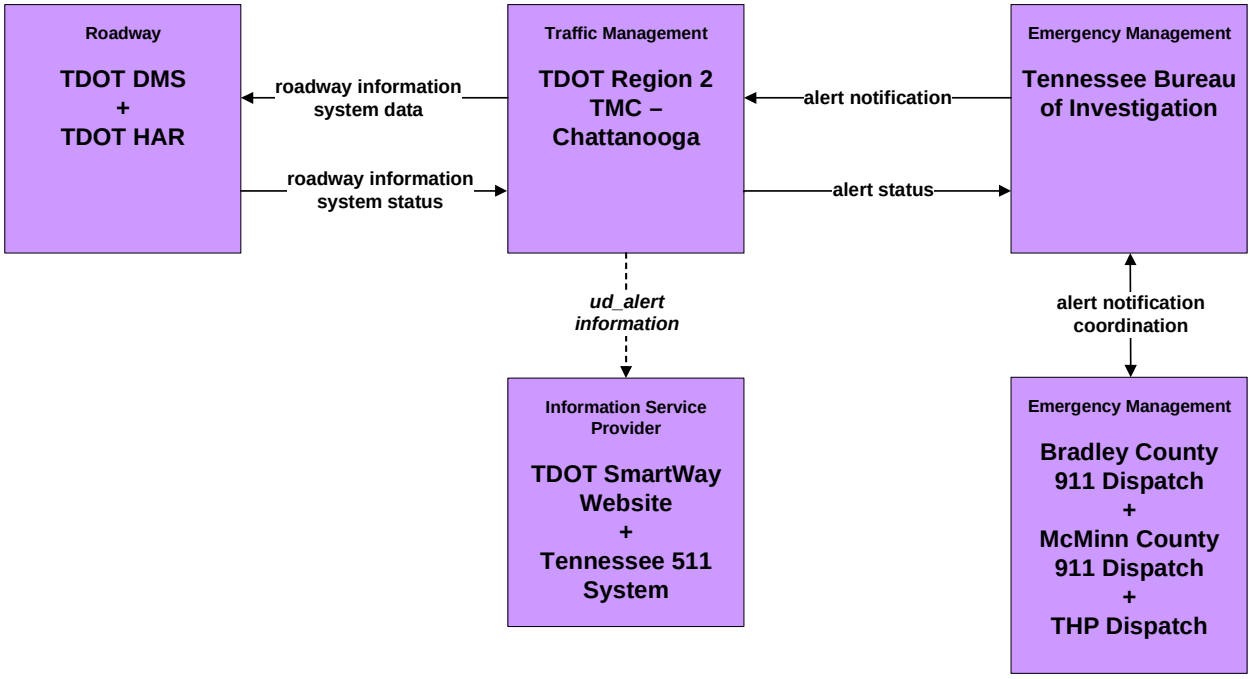


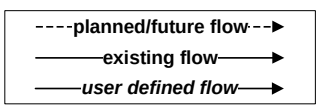
EM04 – Roadway Service Patrols
HELP





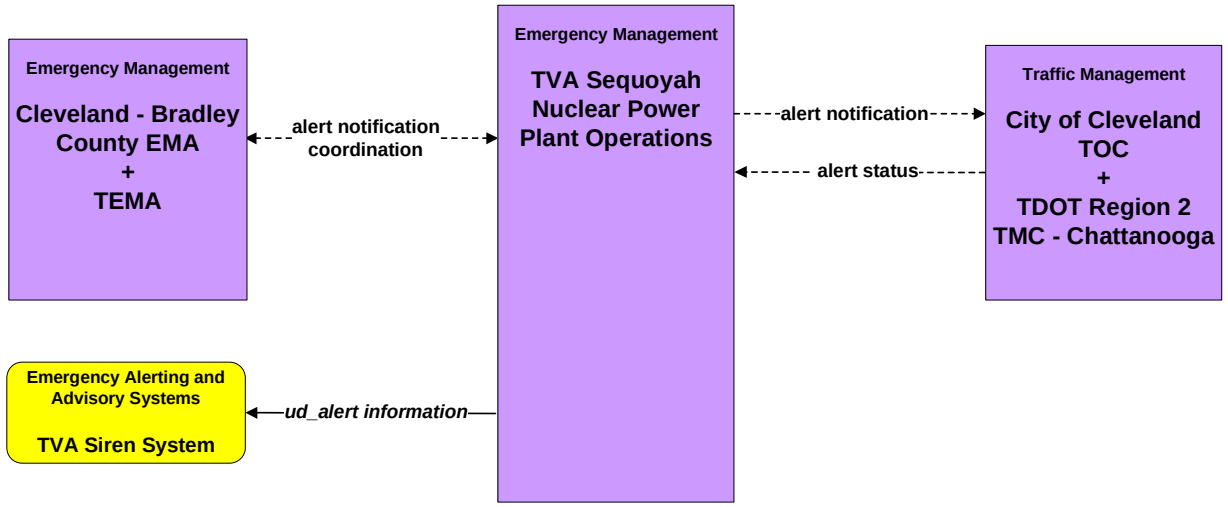
EM06 – Wide-Area Alert
Tennessee AMBER Alert

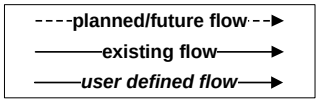




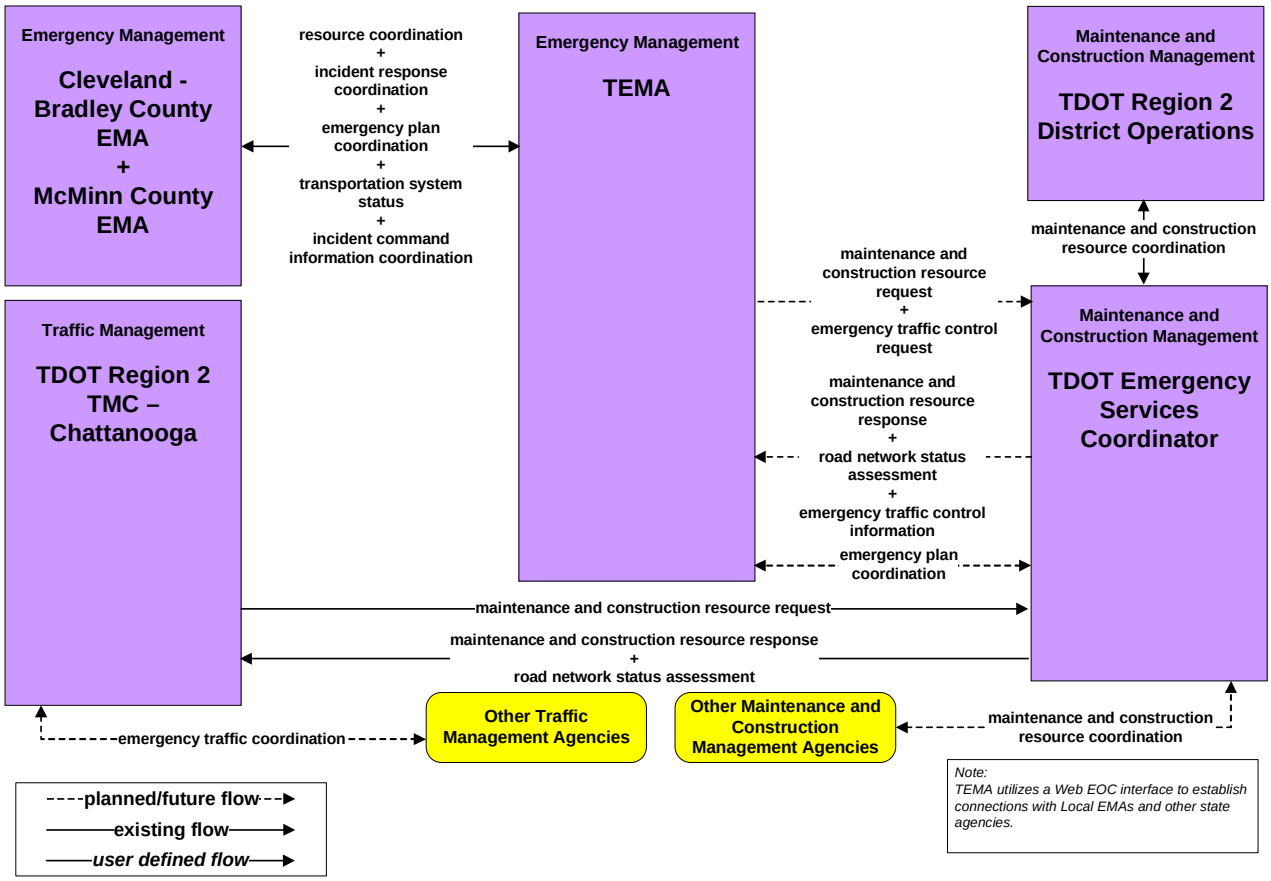
Note:
Connection between emergency management agencies is existing via the NCIC system.

EM06 – Wide-Area Alert
Tennessee Valley Authority

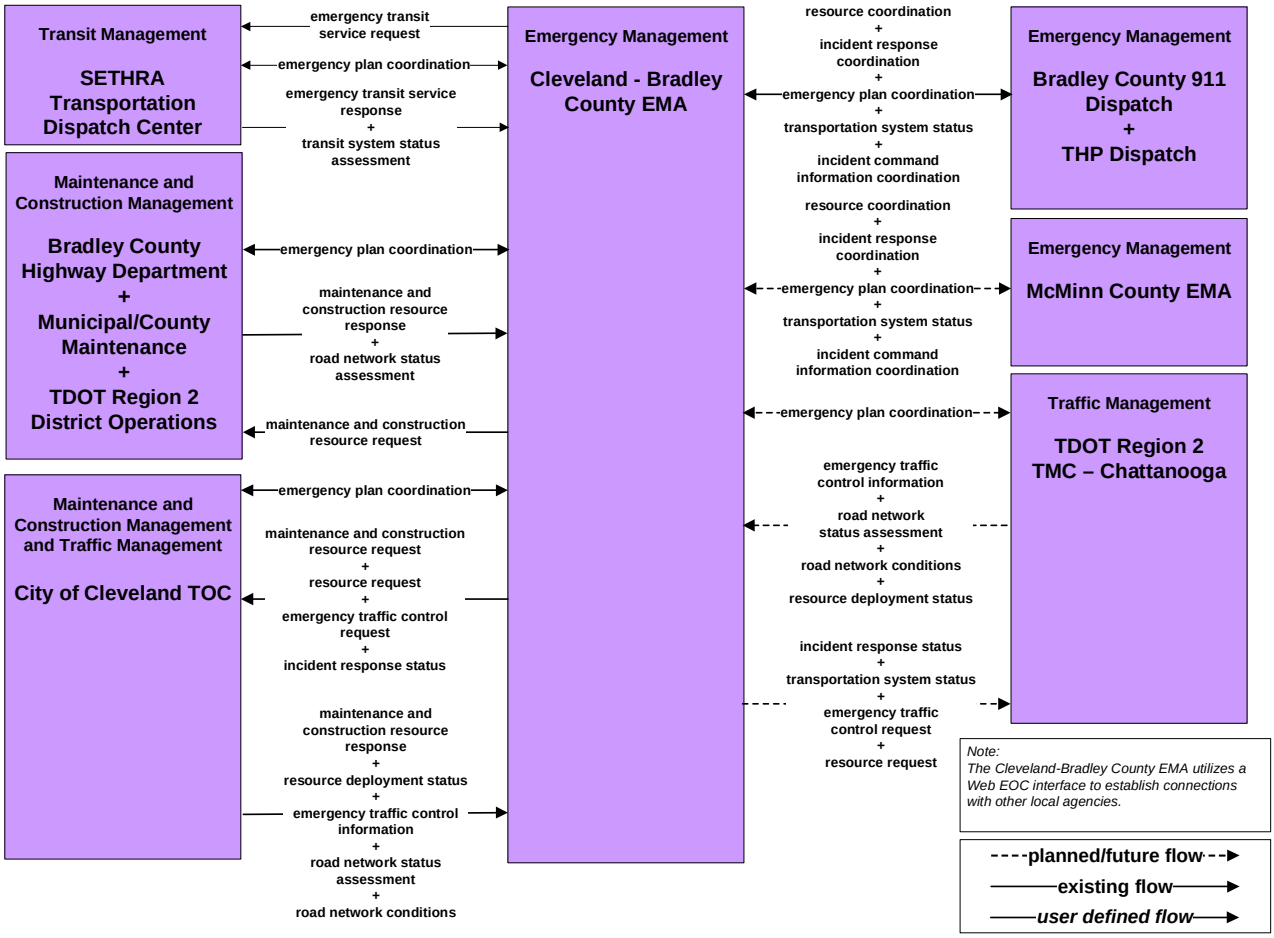




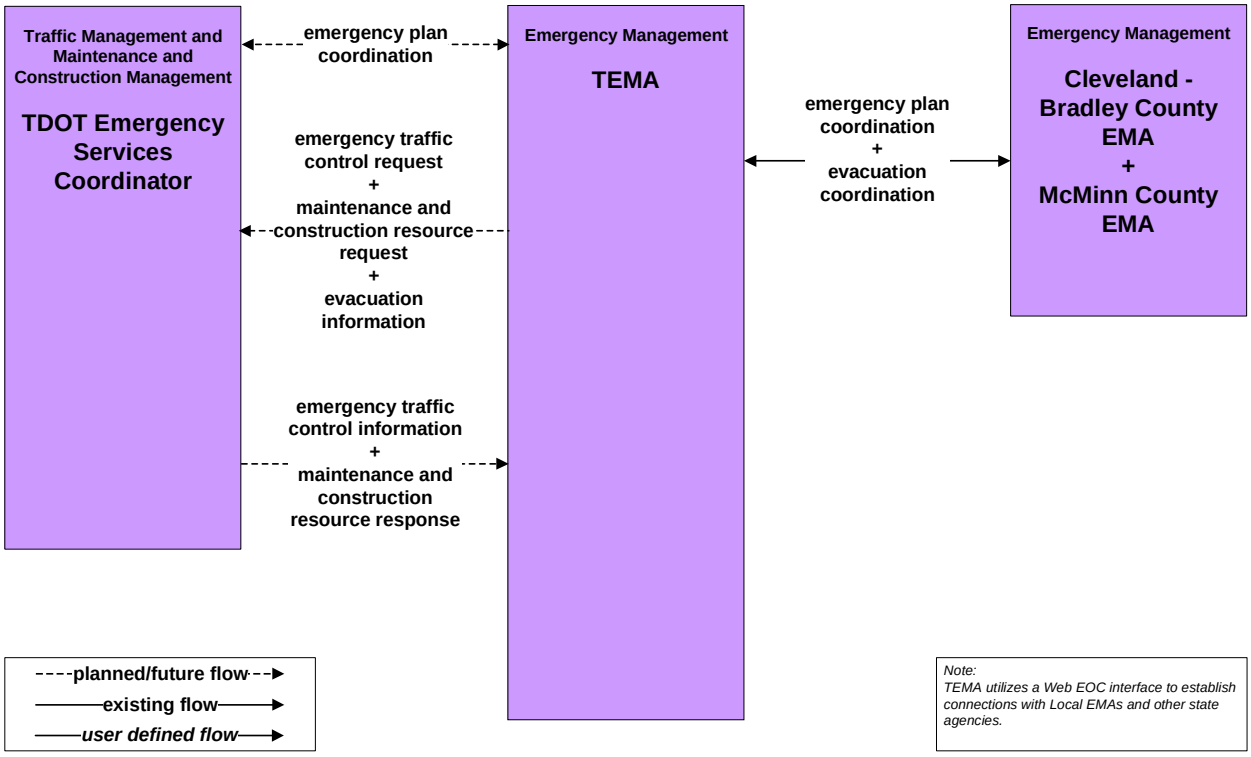
EM08 – Disaster Response and Recovery
TEMA



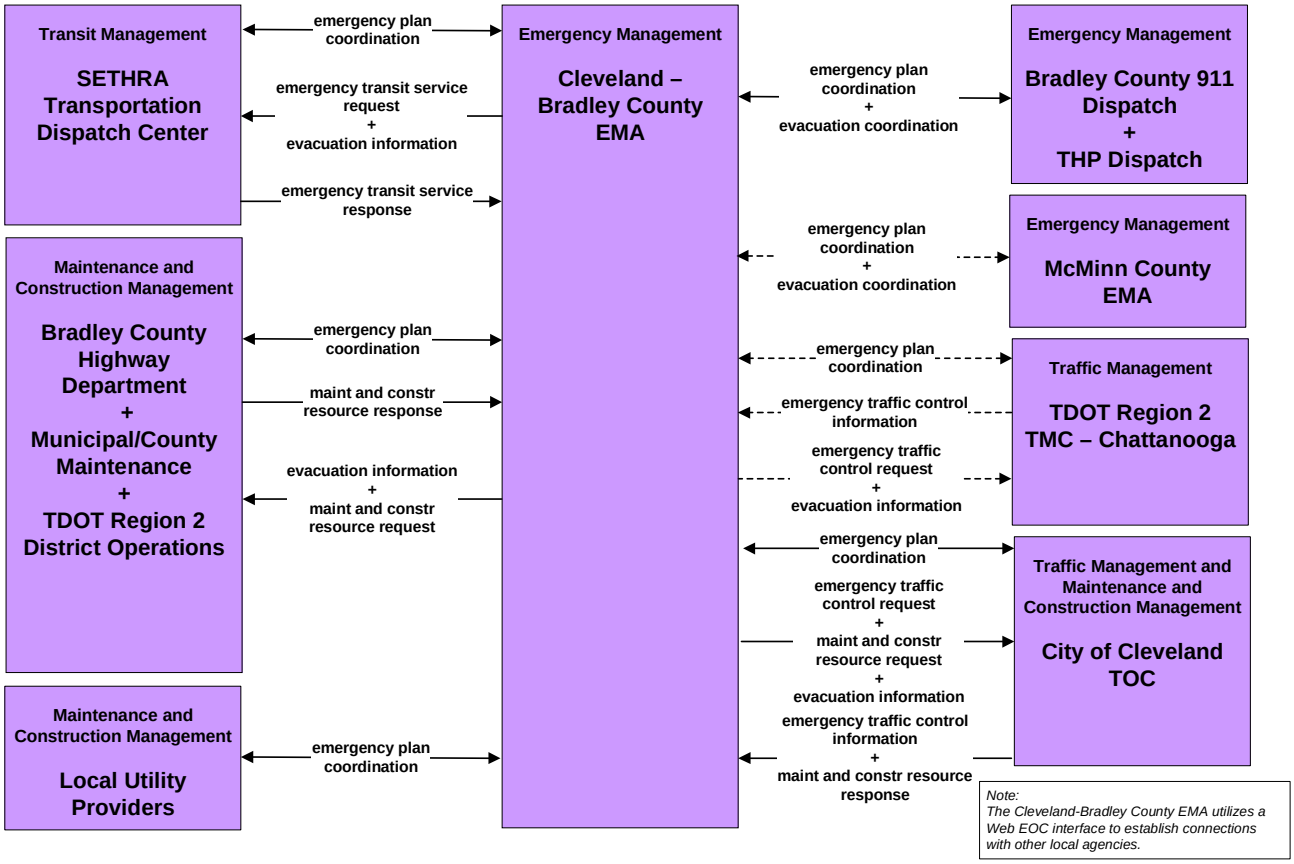
EM08 – Disaster Response and Recovery
Cleveland - Bradley County EMA



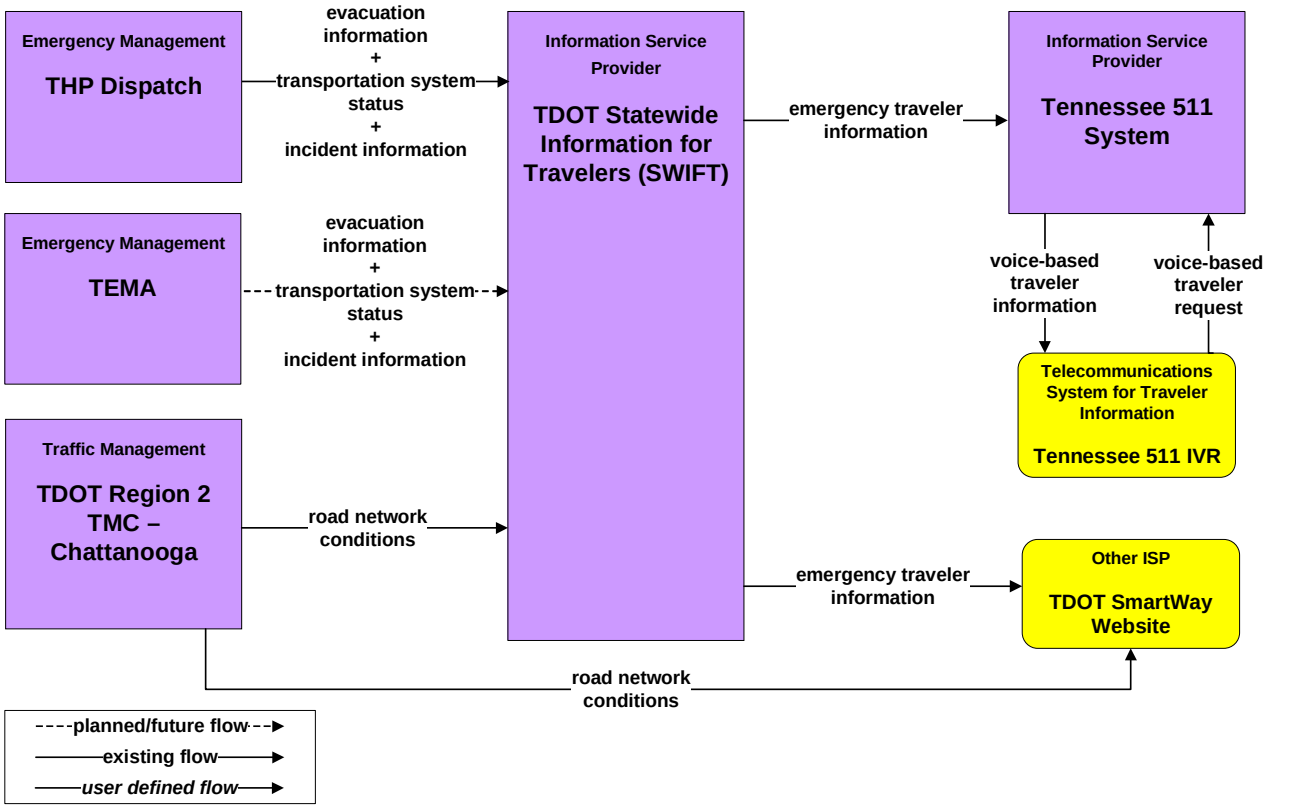
EM09 – Evacuation and Reentry Management
TEMA



EM09 – Evacuation and Reentry Management
Cleveland - Bradley County EMA

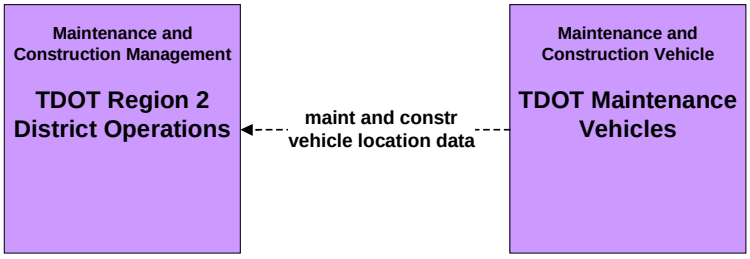


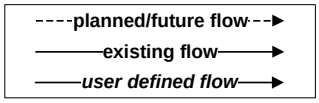
EM10 – Disaster Traveler Information
Tennessee 511 and SWIFT



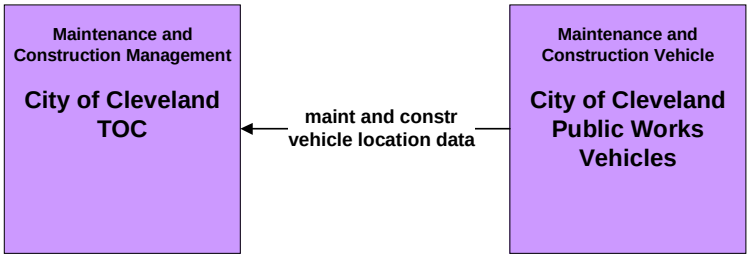
Maintenance and Construction Management

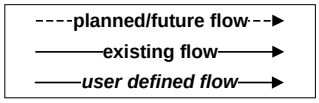
MC01 – Maintenance and Construction Vehicle and Equipment Tracking
TDOT Region 2 District Operations



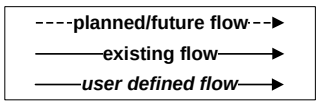


MC01 – Maintenance and Construction Vehicle and Equipment Tracking
City of Cleveland

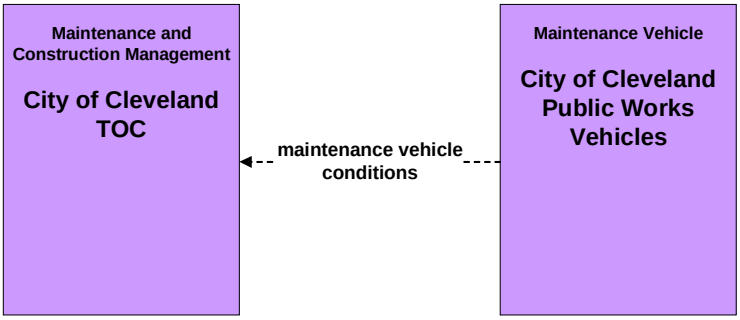


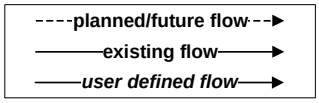


MC01 – Maintenance and Construction Vehicle and Equipment Tracking
Bradley County

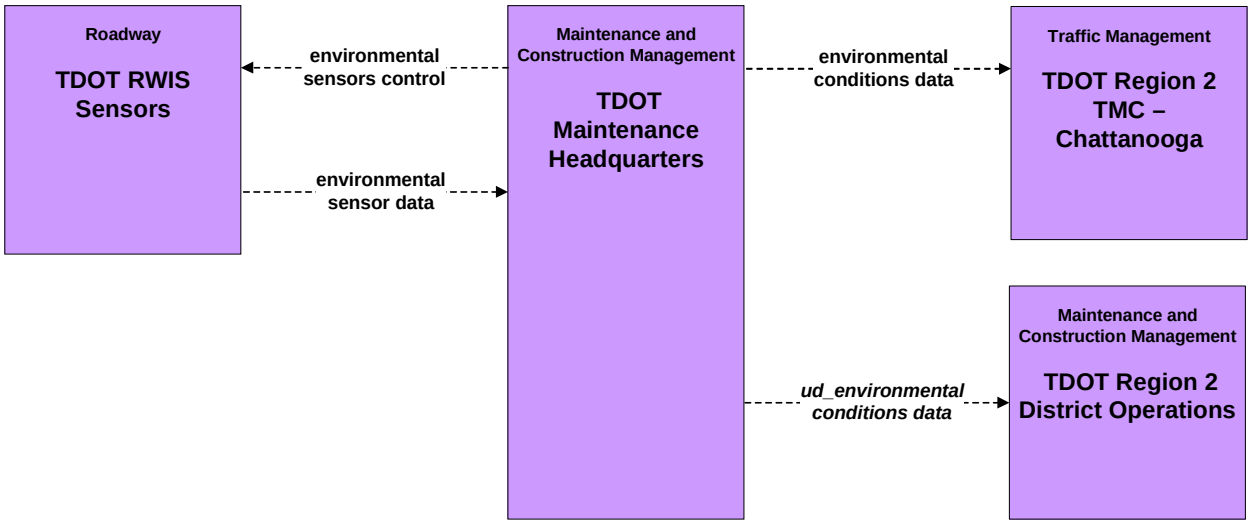


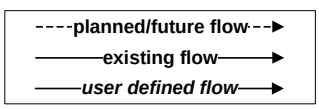
MC02 – Maintenance and Construction Vehicle Maintenance
City of Cleveland



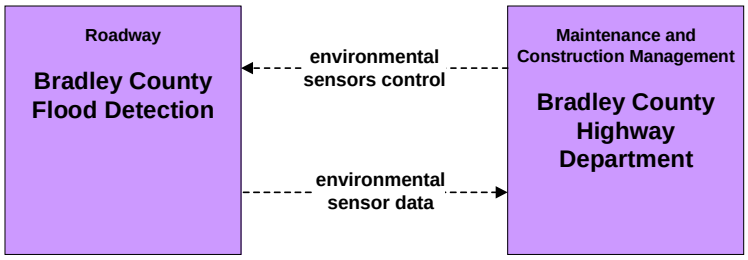


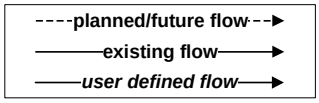
MC03 – Road Weather Data Collection
TDOT RWIS



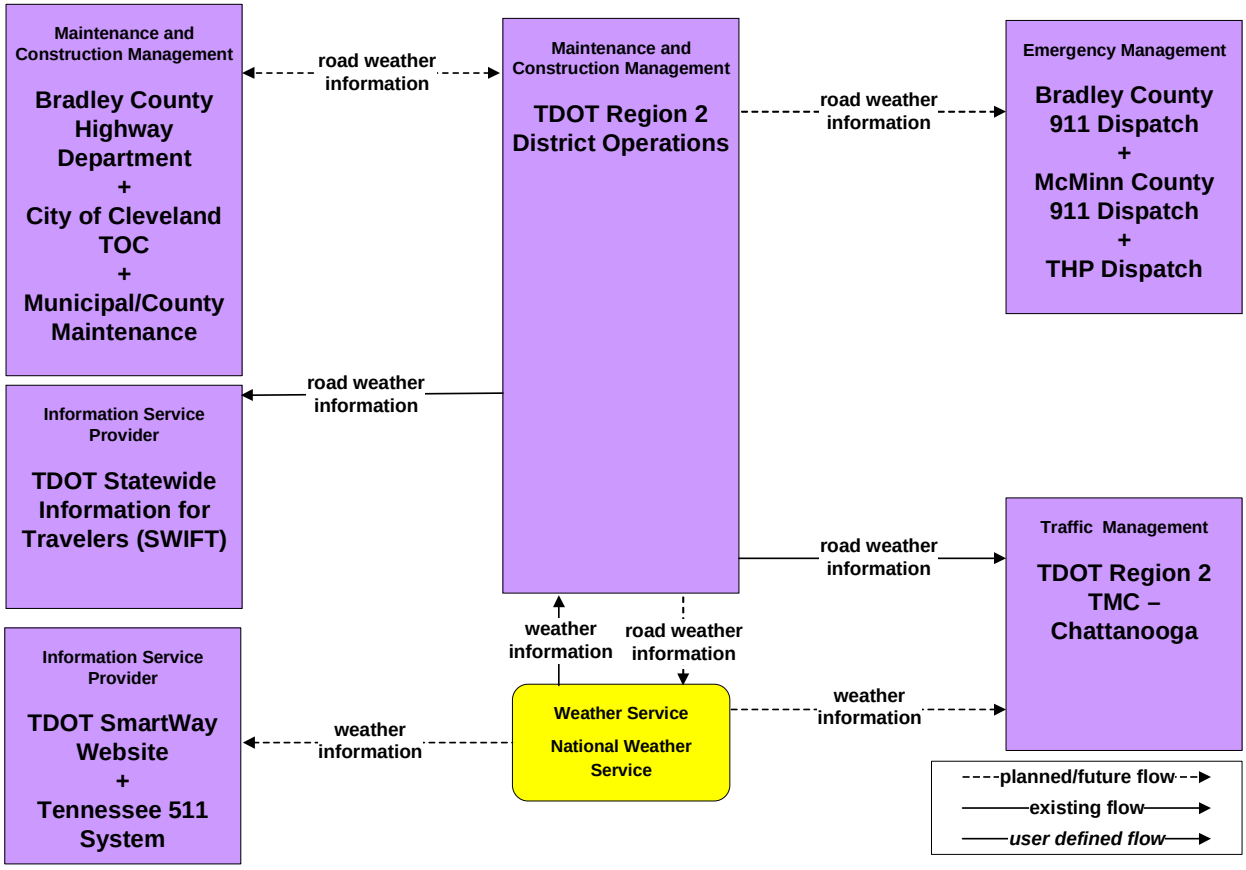


MC03 – Road Weather Data Collection
Bradley County Flood Detection

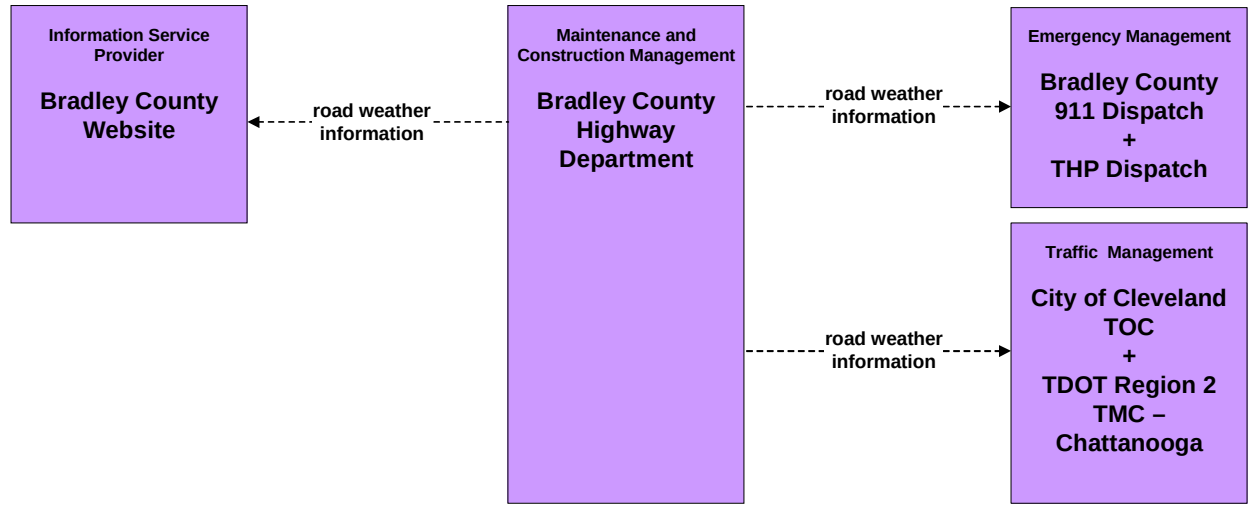


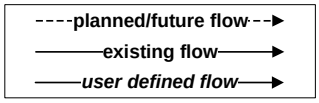


MC04 – Weather Information Processing and Distribution
TDOT Region 2 District Operations

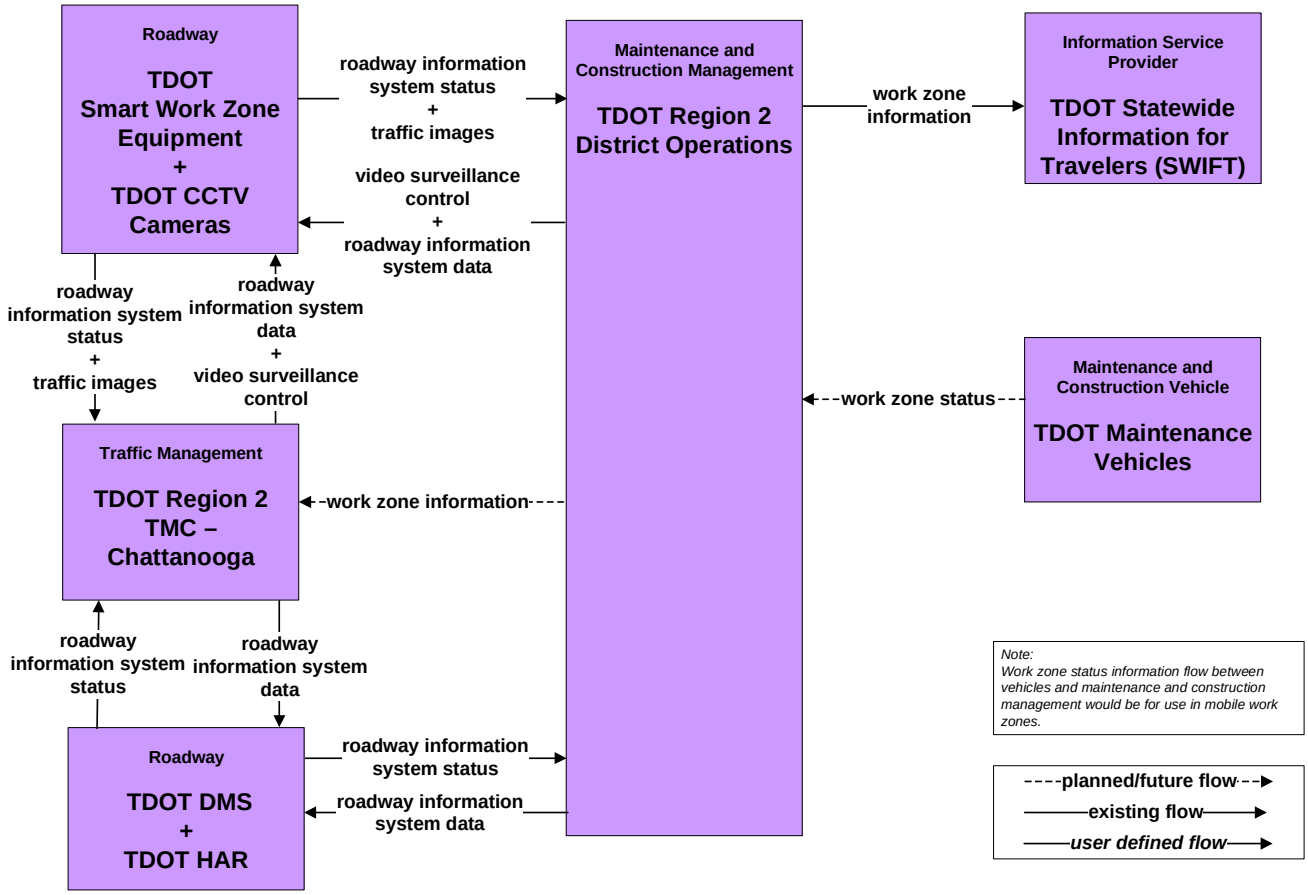


MC04 – Weather Information Processing and Distribution
Bradley County

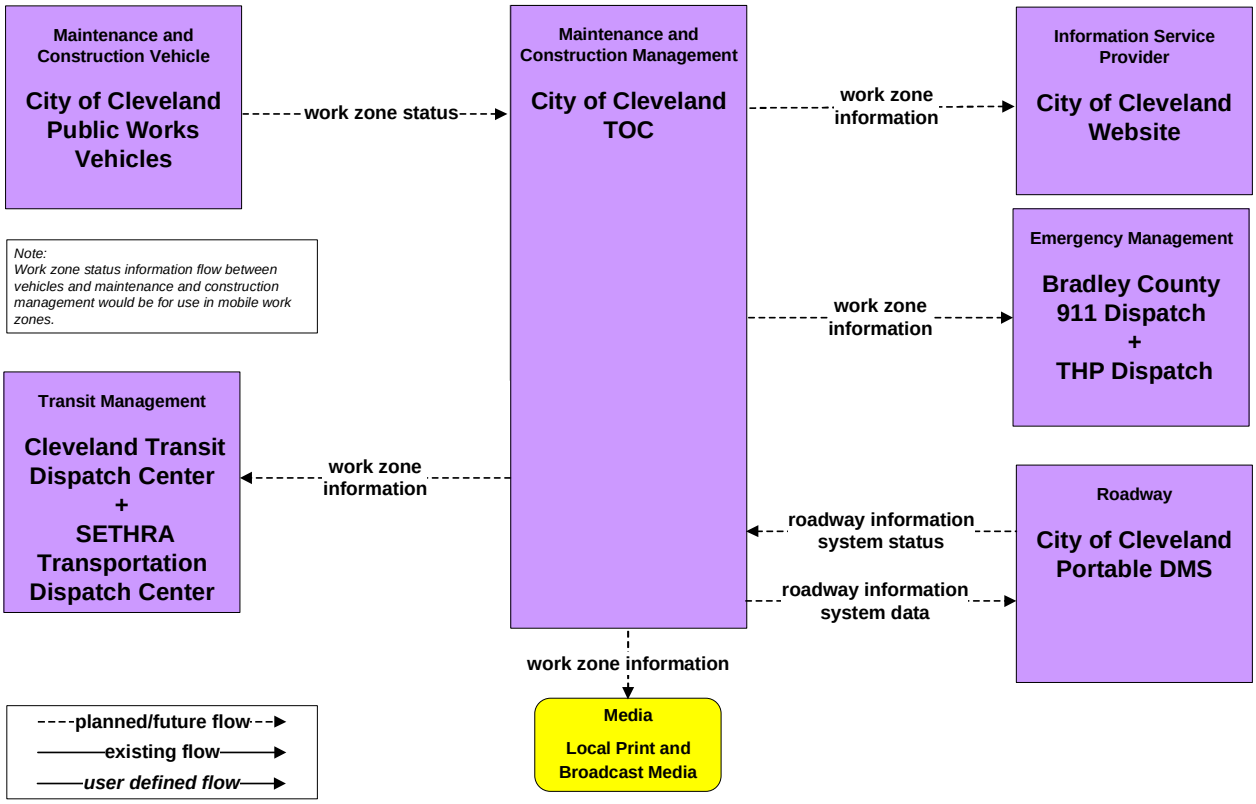




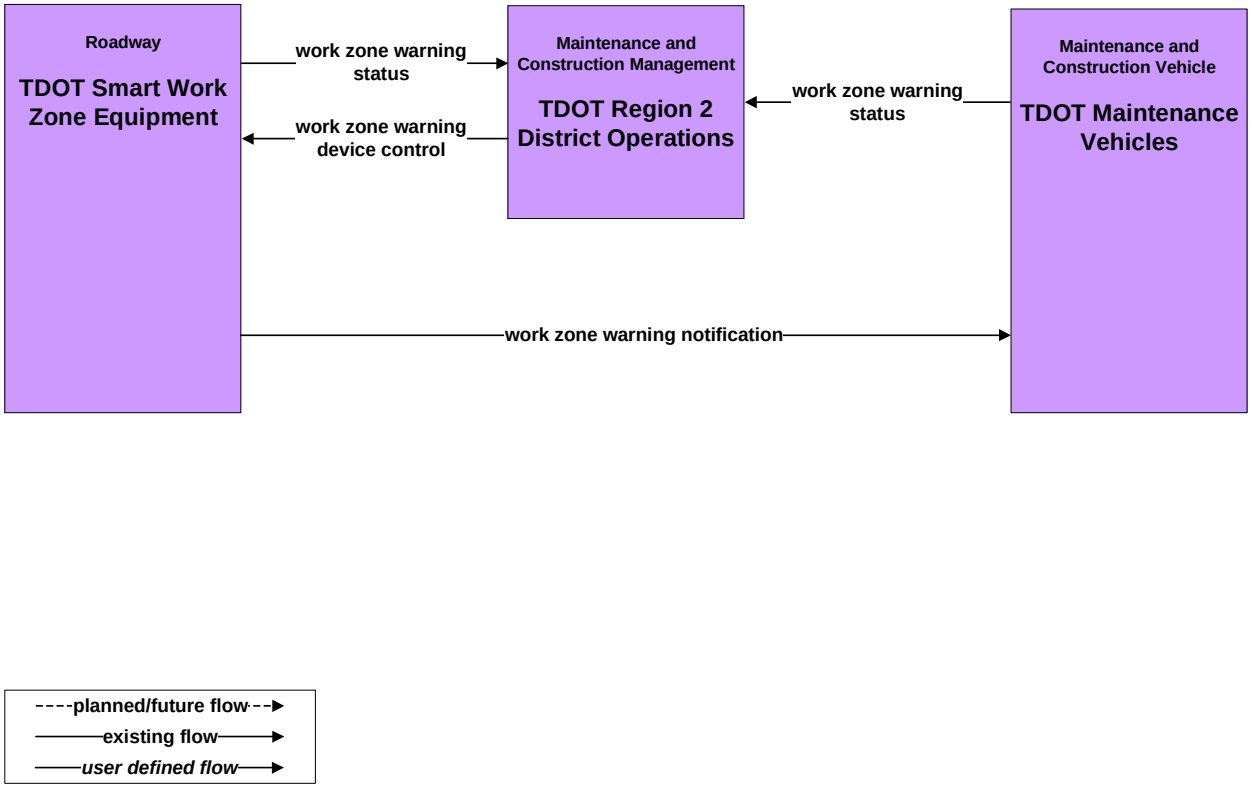
MC08 – Work Zone Management
TDOT Region 2 District Operations



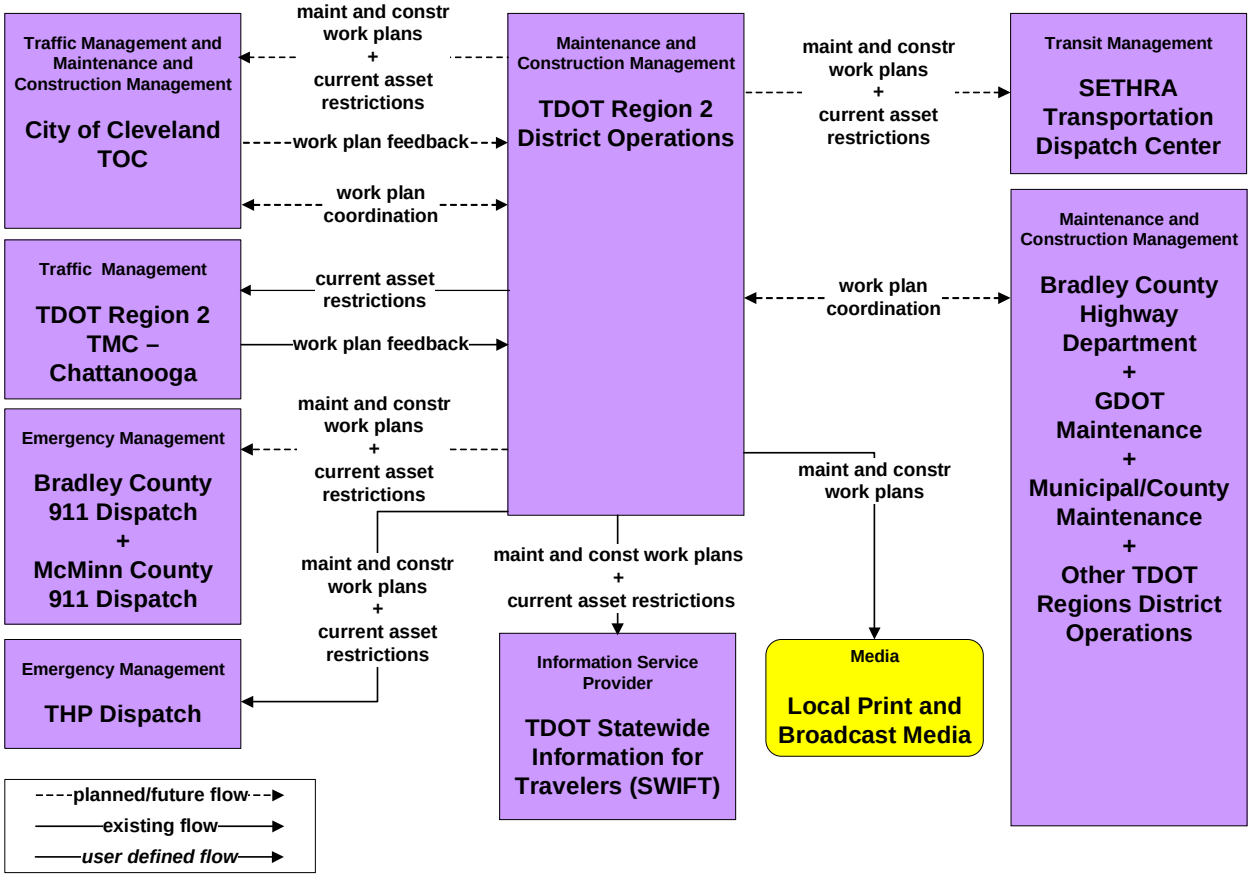
MC08 – Work Zone Management
City of Cleveland



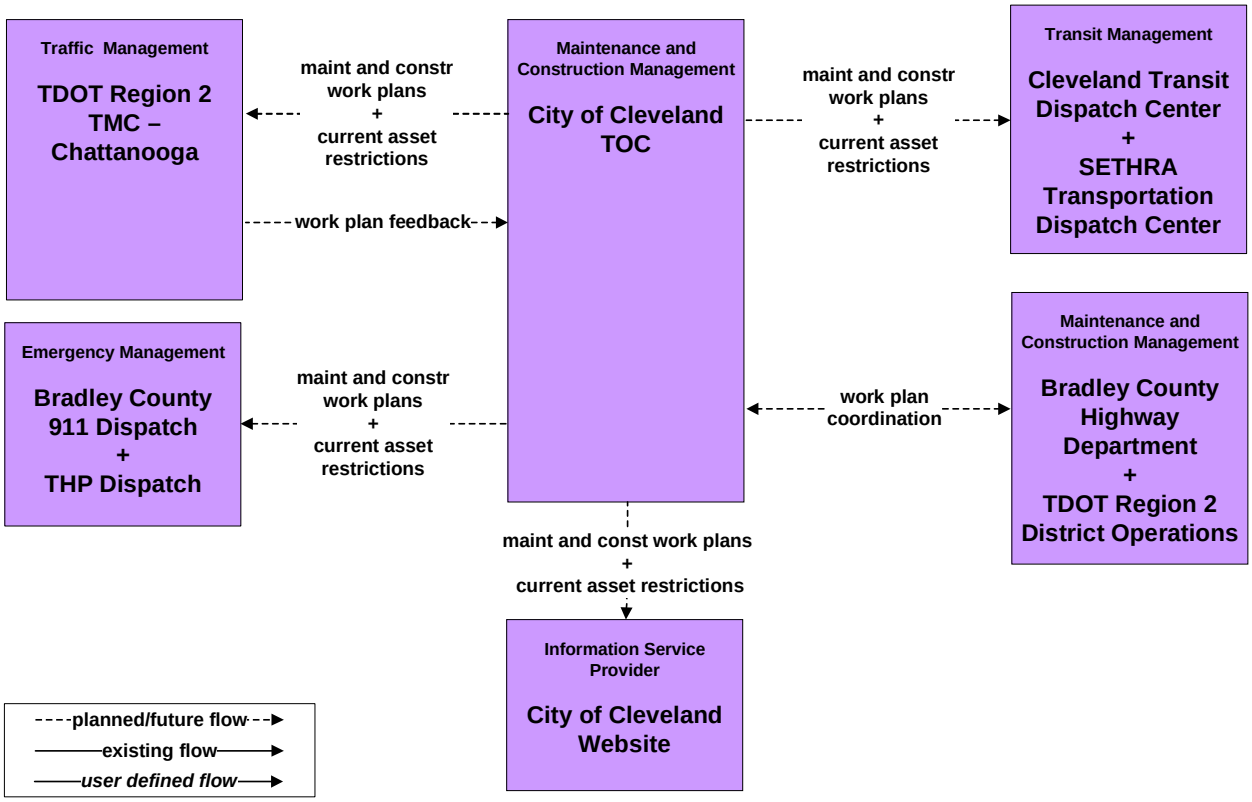
MC09 – Work Zone Safety Monitoring
TDOT Region 2 District Operations



MC10 – Maintenance and Construction Activity Coordination
TDOT Region 2

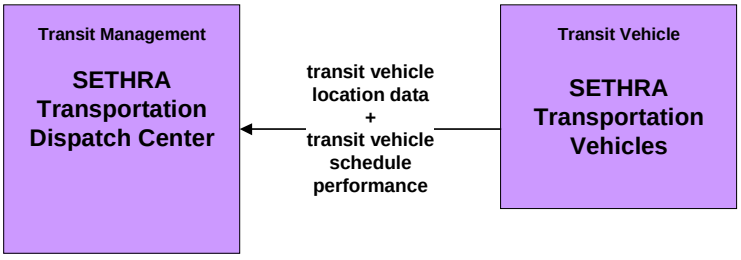


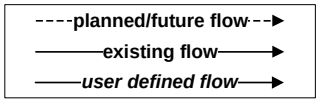
MC10 – Maintenance and Construction Activity Coordination
City of Cleveland



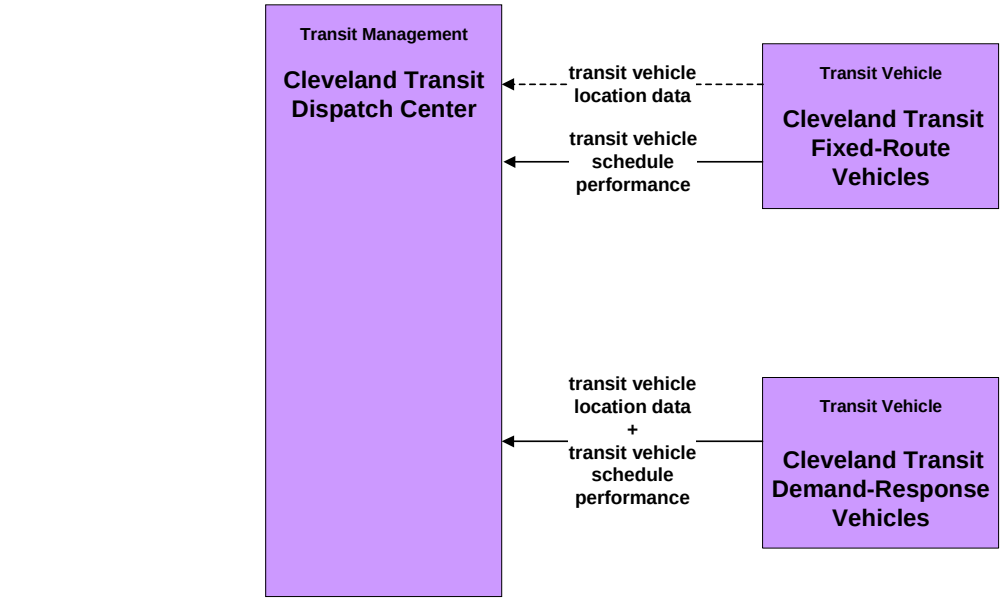
Advanced Public Transportation Systems

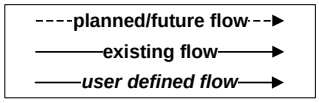
APTS01 – Transit Vehicle Tracking
SETHRA Transportation



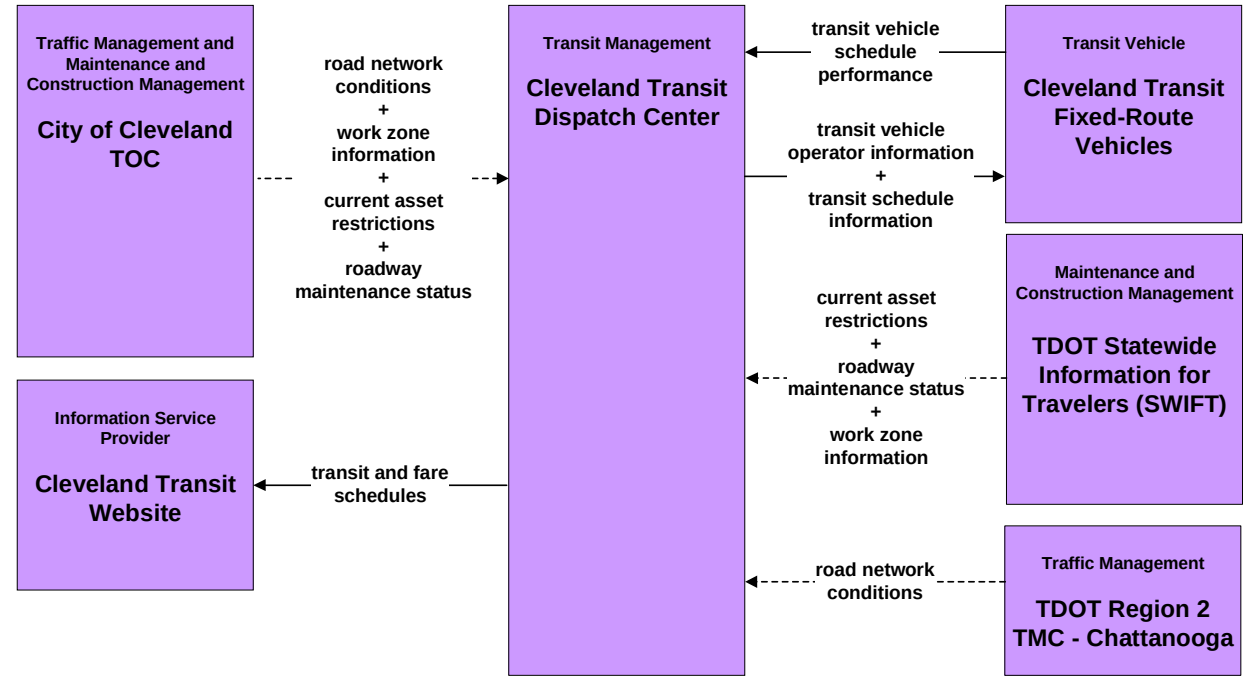


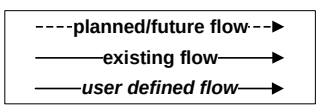
APTS01 – Transit Vehicle Tracking
Cleveland Transit



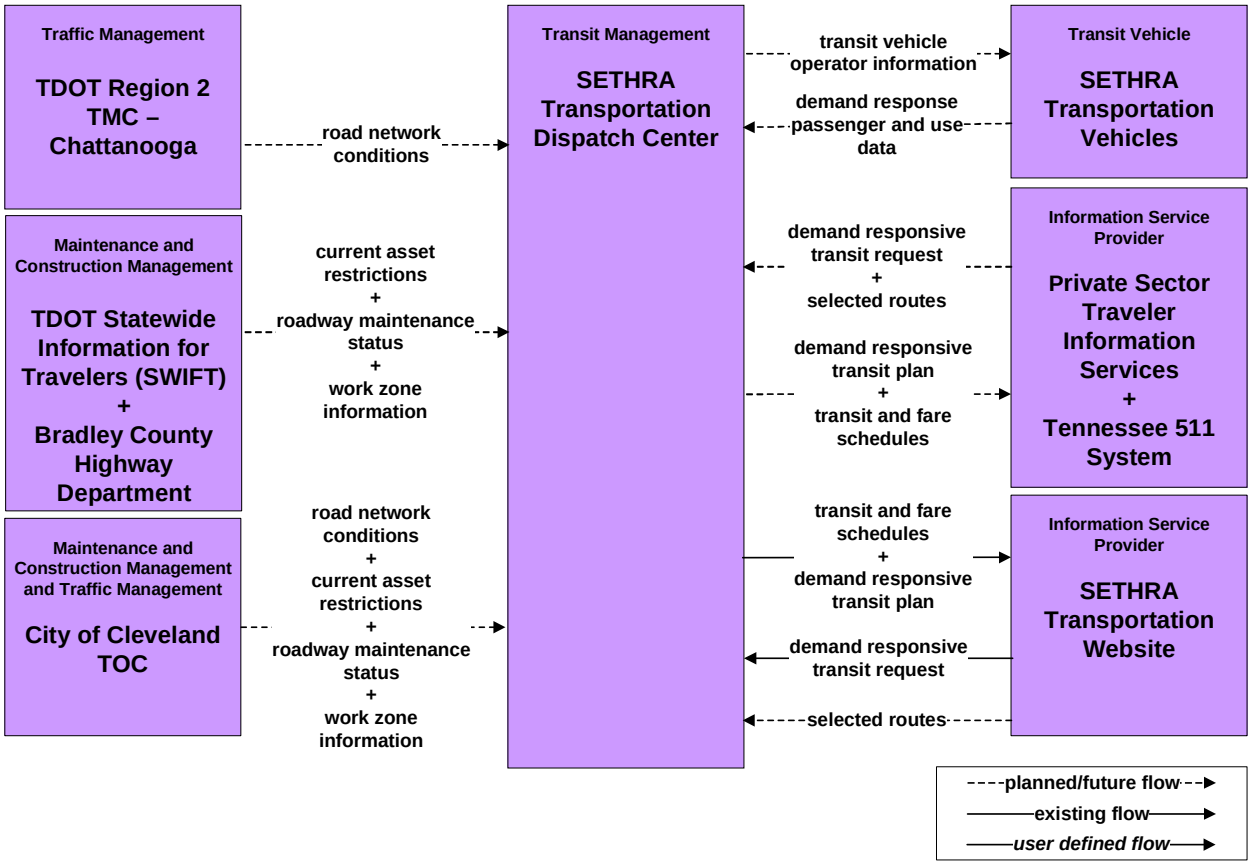


APTS02 – Transit Fixed Route Operations
Cleveland Transit

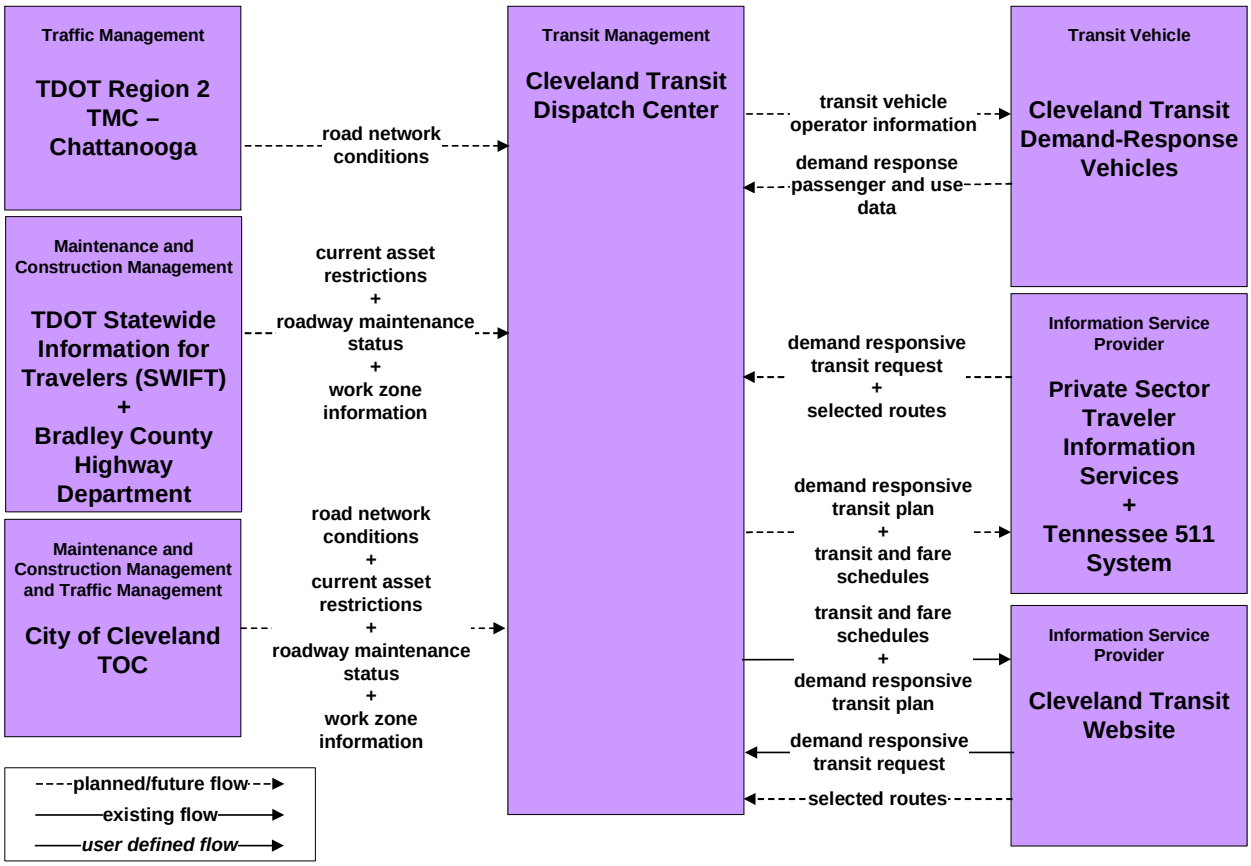




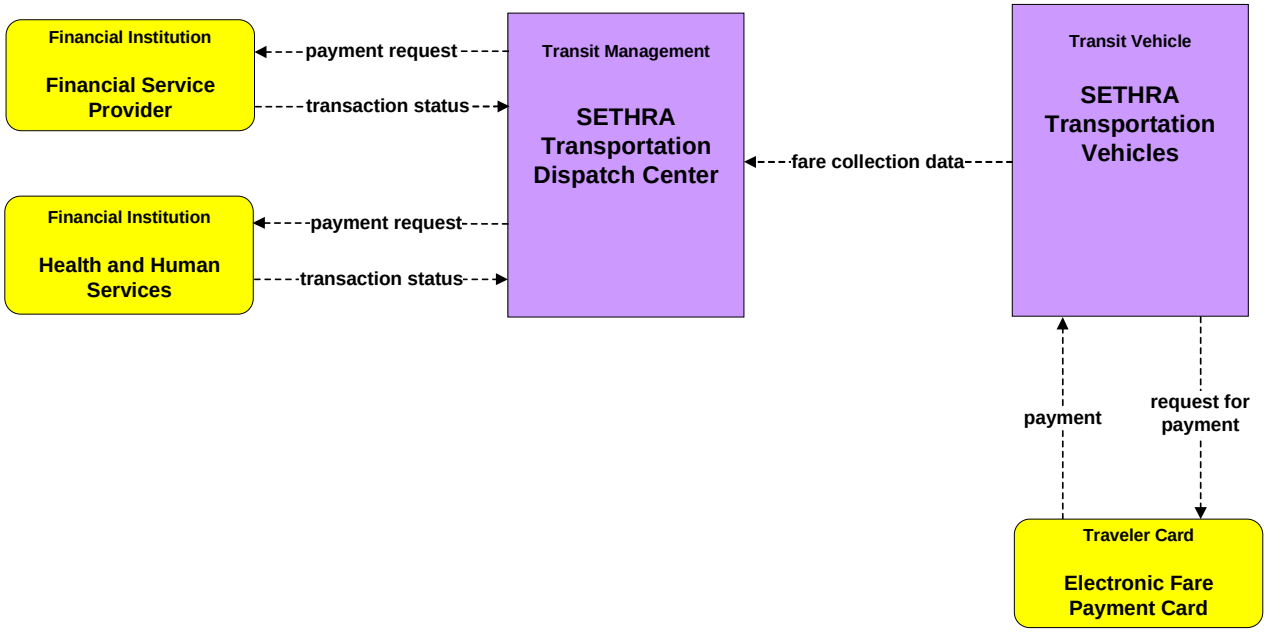
APTS03 – Demand Response Transit Operations
SETHRA Transportation



APTS03 – Demand Response Transit Operations
Cleveland Transit

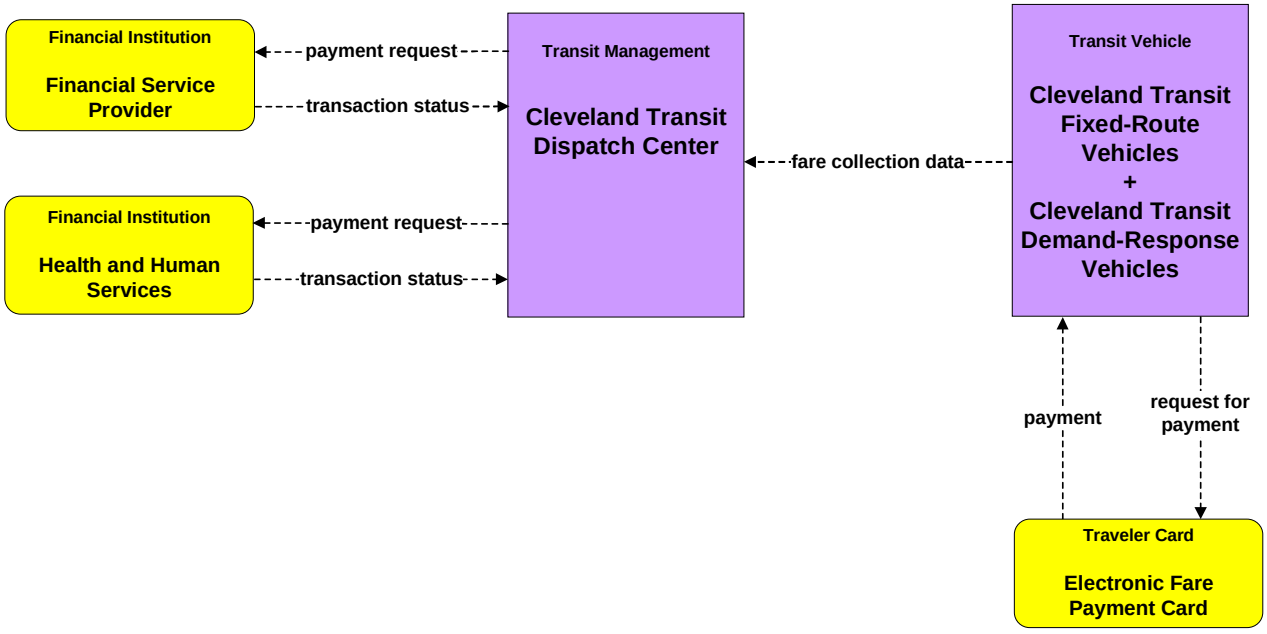


APTS04 – Transit Fare Collection Management
SETHRA Transportation



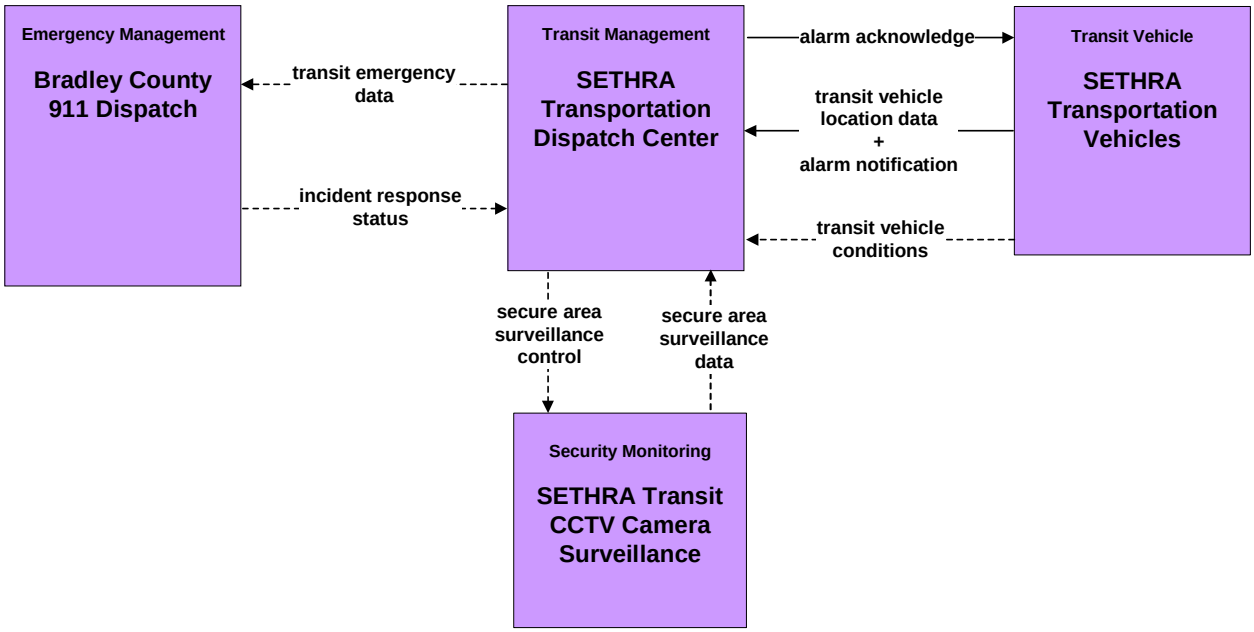
planned/future flow
existing flow
user defined flow

APTS04 – Transit Fare Collection Management
Cleveland Transit



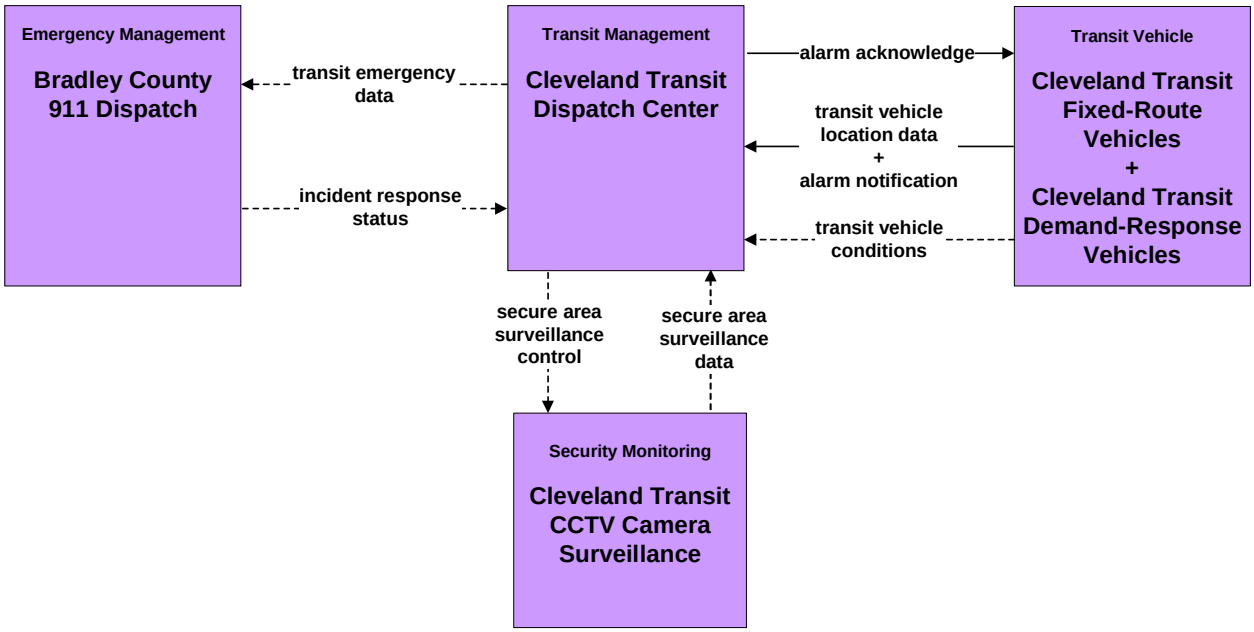
planned/future flow
existing flow
user defined flow

APTS05 – Transit Security
SETHRA Transportation



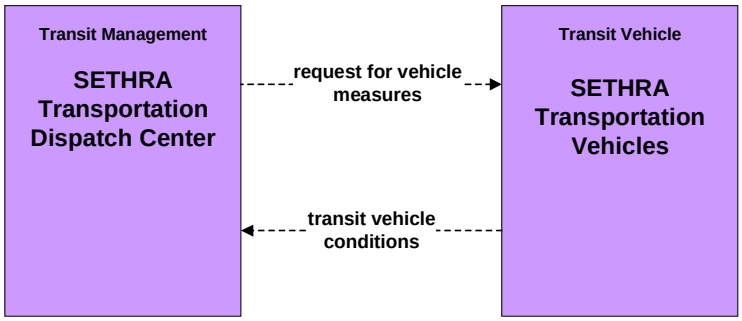
planned/future flow
existing flow
user defined flow

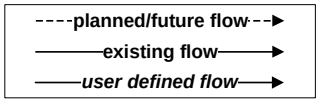
APTS05 – Transit Security
Cleveland Transit



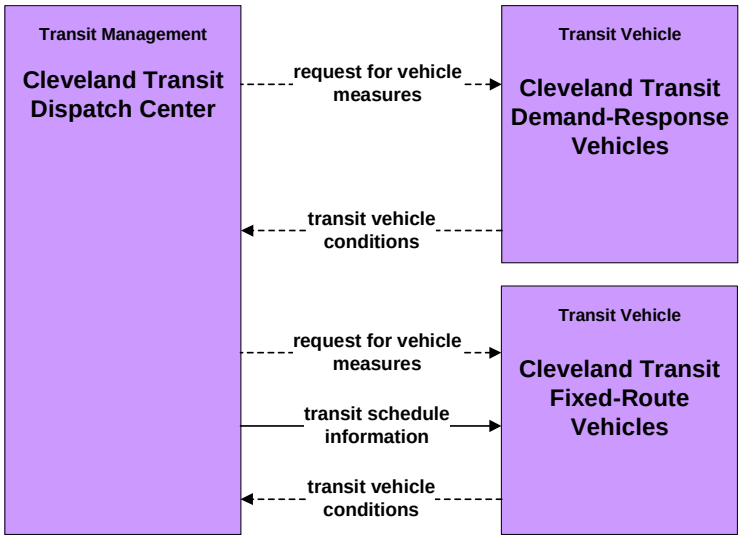
planned/future flow
existing flow
user defined flow

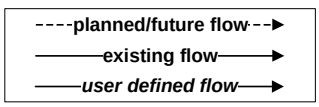
APTS06 – Transit Fleet Management
SETHRA Transportation



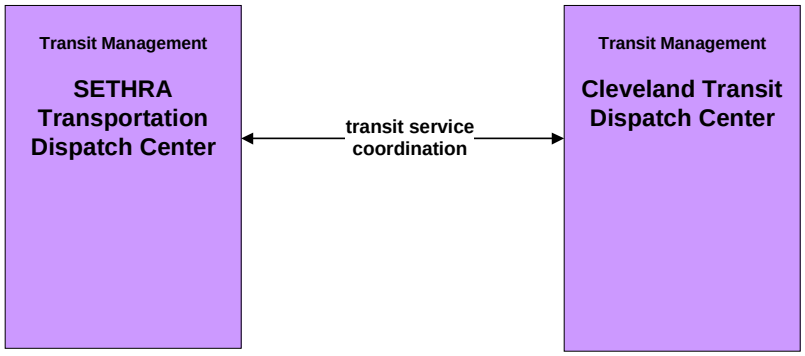


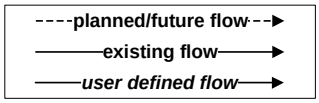
APTS06 – Transit Fleet Management
Cleveland Transit



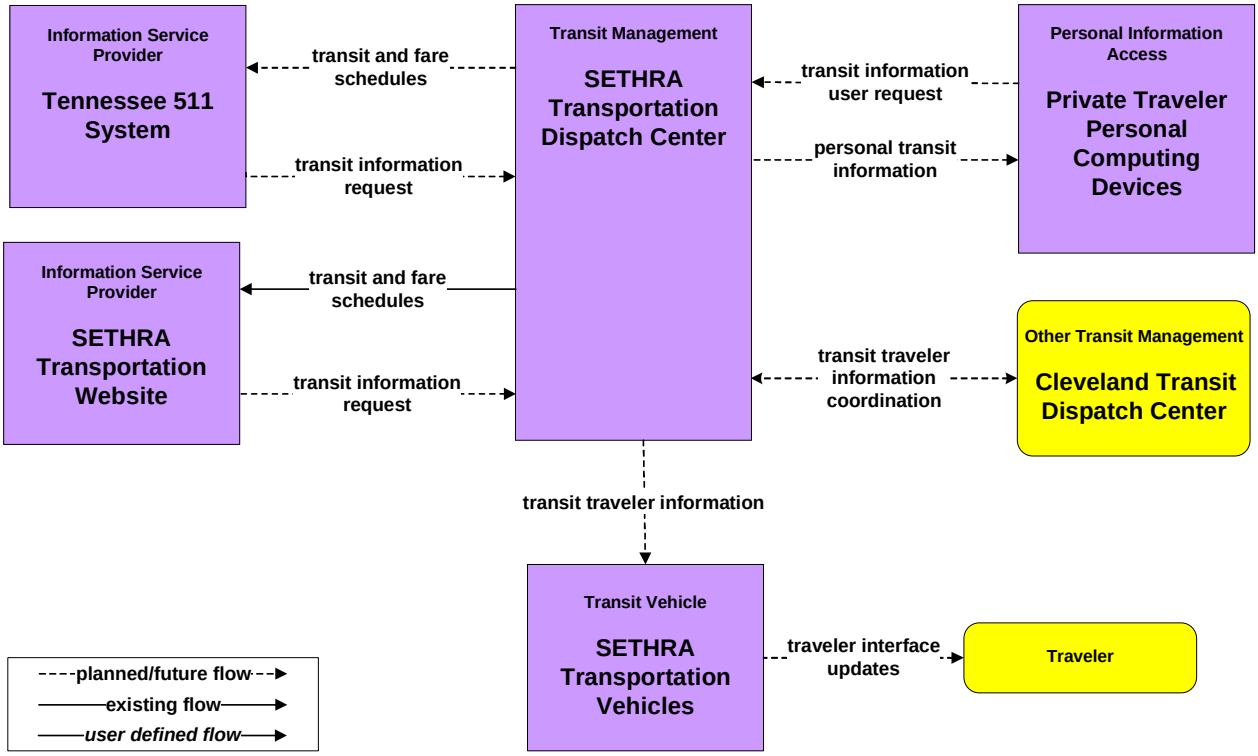


APTS07 – Multimodal Coordination
SETHRA Transportation and Cleveland Transit

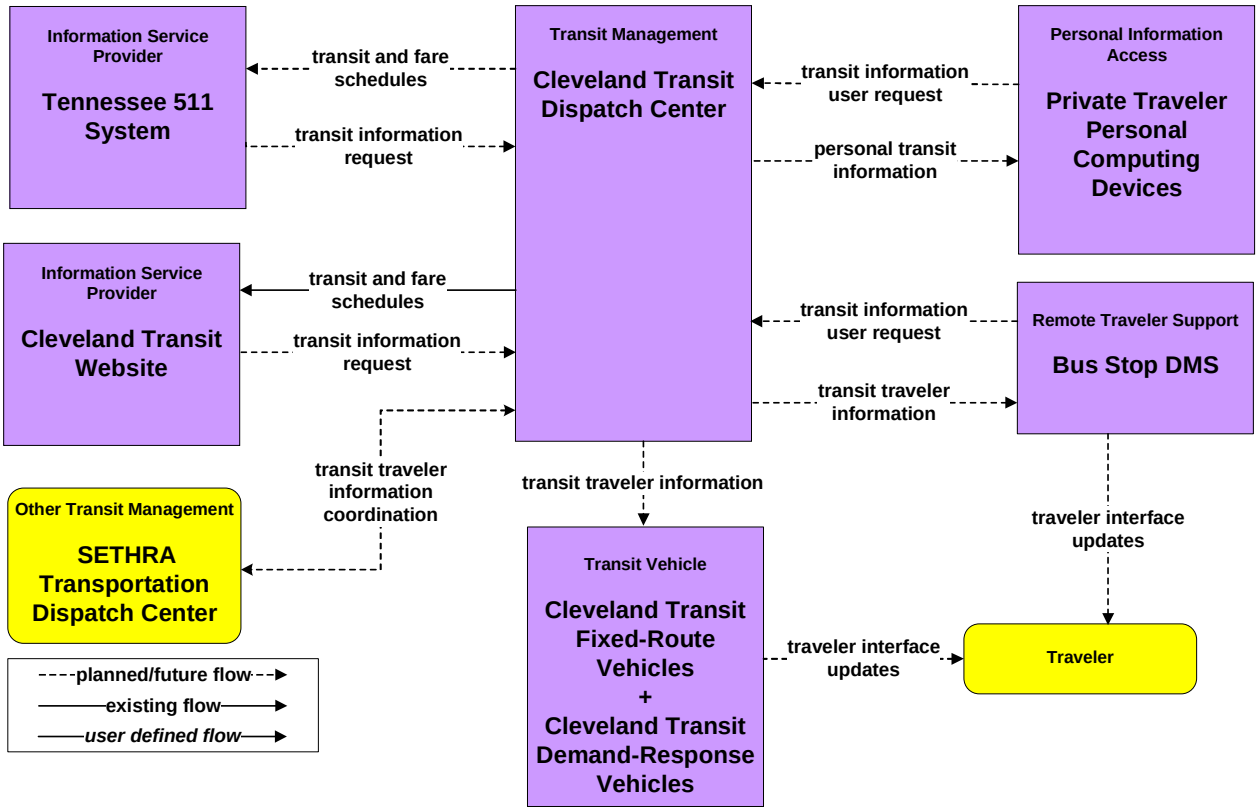




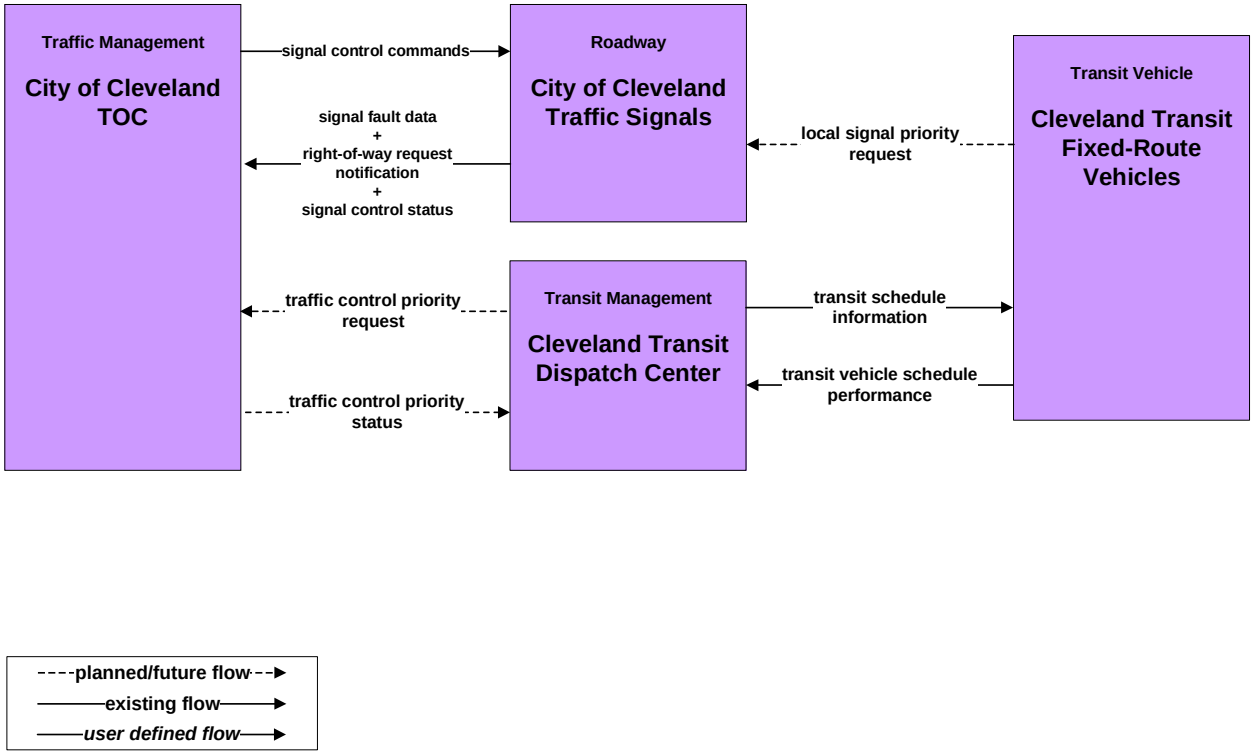
APTS08 – Transit Traveler Information
SETHRA Transportation



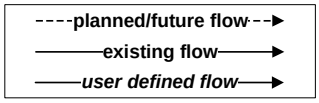
APTS08 – Transit Traveler Information
Cleveland Transit



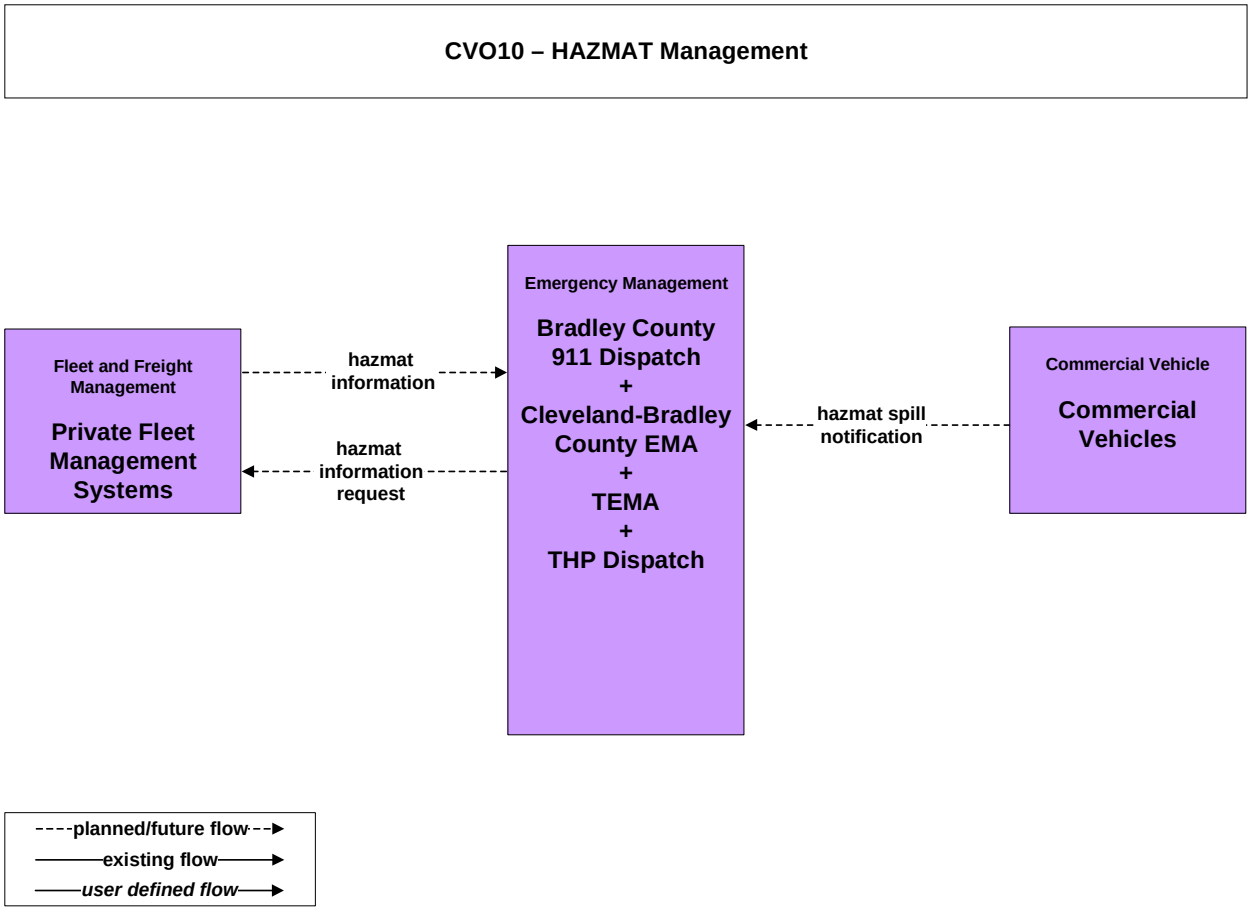
APTS09 – Transit Signal Priority
Cleveland Transit



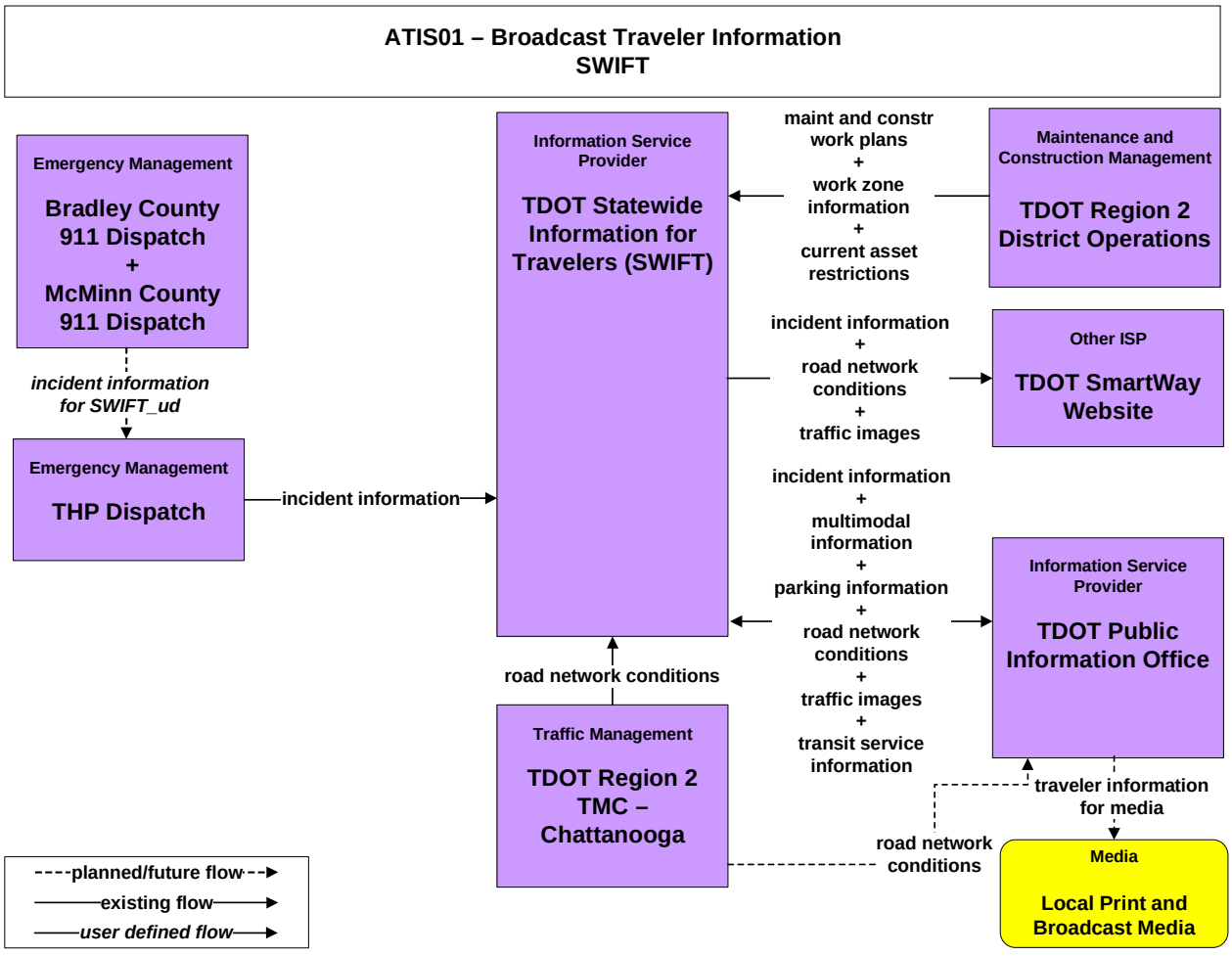
APTS10 – Transit Passenger Counting
Cleveland Transit



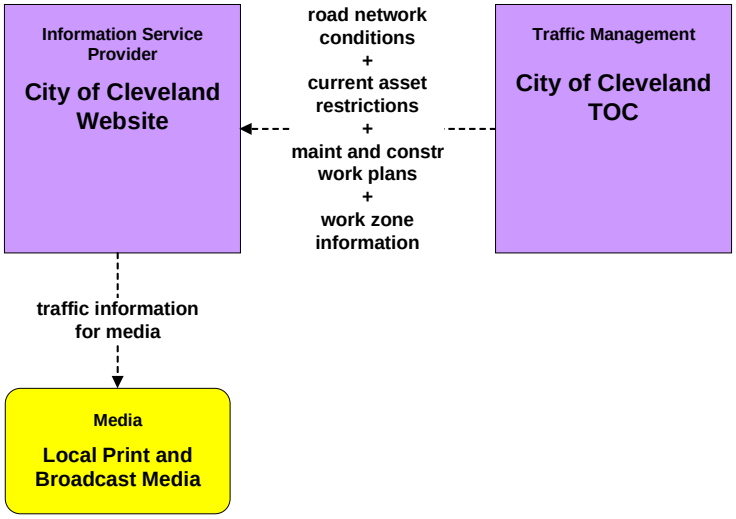
Commercial Vehicle Operations



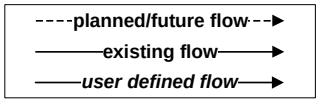
Advanced Traveler Information System



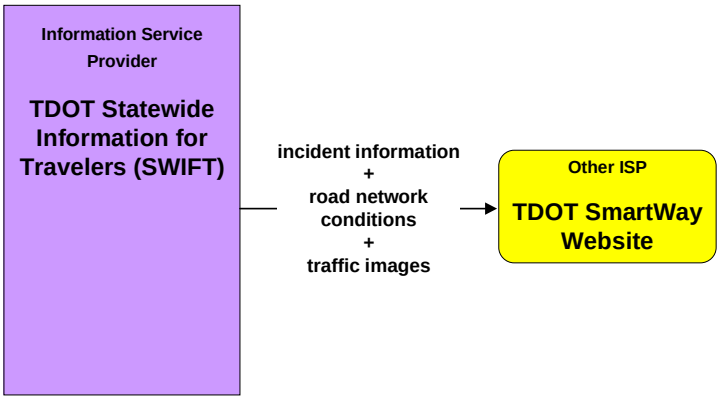
ATIS01 – Broadcast Traveler Information
City of Cleveland

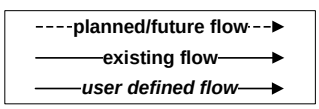


Note:
The City of Cleveland displays power outage information (including signal outages) on its website.

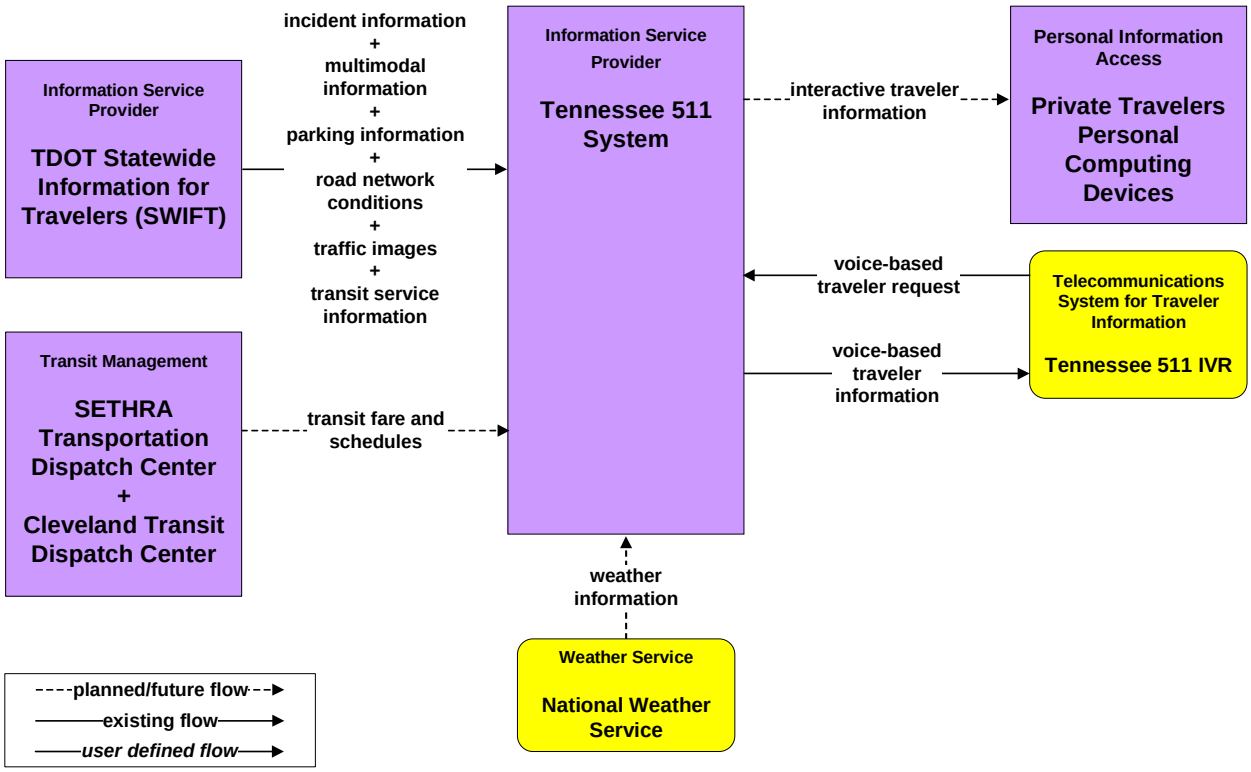


ATIS02 – Interactive Traveler Information
SmartWay Website

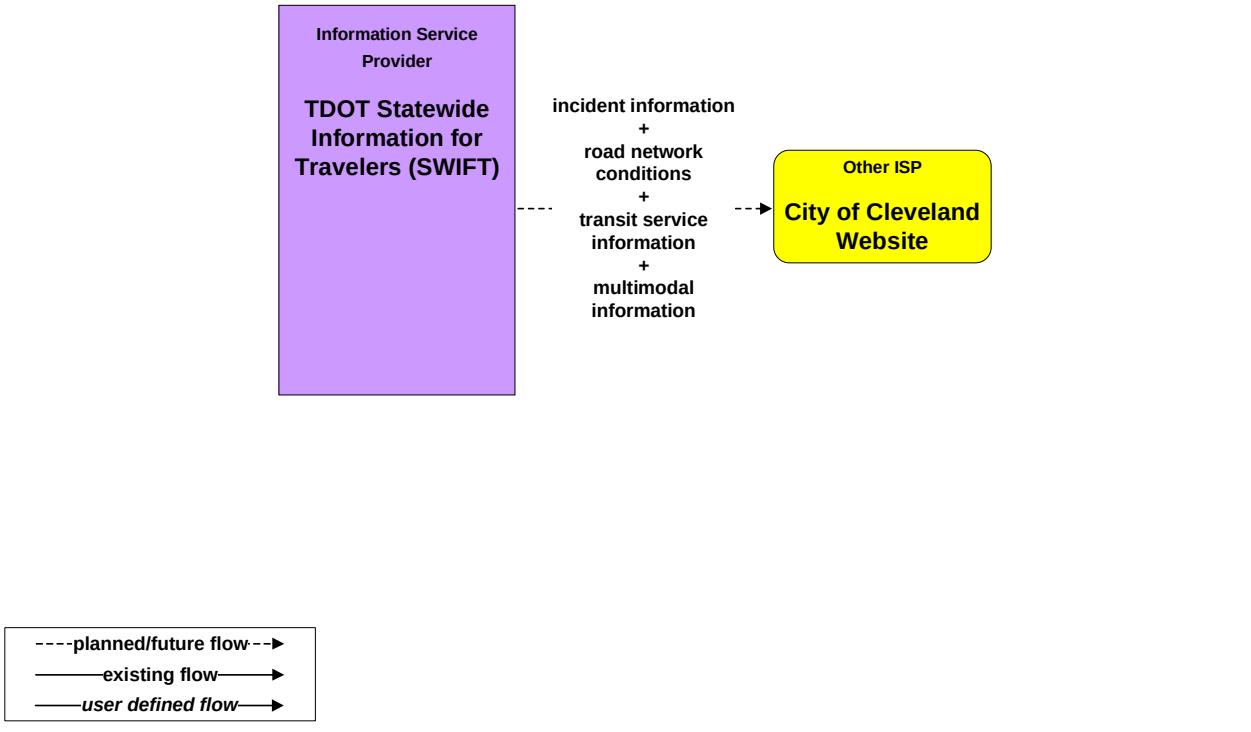




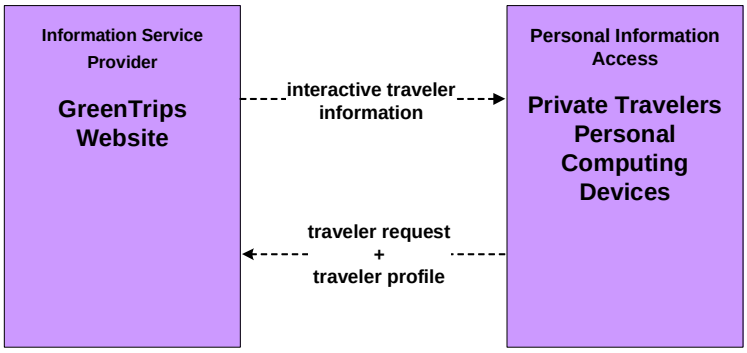
ATIS02 – Interactive Traveler Information
Tennessee 511

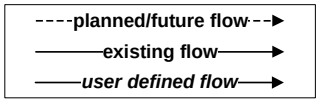


ATIS02 – Interactive Traveler Information
City of Cleveland Website



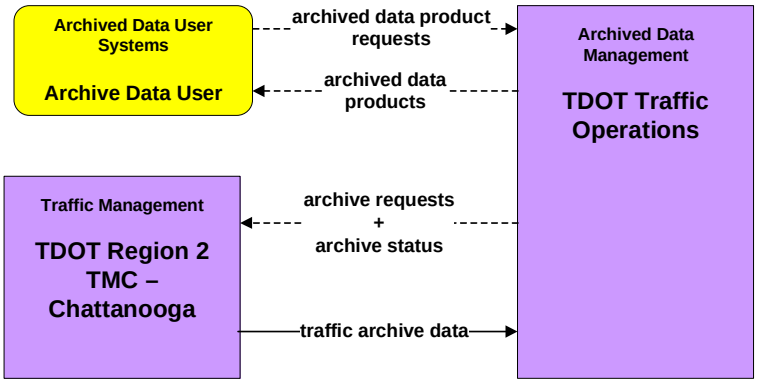
ATIS02 – Interactive Traveler Information
GreenTrips Program





Archived Data

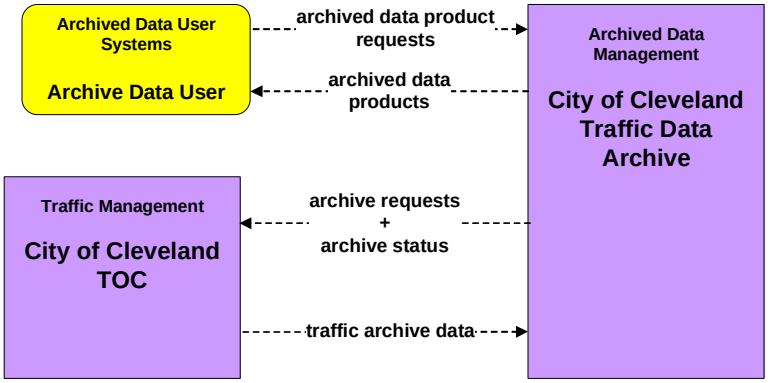
AD1 – ITS Data Mart
TDOT

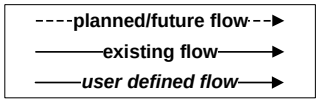


Note:
TDOT Traffic Operations Archive includes data from RDS, fog sensors, and DMS messages.

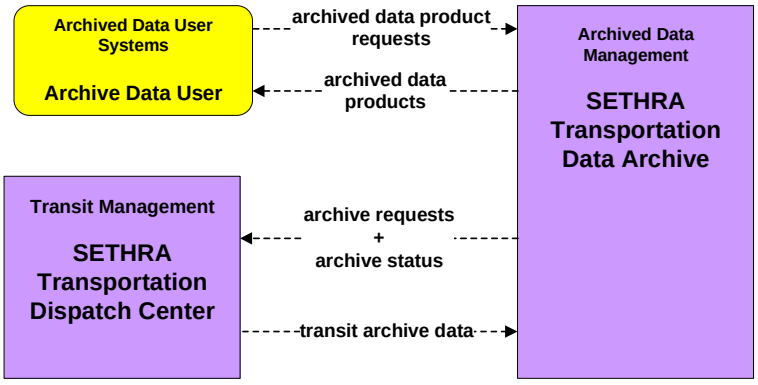
planned/future flow
existing flow
user defined flow

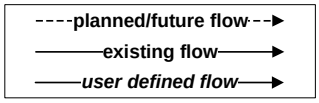
AD1 – ITS Data Mart
City of Cleveland



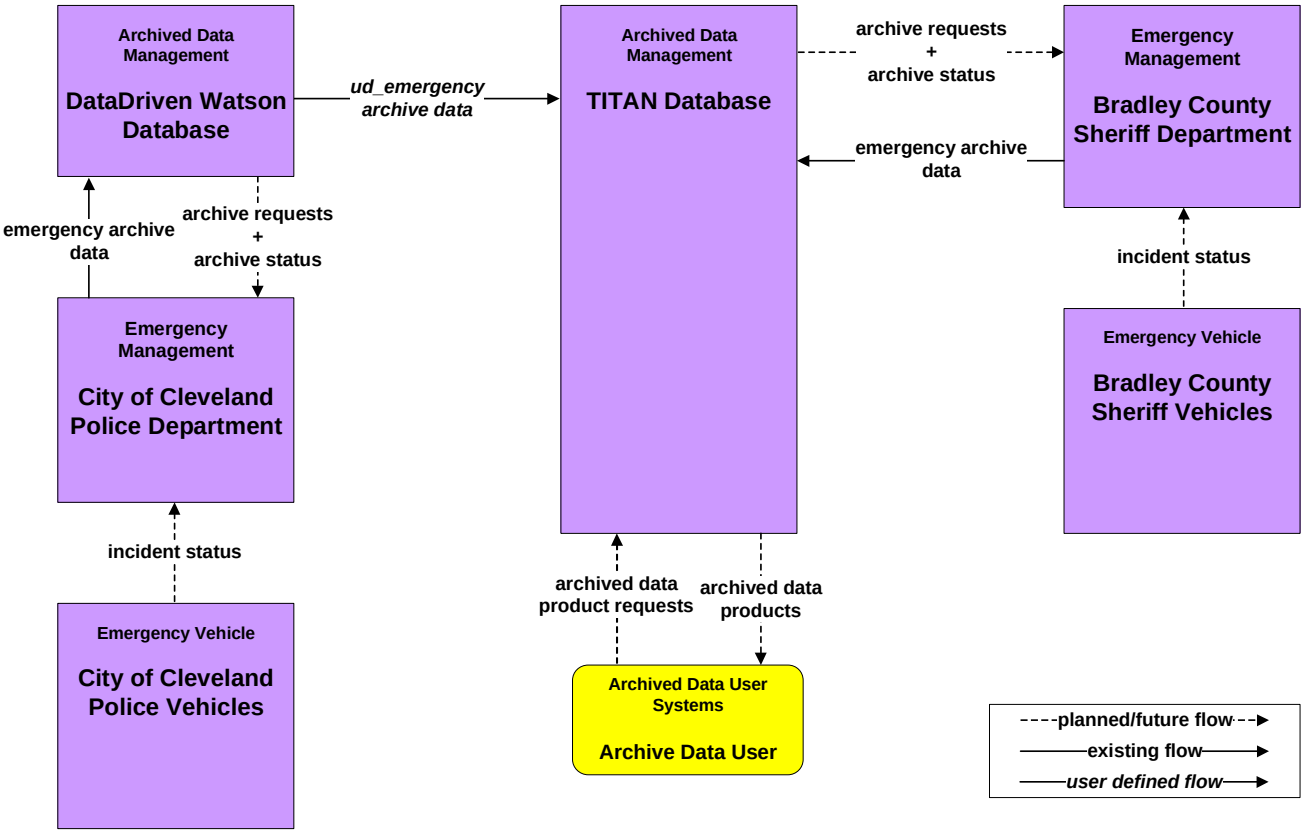


AD1 – ITS Data Mart
SETHRA Transportation

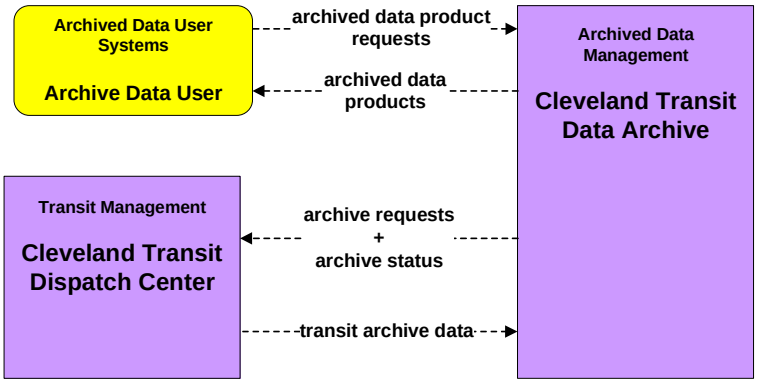


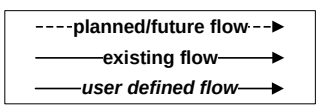


AD1 – ITS Data Mart
TITAN

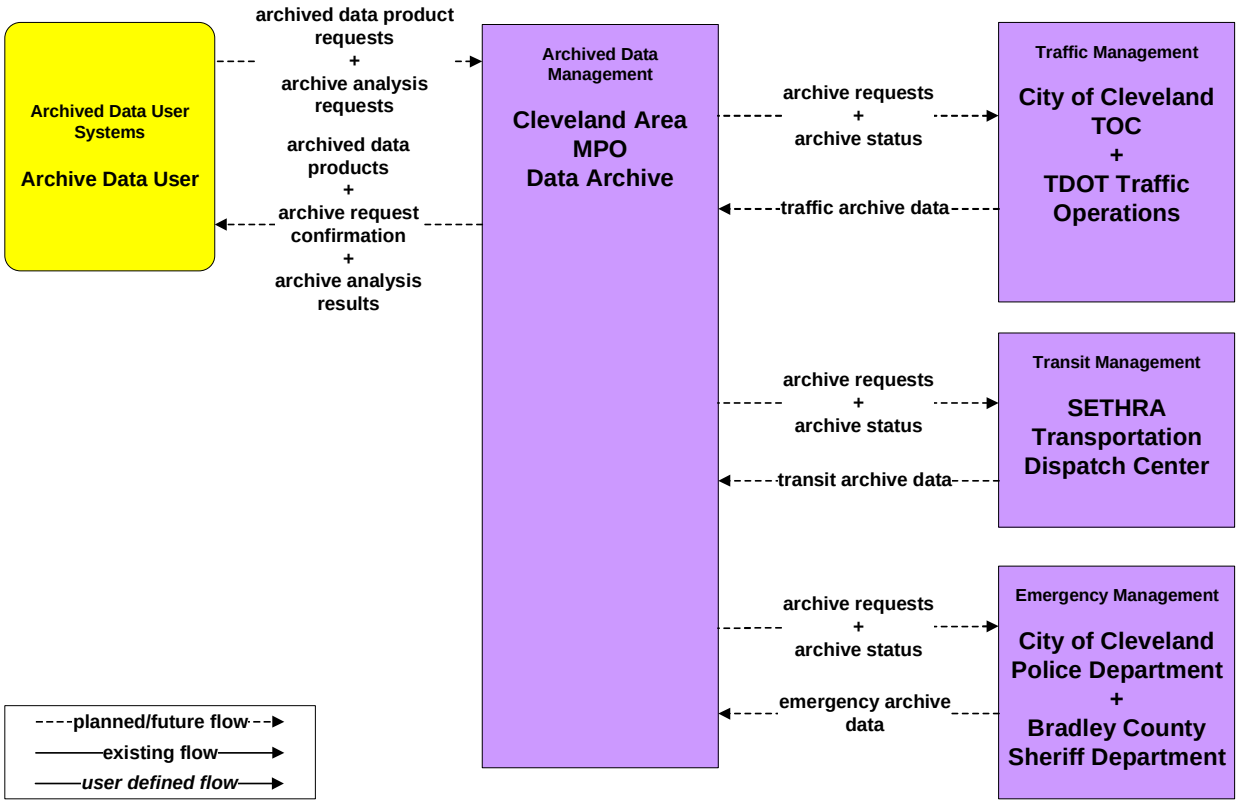


AD1 – ITS Data Mart
Cleveland Transit





AD2 – ITS Data Warehouse
Cleveland Area MPO



APPENDIX C – ELEMENT FUNCTIONS

Element Name	Equipment Package (Function)
Bradley County 911 Dispatch	Center Secure Area Alarm Support
	Center Secure Area Sensor Management
	Center Secure Area Surveillance
	Emergency Call-Taking
	Emergency Commercial Vehicle Response
	Emergency Dispatch
	Emergency Early Warning System
	Emergency Environmental Monitoring
	Emergency Evacuation Support
	Emergency Response Management
	Emergency Routing
	Incident Command
	Mayday Support
Bradley County EMS Vehicles	On-board EV En Route Support
Bradley County Fire Vehicles	On-board EV En Route Support
Bradley County Flood Detection	Roadway Environmental Monitoring
Bradley County Highway Department	MCM Environmental Information Collection
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Roadway Maintenance and Construction
	MCM Vehicle Tracking
	MCM Work Activity Coordination
Bradley County Highway Department Vehicles	MCV Vehicle Location Tracking
Bradley County Sheriff Department	Emergency Data Collection
Bradley County Sheriff Vehicles	On-board EV En Route Support
Bradley County Website	Basic Information Broadcast
	ISP Traveler Data Collection
Bus Stop DMS	Remote Transit Information Services
City of Cleveland Beacon Warning Signs	Roadway Equipment Coordination
City of Cleveland CCTV Cameras	Roadway Basic Surveillance
	Roadway Equipment Coordination
City of Cleveland DMS	Roadway Equipment Coordination

Element Name	Equipment Package (Function)
City of Cleveland DMS (continued)	Roadway Traffic Information Dissemination
	Roadway Work Zone Traffic Control
City of Cleveland Dynamic Overheight Vehicle Warning Signage	Roadway Basic Surveillance
	Roadway Equipment Coordination
	Roadway Warning
City of Cleveland Field Sensors	Roadway Basic Surveillance
	Roadway Equipment Coordination
City of Cleveland Fire Vehicles	On-board EV En Route Support
City of Cleveland Overheight Vehicle Detection	Roadway Basic Surveillance
	Roadway Equipment Coordination
	Roadway Warning
City of Cleveland Police Department	Emergency Data Collection
City of Cleveland Police Vehicles	On-board EV En Route Support
City of Cleveland Portable DMS	Roadway Work Zone Traffic Control
City of Cleveland Public Works Vehicles	MCV Barrier System Control
	MCV Vehicle Location Tracking
	MCV Vehicle System Monitoring and Diagnostics
	MCV Work Zone Support
City of Cleveland Rectangular Rapid Flash Beacons	Roadway Mixed Use Sensing
	Roadway Warning
City of Cleveland School Zone Speed Monitoring Equipment	Roadway Equipment Coordination
	Roadway Speed Monitoring and Warning
City of Cleveland Speed Monitoring Equipment	Roadway Equipment Coordination
	Roadway Speed Monitoring and Warning
City of Cleveland TOC	Collect Traffic Surveillance
	Emissions Data Collection
	Emissions Data Management
	HRI Traffic Management
	MCM Data Collection
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Roadway Maintenance and Construction

Element Name	Equipment Package (Function)
City of Cleveland TOC (continued)	MCM Speed Monitoring and Warning
	MCM Vehicle and Equipment Maintenance Management
	MCM Vehicle Tracking
	MCM Work Activity Coordination
	MCM Work Zone Management
	Rail Operations Coordination
	TMC Environmental Monitoring
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination/Communication
	TMC Multimodal Coordination
	TMC Regional Traffic Management
	TMC Roadway Warning
	TMC Signal Control
	TMC Speed Monitoring and Warning
	TMC Traffic Information Dissemination
	TMC Traffic Metering
	TMC Work Zone Traffic Management
	Traffic Data Collection
	Traffic Equipment Maintenance
City of Cleveland Traffic Data Archive	Government Reporting Systems Support
	ITS Data Repository
	Traffic and Roadside Data Archival
City of Cleveland Traffic Signals	Field Management Stations Operation
	Roadway Basic Surveillance
	Roadway Equipment Coordination
	Roadway Signal Controls
	Roadway Signal Preemption
	Roadway Signal Priority
	Standard Rail Crossing
City of Cleveland Website	Basic Information Broadcast
	Interactive Infrastructure Information

Element Name	Equipment Package (Function)
City of Cleveland Website (continued)	ISP Traveler Data Collection
	ISP Traveler Information Alerts
	Traveler Telephone Information
Cleveland Area MPO Data Archive	Government Reporting Systems Support
	ITS Data Repository
	On-Line Analysis and Mining
	Traffic and Roadside Data Archival
Cleveland Transit CCTV Camera Surveillance	Field Secure Area Sensor Monitoring
	Field Secure Area Surveillance
Cleveland Transit Data Archive	Government Reporting Systems Support
	ITS Data Repository
	Traffic and Roadside Data Archival
Cleveland Transit Demand-Response Vehicles	On-board Maintenance
	On-board Paratransit Operations
	On-board Schedule Management
	On-board Transit Fare Management
	On-board Transit Information Services
	On-board Transit Security
	On-board Transit Trip Monitoring
Cleveland Transit Dispatch Center	Center Secure Area Alarm Support
	Center Secure Area Sensor Management
	Center Secure Area Surveillance
	Emergency Data Collection
	Emergency Response Management
	Transit Center Fare Management
	Transit Center Fixed-Route Operations
	Transit Center Information Services
	Transit Center Multi-Modal Coordination
	Transit Center Paratransit Operations
	Transit Center Passenger Counting
	Transit Center Security
	Transit Center Signal Priority

Element Name	Equipment Package (Function)
Cleveland Transit Dispatch Center (continued)	Transit Center Vehicle Tracking
	Transit Data Collection
	Transit Garage Maintenance
	Transit Vehicle Assignment
	Transit Vehicle Operator Assignment
Cleveland Transit Fixed-Route Vehicles	On-board Maintenance
	On-board Passenger Counting
	On-board Schedule Management
	On-board Transit Fare Management
	On-board Transit Information Services
	On-board Transit Security
	On-board Transit Signal Priority
	On-board Transit Trip Monitoring
Cleveland Transit Website	Infrastructure Provided Trip Planning
	ISP Traveler Data Collection
Cleveland-Bradley County EMA	Emergency Commercial Vehicle Response
	Emergency Early Warning System
	Emergency Evacuation Support
	Emergency Response Management
	Incident Command
	Mayday Support
Commercial Vehicles	On-board Cargo Monitoring
GDOT Maintenance	MCM Work Activity Coordination
Georgia NaviGAtor	TMC Regional Traffic Management
	TMC Signal Control
	TMC Traffic Metering
GreenTrips Website	Interactive Infrastructure Information
	ISP Traveler Data Collection
	ISP Traveler Information Alerts
	Traveler Telephone Information
Local Utility Providers	MCM Incident Management
McMinn County 911 Dispatch	Emergency Call-Taking

Element Name	Equipment Package (Function)
McMinn County 911 Dispatch (continued)	Emergency Dispatch
	Emergency Early Warning System
	Emergency Environmental Monitoring
	Emergency Response Management
	Incident Command
McMinn County EMA	Emergency Evacuation Support
	Emergency Response Management
	Incident Command
Municipal TOC	Collect Traffic Surveillance
	HRI Traffic Management
	TMC Incident Dispatch Coordination/Communication
	TMC Signal Control
	Traffic Equipment Maintenance
Municipal Traffic Signals	Field Management Stations Operation
	Roadway Basic Surveillance
	Roadway Equipment Coordination
	Roadway Signal Controls
	Roadway Signal Preemption
	Roadway Signal Priority
	Standard Rail Crossing
Municipal/County Maintenance	MCM Environmental Information Processing
	MCM Incident Management
	MCM Roadway Maintenance and Construction
	MCM Work Activity Coordination
Municipal/County Public Safety Vehicles	On-board EV En Route Support
Other TDOT Region Construction Office	MCM Work Activity Coordination
Other TDOT Regions District Operations	MCM Work Activity Coordination
Private Fleet Management Systems	Commercial Vehicle and Freight Security
	Fleet HAZMAT Management
Private Traveler Personal Computing Devices	Personal Interactive Information Reception
SETHRA Transit CCTV Camera Surveillance	Field Secure Area Sensor Monitoring
	Field Secure Area Surveillance

Element Name	Equipment Package (Function)
SETHRA Transportation Data Archive	Government Reporting Systems Support
	ITS Data Repository
	Traffic and Roadside Data Archival
SETHRA Transportation Dispatch Center	Center Secure Area Alarm Support
	Center Secure Area Sensor Management
	Center Secure Area Surveillance
	Emergency Data Collection
	Emergency Evacuation Support
	Emergency Response Management
	Incident Command
	Transit Center Fare Management
	Transit Center Fixed-Route Operations
	Transit Center Information Services
	Transit Center Multi-Modal Coordination
	Transit Center Paratransit Operations
	Transit Center Passenger Counting
	Transit Center Security
	Transit Center Vehicle Tracking
	Transit Data Collection
	Transit Evacuation Support
	Transit Garage Maintenance
	Transit Vehicle Assignment
	Transit Vehicle Operator Assignment
SETHRA Transportation Vehicles	On-board Maintenance
	On-board Paratransit Operations
	On-board Schedule Management
	On-board Transit Fare Management
	On-board Transit Information Services
	On-board Transit Security
	On-board Transit Trip Monitoring
SETHRA Transportation Website	Basic Information Broadcast
	Infrastructure Provided Trip Planning

Element Name	Equipment Package (Function)
SETHRA Transportation Website (continued)	ISP Traveler Data Collection
TDOT CCTV Cameras	Roadway Basic Surveillance
	Roadway Equipment Coordination
	Roadway Work Zone Traffic Control
TDOT Changeable Speed Limit Signs	Roadway Equipment Coordination
	Roadway Speed Monitoring and Warning
TDOT DMS	Roadway Equipment Coordination
	Roadway Traffic Information Dissemination
	Roadway Work Zone Traffic Control
TDOT Emergency Services Coordinator	MCM Incident Management
	MCM Roadway Maintenance and Construction
	TMC Evacuation Support
	TMC Incident Dispatch Coordination/Communication
TDOT Field Sensors	Roadway Basic Surveillance
	Roadway Equipment Coordination
TDOT HAR	Roadway Equipment Coordination
	Roadway Traffic Information Dissemination
	Roadway Work Zone Traffic Control
TDOT HELP Vehicles	On-board EV En Route Support
	On-board EV Incident Management Communication
TDOT Maintenance Headquarters	MCM Environmental Information Collection
TDOT Maintenance Vehicles	MCV Barrier System Control
	MCV Vehicle Location Tracking
	MCV Work Zone Support
TDOT On-Ramp Closure Gates	Field Barrier System Control
	Roadway Equipment Coordination
TDOT Public Information Office	Basic Information Broadcast
	ISP Traveler Data Collection
TDOT Ramp Queue Detection System	Field Management Stations Operation
	Roadway Basic Surveillance
	Roadway Equipment Coordination
	Roadway Signal Controls

Element Name	Equipment Package (Function)
TDOT Region 1 TMC - Knoxville	TMC Regional Traffic Management
	TMC Signal Control
	TMC Traffic Metering
TDOT Region 2 Construction Office	MCM Work Activity Coordination
TDOT Region 2 Construction Office (continued)	MCM Work Zone Management
TDOT Region 2 District Operations	MCM Environmental Information Collection
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Roadway Maintenance and Construction
	MCM Vehicle Tracking
	MCM Work Activity Coordination
	MCM Work Zone Management
TDOT Region 2 HELP Dispatch	Service Patrol Management
TDOT Region 2 TMC - Chattanooga	Barrier System Management
	Collect Traffic Surveillance
	MCM Data Collection
	MCM Environmental Information Collection
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Roadway Maintenance and Construction
	MCM Work Activity Coordination
	MCM Work Zone Management
	TMC Environmental Monitoring
	TMC Evacuation Support
	TMC Incident Detection
	TMC Incident Dispatch Coordination/Communication
	TMC Regional Traffic Management
	TMC Signal Control
	TMC Speed Monitoring and Warning
	TMC Traffic Information Dissemination
	TMC Traffic Metering
	TMC Work Zone Traffic Management

Element Name	Equipment Package (Function)
TDOT Region 2 TMC – Chattanooga (continued)	Traffic Data Collection
	Traffic Equipment Maintenance
TDOT Region 3 TMC - Nashville	TMC Regional Traffic Management
	TMC Signal Control
	TMC Traffic Metering
TDOT Region 4 TMC - Memphis	TMC Regional Traffic Management
	TMC Signal Control
	TMC Traffic Metering
TDOT RWIS Sensors	Roadway Environmental Monitoring
TDOT Smart Work Zone Equipment	Roadway Work Zone Traffic Control
TDOT SmartPark Truck Parking Management	Parking Coordination
TDOT SmartWay Website	Basic Information Broadcast
	Interactive Infrastructure Information
	ISP Emergency Traveler Information
	ISP Traveler Data Collection
	ISP Traveler Information Alerts
	Traveler Telephone Information
TDOT Statewide Information for Travelers (SWIFT)	Basic Information Broadcast
	Interactive Infrastructure Information
	ISP Emergency Traveler Information
	ISP Traveler Data Collection
	ISP Traveler Information Alerts
	MCM Environmental Information Processing
	MCM Incident Management
	MCM Work Activity Coordination
	MCM Work Zone Management
	Traveler Telephone Information
TDOT Traffic Operations	Government Reporting Systems Support
	ITS Data Repository
	On-Line Analysis and Mining
	Traffic and Roadside Data Archival
	Traffic Data Collection

Element Name	Equipment Package (Function)
TEMA	Emergency Commercial Vehicle Response
	Emergency Early Warning System
	Emergency Evacuation Support
	Emergency Response Management
	Incident Command
TEMA (continued)	Mayday Support
Tennessee 511 System	Infrastructure Provided Trip Planning
	Interactive Infrastructure Information
	ISP Emergency Traveler Information
	ISP Traveler Data Collection
	ISP Traveler Information Alerts
	Traveler Telephone Information
Tennessee Bureau of Investigation	Emergency Early Warning System
	Incident Command
THP Dispatch	Emergency Call-Taking
	Emergency Commercial Vehicle Response
	Emergency Dispatch
	Emergency Early Warning System
	Emergency Environmental Monitoring
	Emergency Evacuation Support
	Emergency Response Management
	Incident Command
	Mayday Support
THP District 2 Office	Barrier System Management
	Collect Traffic Surveillance
	Emergency Response Management
	TMC Environmental Monitoring
	TMC Speed Monitoring and Warning
	TMC Traffic Information Dissemination
THP Vehicles	On-board EV En Route Support
TITAN Database	Government Reporting Systems Support
	ITS Data Repository

Element Name	Equipment Package (Function)
TITAN Database (continued)	Traffic and Roadside Data Archival
TVA Sequoyah Nuclear Power Plant Operations	Emergency Early Warning System
	Emergency Response Management

APPENDIX D – STAKEHOLDER DATABASE

Cleveland Regional ITS Architecture
Stakeholder Attendance Record

	Invitees		Workshop Attendance		
Organization	**First Name**	**Last Name**	**Kick-off Workshop**	**Interview**	**Review Workshop**
Bradley County	Bently	Thomas	☑	☐	☐
Chattanooga-Hamilton County/North Georgia Transportation Planning Organization	Yuen	Lee	☐	☐	☑
Chattanooga-Hamilton County/North Georgia Transportation Planning Organization	Karen	Rennich	☐	☐	☑
City of Cleveland	David	Sheely	☑	☐	☐
City of Cleveland	Greg	Thomas	☑	☐	☐
City of Cleveland	Brian	Beck	☑	☐	☑
Cleveland City Schools	Hal	Taylor	☑	☐	☐
Cleveland Utilities	Tad	Bacon	☑	☑	☑
Cleveland/Bradley County Chamber of Commerce	Doug	Berry	☑	☐	☐
Southeast Tennessee Human Resource Agency	Mary Lynn	Brown	☑	☐	☐
Southeast Tennessee Human Resource Agency	Ted	Smith	☑	☐	☐
Southeast Tennessee Human Resource Agency	Chris	Kleehammer	☐	☑	☐
Tennessee Department of Transportation	Garris	Bugg	☐	☐	☑
Tennessee Department of Transportation	Emily	Carpenter	☐	☐	☑
Tennessee Department of Transportation	Sara	Elmore	☑	☐	☑
Tennessee Department of Transportation	Nikita	Hemnani	☐	☐	☑
Tennessee Department of Transportation	Lacy	Word	☑	☐	☐
Tennessee Department of Transportation	Victor	Weddle	☑	☐	☑
Tennessee Department of Transportation	Alan	Wolfe	☐	☐	☑
Tennessee Department of Transportation	Zach	Johnson	☑	☐	☐
Tennessee Department of Transportation	Rashad	Pinckney	☑	☐	☑
Tennessee Department of Transportation	Landon	Castleberry	☑	☐	☑
Tennessee Department of Transportation	Joe	Roach	☑	☐	☑
Tennessee Department of Transportation	Eric	Flora	☑	☐	☑
Tennessee Department of Transportation	Khuzaima	Mahdi	☑	☐	☑
Tennessee Department of Transportation	Stacy	Morrison	☑	☐	☑

APPENDIX E – AGREEMENTS

ITS ARCHITECTURE DEVELOPMENT (CLEVELAND URBAN AREA MPO, CHATTANOOGA-HAMILTON COUNTY/NORTH GEORGIA TPO) MEMORANDUM OF UNDERSTANDING

TDOT, TDOSHS, AND LOCAL GOVERNMENT "OPEN ROADS POLICY" (QUICK CLEARANCE FOR SAFETY AND MOBILITY) MEMORANDUM OF UNDERSTANDING

TDOT FOR LIVE CCTV VIDEO ACCESS AND INFORMATION SHARING FOR GOVERNMENTAL AGENCY USERS

TDOT LIVE CCTV VIDEO ACCESS AGREEMENT FOR PRIVATE ENTITY USERS

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

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

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

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

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

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

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

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

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

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

Adopted this 9th day of July, 2014

Chairman, MPO Executive Board
Cleveland Urban Area
Metropolitan Planning Organization

Adopted this 17th day of JUNE, 2014

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

State of Tennessee

"OPEN ROADS POLICY"

Quick Clearance for Safety and Mobility

Between the Tennessee Department of Transportation,

Tennessee Department of Safety and Homeland Security, and

Tennessee Counties and Cities

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

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

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

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

Tennessee Highway Patrol Responsibilities

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

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

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

Tennessee Department of Transportation Responsibilities

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

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

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

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

Local Law Enforcement, Fire and Rescue Department Responsibilities

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

Therefore, it is agreed as follows:

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

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

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

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

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

It is further agreed that:

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

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

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

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

TENNESSEE DEPARTMENT OF TRANSPORTATION

By: _____
Commissioner

Date: 10/12/2012

TENNESSEE DEPARTMENT OF SAFETY AND HOMELAND SECURITY

By: Bill Gibbons
Commissioner

Date: 9/19/12

Tennessee Department of Transportation

TRAFFIC OPERATIONS PROGRAM POLICY

Effective Date:
Title: Access to Live Video

POLICY

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

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

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

BACKGROUND

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

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

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

Tennessee Department of Transportation
And
Governmental Agency Users

ACCESS AGREEMENT FOR LIVE VIDEO

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

The effective date of this Agreement is _____.

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

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

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

A. GENERAL INFORMATION:

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

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

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

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

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

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

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

B. USER'S RESPONSIBILITIES:

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

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

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

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

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

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

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

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

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

C. LIABILILTY AND INDEMNITY PROVISIONS:

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

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

D. TERMINATION:

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

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

State of Tennessee
Department of Transportation

By:_____ Date:_____
John Schroer
Commissioner

Approved as to Form:

By:_____ Date: _____
General Counsel

USER AGENCY:_____

By_____

(Print Name)_____

(Title)_____

Date:_____

Approved by Legal Counsel for USER AGENCY

By_____

(Print Name)_____

(Title)_____

Date:_____

Tennessee Department of Transportation

TRAFFIC OPERATIONS PROGRAM POLICY

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

POLICY

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

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

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

BACKGROUND

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

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

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

Tennessee Department of Transportation
And
Private Entity Users

ACCESS AGREEMENT FOR LIVE VIDEO

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

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

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

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

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

A. GENERAL INFORMATION:

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

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

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

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

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

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

B. USER'S RESPONSIBILITIES:

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

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

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

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

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

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

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

C. LIABILITY AND INDEMNITY PROVISIONS:

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

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

D. TERMINATION:

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

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

State of Tennessee
Department of Transportation

Approved as to Form:

By:_____ _____
JOHN C. SCHROER
Commissioner General Counsel

Date:_____

USER AGENCY_____

By_____

(Print Name)_____

(Title)_____

Date:_____

Approved by Legal Counsel for USER AGENCY

By_____

(Print Name)_____

(Title)_____

Date:_____

APPENDIX F – REGIONAL ITS ARCHITECTURE MAINTENANCE FORM

Cleveland Regional ITS Architecture
Maintenance Form

Please complete the following form to document changes to the 2017 Cleveland Regional Intelligent Transportation System (ITS) Architecture. Forms should be submitted to the Cleveland Metropolitan Planning Organization (MPO) for review and acceptance. All accepted changes will be kept on file by the MPO and shared with the TDOT Traffic Operations Division. Changes will be incorporated into the 2017 Cleveland Regional ITS Architecture during the next scheduled update.

Contact Information

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

Change Information

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

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

Submittal

Please submit ITS Architecture Maintenance Documentation form to:

Cleveland Metropolitan Planning Organization
185 2nd Street NE
Cleveland, TN 37311
Phone: 423-479-1913
E-mail: gthomas@clevelandtn.gov

Form Submittal Date: _____

Cleveland Regional ITS Architecture
Maintenance Form

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

Cleveland Region
Regional ITS Architecture
Maintenance Form (Example of Completed Form)

Question 1 Describe the requested change to the Regional ITS Architecture or Deployment Plan.	*Example: City A is planning to deploy CCTV cameras for network surveillance on arterial streets. In the Regional ITS Architecture, the City A Traffic Operations Center (TOC) is shown as the only center controlling the CCTV cameras. The City A TOC is now planning to provide images and control of the CCTV cameras to the City A Police Department for use during incidents.*
Question 2 Are any of the Regional ITS Architecture service packages impacted by the proposed change?	☑ Yes: Please complete Questions 2A and 2B ☐ No: Please proceed to Question 3 ☐ Unknown: Please coordinate with the Cleveland MPO to determine impacts of the change to the Regional ITS Architecture
Question 2A List all of the ITS service packages impacted by the proposed change.	*Example: ATMS08 – Traffic Incident Management System* *ATMS01 – Network Surveillance*
Question 2B Include a copy of the ITS service packages impacted by the proposed change and mark any proposed modifications to the ITS service packages. Add any additional notes on proposed changes in this section.	*Example: A sketch of the ATMS08 – Traffic Incident Management System service package diagram for City A is attached. Changes have been marked by hand to indicate the new data connections that will be established to allow the City A TOC to send traffic images to the City A Police Department and for the City A Police Department to control the CCTV cameras. The deployment of the CCTV cameras will also result in several of the data flows in ATMS01 – Network Surveillance being changed from planned to existing. These have also been marked on the service package diagram. (Note: The ITS service package diagrams can be found in Appendix B of the Regional ITS Architecture.)*
Question 3 Does the proposed change impact any stakeholder agencies other than the agency completing this form?	☑ Yes: Please complete Questions 3A and 3B ☐ No: Form is complete ☐ Unknown: Please coordinate with the Cleveland MPO to determine impacts of change to other agencies in the Regional ITS Architecture
Question 3A Identify the stakeholder agencies impacted by the change and a contact person for each agency.	*Example: The City A TOC and City A Police Department are the two agencies impacted by this change. (Note: Assuming the City A TOC representative is completing this form, the contact person from the City A Police Department working on this project should be listed.)*
Question 3B Describe the coordination that has occurred with the stakeholder agencies and the results of the coordination?	*Example: The City A TOC and City A Police Department have had several meetings in the last year to discuss the operations of the arterial CCTV cameras. An operational agreement for the joint operations of the CCTV cameras is currently being developed.*