Tennessee Department of Transportation
Regional ITS Architectures and Deployment Plans

# Cleveland Region

# Regional ITS Architecture Report

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| | |
|---|---|
| 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 |
| CVO | Commercial Vehicle Operations |
| 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 |
| GDOT | Georgia Department of Transportation |
| HAR | Highway Advisory Radio |
| IEEE | Institute of Electrical and Electronics Engineers |
| ITE | Institute of Transportation Engineers |
| ITS | Intelligent Transportation System |
| IVR | Interactive Voice Response |
| LRTP | Long Range Transportation Plan |
| MC | Maintenance and Construction |
| 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 |
| RWIS | Road Weather Information System |
| SAE | Society of Automotive Engineers |
| SAFETEA-LU | Safe, Accountable, Flexible and Efficient Transportation Equity Act – A Legacy for Users |
| SETHRA | Southeast Tennessee Human Resource Agency Transportation |
| SDO | Standards Development Organization |
| TCIP | Transit Communication Interface Protocol |
| TDOT | Tennessee Department of Transportation |
| TEA-21 | Transportation Equity Act for the 21st Century |
| TEMA | Tennessee Management Emergency Agency |
| TIP | Transportation Improvement Program |
| TPO | Transportation Planning Organization |
| TVA | Tennessee Valley Authority |
| THP | Tennessee Highway Patrol |
| TMC | Transportation Management Center |
| TOC | Traffic Operations Center |
| TraCS | Traffic and Criminal Software |
| TSIS | TDOT SmartWay Information System |
| USDOT | United States Department of Transportation |
| VIVDS | Video Image Vehicle Detection Systems |
| WAVE | Wireless Access in Vehicular Environments |

# 1. INTRODUCTION

## 1.1 Project Overview

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

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

In October 2007 the Tennessee Department of Transportation (TDOT), in coordination with the Cleveland Urban Area Metropolitan Planning Organization (MPO), began development of the Cleveland Regional ITS Architecture. The Cleveland Regional ITS Architecture included the same geographic boundaries as the Cleveland Urban Area MPO plus a portion of the I-75 corridor in McMinn County. Stakeholders developed the Regional ITS Architecture based on a 20-year vision of how they wanted to implement ITS in the Region. In addition to the Regional ITS Architecture, a separate ITS Deployment Plan was developed to identify and prioritize specific ITS projects recommended for the Region in order to implement the ITS Architecture.

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

## 1.2 Document Overview

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

**Section 1 – Introduction**

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

**Section 2 – Regional ITS Architecture Development Process**

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

**Section 3 – Customization of the National ITS Architecture for the Cleveland Region**

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

**Section 4 – Application of the Regional ITS Architecture**

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

**Section 5 – Maintaining the Regional ITS Architecture**

A maintenance plan has been developed for the Cleveland Regional ITS Architecture and is included in this section. The plan outlines the procedure for updating the ITS architecture over time.

The Cleveland Regional ITS Architecture also contains five appendices:

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

## 1.3 Cleveland Region

### *1.3.1 Geographic Boundaries*

The Cleveland Region includes all of Bradley County plus a portion of McMinn County as shown in **Figure 1**. The portion of McMinn County along the I-75 corridor to Exit 42 was included in the Cleveland Regional ITS Architecture for continuity with planning for management of fog events that impact I-75.

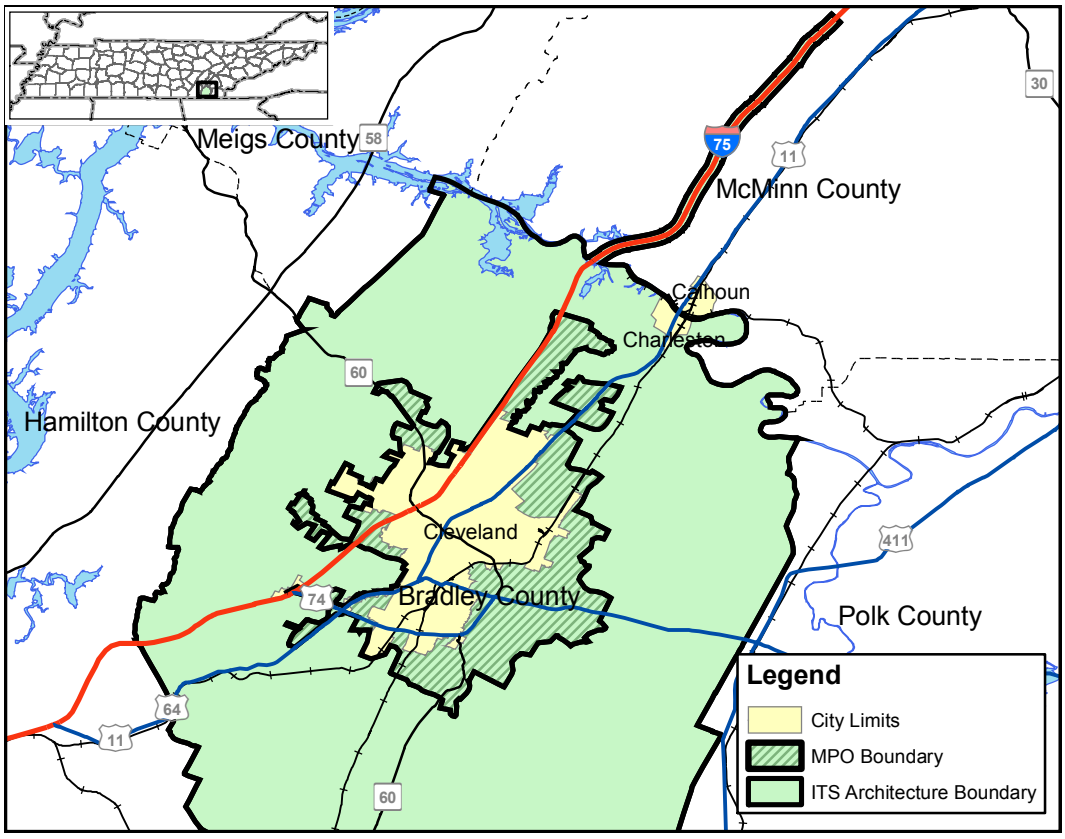


**Figure 1 – Cleveland Regional Boundaries**

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

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.

### 1.3.2 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 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.

### 1.3.3 Cleveland Region ITS Plans

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

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

The Cleveland Region has several ITS components deployed in the field. Examples of implementations in the Region include closed loop signal systems with video image vehicle detection systems (VIVDS), emergency vehicle signal preemption, and computer aided dispatch for emergency vehicles. As the Cleveland Region pursues funding opportunities for proposed projects, it will be necessary to show that a project fits within the ITS Architecture developed for the Region.

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

### 1.3.4 Stakeholders

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

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

**Table 1 – Cleveland Stakeholder Agencies and Contacts**

| Stakeholder Agency | Address | Contact |
|---|---|---|
| Bradley County Engineering Office | 155 Broad Street NW<br>Cleveland, Tennessee 37311 | Sandra Knight |
| Bradley County Engineering Office | 155 Broad Street NW<br>Cleveland, Tennessee 37311 | Shane Ware |
| Chattanooga-Hamilton County/North Georgia Transportation Planning Organization | 1250 Market Street Suite 2000<br>Chattanooga, Tennessee 37402 | R.C. Hoff |
| City of Cleveland | 190 Church Street SE<br>Cleveland, Tennessee 37311 | Janice Casteel |
| City of Cleveland | 474 2nd Street SE<br>Cleveland, Tennessee 37311 | Tom Grant |
| City of Cleveland | 160 2nd Street NE<br>Cleveland, Tennessee 37311 | James Long |
| City of Cleveland | 160 2nd Street NE<br>Cleveland, Tennessee 37311 | Megan Wilson |
| City of Cleveland Fire Department | 555 South Ocoee Street SE<br>Cleveland, Tennessee 37311 | Chuck Atchley |
| City of Cleveland Police Department | 100 Church Street SE<br>Cleveland, Tennessee 37311 | Wes Snyder |
| Cleveland – Bradley County EMA | 1555 Guthrie Drive NW<br>Cleveland, Tennessee 37311 | Matthew Cason |
| Cleveland – Bradley County EMA | 1555 Guthrie Drive NW<br>Cleveland, Tennessee 37311 | Jerry Johnson |
| Cleveland – Bradley County EMA | 1555 Guthrie Drive NW<br>Cleveland, Tennessee 37311 | Troy Spence |
| Cleveland – Bradley County EMA | 1555 Guthrie Drive NW<br>Cleveland, Tennessee 37311 | Brian Teague |
| Cleveland Urban Area MPO | 185 2nd Street NE<br>Cleveland, Tennessee 37311 | Anthony Casteel |
| Cleveland Urban Area MPO | 185 2nd Street NE<br>Cleveland, Tennessee 37311 | Greg Thomas |
| Cleveland Urban Area MPO | 190 Church Street NE<br>Cleveland, Tennessee 37364 | Tom Rowland |
| Cleveland Transit | 1250 Old Chattanooga Pike<br>Cleveland, Tennessee 37311 | Bill Walker |
| Cleveland Utilities | 2450 Guthrie Drive NW<br>Cleveland, Tennessee 37311 | Bart Borden |
| Cleveland Utilities | 2450 Guthrie Drive NW<br>Cleveland, Tennessee 37311 | Ken Longley |
| Federal Highway Administration – TN Division | 640 Grassmere Park Road<br>Suite 112<br>Nashville, Tennessee 37211-3568 | Don Gedge |
| Southeast Tennessee Human Resource Agency | 1012 Resource Road<br>Dunlap, Tennessee 37327 | Ray Evans |
| Southeast Tennessee Human Resource Agency | 1012 Resource Road<br>Dunlap, Tennessee 37327 | Chris Kleehammer |
| Southeast Tennessee Human Resource Agency | 1250 Old Chattanooga Pike<br>Cleveland, Tennessee 37311 | David Tortorich |

**Table 1 – Cleveland Stakeholder Agencies and Contacts (continued)**

| Stakeholder Agency | Address | Contact |
|---|---|---|
| State of Tennessee Office of Homeland Security | P.O. Box 3570<br>Cleveland, Tennessee 37320 | Dan Gilley |
| Tennessee Department of Transportation – Long Range Planning Division | 505 Deadrick Street<br>Suite 900, James K. Polk Bldg.<br>Nashville, Tennessee 37243-0334 | Ralph Comer |
| Tennessee Department of Transportation – Long Range Planning Division | 505 Deadrick Street<br>Suite 900, James K. Polk Bldg.<br>Nashville, Tennessee 37243-0334 | Deborah Fleming |
| Tennessee Department of Transportation – Long Range Planning Division | 505 Deadrick Street<br>Suite 900, James K. Polk Bldg.<br>Nashville, Tennessee 37243-0334 | Joe Roach |
| Tennessee Department of Transportation – Region 2 | 4005 Cromwell Road<br>Chattanooga, Tennessee 37422 | Jeff Blevins |
| Tennessee Department of Transportation – Region 2 | 4005 Cromwell Road<br>Chattanooga, Tennessee 37422 | Jennifer Flynn |
| Tennessee Department of Transportation – Region 2 | 4005 Cromwell Road<br>Chattanooga, Tennessee 37422 | Scott Medlin |
| Tennessee Department of Transportation – Region 2 SmartWay Center | 4005 Cromwell Road<br>Chattanooga, Tennessee 37422 | Alan Wolfe |
| Tennessee Department of Transportation – Region 2 HELP Operations | 4005 Cromwell Road<br>Chattanooga, Tennessee 37422 | Bob Van Horn |

# 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. A series of four workshops was held with stakeholders to gather input, and draft documents were made available to stakeholders for review and comment.

The process followed for the 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.

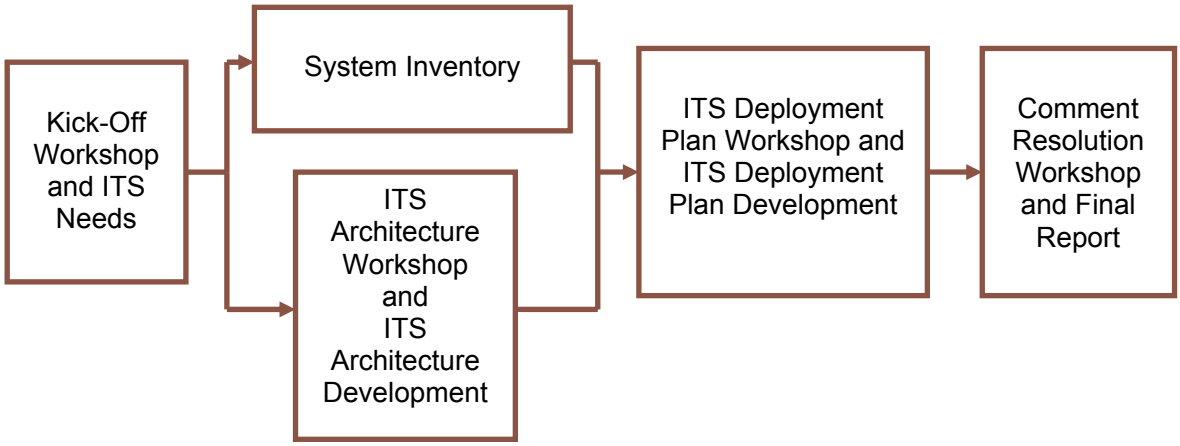


**Figure 2 – Cleveland Regional ITS Architecture and Deployment Plan Development Process**

## 2.1 Stakeholder Workshops

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

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

Key components of the process are described below:

**Task 1 – Kick-Off Workshop and ITS Needs:** A stakeholder group was identified that included representatives from regional transportation, transit, and emergency management agencies. The group was invited to the project Kick-Off Workshop where ITS needs for the Region were identified and dates for upcoming workshops agreed upon.

**Task 2 – System Inventory:** Collecting information for the system inventory began at the Kick-Off Workshop through discussions with the stakeholders to determine existing and planned ITS elements in the Region. After the Kick-Off Workshop, follow-up calls were conducted with several local stakeholders to gather additional input.

**Task 3 – ITS Architecture Workshop and ITS Architecture Development:** The purpose of the Regional ITS Architecture Workshop was to review the system inventory with stakeholders and develop the Cleveland Regional ITS Architecture. Training on the National ITS Architecture was integrated into the workshop so that key elements of the architecture, such as market packages, could be explained prior to the selection and editing of these elements. The result of the Regional ITS Architecture Workshop was an ITS architecture for the Cleveland Region that included a system inventory, interconnect diagram, customized market packages, functional requirements, and relevant ITS standards. Following the workshop, a Draft Regional ITS Architecture document was prepared and sent to stakeholders for review and comment.

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

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

## 2.2 Turbo Architecture

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

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

**Table 2 – Turbo Architecture Report and Diagrams**

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

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

# 3. CUSTOMIZATION OF THE NATIONAL ITS ARCHITECTURE FOR THE CLEVELAND REGION

## 3.1 Systems Inventory

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

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

- ***Traffic Management*** – includes the TDOT SmartWay TMC in 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 coordination with CVISN efforts.
- ***Traveler Information*** – includes broadcast traveler information, traveler information kiosks, and highway advisory radio (HAR).
- ***Archived Data Management*** – includes electronic data management and archiving systems.
- ***Vehicle Safety*** – these systems were discussed, but at this time this service group is primarily a private sector initiative to incorporate technologies such as intersection collision avoidance and automated vehicle operation systems into vehicles.

## 3.2 Regional Needs

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

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

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

## 3.3 Element Customization

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

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

### *3.3.1 Subsystems and Terminators*

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

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

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

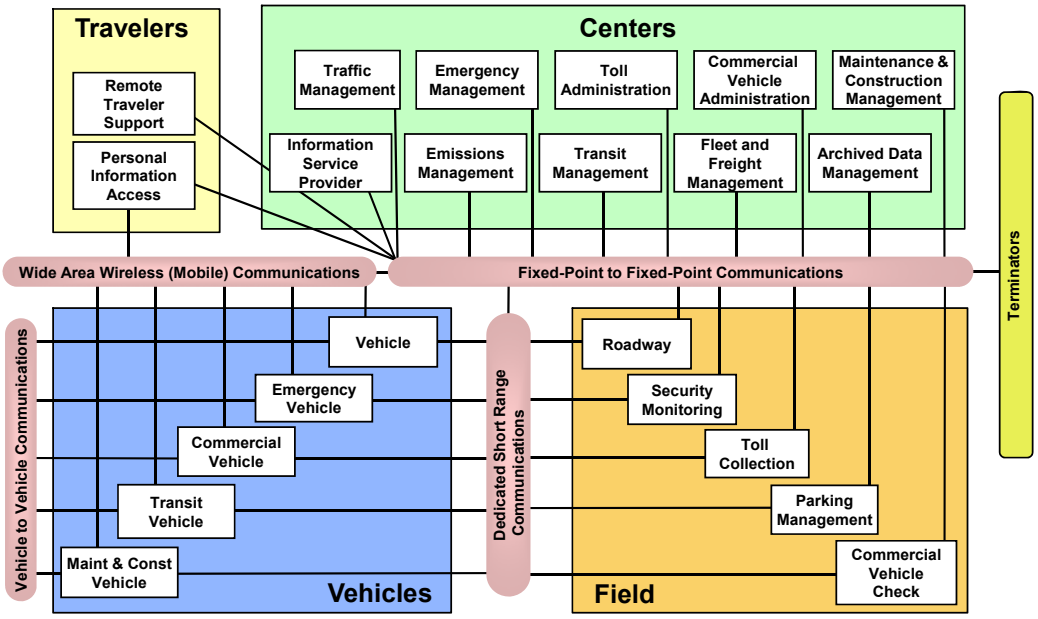


**Figure 3 – National ITS Architecture Physical Subsystem Interconnect Diagram**

### *3.3.2 ITS Inventory by Stakeholder*

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

**Table 3 – Cleveland Region Stakeholder Descriptions**

| Stakeholder | Stakeholder Description |
|---|---|
| Bradley County | County government for Bradley County. Includes all county departments including Emergency Medical Services (EMS), Fire, Sheriff and Highway as well as the Cleveland-Bradley County Emergency Management Agency (EMA). |
| 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 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 | The National Oceanic and Atmospheric Administration gathers weather information and issues severe weather warnings. |
| Other Agencies | This stakeholder represents a wide variety of agencies. The associated elements are groups of agencies or providers that do not have a primary stakeholder agency. |
| Other States | Emergency or traffic management agencies in other states adjacent to Tennessee. 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 | Regional agency that operates the Southeast Tennessee Human Resource Agency (SETHRA) Public Transportation. 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 | The Tennessee Emergency Management Agency is responsible for emergency operations during a disaster or large scale incident. |
| Tennessee Bureau of Investigation | Statewide law enforcement agency responsible for issuing statewide AMBER Alerts in Tennessee. |
| Tennessee Department of Health and Human Services | State department that manages funding for medical transportation services. |
| Tennessee Valley Authority | The Tennessee Valley Authority produces power for distribution by local power distributors in the Tennessee River Valley (TVA). 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. |

**Table 4 – Cleveland Region Inventory of ITS Elements**

| Stakeholder | Element Name | Element Description | Status |
|---|---|---|---|
| Bradley County | Bradley County 911 Dispatch | 911 Public Safety Answering Point (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's Office | Bradley County law enforcement agency. The emergency dispatch functions for the Sheriff's Office 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 Office. | 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 are part of the overheight vehicle detection system in Cleveland and notify drivers when their vehicle is overheight, indicating the need to detour. | Planned |
| | City of Cleveland CCTV Cameras | Closed circuit television cameras operated by the City of Cleveland TOC for traffic condition monitoring and management of incidents. | Planned |
| | City of Cleveland DMS | Dynamic message signs for traffic information dissemination operated by the City of Cleveland; includes portable signs. | Existing |
| | City of Cleveland Emissions Sensors | Emissions monitoring equipment operated by the City of Cleveland. | 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 VIVDS and any other vehicle detection. | 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. | Existing |
| | City of Cleveland Overheight Vehicle Detection | Sensors that detect overheight vehicles on the approach to a height restricted underpass. The sensors trigger beacon warning signs 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 Public Works Department | Department that oversees the maintenance of streets, sidewalks, and roadway right-of-way. The Department operates the Cleveland traffic signal system and will also operate any future CCTV cameras or DMS. | Existing |
| | City of Cleveland Public Works Department Vehicles | Vehicles used by the City of Cleveland Public Works Department in maintenance and construction activities. | 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 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 |
| | Cleveland Urban Area MPO Data Archive | Archive for transportation information such as traffic counts and transit ridership data for use in regional transportation planning. | Planned |
| | Cleveland Utilities | Energy provider for the City of Cleveland. Also performs traffic signal maintenance. | Existing |
| Financial Institution | Financial Service Provider | Handles exchange of money for transit electronic payment collection. | Existing |
| McMinn County | McMinn County 911 Dispatch | 911 PSAP responsible for answering all 911 calls made within the county and dispatching emergency responders. | Existing |

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

| Stakeholder | Element Name | Element Description | Status |
|---|---|---|---|
| McMinn County (continued) | 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 Public Safety Vehicles | Municipal law enforcement, fire, and EMS vehicles. | Existing |
| | Municipal TOC | Municipal Traffic Operations Center responsible for municipal signal system operations. | Existing |
| | Municipal Traffic Signals | Municipal traffic signal systems, including those operated by Bradley County. | Existing |
| | Municipal/County Maintenance | Division of municipal government responsible for the maintenance of roadways. | Planned |
| 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 | 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 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 |
| | Georgia NaviGAtor | Statewide traffic management center for the State of Georgia. | Existing |
| Private Information Provider | Private Sector Traveler Information Services | Traveler information service operated by a private entity. | Existing |
| Rail Operators | Rail Operator Wayside Equipment | Equipment located along the tracks including railroad crossing gates, bells, and lights as well as the interface to the traffic signal controller indicating the presence of a train. | Existing |
| | Railroad Operators | Centers responsible for the operation and tracking of trains. | Existing |

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

| Stakeholder | Element Name | Element Description | Status |
|---|---|---|---|
| Southeast Tennessee Human Resource Agency | Cleveland Urban Area Transit System Vehicles | Fixed route transit vehicles used within the City of Cleveland. The Cleveland Urban Area Transit system is operated by SETHRA. | Existing |
| | Electronic Fare Payment Card | Medium for collection of transit fares electronically. | 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 and the Cleveland Urban Area Transit System. | Existing |
| | SETHRA Transportation Vehicles | SETHRA demand response transit vehicles including those that provide paratransit services for disabled travelers. | Existing |
| | SETHRA Transportation Website | Website with information about fares and schedules. At this time the website is static. | Existing |
| System Users | Archive Data User | Those who request information from the data archive systems. | Existing |
| | Commercial Vehicles | Privately owned commercial vehicles traveling within the Region. | Existing |
| | Private Fleet Management Systems | Responsible for commercial vehicle fleet operations including vehicle tracking and records management. | Existing |
| | Personal Computing Devices | Computing devices that travelers use to access public information. | Existing |
| | Traveler | User of the transportation system. | Existing |
| TDOT | Other TDOT Regions Construction Office | Other Tennessee Department of Transportation regional construction offices. | Existing |
| | Other TDOT Regions Maintenance | Other Tennessee Department of Transportation regional maintenance offices. | Existing |
| | TDOT CCTV Cameras | Closed circuit television cameras for traffic surveillance and incident management. | Existing |
| | TDOT Changeable Speed Limit Signs | Roadway equipment that is part of the fog management system used to lower speed limits on the affected roadway segment during fog conditions. | Existing |
| | TDOT District 21 Maintenance | Each Tennessee Department of Transportation Region contains several TDOT District Maintenance Offices. These District Maintenance Offices handle most of the routine roadway maintenance and respond to incidents when their services are requested by local emergency management. | Existing |

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

| Stakeholder | Element Name | Element Description | Status |
|---|---|---|---|
| TDOT (continued) | TDOT DMS | Dynamic message signs for traffic information dissemination. | Existing |
| | TDOT Emergency Services Coordinator | The Tennessee Department of Transportation emergency services coordinator is responsible for managing the TDOT response in a large scale incident or disaster in which TEMA activates the state emergency operations center (EOC). | Existing |
| | TDOT Field Sensors | Roadway equipment used to detect vehicle volumes and/or speeds. Includes equipment such as VIVDS, remote traffic microwave sensor (RTMS), or traditional loops. | Planned |
| | TDOT Fog Sensors | Roadway equipment used to detect the presence of fog and activate the rest of the fog management system. | Existing |
| | TDOT Fog Zone Speed Detection | Roadway equipment that is part of the fog management system used to detect vehicle speeds. | Existing |
| | TDOT HAR | Highway advisory radio for traffic information dissemination. | Existing |
| | TDOT HELP Vehicles | Roadway service patrol vehicles. Currently operate in Chattanooga and are dispatched to the Cleveland Region for special events or large incidents. | Existing |
| | TDOT Maintenance Headquarters | The Tennessee Department of Transportation maintenance headquarters. | Existing |
| | TDOT Maintenance Vehicles | The Tennessee Department of Transportation vehicles used in maintenance operations. | Existing |
| | TDOT On-Ramp Closure Gates | Roadway equipment that is part of the fog management system used to close freeway on-ramps during a fog event. | Existing |
| | TDOT Project Planning Division Archive | Data archive for the Project Planning Division. The Division is responsible for traffic data collection and analysis and includes the Short Range Planning Office. | Existing |
| | TDOT Public Information Office | Office responsible for the dissemination of traffic information to the media and the public. | Existing |
| | TDOT Region 1 TMC – Knoxville | Transportation management center for Region 1, located in Knoxville. Responsible for the operation of the ITS equipment located in Region 1. This includes the freeway management system in Knoxville as well as rural ITS deployments. | Existing |

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

| Stakeholder | Element Name | Element Description | Status |
|---|---|---|---|
| TDOT (continued) | TDOT Region 2 Construction Office | The Tennessee Department of Transportation office responsible for oversight of construction projects in Region 2. | Existing |
| | TDOT Region 2 Engineers Office | Region 2 Engineer's office is responsible for administration of maintenance and construction projects within the Region as well as communicating work zone information to the public through the Public Information Officer. | Existing |
| | TDOT Region 2 HELP Dispatch | Roadway service patrol dispatch center located in Chattanooga. Currently service is limited to the Chattanooga area except in the case of a large scale incident or special events. | Existing |
| | TDOT Region 2 Maintenance | 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; District 21 serves the Cleveland Region. | Existing |
| | TDOT Region 2 TMC – Chattanooga | Transportation management center for Region 2, located in Chattanooga. Responsible for the operation of the ITS equipment located in Region 2. This includes the freeway management system in Chattanooga as well as rural ITS deployments. The Cleveland Region is located in Region 2. | Existing |
| | TDOT Region 3 TMC – Nashville | Transportation management center for Region 3, located in Nashville. Responsible for the operation of the ITS equipment located in Region 3. This includes the freeway management system in Nashville as well as rural ITS deployments. | Existing |
| | TDOT Region 4 TMC – Memphis | Transportation management center for Region 4, located in Memphis. Responsible for the operation of the ITS equipment located in Region 4. This includes the freeway management system in Memphis as well as rural ITS deployments. | Existing |
| | TDOT RWIS Sensors | Road weather information system (RWIS) sensors to monitor road conditions. | Planned |
| | TDOT Smart Work Zone Equipment | Portable ITS equipment that can be used in work zones to more efficiently manage traffic and provide traveler information. Includes portable CCTV cameras, vehicle detection, and DMS. | Existing |

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

| Stakeholder | Element Name | Element Description | Status |
|---|---|---|---|
| TDOT(continued) | TDOT SmartWay Information System (TSIS) | TSIS is a statewide roadways conditions database. Currently information can be entered by District and Regional maintenance personnel as well as staff at any of the transportation management centers or the THP. TSIS feeds the Statewide 511 system. | Existing |
| | TDOT SmartWay Website | Website providing road network conditions information. Much of the information for the website comes from TSIS. In areas that have an operational TDOT Region TMC, additional information may be available such as camera views. | Existing |
| | Tennessee 511 IVR | Tennessee 511 Interactive Voice Response (IVR). TDOT contracts the interactive voice response (IVR) operation to a vendor. The IVR accepts callers' requests and provides responses to specific traveler information needs. This is the customer interface component of the 511 phone system. | Existing |
| | Tennessee 511 System | 511 traveler information system central server. | Existing |
| | Tennessee GoSmart Kiosks | Kiosks in rest areas that provide traveler information, including weather, road, and travel conditions. | Existing |
| TEMA | TEMA | The Tennessee Emergency Management Agency manages emergency operations during a disaster or large scale incident. | Existing |
| Tennessee Bureau of Investigation | Tennessee Bureau of Investigation | Responsible for issuing statewide AMBER Alerts in Tennessee. | Existing |
| Tennessee Department of Health and Human Services | Health and Human Services | Provides health related services including the subsidization of transportation to obtain medical services. | Existing |
| 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 |
| Tennessee Valley Authority (continued) | TVA Siren System | Emergency alerting siren system in case of an incident at the Sequoyah nuclear power plant. | Existing |

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

| Stakeholder | Element Name | Element Description | Status |
|---|---|---|---|
| THP | THP Dispatch | Tennessee Highway Patrol dispatch center. There are several THP dispatch centers around the State. | Existing |
| | THP 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 |
| | TraCS Database | Traffic and Criminal Software (TraCS) owned by the Tennessee Department of Safety. THP operates the system. | Existing |

### 3.3.3 Top Level Regional System Interconnect Diagram

A system interconnect diagram, or "sausage diagram" (shown previously in **Figure 3**), shows the systems and primary interconnects in the Region. The National ITS Architecture interconnect diagram has been customized for the Cleveland Region based on the system inventory and information gathered from the stakeholders. **Figure 4** 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.

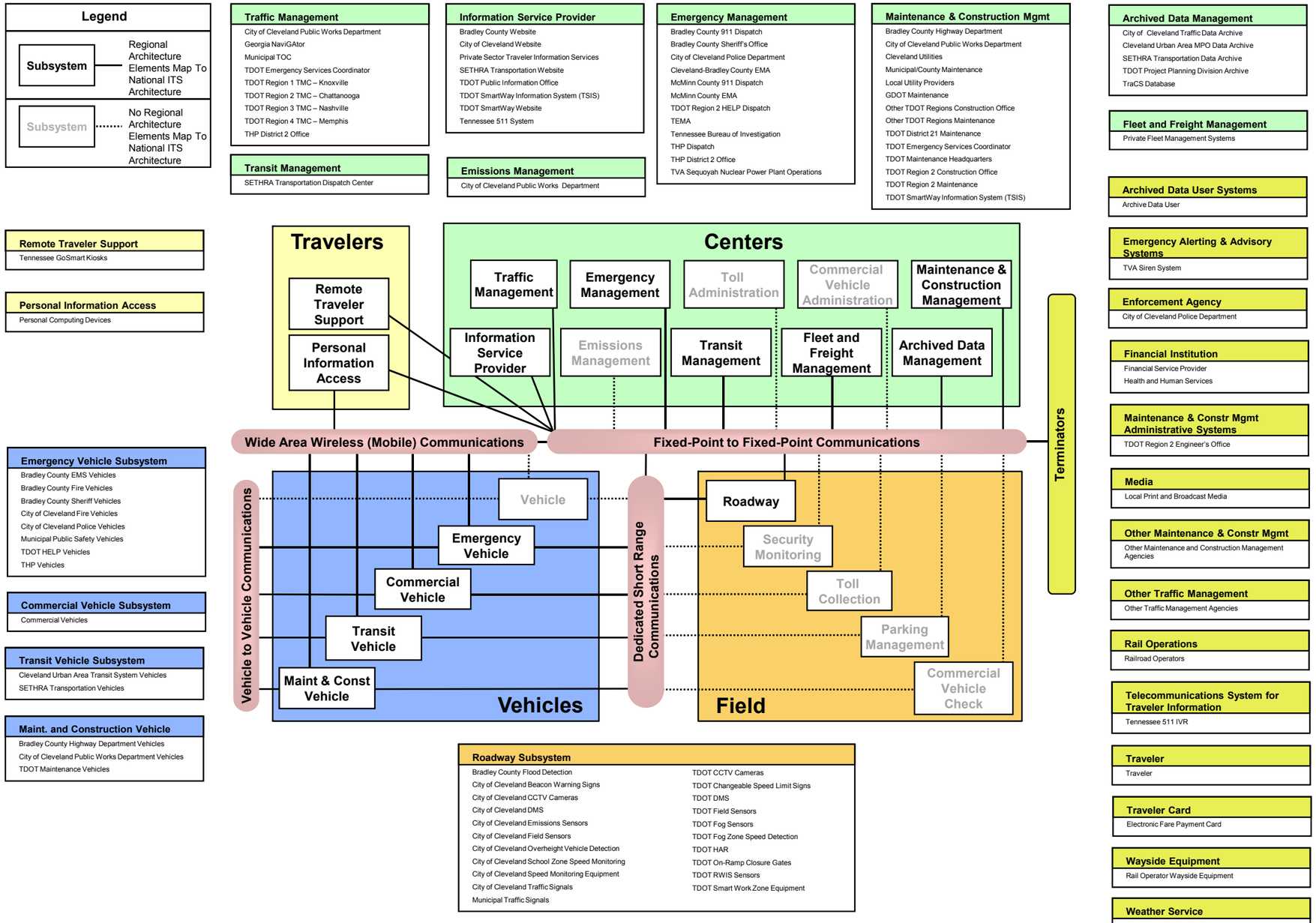


**Figure 4 – Cleveland Regional System Interconnect Diagram**

## 3.4 Market Packages

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

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

### *3.4.1 Selection and Prioritization of Regional Market Packages*

In the Cleveland Region, the National ITS Architecture market packages were reviewed by the stakeholders and selected based on the relevance of the service that the market package could provide to the Region. Stakeholders selected 36 market packages for implementation in the Region. They are identified in **Table 5**. Stakeholders prioritized the selected market packages during the workshop, and the table organizes the market packages into service areas and priority groupings.

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

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

**Table 5 – Cleveland Region Market Package Prioritization by Functional Area**

| High Priority Market Packages | Medium Priority Market Packages | Low Priority Market Packages |
|---|---|---|
| ***Travel and Traffic Management*** | | |
| ATMS01 Network Surveillance<br>ATMS03 Surface Street Control<br>ATMS06 Traffic Information Dissemination<br>ATMS08 Traffic Incident Management System<br>ATMS21 Roadway Closure Management | ATMS07 Regional Traffic Management<br>ATMS13 Standard Railroad Grade Crossing<br>ATMS19 Speed Monitoring | ATMS11 Emissions Monitoring and Management<br>ATMS15 Railroad Operations Coordination |
| ***Emergency Management*** | | |
| EM01 Emergency Call-Taking and Dispatch<br>EM02 Emergency Routing<br>EM06 Wide-Area Alert<br>EM10 Disaster Traveler Information | EM04 Roadway Service Patrols<br>EM08 Disaster Response and Recovery<br>EM09 Evacuation and Reentry Management | |
| ***Maintenance and Construction Management*** | | |
| MC03 Road Weather Data Collection<br>MC04 Weather Information Processing and Distribution<br>MC08 Work Zone Management<br>MC10 Maintenance and Construction Activity Coordination | MC01 Maintenance and Construction Vehicle and Equipment Tracking | MC02 Maintenance and Construction Vehicle Maintenance |
| ***Public Transportation Management*** | | |
| APTS01 Transit Vehicle Tracking<br>APTS02 Transit Fixed-Route Operations<br>APTS03 Demand Response Transit Operations<br>APTS05 Transit Security | APTS04 Transit Fare Collection Management<br>APTS08 Transit Traveler Information<br>APTS10 Transit Passenger Counting | APTS06 Transit Fleet Management |
| ***Commercial Vehicle Operations*** | | |
| | CVO10 HAZMAT Management | |
| ***Traveler Information*** | | |
| ATIS01 Broadcast Traveler Information<br>ATIS02 Interactive Traveler Information | | |
| ***Archived Data Management*** | | |
| | AD1 ITS Data Mart | AD2 ITS Data Warehouse |

### 3.4.2 Customized Market Packages

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

**Figure 5** is an example of an ATMS market package for Surface Street Control that has been customized for the Region. This market package shows the two subsystems, Traffic Management and Roadway, and the associated entities (City of Cleveland Public Works Department and City of Cleveland Traffic Signals) for surface street control in the Region. Data flows between the subsystems indicate what information is being shared. The remainder of the market packages that were customized for the Cleveland Region are shown in **Appendix B** along with a market package diagram component and terminology key.

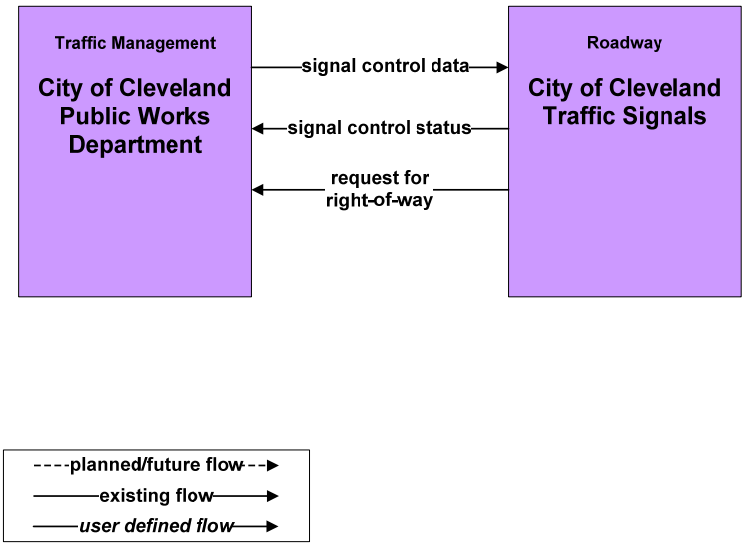


**Figure 5 – Example Market Package Diagram: ATMS03 – Surface Street Control**

### 3.4.3 Regional ITS Needs and Customized Market Packages

Input received from stakeholders at the Kick-Off Workshop provided valuable input for the market package customization process. The specific needs identified are included in **Table 6**. The table also identifies which market package documents the particular ITS need.

**Table 6 – Regional ITS Needs and Corresponding Market Packages**

| ITS Need | Market Package |
|---|---|
| Travel and Traffic Management | |
| Need an expanded and coordinated closed loop signal system for the City of Cleveland | ATMS03 |
| Need to upgrade traffic signal controllers | AMTS03 |
| 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 |
| Need DMS on US 411 primarily to provide information to those detouring from I-75 | ATMS06 |
| Need CCTV cameras within the City and along TDOT roadways for DMS verification and to monitor traffic | ATMS01 |
| Need improved information dissemination of road conditions information on state and local routes | ATMS06<br>ATIS1<br>ATIS2 |
| Need driver feedback signs and associated speed data archive to support targeted enforcement | ATMS19 |
| Need overheight detection system on SR 40/US 64 at low railroad crossing | ATMS01 |
| Need school zone flasher control system | ATMS19 |
| Public Transportation Management | |
| Need security monitoring systems on buses | APTS05 |
| Emergency Management | |
| Need to expand emergency vehicle traffic signal preemption system for the Fire Department and possibly add traffic signal preemption for EMS | EM02 |
| Need data and video transfer capabilities between 911 and traffic management | ATMS08 |
| Need to be able to receive real-time traffic information to aid in emergency vehicle dispatch | ATMS06<br>EM02 |
| Need detection and notification system for railroad crossing blockages to support emergency vehicle dispatch | ATMS13<br>EM02 |
| Need capability to monitor CCTV and control DMS from the EOC during evacuations | ATMS08 |
| Maintenance and Construction Management | |
| Need improved communication and dissemination of information on lane closures to traffic management | MC10 |
| Need additional weather detection | MC03 |
| Need flood detection for Bradley County | MC03 |

## 3.5 Architecture Interfaces

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

### *3.5.1 Element Connections*

A 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 particular interconnect diagram is for the City of Cleveland Traffic Signals.

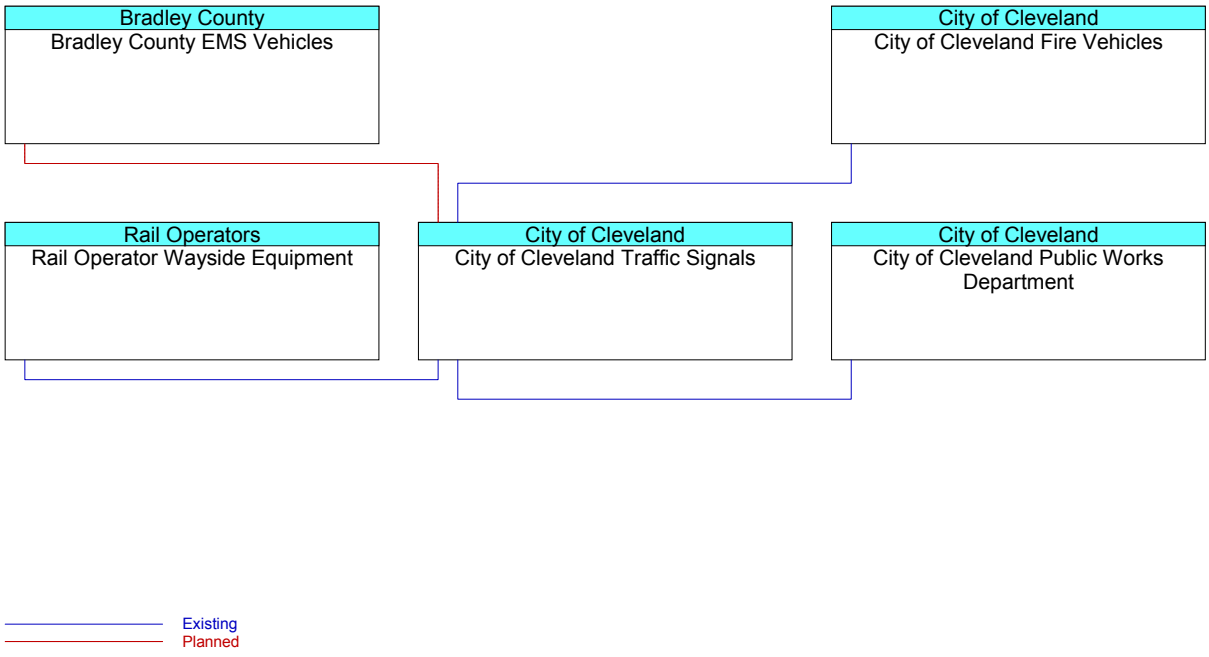


**Figure 6 – Example Interconnect Diagram: City of Cleveland Traffic Signals**

### 3.5.2 Data Flows Between Elements

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

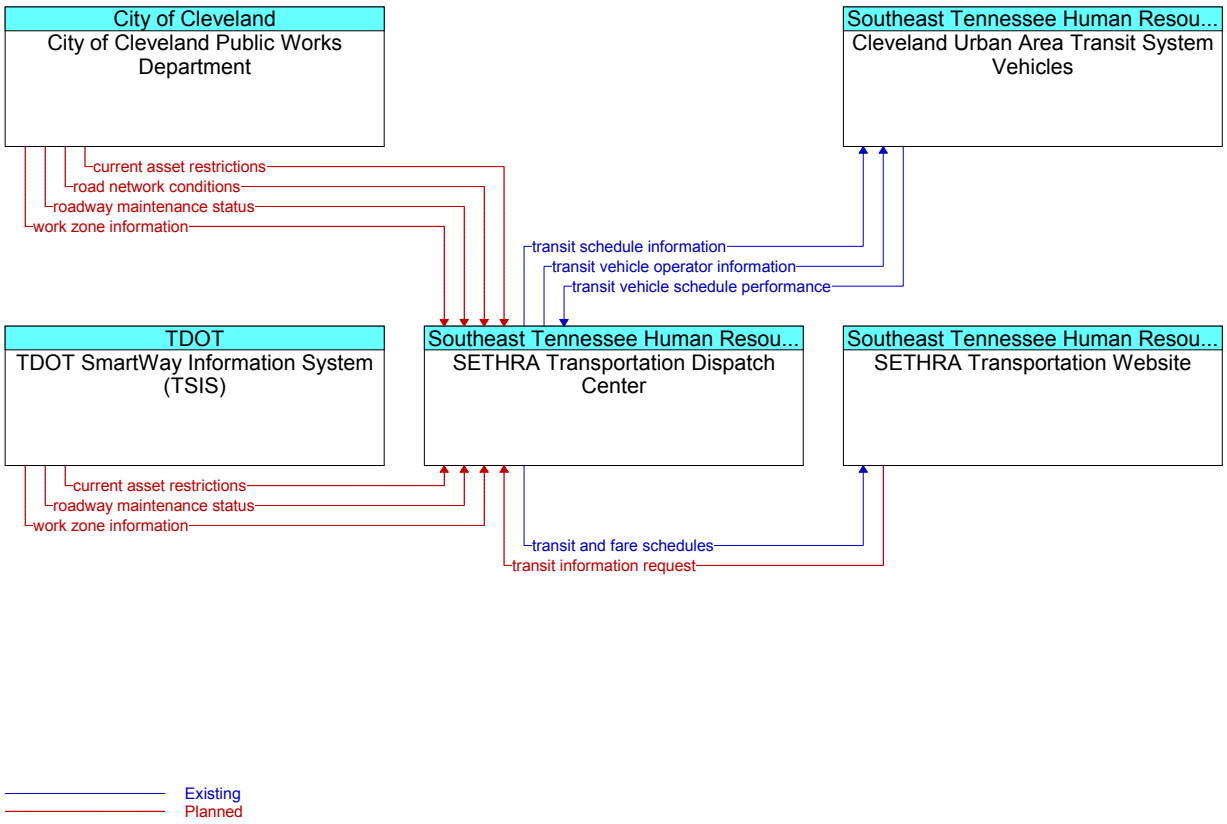


**Figure 7 – Example Flow Diagram: APTS02 – Transit Fixed Route Operations**

# 4. APPLICATION OF THE REGIONAL ITS ARCHITECTURE

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

## 4.1 Functional Requirements

Functions are a description of what the system has to do. In the National ITS Architecture, functions are defined at several different levels, ranging from general subsystem descriptions through somewhat more specific equipment package descriptions to Process Specifications that include substantial detail. Guidance from the USDOT on developing a Regional ITS Architecture recommends that each Region determine the level of detail of the functional requirements for their Region. In the 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 market packages, discussed previously in Section 3.4.2, describe the services that ITS needs to provide in the Region and the architecture flows between the elements. These market packages and data flows describe what ITS in the 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.

## 4.2 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 7** identifies each of the ITS standards that could apply to the Cleveland Regional ITS Architecture. These standards are based on the physical subsystem architecture flows previously identified in Section 3.5.2.

**Table 7 – Cleveland Region Applicable ITS Standards**

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

**Table 7 – Cleveland Region Applicable ITS Standards (continued)**

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

## 4.3 Operational Concepts

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

- ***Surface Street Management*** – The development of signal systems that react to changing traffic conditions and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions.
- ***Freeway Management*** – The development of systems to monitor freeway traffic flow and roadway conditions, and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. Includes systems to provide information to travelers on the roadway.
- ***Incident Management*** – The development of systems to provide rapid and effective response to incidents. Includes systems to detect and verify incidents, along with coordinated agency response to the incidents.

- ***Emergency Management*** – The development of systems to provide emergency call taking, public safety dispatch, and emergency operations center operations.
- ***Maintenance and Construction Management*** – The development of systems to manage the maintenance of roadways in the Region, including winter snow and ice clearance. Includes the managing of construction operations and coordinating construction activities.
- ***Transit Management*** – The development of systems to more efficiently manage fleets of transit vehicles or transit rail. Includes systems to provide transit traveler information both pre-trip and during the trip.
- ***Electronic Payment*** – The development of electronic fare payment systems for use by transit and other agencies (e.g., parking).
- ***Commercial Vehicle Operations*** – The development of systems to facilitate the management of commercial vehicles (e.g., electronic clearance).
- ***Traveler Information*** – The development of systems to provide static and real time transportation information to travelers.
- ***Archived Data Management*** – The development of systems to collect transportation data for use in non-operational purposes (e.g., planning and research).

**Table 8** identifies the roles and responsibilities of key stakeholders for a range of transportation services.

**Table 8 – Cleveland Region Stakeholder Roles and Responsibilities**

| Transportation Service | Stakeholder | Roles/Responsibilities |
|---|---|---|
| Surface Street Management | 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 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. |

**Table 8 – Cleveland Region Stakeholder Roles and Responsibilities (continued)**

| Transportation Service | Stakeholder | Roles/Responsibilities |
|---|---|---|
| Incident Management (Traffic) | 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. |
| Incident Management (Emergency) | 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 8 – 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 8 – 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 TSIS. |
| | | Disseminates work activity schedules and current asset restrictions to other agencies. |
| | | Operates work zone traffic control equipment including portable surveillance equipment, DMS, and HAR transmitters. |
| 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 8 – Cleveland Region Stakeholder Roles and Responsibilities (continued)**

| Transportation Service | Stakeholder | Roles/Responsibilities |
|---|---|---|
| Traveler Information (continued) | TDOT (continued) | Provide transportation information to travelers via traveler information kiosks. |
| | | 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. |

## 4.4 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 data flows among public and private entities in the Region will require agreements among agencies that establish parameters for sharing agency information to support traffic management, incident management, provide traveler information, and perform other functions identified in the Regional ITS Architecture.

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

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

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

Common agreement types and potential applications include:

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

There is only one agreement that is currently existing in the Cleveland Region related to ITS. In 2007 the Cleveland Urban Area MPO and the Chattanooga Hamilton County-North Georgia Transportation Planning Organization (TPO) signed a MOU regarding the development and maintenance of Regional ITS Architectures in the Cleveland and Chattanooga Regions. The MOU stated that the:

- Cleveland Urban Area MPO and Chattanooga Hamilton County-North Georgia TPO will develop separate Regional ITS Architectures for their respective Regions;
- Cleveland Urban Area MPO elements that were covered in the Chattanooga ITS Architecture at that time will remain in the Chattanooga ITS Architecture until the Cleveland Regional ITS Architecture is completed;
- Cleveland Urban Area MPO and Chattanooga Hamilton County-North Georgia TPO will actively coordinate and cooperate in the development and maintenance of each others respective Regional ITS Architectures;
- Interstate 75 Fog Detection System will be included in the Chattanooga Regional ITS Architecture; and
- Each Regional ITS Architecture will work to establish a cooperative agreement among and between ITS stakeholders in each respective Region, to promote safe and efficient development, management, and operation of the surface transportation system.

**Table 9** 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.

**Table 9 – Cleveland Region Existing and Potential Agreements**

| Status | Agreement and Agencies | Agreement Description |
|---|---|---|
| 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. |
| Future | **Data Sharing and Usage (Public-Private)** – (TDOT, City of Cleveland, Media) | Agreement would allow private sector media and information service providers to access and broadcast public sector transportation agency CCTV camera video feeds, real time traffic speed and volume data, and incident data. Agreements should specify the control priority to allow traffic agencies first priority to control cameras during incidents or other events. The ability of the traffic agency to deny access to video and data feeds if a situation warrants such action should also be part of the agreement. |
| Future | **Data Sharing and Usage (Public-Public)** – (TDOT, 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. |
| 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. |
| 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. |
| 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. |
| 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. |
| Future | **Shared Maintenance Agreements** – (TDOT, City of Cleveland) | Agreement that would allow multiple public agencies to pool their funding together to hire a single maintenance contractor to maintain ITS devices throughout the Region. This type of agreement may reduce the cost of maintenance particularly for agencies with a limited number of ITS devices deployed. By combining all maintenance into a single contract the need for each agency to provide specialized training and equipment to staff is eliminated. |

## 4.5 Phases of Implementation

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

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

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

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

## 4.6 Incorporation into the Regional Planning Process

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

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

### *4.6.1 Process for Determining Architecture Conformity*

The Cleveland Regional ITS Architecture documents the customized market 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. The steps of the process are as follows:

- Identify the ITS components in the project;
- Identify the corresponding market packages(s) from the Regional ITS Architecture;
- Locate the component within the market package;

- Compare the connections to other agencies or elements documented in the ITS architecture as well as the information flows between them to the connections that will be part of the project; and
- Document any changes necessary to the Regional ITS Architecture or the project to ensure there is conformance.

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

**Step 1 – Identify the ITS Components**

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

**Step 2 – Identify the Corresponding Market Packages**

If a project was included in Table 9 through Table 15 of the Cleveland Regional ITS Deployment Plan, then the applicable market package(s) for that project are identified in a column of the tables. However, ITS projects are not required to be included in the ITS Deployment Plan in order to be eligible for federal funding; therefore, market packages might need to be identified for projects that have not been covered in the ITS Deployment Plan. In that case, the market packages selected and customized for the Cleveland Region should be reviewed to determine if they adequately cover the project. Market packages selected for the Cleveland Region are identified in **Table 4** of this document and detailed market package definitions are located in **Appendix A**.

**Step 3 – Identify the Component within the Market Package**

The customized market packages for the Cleveland Region are located in **Appendix B**. Once the element is located within the appropriate market package the evaluator should determine if the element name used in the market package is accurate or if a change to the name is needed. For example, an element called the City of Cleveland Public Works Department was included in the Regional ITS Architecture and included the City's TOC, but at the time of deployment, the City might decide to call the TOC by a new name. This name change should be documented using the process outlined in Section 5.2.

**Step 4 – Evaluate the Connections and Flows**

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

**Step 5 – Document Required Changes**

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

# 5. MAINTAINING THE REGIONAL ITS ARCHITECTURE

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

## 5.1 Maintenance Process

The Cleveland Urban Area MPO will be responsible for leading the process to update the Cleveland Regional ITS Architecture and Deployment Plan in coordination with the TDOT Long Range Planning Division. **Table 10** summarizes the maintenance process agreed upon by stakeholders in the Region.

**Table 10 – Regional ITS Architecture and Deployment Plan Maintenance Summary**

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

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

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

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

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

## 5.2 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 5.1 to maintain the architecture as a useful planning tool. Between major plan updates smaller modifications will likely be required to accommodate ITS projects in the Region. Section 4.6.1 contains step by step guidance for determining whether or not a project requires architecture modifications to the Regional ITS Architecture.

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