# Toledo Regional ITS Architecture Update Documentation

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**Revision History**

| Filename | Version | Date | Author | Comment |
| --- | --- | --- | --- | --- |
| Toledo Regional ITS Architecture Doc-v2.0 (06-30-16 | 2.0 | 6/30/2016 | J. Baker | Revised draft of Document |
| Toledo Regional ITS Architecture Doc- v2 Final | 2.0 | 9/29/16 | B Eisenhart | Final document for Updated Architecture |
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# 1. Introduction

The ***Toledo Regional Intelligent Transportation Systems (ITS) Architecture*** is a roadmap for transportation systems integration in the Lucas, Wood, and portions of Monroe Counties over the next 15 years. The architecture, originally developed in 2004, has been updated through a cooperative effort by the region's transportation agencies, covering all modes and all roads in the region. The architecture represents a shared vision of how each agency's systems will work together in the future, sharing information and resources to provide a safer, more efficient, and more effective transportation system for travelers in the region.

The architecture is an important new tool that will be used by:

- Operating Agencies to recognize and plan for transportation integration opportunities in the region.
- Planning Agencies to better reflect integration opportunities and operational needs into the transportation planning process.
- Other organizations and individuals that use the transportation system in the region.

The architecture provides an overarching framework that spans all of these organizations and individual transportation projects. Using the architecture, each transportation project can be viewed as an element of the overall transportation system, providing visibility into the relationship between individual transportation projects and ways to cost-effectively build an integrated transportation system over time. The architecture is described by this document, by a Turbo Architecture database and by a hyperlinked website that can be found at http://www.consystec.com/ohio/toledo/web/index.htm.

## *1.1. Document Overview*

This document is organized into twelve main sections. Section 1 provides introductory information. Section 2 describes the process used to develop the regional ITS architecture. The stakeholders are identified in Section 3, while their systems are inventoried in Section 4. The transportation services, information exchanges, functional requirements, and standards associated with the systems are discussed in Sections 5, 6, 7, and 8, respectively. Section 9 describes regional projects and sequencing, while Section 10 discusses the agreements needed between stakeholders to maximize system benefits. Finally, Section 11 provides guidance on using the regional ITS architecture and Section 12 summarizes the architecture maintenance plan. Because this document contains a number of architecture terms that may be unfamiliar to the reader a Glossary of these common terms is provided in Appendix A.

## *1.2. Description of the Region*

The Toledo Metro region considered in the development of the regional ITS architecture includes two counties in Ohio: Lucas and Wood, as well as the southern portion of Monroe County Michigan. The region covers the area served by the Toledo Metropolitan Area Council of Governments (TMACOG). The primary east-west Interstate in the region is the Ohio Turnpike (Interstate 80). The primary north-south Interstate in the region is I-75. In addition, connector interstates I-475 and I-280 provide ring roads on the west and east sides of Toledo. US Routes 23 and 24 provide key north-south arterials from Toledo north into Michigan. US 20 is a primary east-west arterial.

The regional ITS architecture for the Toledo metro area provides approximately a 15-year outlook for ITS activities in the region. The architecture addresses existing ITS systems as well as those planned for development over the next 15 years. It represents a snapshot of the currently anticipated projects based on information from stakeholders. As such, the architecture will require regular updates to ensure that it maintains accurate representation of the region. The architecture covers services across a broad range of ITS, including traffic management, transit management, traveler information, emergency services, archived data management, maintenance and construction operations, and electronic payment. Commercial vehicle services are covered as they relate to regional integration, but a more complete coverage of these would be expected at a statewide architecture level.

# 2. Regional ITS Architecture Update Process

## *2.1. Process used to update the architecture.*

The update of the Toledo Metro Area Regional ITS Architecture relied heavily on stakeholder input to ensure that the ITS architecture reflected local and regional needs and plans. A seven-step process was used to update the previous version of the ITS architecture:

1. Update the regional ITS architecture to the current version of the National ITS Architecture (NITSA), version 7.1
2. Conduct stakeholder outreach through one-on-one interviews with key stakeholders
3. Create a draft ITS architecture for review
4. Conduct a stakeholder workshop to review the draft architecture
5. Update the draft ITS architecture based on input from the workshop
6. Conduct a one-month stakeholder review period of the draft ITS architecture
7. Finalize the ITS architecture based on review comments.

**1) Update the regional ITS architecture to the current version of the National ITS Architecture (NITSA), version 7.1.**

First, the project team reviewed the 2004 version of the Toledo Metro Area ITS Architecture. This version of the ITS architecture was created using NITSA version 4.0. First, the Turbo Architecture database was updated to the current version of NITSA 7.1. Conversion reports were created during this process, and the project team reviewed these reports to ensure that no data was lost in the conversion process.

Once this was confirmed, the customized service package diagrams created as part of the 2004 ITS architecture effort were updated to NITSA 7.1. Each diagram was reviewed, and any subsystems, information flows, or service package names were updated to conform with NITSA 7.1.

**2) Conduct stakeholder outreach through one-on-one interviews with key stakeholders.**

The project team, using the 2004 ITS architecture as a starting point, developed a list of stakeholders. This stakeholder list included identification of key regional stakeholders that warranted one-on-one interviews with the project team. Remaining stakeholders on the stakeholder list had the opportunity to provide input at the stakeholder workshop and during the architecture review period. This stakeholder list was reviewed and updated by TMACOG staff before interviews were conducted, and stakeholder representatives were identified for each key stakeholder.

Next, the project team reached out to key stakeholder representatives and scheduled interviews, which were held via webinar. The agenda for these interviews were as follows:

- Review relevant portions of the 2004 Toledo Metro Area Regional ITS Architecture
- Current ITS systems deployed since 2004
- Review short and long term projects for inclusion in the ITS architecture update

Meeting notes were provided for each stakeholder interview and stakeholder representatives were given the opportunity to review inputs recorded by the project team.

**3) Create a draft ITS architecture.**

Following the interviews, draft architecture was created. This involved the following activities:

- Updating regional stakeholders
- Updating the ITS inventory
- Revising the customized service packages.

In addition to creating the Turbo Architecture database and the customized set of service packages, the project team created a set of regional projects. These projects were collected through the stakeholder interviews. In addition to a project name and brief description, each project was mapped to a customized service package diagram in the Draft Toledo Metro Area Regional ITS Architecture Update, and assigned a time frame:

- Near-term projects were defined as projects that would be completed in the next five years
- Medium-term projects were defined as projects that would be completed in the next 5-10 years
- Long-term projects were defined as projects that would be completed in more than 10 years.

**4) Conduct a stakeholder workshop to review the draft ITS architecture.**

A full day draft ITS architecture review meeting was held on April 7, 2016. At the workshop, stakeholders reviewed the updated inventory, service packages, operational concept, and regional projects.

**5) Update the draft ITS architecture based on input from the workshop.**

Following the architecture review workshop, the draft architecture was revised based on comments from the workshop. The project team updated the inventory, service packages, operational concept, and regional projects based on stakeholder inputs. Next, the draft architecture was created by updating operational concepts, customizing functional requirements for each system in the inventory, and creating individual projects architectures for each project. These updates were entered into the Turbo Architecture database. Finally, a draft ITS architecture website was created based on the customized service packages and updated Turbo Architecture database.

**6) Conduct a one-month stakeholder review period of the draft ITS architecture.**

All stakeholders identified during the ITS architecture update process were provided with a link to the Draft Toledo Metro Area Regional ITS Architecture, as well as instructions on how to review their individual portions of the ITS architecture. Stakeholders were given one month to provide comments. At the end of a month, all comments were collected by the project team in a spreadsheet.

**7) Finalize the ITS architecture based on review comments (Note this step is still to be accomplished)**

Finally, the ITS architecture was updated based on stakeholder feedback. A review webinar with the stakeholders was held to review the changes, the final version of the architecture was presented to the Transportation Council and training on how to use the Turbo Architecture file was provided. This final version of the ITS architecture serves as input to this document, and a final ITS architecture website was created.

## 2.2. Requirements of the Final FHWA Rule and FTA Policy on Architecture

The FHWA Final Rule (23CFR 940) and FTA Policy on Intelligent Transportation System Architecture and Standards, which took effect on April 8, 2001 defines a set of requirements that regional ITS architectures must meet. Table 1 shows how the requirements of the rule are met by the outputs developed for the Toledo Metro Area Regional ITS Architecture.

**Table 1: Mapping of Requirements to Architecture Outputs**

| Regional ITS Architecture Requirements | Where Requirements documented |
|---|---|
| Description of region | Geographic definition, as well as timeframe and scope of services are given in Section 1.2 of this document. |

| Regional ITS Architecture Requirements | Where Requirements documented |
|---|---|
| Identification of participating agencies and other stakeholders | Listing of stakeholders and their definitions is given in Section 3.1 of this document. An inventory of the elements operated by the stakeholders is contained in Section 4 of this document. The same information is also available in the hyperlinked web site and in the Turbo Architecture database. |
| An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders | The operational concept is defined in Section 4.2 of this document. |
| A list of any agreements (existing or new) required for operations | A discussion of existing and needed new agreements is given in Section 11 of this document |
| System functional requirements; | The functional requirements of the ITS systems are provided in detail in the hyperlinked web site and in the turbo architecture database. |
| Interface requirements and information exchanges with planned and existing systems and subsystems | The Interfaces and information flows are described in detail in the hyperlinked web site and in the Turbo Architecture database. |
| Identification of ITS standards supporting regional and national interoperability | An overview of the ITS standards is given in Section 8 of the document. The detailed listing of ITS standards applicable to each interface in the architecture is described in the hyperlinked web site and in the Turbo Architecture database. |
| The sequence of projects required for implementation | Projects and their sequencing are covered in Section 10 of this document as well as the hyperlinked website and the Turbo Architecture database. |

# 3. ITS Architecture Concepts

The Toledo Metro Area Regional ITS Architecture is an example of a Regional ITS Architecture, which has been defined by FHWA Rule 940 as a "regional framework for ensuring institutional agreement and technical integration for implementation of ITS projects". Regional ITS architectures, including the Toledo Metro Area Regional ITS Architecture, are developed in order to provide a guide for the integration of transportation systems. The updated architecture is based upon the US National ITS Architecture Version 7.1. A complete description of this architecture can be found at http://www.iteris.com/itsarch. The Toledo Metro Area Regional ITS Architecture Update uses a set of common concepts or terms drawn from the National ITS Architecture to describe the parts of the Toledo region. This section will provide a description of the most common concepts or terms as an aid to the understanding the remainder of the document.

What are some of the main parts of an ITS architecture? They are made of the following:

- Organizations
- Systems operated
- Services provided
- Functions performed
- Information exchanged

The organizations that operate systems in the region covered by the architecture are referred to as **stakeholders**. These are public agencies, private organizations or the traveling public with a vested interest, or a "stake" in one or more transportation elements within a Regional ITS Architecture.

The systems operated by the stakeholders are referred to as **elements**. In the Toledo Metro Area Regional ITS Architecture the elements represent actual systems, such as *City of Toledo Traffic Management Center*. An element may also represent field devices, for example the element *City of Toledo Field Equipment.* A more thorough discussion of the architecture elements is contained in Section 5. As mentioned above, the Toledo Metro Area Regional ITS Architecture Update is based upon the National ITS Architecture which contains general terms for these systems (elements). Since these National ITS Architecture terms show up repeatedly in later discussion they will be defined here.

The National ITS Architecture uses two terms to describe the systems that make up an architecture. They are:

- **Subsystems**, which represent the primary systems described by the architectures.  For example the TMC element mentioned above represents a regional ITS architecture example of the Traffic Management Subsystem defined in the National ITS Architectures.  The National ITS Architecture has 22 subsystems defined.
- **Terminators**, which represent systems that are on the boundary of the architecture.  In general only interfaces to the terminators are described in the national architectures.  An example of a terminator from the National ITS Architecture is the Weather Service.  The National ITS Architecture has 79 terminators defined.

As a part of developing a regional ITS architecture, each element of the region is mapped to the subsystems and/or terminators that most closely define the functions of the element.  This mapping allows the regional version to use the details associated with the subsystems and terminators in the National ITS Architecture.  As an example, the element in the Toledo Metro Area Regional ITS Architecture Update called *National Weather Service* is mapped to the National ITS Architecture terminator Weather Service.

The information exchanged between elements (in the Toledo Metro Area Regional ITS Architecture Update) or between subsystems and terminators in the National ITS Architecture is described by **information flows** or **architecture flows.**  There are hundreds of these flows defined in the National ITS Architecture, and it is this information that is used to create the interface definitions in the Toledo Metro Area Regional ITS Architecture.  For example, in Figure 1 the top two boxes show an interface between two subsystems, with its information flows defining the exchange of information.  A corresponding interface in the Toledo Metro Area Regional ITS Architecture is shown in the bottom two boxes.

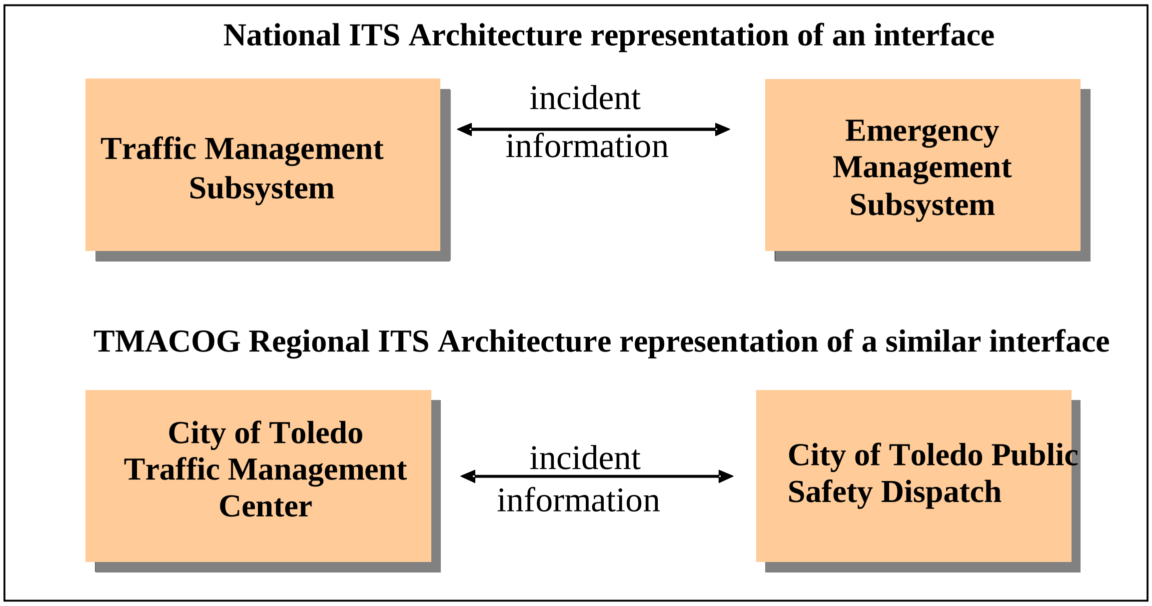



**Figure 1. Information flows**

By mapping the Toledo Metro Area Regional ITS Architecture elements (e.g. City of Toledo Traffic Management Center) to National ITS Architecture subsystems (or terminators) (e.g. Traffic Management Subsystem), the interfaces defined in the National ITS architecture can be used as the basis for defining the interfaces in the Toledo Metro Area Regional ITS Architecture.

The next key concept used by the architectures is that of **service packages**. These represent slices of an architecture that provide a transportation service. In the National ITS Architecture, these service packages are combinations of subsystems and information flows that are used to provide the service. An example of a National ITS Architecture service package is shown in Figure 2. This shows the subsystems and information flows (some of which go to terminators) that perform the collection and distribution of traffic flow and traffic images used to monitor a road network. In the development of the Toledo Metro Area Regional ITS Architecture, a set of customized service packages were created that define the elements and interfaces used to provide the transportation services in the Toledo Metro Area Region.

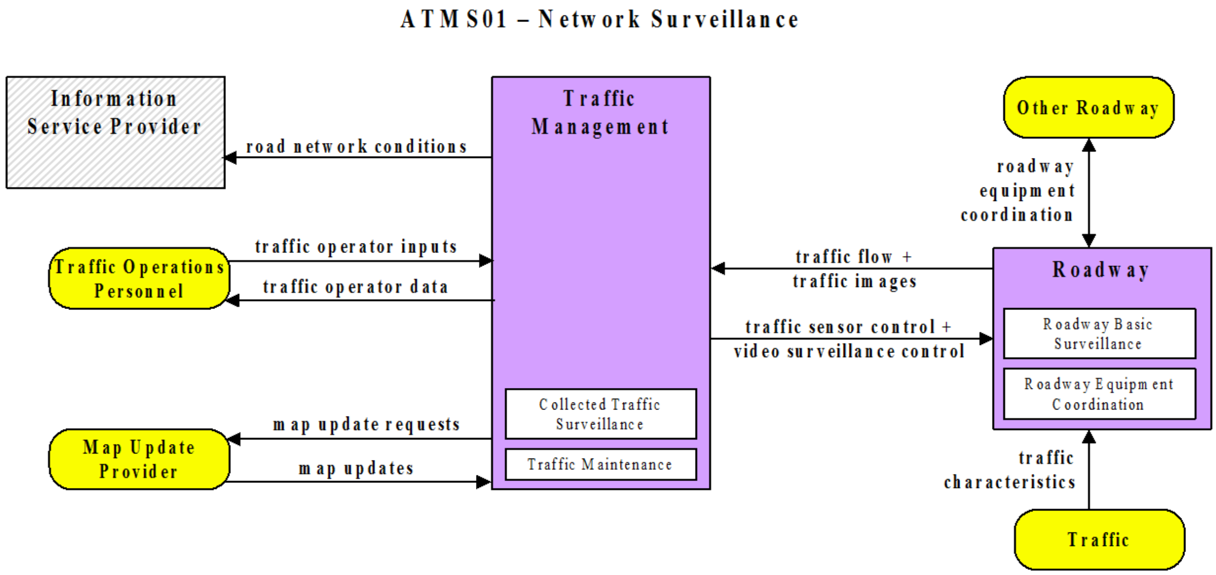



**Figure 2. Example of a National ITS Architecture Service Package**

Figure 3 shows one of the customized service packages within the Toledo Regional ITS Architecture (in this case for the City of Toledo). This diagram shows how the city might implement this service. There are two types of interfaces shown in the customized service package:

- Traffic Management Center to Roadside Equipment and
- Traffic Management Center to Information Service Provider (including an additional interface for probe data inputs)

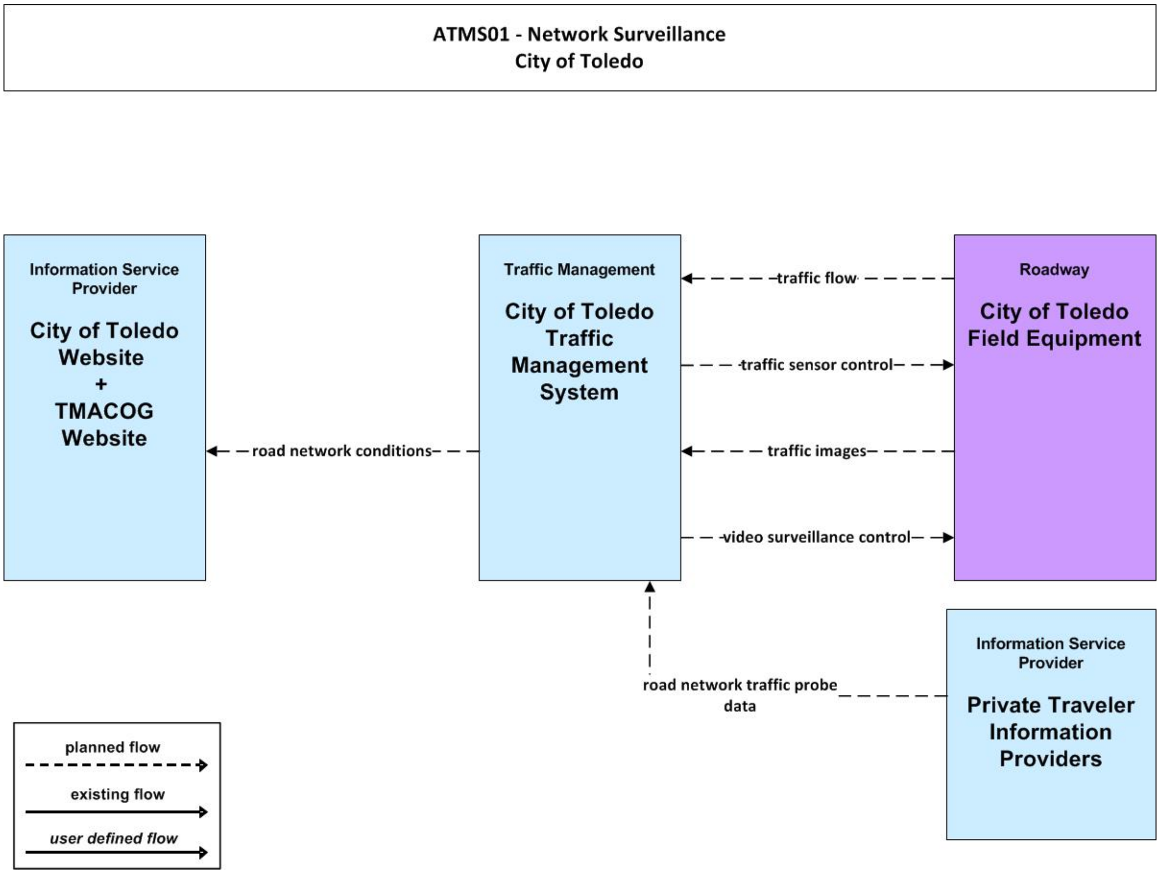



**Figure 3. Example of Toledo Metro Area Regional ITS Architecture Customized Service Package**

Notice that the customized service package includes only some of the interfaces that were in the National ITS Architecture service package. It does not include interfaces to personnel or a map update provider element. Elements mapping to these are not included in the Toledo Regional ITS Architecture. Also it includes an additional interface for probe data, which usually shows up in another service package, but which the stakeholders wished to have shown in this diagram.

One final concept to mention relates to the functions performed by the elements in the architecture. The National ITS Architecture has the concept of an **equipment package,** which defines a piece of a subsystem (within the service package) that performs a specific function. For example, in Figure 4, *Collect Traffic Surveillance* (identified by the white box within the Traffic Management Subsystem) is a function (or equipment package) that is performed by the Traffic Management Subsystem when performing the Network Monitoring Transportation Service. In the Toledo Metro Area Regional ITS Architecture functions have been identified for the key elements from a mapping of equipment packages to elements using a mapping of equipment packages to each element. For example, the City of Toledo Traffic Management Center (shown in Figure 5) will implement the Collect Traffic Surveillance equipment package (shown in Figure 4 as functionality in the Traffic Management Subsystem). Further information regarding how functions are defined for each element is found in Section 8 on Functional Requirements.

# 4. Identification of Stakeholders

## *4.1. Regional Stakeholders*

Stakeholder coordination and involvement is one of the key elements of the development of a regional ITS architecture. Because ITS often transcends traditional transportation infrastructure, it is important to consider a range of stakeholders beyond the traditional traffic, transit, and maintenance areas. In addition, it is important to consider stakeholders at a statewide level or stakeholders in adjoining regions.

A group of Core Stakeholders was involved through the development of the architecture, from initial interviews to the workshop. These core stakeholders included:

- City of Toledo
- City of Bowling Green
- Lucas County
- Wood County
- Monroe County
- ODOT
- Ohio Turnpike & Infrastructure Commission (OTIC)
- Toledo Area Regional Transit Authority (TARTA)
- TMACOG

These stakeholders were identified by the project team, based on the 2004 ITS architecture, and reviewed by TMACOG staff. Core Stakeholders were interviewed by the project team prior to the architecture workshop.

The Toledo Metro Area Regional ITS architecture includes a wide range of stakeholders. Table 2 identifies the stakeholders and provides a description of the agency, department, or organization represented by the stakeholder. This table includes the full range of stakeholders who own, operate or maintain elements (i.e. systems) in the regional ITS architecture.

**Table 2: Stakeholders**

| Stakeholder | Description |
| --- | --- |
| AMTRAK | AMTRAK provides passenger rail service across the country. |
| Bowling Green State University Shuttle | BGSU - runs fixed routes, primarily for students, but will pick up non-students |
| Cellular Provider | Private Cellular Companies |
| City of Bowling Green | Located in Wood County. |

| Stakeholder | Description |
|---|---|
| City of Bowling Green Department of Public Works (consisting of Public Works Division and Engineering Division) | Responsibilities:<br>Daily Refuse and Recycling<br>Unlimited Brush Pickup<br>Leaf Pickup<br>Heavy Item Pickup<br>Street, Alley & Parking Lot Repair<br>Street and Parking Lot Striping<br>Street Cleaning - Sweeping and Snow Removal<br>Cemetery Care and Maintenance<br>Dead Animal Removal<br>Engineering, surveying, and design of City water, sewer, pavement, and sidewalks<br>Inspect all work on City projects for compliance |
| City of Bowling Green Electric Division | A division of the Public Utilities Department. Responsibilities include operating and maintaining the municipal electric system and traffic control equipment. |
| City of Bowling Green Water Distribution And Wastewater Collection Division | The Water Distribution Division operates and maintains the water distribution system. The responsibility of the Wastewater Collection Division is to maintain the sewer system, which includes all city sewer pipes and lift stations. |
| City of Oregon | Located in Lucas County |
| City of Toledo | City of Toledo departments providing public safety. |
| City of Toledo Department of Public Services | Responsible for street cleaning, snow & ice removal, leaf collection, pothole repair. Includes Divisions of Facility and Fleet, Streets, Bridges, and Harbor, and Transportation. |
| City of Toledo Division of Transportation | City of Toledo department providing traffic operations for the city. |
| City of Toledo Division of Public Utilities | Responsible for engineering services, environmental services, sewer and drainage, and water distribution, reclamation, and treatment. |
| Crash Record Users | Systems and agencies that use crash record archive data. |
| Financial Institutions | Financial companies involved in electronic payment transactions. |
| Great Lakes Vessel Operators | Companies that operate great lakes vessels |
| Greater Toledo Convention and Visitors Bureau | Convention and Visitors bureau for greater Toledo area. |
| Independent School Districts | School districts in the region. |
| Lake Erie Transit | Transit agency providing dial a ride program in Monroe County. |
| Lucas County Emergency Management Agency | Coordinates agencies to deal with the problem at hand. Activate the EOC. |

| Stakeholder | Description |
|---|---|
| Lucas County Emergency Services 911 | Departments of Lucas County |
| Lucas County EMS | Represents the emergency medical services for Lucas County |
| Lucas County Engineer | Responsible for traffic signal systems in the county |
| Lucas County Fire Departments | Represents the various Fire Departments for Lucas County. |
| Lucas County Road Maintenance and Repair | Responsible for road and equipment maintenance in the county. |
| Lucas County Sanitary Engineer | Responsible for the County's water and wastewater services and oversight of the Solid Waste Management District. |
| Lucas County Sheriff | Responsible for public safety dispatch in county. |
| MDOT | Michigan Department of Transportation |
| Michigan State Police | State Police in Michigan |
| Mid American Association of State Transportation Officials | MAASTO is creating an interstate truck parking system that will include the Toledo region. |
| Monroe County | Departments of Monroe County Michigan. http://co.monroe.mi.us/index.html |
| Monroe County Office of Emergency Management | Represents the Office of Emergency Management for Monroe County. |
| Monroe County Road Commission | Agency responsible for traffic operations and roadway maintenance in Monroe County Michigan. http://www.mcrc-mi.org/ |
| Monroe County Sheriff | Represents the sheriff department for Monroe County. |
| Municipal Engineering Departments | Represents the traffic sections of municipalities in the region other than Toledo and Bowling Green. |
| Municipal Public Safety Agencies | Public Safety agencies in the municipalities in the region other than the cities of Toledo and Bowling Green. |
| Municipal Service Departments | Departments providing traffic and maintenance operations in cities and townships > 10,000 people in the region. |
| National Weather Service | US Agency, part of National Oceanic and Atmospheric Administration, that is responsible for national and local weather |
| Northwest Ohio Regional Water and Sewer | Represents the water and sewer districts in the region including the Northwestern Water and Sewer District. |
| ODOT | Includes ODOT Central Office and District 2. Responsible for planning, designing, and maintaining state and interstate highways and arterials. |
| Ohio Department of Public Safety | Statewide agency responsible for emergency operations. |
| Ohio State Highway Patrol | Agency responsible for public safety of rural highways and freeways, |

| Stakeholder | Description |
|---|---|
| (OSHP) | Ohio Turnpike, and state owned or leased buildings. |
| Ohio Turnpike & Infrastructure Commission (OTIC) | Agency responsible for construction, maintenance, and operations of the Ohio Turnpike. |
| Other Counties | County government of the counties that border the region |
| Private Commercial Carriers | Private commercial vehicle operators |
| Private Tow, Wreckers, and Cleanup Service Providers | Represents private towing companies operating in the region. |
| Private Traveler Information Systems | Represents a generic stakeholder for privately owned traveler information systems. |
| Private Travelers | Represents private travelers. |
| Private Utilities | Includes water, power, cable and other private utilities. |
| Private Weather System Operator | Private companies that provide weather information tailored for transportation purposes. |
| Regional Event Operators | Represents the many organizations whose facilities hold events that have significant impact on traffic or transit. |
| Regional Hospitals | Regional hospitals and trauma centers. |
| RR Operator | Companies that operate freight railroad in the region. |
| Special Police Forces | Police forces for Metroparks and Park Districts, Universities/Colleges, Airports, and Railroads |
| State of Ohio | Departments of Ohio state government |
| TMACOG | MPO for Wood and Lucas Counties in Ohio and the southern three townships in Monroe County, Michigan. |
| Toledo - Lucas County Port Authority | Port Authority for Great Lakes ports in the region. |
| Toledo Area Regional Transit Authority (TARTA) | Toledo transit agency |
| Travelers | Private travelers. |
| TV and Radio Stations | Television, Radio, and Print Media. Includes TV network affiliates |
| United States Postal Service | Department of U.S. federal government responsible for mail delivery. |
| University of Toledo | Major university in the region |
| Wood County | Departments of Wood County Government |
| Wood County Emergency Management Agency | Agency responsible for emergency management in Wood County |

The stakeholders listed in Table 2 represent a mix of specific agencies or organizations and generic names used to represent a variety of stakeholders.  Examples of specific agency or organizations would be Toledo Area Regional Transit Authority (TARTA). An example of a generic stakeholder name would be Municipal Engineering Departments, which represents any of the municipal agencies in the region responsible for traffic signal systems or other, related ITS elements.

## *4.2. Operational Concept*

An Operational Concept documents each stakeholder's current and future roles and responsibilities in the operation of the regional ITS systems. The operational concept documents these roles and responsibilities across a range of transportation services. The services covered are:

- Traffic Signal Control: the development of signaling systems that react to changing traffic conditions and provide coordinated intersection timing over a corridor, an area, or multiple jurisdictions.
- Freeway Control: the development of systems to monitor freeway (or tollway) traffic flow and roadway conditions, and provide strategies such as ramp metering or lane access control to improve the flow of traffic on the freeway. Includes systems to provide information to travelers on the roadway.
- Incident Management: the development of systems to provide rapid and effective response to incidents. Includes systems to detect and verify incidents, along with coordinated agency response to the incidents.
- Transit Management: the development of systems to more efficiently manage fleets of transit vehicles or transit rail. Includes systems to provide transit traveler information both pre-trip and during the trip.
- Traveler Information: the development of systems to provide static and real time transportation information to travelers.
- 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.
- Archive Data Management: the development of systems to collect transportation data for use in non-operational purposes (e.g. planning and research).
- Electronic Payment: the development of electronic fare payment systems for use by transit and other agencies (e.g. parking).

Roles and Responsibilities may be found on the Toledo Metro Area ITS Architecture Update website at http://www.consystec.com/ohio/toledo/web/opsconstake.htm. To access the Roles and Responsibilities, select the Operational Concept tab under the Stakeholder pulldown.

# 5. Inventory

Each stakeholder agency, company, or group owns, operates, maintains or plans ITS systems in the region. A regional ITS architecture inventory is a list of "elements" that represent all existing and planned ITS systems in a region as well as non-ITS systems that provide information to or get information from the ITS systems. The focus of the inventory is on those systems that support, or may support, interfaces that cross stakeholder boundaries (e.g., inter-agency interfaces, public/private interfaces).

The vast majority of the inventory represents ITS systems in the five-county region, but the inventory does contain some elements that represent systems in adjoining regions, or systems that exist at a statewide level. An example of an element in an adjoining region would be the Southeast Michigan Traffic Operations Center, which represents the traffic management center in the MDOT University Region. It would interface with a traffic element in the TMACOG region. An example of a statewide element is the ODOT Statewide TMC, which is a Traffic Management Center in Columbus that interfaces to other TMCs in the State of Ohio. As part of the long-term maintenance of the Toledo Metro Area Regional ITS Architecture it will be necessary to coordinate the "inter-regional" interfaces with these elements that are outside the region.

Each element in the inventory is described by a name, the associated stakeholder, a description, general status (e.g. existing or planned), and the associated subsystems or terminators from the National ITS Architecture.

## *5.1. Inventory by Stakeholder*

The Toledo Metro Area ITS Architecture Update website sorts the inventory by stakeholder so that each stakeholder can easily identify all the relevant elements that are defined in the architecture. For each element in the inventory the webpage provides an element description and an indication of whether the element exists or is planned. The inventory by stakeholder can be found at http://www.consystec.com/ohio/toledo/web/invstake.htm

The majority of elements in the inventory represent a specific existing or planned system. Some examples of specific systems are the City of Toledo Traffic Management System and ODOT District 2 Maintenance Garages.\

Some of the elements represent sets of devices, rather than a single specific system or device. An example of this type of element is the element "ODOT District 2 ITS Field Equipment ". This element represents all of the traffic signals, traffic detectors, CCTV, Dynamic Message Signs (DMS), weather sensors (monitors road for icing), automatic traffic recorders, signal preemption for emergency vehicles and buses.

A third type of element in the inventory is a "generic" element that represents all of the systems of a certain type in the region. An example of this type of element is Municipal and Township Public Safety Dispatch, which represents the many municipal and township public safety answering points (PSAPs) in the region. These generic elements have been created for two primary reasons. First, they represent elements with similar types of interfaces, so from a standardization standpoint, describing how one of the major elements in the region (e.g. the ODOT Statewide TMC) interfaces with various PSAPs would be the same. Second, describing many systems with a single element helps keep the architecture from growing too large.

# 6. Service Packages

The ITS systems in the region currently provide a wide array of transportation services and that list will grow as more systems are developed or upgraded. The services can be described by Services Packages, which is a term borrowed from the National ITS Architecture. In the 2004 version of the Toledo Metro Area ITS Architecture, Service Packages were known as "Market Packages" but this term has been updated in more recent versions of the National ITS Architecture.

Service Packages represent collections of subsystems and terminators that exchange information to do a specific service. The service packages are customized to represent the operational concept for service delivery specific to this region. Each subsystem or terminator in a service package diagram is labeled with both its generic National ITS Architecture name and the name of the local regional element that participates in the customized service package. In this way the service package identifies the information exchange (using architecture flows) between specific stakeholders elements in the region to affect a particular service or set of services. For additional information on Service Packages refer to the National ITS Architecture website, which can be found at http://www.its.dot.gov/arch/arch.htm.

The Service Packages for the Toledo Metro Area ITS Architecture can be found at http://www.consystec.com/ohio/toledo/web/services.htm.

In addition, service packages are organized by stakeholder on the following webpage: http://www.consystec.com/ohio/toledo/web/servstake.htm

# 7. Interfaces and Information Exchanges

## *7.1. Customized Service Packages*

The service packages of the National ITS Architecture were customized to reflect the unique systems and connections of the Toledo region. Each service package is shown graphically, with the service package name, the entity from the National ITS Architecture, and the specific Toledo elements associated with the entity. In addition the service packages show the information flows that move between elements.

Figure 4 is an example of an ATMS service package for Traffic Signal Control that has been customized for the Toledo region.

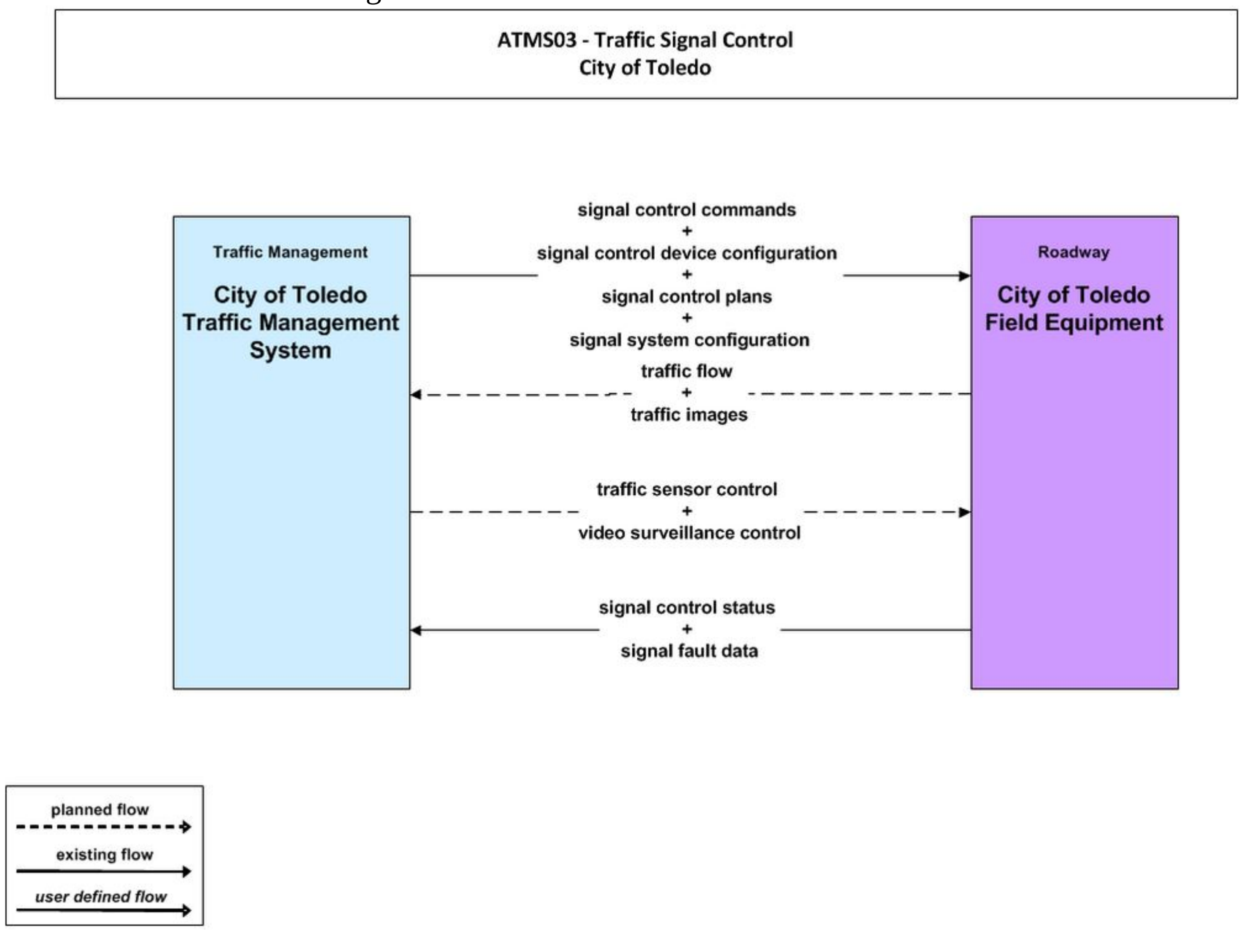



**Figure 4: Example Customized Service Package**

This service package shows the two subsystems, Traffic Management and Roadway, and the associated elements. Information flows (called "architecture flows" in the National ITS Architecture) between the subsystems indicate what information is being shared. These service packages can also be found on the Toledo web page by selecting the "Services" button. Service packages are grouped by functional areas (e.g. Traffic Management, Maintenance and Construction, and Public Transportation) and each set of customized service packages can be viewed by clicking on the Service Package Description tab under "Services" in the menu. The table displays only those service packages from the National ITS Architecture that have been selected for the Toledo Metro Area Regional ITS Architecture Update.

## *7.2. Regional Architecture Information Flows*

While it is important to identify the various systems and stakeholders as part of a regional ITS architecture, a primary purpose of the architecture is to identify the *connectivity* between transportation systems in the region. The customized service packages represent services that can be deployed as an integrated capability, and the service package diagrams show the information flows between the subsystems and terminators that are most important to the operation of the service packages. How these systems interface with each other is an integral part of the overall architecture.

There are 130 different elements identified as part of the Toledo Metro Area Regional ITS Architecture. These elements include city, county, and state traffic operations centers, transit centers, transit vehicles, public safety dispatch centers, media outlets, and others—essentially all of the existing and planned physical components that contribute to the regional intelligent transportation system. Interfaces have been defined for each element in the architecture. For example, the ODOT Statewide TMC has planned interfaces with 32 other elements in the region ranging from field equipment to transit centers. Some of the interfaces are far less complex. For example Toledo Express Airport has interfaces with only three other elements in the architecture.

Elements and their interfaces are accessible via the Toledo Metro Area Regional ITS Architecture web page by clicking on the “Architectures Interfaces” button under "Architecture". On the web page, elements are listed alphabetically in the column on the left, and each entry in the Interfacing Element column on the right is a link to more detailed information about the particular interface.

Architecture flows between the elements define specific information that is exchanged by the elements. Each architecture flow has a direction, name and definition. Most of the architecture flows match ones from the National ITS Architecture (the mapping of elements to National ITS Architecture entities allowed the developers to match the architecture flows to the appropriate interfaces.) In some cases new user defined flows have been created for interfaces or connectivities that are not expressed in the National ITS Architecture. These architecture flows define the interface requirements between the various elements in the regional architecture. An example of the architecture flows between two elements is shown in Figure 5.

In this interface the flows that go between the ODOT Statewide TMC and the Lucas County Emergency Communications Center are shown. There is currently no existing electronic connection between these two centers, so all the flows on this interface are shown as planned.

Each of the individual element interfaces can be accessed on the Toledo Metro Area Regional ITS Architecture web page by clicking on the “Interfaces” button. Selecting any of the interfacing elements from the column on the right will display an interface diagram and architecture flows between two specific elements, similar to the diagram shown in Figure 5. Each architecture flow is defined, and any standards associated with that data flow are noted.

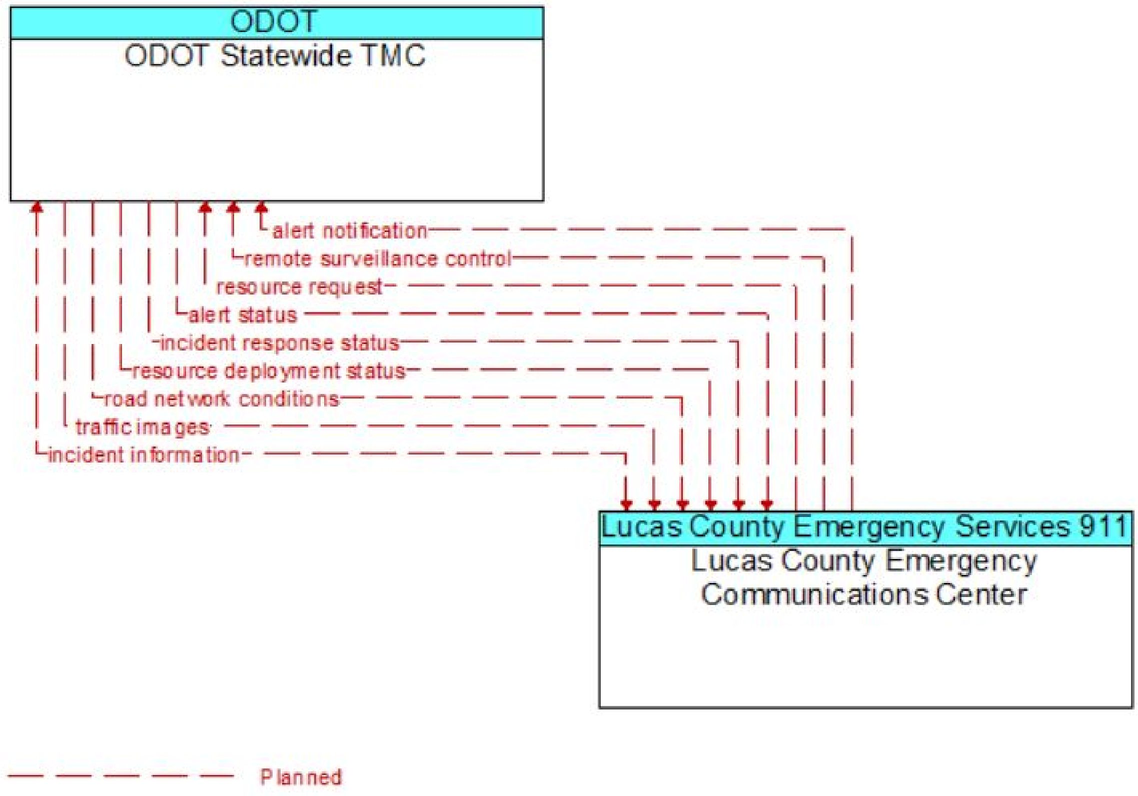



**Figure 5: Example of Architecture Flows Between Elements**

## 8. Functional Requirements

Functional requirements are a description of the functions or activities that are currently performed by the ITS elements or that are planned to be performed in the future. For the Toledo Metro Area Regional ITS Architecture, these functions have been developed by using the functional assignments underlying the National ITS Architecture and the mapping from transportation services to elements.

In the National ITS Architecture a service package is defined by subsystems, equipment packages, and architecture flows, all of which operate together to perform a particular transportation service. Equipment Packages represent pieces of a subsystem that perform a single function. (Note there are no equipment packages defined for the Terminators of the National ITS Architecture, since they represent systems on the boundary of the architecture and do not have functional descriptions within the architecture.) For example the Traffic Signal Control service package is composed of the three Traffic Management Subsystem equipment packages TMC Signal Control, Collect Traffic Surveillance and Traffic Equipment Maintenance and the Roadway Subsystem with its four equipment packages Field Management Stations Operation, Roadway Basic Surveillance, Roadway Signal Control and Roadway Equipment Coordination. The definitions of these four equipment packages, copied from version 7.1 of the National ITS Architecture are:

- **TMC Signal Control**- This equipment package provides the capability for traffic managers to monitor and manage the traffic flow at signalized intersections. This capability includes analyzing and reducing the collected data from traffic surveillance equipment and developing and implementing control plans for signalized intersections. Control plans may be developed and implemented that coordinate signals at many intersections under the domain of a single traffic management subsystem and are responsive to traffic conditions and adapt to support incidents, preemption and priority requests, pedestrian crossing calls, etc.
- **Traffic Maintenance**- This equipment package provides monitoring and remote diagnostics of field equipment to detect field equipment failures, issues problem reports, and tracks the repair or replacement of the failed equipment.
- **Collect Traffic Surveillance** - This equipment package remotely monitors and controls traffic sensors and surveillance (e.g., CCTV) equipment, and collects, processes and stores the collected traffic data. Current traffic information and other real-time transportation information is also collected from other centers. The collected information is provided to traffic operations personnel and made available to other centers.
- **Traffic Equipment Maintenance** - This equipment package monitors the operational status of field equipment and detects failures. It presents field equipment status to Traffic Operations Personnel and reports failures to the Maintenance and Construction Management Subsystem. The equipment package tracks the repair or replacement of the failed equipment. The entire range of ITS field equipment may be monitored by this equipment package including sensors (traffic, infrastructure, environmental, security, speed, etc.) and devices (highway advisory radio, dynamic message signs, automated roadway treatment systems, barrier and safeguard systems, cameras, traffic signals and override equipment, ramp meters, beacons, security surveillance equipment, etc.).
- **Roadway Signal Controls** - This equipment package includes the field elements that monitor and control signalized intersections. It includes the traffic signal controllers, signal heads, detectors, and other ancillary equipment that supports traffic signal control. It also includes field masters, and equipment that supports communications with a central monitoring and/or control system, as applicable. The communications link supports upload and download of signal timings and other parameters and reporting of current intersection status. This equipment package represents the field equipment used in all levels of traffic signal control from basic actuated systems that operate on fixed timing plans through adaptive systems. It also supports all signalized intersection configurations, including those that accommodate pedestrians.
- **Roadway Equipment Coordination** - This equipment package supports direct communications between field equipment. It includes field elements that control and send data to other field elements. This includes coordination between remote sensors and field devices (e.g., Dynamic Message Signs) and coordination between the field devices

themselves (e.g., direct coordination between traffic controllers that are controlling adjacent intersections.).

- **Roadway Basic Surveillance** - This equipment package monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras.
- **Field Management Station Operation** - This equipment package supports direct communications between field management stations and the local field equipment under their control.

The approach used in the Toledo Metro Area Regional ITS Architecture is to begin with the mapping of equipment packages to service packages to elements as an initial definition of the functions being performed by each element. Then this mapping is tailored to provide a more accurate picture of the functions performed by the element.

The details of this functional definition are provided on the hyperlinked web site version of the architecture. Each element that has been mapped to a subsystem entity (eg. traffic management subsystem) has a set of Functional Areas (e.g. equipment packages) assigned to it.

For example, the City of Toledo Traffic Management System element has the following functional areas (e.g. equipment packages) assigned to it:

- Collect Traffic Surveillance
- HRI Traffic Management
- Rail Operations Coordination
- TMC Evacuation Support
- TMC Incident Detection
- TMC Incident Dispatch Coordination/Communication
- TMC Multi-Modal Coordination
- TMC Probe Information Collection
- TMC Multimodal Crossing Management
- TMC Regional Traffic Management
- TMC Signal Control
- TMC Traffic Information Dissemination
- Traffic Data Collection

This represents a first level of detail that can be obtained in the hyperlinked web site in connection with functionality. For each of the functional areas (e.g. equipment packages) assigned to an element, selecting that functional area will take the user to additional levels of detail about the function. The hyperlinked web site uses the relationships inherent in the National ITS Architecture (equipment packages are mapped to process specifications which are mapped to user service requirements) to provide the additional levels of detail.

# 9. Standards

## *9.1. Discussion of key standards in the region*

ITS standards establish a common way in which devices connect and communicate with one another. This allows transportation agencies to implement systems that cost-effectively exchange pertinent data and accommodate equipment replacement, system upgrades, and system expansion. Standards benefit the traveling public by providing products that will function consistently and reliably throughout the region. ITS standards contribute to a safer and more efficient transportation system, facilitate regional interoperability, and promote an innovative and competitive service for transportation products and services.

Use of ITS standards is very important to project development in the Toledo region.
Table 3 identifies the ITS standards that are potentially applicable to the regions. This table was created by taking the standards information available in the Turbo Architecture database (which identifies standards applicable to each architecture flow) and taking the total set of standards that result from all of the selected flows. The table provides the status of the standards effort as of November 2015 (the most recent update of the information).

The following section explains how to identify the specific applicable standards for an individual interface. The table lists the name of the standard in the first column and the Standards Development Organization (SDO) and number of the standard in the second column. Regular updates of SDO activities will help ensure that the latest standards are utilized. The SDOs listed above include:

- American Association of State Highway and Transportation Officials (AASHTO)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- Institute of Electrical and Electronics Engineers (IEEE)
- Institute of Transportation Engineers (ITE)
- National Equipment Manufacturers Association (NEMA)
- Society of Automotive Engineers (SAE)

**Table 3: Applicable ITS Standards**

| SDO | Standard Title | Standard Doc ID |
|---|---|---|
| AASHTO/ITE | Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) | ITE TMDD |
| AASHTO/ITE/NEMA | Data Element Definitions for Transportation Sensor Systems (TSS) | NTCIP 1209 |
| AASHTO/ITE/NEMA | Field Management Stations (FMS) - Part 1: Object Definitions for Signal System Masters | NTCIP 1210 |
| AASHTO/ITE/NEMA | Global Object Definitions | NTCIP 1201 |
| AASHTO/ITE/NEMA | NTCIP Center-to-Center Standards Group | NTCIP C2C |
| AASHTO/ITE/NEMA | NTCIP Center-to-Field Standards Group | NTCIP C2F |
| AASHTO/ITE/NEMA | Object Definitions for Actuated Traffic Signal Controller (ASC) Units | NTCIP 1202 |

| SDO | Standard Title | Standard Doc ID |
|---|---|---|
| AASHTO/ITE/NEMA | Object Definitions for Closed Circuit Television (CCTV) Camera Control | NTCIP 1205 |
| AASHTO/ITE/NEMA | Object Definitions for Closed Circuit Television (CCTV) Switching | NTCIP 1208 |
| AASHTO/ITE/NEMA | Object Definitions for Conflict Monitor Units (CMU) | NTCIP 1214 |
| AASHTO/ITE/NEMA | Object Definitions for Data Collection and Monitoring (DCM) Devices | NTCIP 1206 |
| AASHTO/ITE/NEMA | Object Definitions for Dynamic Message Signs (DMS) | NTCIP 1203 |
| AASHTO/ITE/NEMA | Object Definitions for Environmental Sensor Stations (ESS) | NTCIP 1204 |
| AASHTO/ITE/NEMA | Object Definitions for Ramp Meter Control (RMC) Units | NTCIP 1207 |
| AASHTO/ITE/NEMA | Object Definitions for Signal Control and Prioritization (SCP) | NTCIP 1211 |
| APTA | Standard for Transit Communications Interface Profiles | APTA TCIP-S-001 3.0.4 |
| ASTM | Dedicated Short Range Communication at 915 MHz Standards Group | DSRC 915MHz |
| ASTM | Standard Practice for Metadata to Support Archived Data Management Systems | ASTM E2468-05 |
| ASTM | Standard Specifications for Archiving ITS-Generated Traffic Monitoring Data | ASTM E2665-08 |
| ASTM/IEEE/SAE | Dedicated Short Range Communication at 5.9 GHz Standards Group | DSRC 5GHz |
| IEEE | Incident Management Standards Group | IEEE IM |
| IEEE | Standard for Message Sets for Vehicle/Roadside Communications | IEEE 1455-1999 |
| IEEE | Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection | IEEE 1570-2002 |
| SAE | Advanced Traveler Information Systems (ATIS) Bandwidth Limited Standards Group | ATIS Low Bandwidth |
| SAE | Advanced Traveler Information Systems (ATIS) General Use Standards Group | ATIS General Use |
| SAE | Dedicated Short Range Communications (DSRC) Message Set Dictionary | SAE J2735 |

***Notes:***

The following definitions come from Version 7.1 of the National ITS Architecture. For a more up to date description of the following standards groups, please refer to the National ITS Architecture website.

**NTCIP C2F: NTCIP Center-to-Field Standards Group**

The table above specifies the NTCIP Center-to-Field Standards Group, which addresses the communications protocols between a center and the ITS field devices it manages. The family includes the communications profiles that cover the interfaces between a traffic management center and dynamic message signs, ramp meters, environmental sensors, or CCTVs under its control. These protocols are common across all Center-to-Field interfaces in the National ITS Architecture, and rather than repeat the entire list for each architecture flow, we have created this summary entry – the NTCIP C2C Group of communications standards.

The "vocabulary" (objects) is specific to the actual architecture flow in the National ITS Architecture and is therefore mapped to the corresponding Data Object standard. (In the example above, the "Object Definitions for Dynamic Message Signs" standard would be mapped to the specific control and data flows between the Traffic Management Subsystem and the Roadway DMS equipment).

In order to satisfy a wide spectrum of system and regional communications requirements, Center-to-Field ITS deployments should each implement the combinations of the following NTCIP C2F communications protocols that best meet their needs.

This Group includes the following Standards Activities:

NTCIP 1101: Simple Transportation Management Framework (STMF)
NTCIP 1102: Base Standard: Octet Encoding Rules (OER)
NTCIP 1103: NTCIP Transportation Management Protocols (TMP)
NTCIP 2101: Point to Multi-Point Protocol Using RS-232 Subnetwork Profile
NTCIP 2102: Subnet Profile for PMPP Over FSK modems
NTCIP 2103: Subnet Profile for Point-to-Point Protocol using RS 232
NTCIP 2104: Subnet Profile for Ethernet
NTCIP 2201: Transportation Transport Profile
NTCIP 2202: Internet (TCP/IP and UDP/IP) Transport Profile
NTCIP 2301: Application Profile for Simple Transportation Management Framework (STMF)
NTCIP 2302: Application Profile for Trivial File Transfer Protocol
NTCIP 2303: Application Profile for File Transfer Protocol (FTP)

**NTCIP C2C: NTCIP Center-to-Center Standards Group**

The table above specifies the NTCIP Center-to-Center (NTCIP C2C) Group of Standards, which address the communications protocols between two centers (e.g. two traffic management centers exchanging information to facilitate regional coordination of traffic signals). Some of the communication protocols covered by this family are CORBA, DATEX-ASN and FTP. These protocols are common across all Center-to-Center interfaces in the National ITS Architecture, and rather than repeat the entire list for each architecture flow, we have created this summary entry – the NTCIP C2C Group of communications standards.

The standards that describe the "vocabulary" (data elements and messages) are mapped to specific architecture flows rather than the entire set of NTCIP C2C interfaces. In the regional traffic coordination example above, the "Traffic Management Data Dictionary" and the "Message Set for External TMC Communications" standards would be mapped to the specific flows between two Traffic Management Subsystems.

In order to satisfy a wide spectrum of system and regional communications requirements, Center-to-Center ITS deployments should each implement the combinations of the following NTCIP C2C communications protocols that best meet their needs.

This Group includes the following Standards Activities:

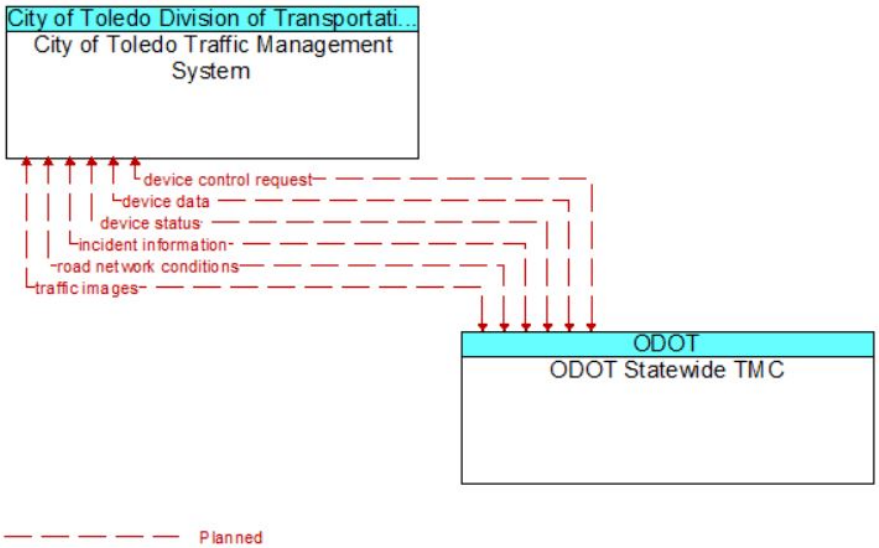
NTCIP 1102: Base Standard: Octet Encoding Rules (OER)
NTCIP 1104: CORBA Naming Convention
NTCIP 1105: CORBA Security Service
NTCIP 1106: CORBA Near-Real Time Data Service
NTCIP 2104: Subnet Profile for Ethernet
NTCIP 2202: Internet (TCP/IP and UDP/IP) Transport Profile
NTCIP 2303: Application Profile for File Transfer Protocol (FTP)
NTCIP 2304: Application Profile for Data Exchange ASN.1 (DATEX)
NTCIP 2305: Application Profile for Common Object Request Broker Architecture (CORBA)
NTCIP 2501: Information Profile for DATEX
NTCIP 2502: Information Profile for CORBA

## ***9.2. Reference to the detailed standards information on the Web Site***

The previous section provides a general discussion of the standards environment in the region. However the architecture does contain a far more detailed standards view, one that maps applicable standards to the individual information flow that goes from one element to another. This detailed information is contained in the hyperlinked web site and can be accessed in two different ways. Each element description page has a set of links that describe the information flowing to and from the element to other elements of the architecture. Selecting any of these interface links brings the user an interface page. For example, the interface between the ODOT Statewide TMC and the City of Toledo Traffic Management System is shown in Figure 6. The information flow in the diagram is defined at the bottom of the as shown in Figure 7. Name of the architecture flow will provide the applicable standards for the flow. An example, for the *road network conditions* flow, is shown in Figure 8.

**INTERCONNECT: CITY OF TOLEDO TRAFFIC MANAGEMENT SYSTEM - ODOT STATEWIDE TMC**

(Click on image to view full-size)




(E) = Existing Flow
(P) = Planned/Future Flow
(E/P) = Existing and Planned Flow - Flow appears as Existing and Planned

**Figure 6: Example of Interface**

| Source | Architecture Flows | Destination |
|---|---|---|
| City of Toledo Traffic Management System | device status (P)<br>device data (P)<br>device control request (P)<br>traffic images (P)<br>road network conditions (P)<br>incident information (P) | ODOT Statewide TMC |
| ODOT Statewide TMC | device status (P)<br>device data (P)<br>device control request (P)<br>traffic images (P)<br>road network conditions (P)<br>incident information (P) | City of Toledo Traffic Management System |

**Figure 7: Information flows on example interface**

### FLOW: ROAD NETWORK CONDITIONS

| | | | |
|---|---|---|---|
| **Description:** | | | |
| Current and forecasted traffic information, road and weather conditions, and other road network status. Either raw data, processed data, or some combination of both may be provided by this architecture flow. Information on diversions and alternate routes, closures, and special traffic restrictions (lane/shoulder use, weight restrictions, width restrictions, HOV requirements) in effect is included along with a definition of the links, nodes, and routes that make up the road network. | | | |
| **Communications Standards:** | | | |
| NTCIP C2C | AASHTO-17 | File Transfer Protocol (FTP) Application Profile | NTCIP 2303 |
| NTCIP C2C | AASHTO-20 | Application Profile for DATEX-ASN (AP-DATEX) | NTCIP 2304 |
| NTCIP C2C | AASHTO-21 | Octet Encoding Rules (OER) Base Protocol | NTCIP 1102 |
| NTCIP C2C | AASHTO-28 | Ethernet Subnetwork Profile | NTCIP 2104 |
| NTCIP C2C | AASHTO-39 | Center-to-Center Naming Convention Specification | NTCIP 1104 |
| NTCIP C2C | AASHTO-XML | Application Profile for XML Message Encoding and Transport in ITS Center-to-Center Communications (C2C XML) | NTCIP 2306 |
| NTCIP C2C | S-88 | Internet (TCP/IP and UDP/IP) Transport Profile | NTCIP 2202 |
| **Message Standards:** | | | |
| ATIS General Use | SAE J2540 | Messages for Handling Strings and Look-Up Tables in ATIS Standards | SAE J2540 |
| ATIS General Use | SAE J2540-1 | RDS (Radio Data System) Phrase Lists | SAE J2540/1 |
| ATIS General Use | SAE J2540-2 | ITIS (International Traveler Information Systems) Phrase Lists | SAE J2540/2 |
| ATIS General Use | SAE J2540-3 | National Names Phrase List | SAE J2540/3 |
| ATIS General Use | SAE-J2354 | Message Set for Advanced Traveler Information System (ATIS) | SAE J2354 |
| ITE-TMDD21 | ITE-TMDD21 | Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC) | ITE TMDD |
| **Data Standards:** | | | |
| No Data Standards | | | |

**Figure 8: Example of Standards Mapping**

# 10. Regional Projects

The regional ITS architecture defines a number of planned elements, interfaces, and information flows. As regional plans are developed these parts of the regional ITS architecture will be implemented by a series of projects. Table 4 provides a summary of regional projects that have been identified. The Timeframe column represents the following information about when the project is planned for implementation:

- Short Term- 1-5 years
- Mid Term- 6-10 years
- Long Term- over 10 years.

The projects listed represent a very small percentage of the interfaces of the Regional ITS Architecture. Over time additional projects will be developed to address further aspects of the architecture.

**Table 4: Toledo Metro Area Projects**

| Project Name | Project Description | Timeframe |
|---|---|---|
| Bowling Green CCTV Expansion | This project will add additional cameras for surveillance in the City of Bowling Green. | Long |
| City of Toledo Adaptive Signal System | This project will upgrade two intersections on the outskirts of the COT coordinated system and allows signal timing optimization based on live traffic demands. In addition, this project will use video to analyze traffic flow at intersections and adjust timing based on historical data obtained by the video. This video can also be utilized for traffic counts. | Short |
| City of Toledo and Lucas County Coordination | This project will create an interconnect between Lucas County and the City of Toledo to allow signal timing coordination across jurisdictional boundaries. | Long |
| City of Toledo Arterial Monitoring | This project will add detection capabilities to key arterials in the City of Toledo, potentially including Bluetooth. | Long |
| City of Toledo Central Software Upgrade | Overhaul the Central System with the latest software available that would fit the agency's needs. | Long |
| City of Toledo Traffic Signals Coordination | This project will connect City of Toledo traffic signals to the central system so they can be remotely monitored and timing patterns revised. | Short |
| City of Toledo Video to Central System | This project will upgrade communications for the City of Toledo to Ethernet, which will allow the City to bring intersection video back to the central system | Short |
| Lucas County 911 Center | This project will update the Lucas County 911 Center, including access to County and ODOT traffic cameras on a video wall. | Short |
| Lucas County CCTV Replacement | This project will upgrade CCTV cameras for Lucas County. | Long |
| Lucas County Fiber Expansion | This project will install fiber to connect additional CCTV and signals. | Long |
| Lucas County Maintenance AVL | This project, which is currently underway, will add AVL to Lucas County Maintenance Vehicles. | Short |
| Lucas County Signal Replacement | This project will upgrade traffic signals in Lucas County. | Long |
| MAASTO Truck Parking | Interstate truck parking system that will provide parking information to commercial vehicles. | Short |

| Project Name | Project Description | Timeframe |
|---|---|---|
| MDOT I-75 ICM | This project will manage I-75 using an Integrated Corridor Management (ICM) strategy. | Long |
| ODOT Advanced Transportation and Demand Management | This project will implement an ATDM strategy on highways in District 2. This could include dynamic lane control and additional cameras. | Long |
| ODOT DDMS | This project will add Destination Dynamic Message Signs (DDMS) on ODOT freeways. This signs will provide travel times to travelers to specific destinations. | Short |
| ODOT Expansion of Arterial Monitoring System | This project will expand the ODOT Freeway Management System (FMS) to include arterials in the TMACOG region. | Short |
| ODOT Fiber Expansion | This project will expand fiber on ODOT facilities to connect additional devices. | Long |
| ODOT Signal Coordination | This project will coordinate signals between, ODOT and multiple other jurisdictions in the TMACOG region. | Short |
| ODOT Wrong-Way Driving | This project will deploy wrong-way driving solutions, including sensors to detect wrong-way drivers, alerts to ODOT and public safety, and dynamic signage to warn vehicles. | Long |
| OHGO Mobile Application | This project will create a mobile application for the website ohgo.com. | Short |
| TARTA AVL Expansion | This project will expand AVL to additional TARTA vehicles. | Long |
| TARTA Camera Upgrade and Coordination | This project will upgrade the camera systems for TARTA and potentially allow the capability to share video feeds with public safety agencies. | Long |
| TARTA Downtown Information Kiosks | This project will install traveler information kiosks at downtown stops. | Long |
| TARTA GTFS | This project will create a GTFS feed of electronic schedule data available on the agency website. | Short |
| TARTA Payment System Upgrade | This project will upgrade payment systems to include smartcards and/or mobile payment instruments. | Long |
| TMACOG Enhanced Data Collection Capabilities | This project will enhance TMACOG data collection capabilities, which would incorporate data collection from city, state, and counties as well as third party data vendors. | Long |
| Wood County Maintenance AVL | This project will add an AVL system to track maintenance vehicles in Wood County. | Long |

## 11. Agreements

Agreements were collected from stakeholders in the TMACOG region during the one-on-one stakeholder interviews, as well as at the ITS Architecture Update Workshop. Table 5 outlines the agreements identified by regional stakeholders during the ITS Architecture Update process.

**Table 5: Agreements**

| Number | Title | Type | Description | Stakeholders |
|---|---|---|---|---|
| 1 | Ohio Turnpike and ODOT Mutual Aid Agreement | MOU | This short term agreement provides for mutual aid between the Ohio Department of Transportation and the Ohio Turnpike Commission. | • ODOT<br>• Ohio Turnpike Commission |
| 2 | TARTA and LakeTran Fare-Sharing Agreement | Operational Agreement | This agreement allows fare-sharing and transfers for passengers between TARTA and LakeTran services. | • TARTA<br>• Lake Erie Transit |
| 3 | MDOT and Monroe County Maintenance Agreement | MOU | This agreement between MDOT and the Monroe County Road Commission provides that Monroe County will remove snow on I-75. | • MDOT<br>• Monroe County Road Commission |

## 12. Using the Regional ITS Architecture

Once a regional ITS architecture has been created, it's important that it be used as a key reference in the transportation planning process. This will ensure all proposed ITS projects are consistent with the regional ITS architecture and additional integration opportunities are considered, leading to more efficient implementations.

For the Toledo metro area the primary planning document is the *On the Move: 2015-2045 Transportation Plan*. It is the long-range guide for major investments in Toledo's multimodal ground transportation system. The RTP recommends major projects, systems, policies and strategies designed to maintain the existing transportation system and serve the region's future travel needs. With the completion of the initial version of the Toledo Metro Area Regional ITS Architecture, it is recommended that the draft Regional Transportation Plan be reviewed and updated as necessary to incorporate any new aspects of transportation connectivity defined in the architecture.

The regional ITS architecture should also be considered for support in ITS project development cycle. This begins with project definition, followed by procurement, leading to implementation. Information in the regional ITS architecture can assist in all three of these areas of project development.

Project Definition may occur at several levels of detail. Early in the planning process a project may be defined only in terms of the transportation services it will provide, or by the major system pieces it contains. At some point prior to the beginning of implementation the details of the project must be developed. This could include further system definition and interface definition including exactly what systems or parts of systems will make up the project, what interconnections the project entails, and what information needs to flow across the system interconnections. Requirements definition may go through similar levels of detail, starting with very high-level description of project functions and moving toward system specifications. By identifying the portions of the regional ITS architecture that define the project, the regional ITS architecture outputs can be used to create key aspects of the project definition.

The areas that a regional ITS architecture can assist in project definition are:

- The identification of agency roles and responsibilities (including any inter-agency cooperation) can come from the operational concept developed as part of the regional ITS architecture. This operational concept can either serve as a starting point for a more detailed definition, or possibly provide all the needed information.
- Requirements definition can be completely or partly defined by using the regional ITS architecture functional requirements applicable to the project.
- The regional ITS architecture includes a map to ITS standards and the project mapping to the regional ITS architecture can extract the applicable ITS standards for the project.

Once a project is defined, and funding for it is committed, the implementation process can commence with the generation of a Request For Proposal (RFP), which is the common governmental practice for initiating a contract with the private sector to implement the project. Once a contract is in place, project implementation begins and moves through design, development, integration, and testing.

The regional ITS architecture, and the products produced during its development, can support this RFP generation. First the project definition described above forms the basis for what is being procured. Mapping the project to the regional ITS architecture allows bidders to have a clear understanding of the scope of the project and of the interfaces that need to be developed. The functional requirements created as part of the regional ITS architecture can be used to describe the functional requirements for the project. In addition a subset of the ITS Standards identified as part of the regional ITS architecture development can be specified in the RFP.

Because ITS projects involve systems and their interconnections, it is very important to follow a system engineering approach to designing and implementing the project. While the exact process followed is at the discretion of the local agency, the ITS Architecture and Standards Rule/Policy lay out a set of required system engineering analyses for ITS projects funded through the highway trust fund.

The required system engineering analysis steps are:

- Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of the *National ITS Architecture*);
- Identification of participating agencies' roles and responsibilities;
- Requirements definitions;
- Analysis of alternative system configurations and technology options to meet requirements;
- Procurement options;
- Identification of applicable ITS standards and testing procedures; and
- Procedures and resources necessary for operations and management of the system.

The regional ITS architecture can provide inputs to a number of these steps as shown in Table 6:

**Table 6: System Engineering Requirements supported by Regional ITS Architecture**

| System Engineering Requirements | Regional ITS Architecture output |
|---|---|
| Identification of portions of the regional ITS architecture being implemented | Mapping project to the elements and interfaces of the regional ITS architecture |
| Identification of participating agencies' roles and responsibilities | Use Operational Concept as a starting point |
| Requirements definitions | Use Functional Requirements as a starting point. |
| Identification of applicable ITS standards and testing procedures | Use regional architecture standards outputs as a starting point for the standards definition. |

In summary, the regional ITS architecture represents a detailed plan for the evolution of the ITS systems in the region and can be used to support regional transportation planning efforts and project development efforts.

# 13. Maintaining the Regional ITS Architecture

The Toledo Metro Area Regional ITS architecture is not a static set of outputs. It must change as plans change, ITS projects are implemented, and the ITS needs and services evolve in the region. This section describes a proposed plan for the maintenance of the architecture. The plan covers the following four key areas:

- Who will be involved in the maintenance of the architecture?

- When will the architecture be updated?
- What will be maintained?
- How it will be maintained (i.e. what configuration control process will be used)?

The regional ITS architecture is created as a consensus view of what ITS systems the stakeholders in the region have currently implemented and what systems they plan to implement in the future. The regional ITS architecture will need to be updated to reflect changes resulting from project implementation or resulting from the planning process itself.

- Changes for Project Definition. When actually defined, a project may add, subtract or modify elements, interfaces, or information flows from the regional ITS architecture. Because the regional ITS architecture is meant to describe the current (as well as future) regional implementation of ITS, it must be updated to correctly reflect how the developed projects integrate into the region.
- Changes for Project Addition/Deletion. Occasionally a project will be added or deleted through the planning process and some aspects of the regional ITS architecture that are associated with the project may be expanded, changed or removed.
- Changes in Project Priority. Due to funding constraints, or other considerations, the planned project sequencing may change. Delaying a project may have a ripple effect on other projects that depend on it. Raising the priority for a project's implementation may impact the priority of other projects that are dependent upon it.
- Changes in Regional Needs. Transportation planning is done to address regional needs. Over time these needs can change and the corresponding aspects of the regional ITS architecture that addresses these needs may need to be updated.

In addition, new stakeholders may come to the table and the regional ITS architecture should be updated to reflect their place in the regional view of ITS elements, interfaces, and information flows.

Finally, the National ITS Architecture may be expanded and updated from time to time to include new user services or better define how existing elements satisfy the user services. The National ITS Architecture may have expanded to include a user service that has been discussed in a region, but not been included in the regional ITS architecture, or been included in only a very cursory manner.

## 13.1. Roles and Responsibilities for Maintenance

Responsibility for maintenance of the Toledo Metro Area Regional ITS Architecture will lie with TMACOG, since they are the primary planning organization for the region, and will be one of the primary users of the architecture. While they assume responsibility for maintenance, the region will also need a group of core stakeholders to act as an "institutional framework" to review proposed changes to the architecture. The regional ITS architecture is a consensus framework for integrating ITS systems in the region. As it was a consensus driven product in its initial creation, so it should remain a consensus driven product as it is maintained. An institutional framework is needed for maintaining the products. This might be an advisory committee or some similar group, convened by TMACOG and having representatives from key stakeholder agencies in the region. This section defines the stakeholder groups and their roles and responsibilities for the maintenance of the Toledo Metro Area Regional ITS Architecture.

**Definitions**

The following stakeholder groups will have a role in the maintenance of the architecture:

- Stakeholders – Any government agency or private organization that has a role in providing transportation services in the region.
- Maintenance Working Group – A group of stakeholder representatives who are responsible for the technical review of updates/changes to the Toledo Metro Area Regional ITS Architecture, and for approving changes to go into the architecture.
- Responsible Agency – The stakeholder agency with primary responsibility for maintenance of the architecture.
- Maintenance Manager – A person responsible for overseeing and guiding the maintenance efforts.

**Stakeholders**

Stakeholders are any government agency or private organization that is involved with or has an interest in providing transportation services in the state. Each stakeholder owns, operates, and/or maintains one or more ITS elements in the architecture.

The success of the change management process outlined in this Maintenance Plan is highly dependent on the participation of the stakeholders identified in the architecture. Without stakeholders participation in tracking the development of they're ITS systems, and properly updating the architecture, the change management process will not succeed and the usefulness of the architecture will diminish over time.

The primary responsibilities of the stakeholder agencies are submitting the changes in plans or projects to the Maintenance Working Group.

If stakeholders desire more involvement, they can get involved through voluntary representation on the Maintenance Working Group.

**Maintenance Working Group**

The Toledo Metro Area Regional ITS Architecture Maintenance Working Group or the Maintenance Working Group has the following responsibilities:

- Collecting and compiling proposed changes and updates to the architecture from stakeholder agencies.
- Evaluating each proposed change from a technical standpoint, and reaching a consensus on the proposed change.
- Approving changes to the architecture.
- Making any institutional or policy related decisions that arise in the maintenance of the architecture.

The logical composition of the maintenance working group for the region is a subset of the Advisory Committee dealing with ITS in the region. The maintenance working group should have one "voting member" from each major stakeholder in the region.

The Maintenance Working Group should elect a Chairperson to conduct the meetings. The Chairperson will be responsible for calling meetings and leading the meetings. It is suggested that the Chairperson be elected for a two-year term by a majority vote of the eligible representatives present.

**Responsible Agency**
The Responsible Agency is the government agency that will formally maintain the architecture. The Responsible Agency will assign resources for making the physical changes to the architecture baseline, and for coordinating the maintenance of the architecture. For the maintenance of the Toledo Metro Area Regional ITS Architecture, the Responsible Agency is TMACOG, since they are the primary planning organization for the region, and will be primary users of the architecture.

**Maintenance Manager**
The Responsible Agency should appoint a person to the role of Maintenance Manager to coordinate the maintenance activities of the Toledo Metro Area Regional ITS Architecture. The Maintenance Manager will be the coordinator and main point of contact for all maintenance activities, including receiving Change Requests forms, tracking Change Requests, and distributing documentation. The Maintenance Manager is ideally an employee of the Responsible Agency who is formally tasked with the described efforts, but it is not a requirement
The Maintenance Manager has the following responsibilities:

- Coordinate the activities of the Maintenance Working Group
- Receive Change Request forms and requests for documentation from Stakeholders
- Distribute the baseline documents and outputs of the architectures to stakeholders.
- Maintain the "official" records of the Toledo Metro Area Regional ITS Architecture, including the baseline documents, meeting minutes, the Change Request Database, and the list of Points of Contacts for the Stakeholder
- Ensures the status of each Change Request are properly updated in the Change Request Database

Some of these responsibilities will likely be delegated to staff or consultants.

## *13.2. Timetable for Maintenance*

How often will the regional ITS architecture be modified or updated? What events or timetable will be used for making updates or changes to the architecture?

The timetable will depend on the basic approach chosen for maintaining the architecture. There are several options that could be considered:

- **Periodic Maintenance.** This approach ties the maintenance of the architecture to one of the recurring activities of the transportation planning process. For example, it's natural that the ITS architecture would be updated at the same frequency as the regional transportation plan is updated (every three to five years) or the Transportation Improvement Program is updated (at least every two years). The update of the architecture should occur several months prior to the transportation planning document update, so that the revised architecture could serve as an input to the planning update. Publication and versioning costs are minimized for the periodic maintenance approach since there is a new version only once in the maintenance cycle.

- **Exception Maintenance.** This approach considers and makes changes to the regional ITS architecture in a process that is initiated as needed. Publication and versioning costs are dependent on the frequency of changes made to the regional ITS architecture.

**Timetable Approach**

***A comprehensive architecture update should occur every three years***, concurrent with the formal update of the TIP. This is a natural result of the Toledo Metro Area Regional ITS Architecture being a component of the regional transportation planning process. The update is necessary to ensure that the architecture continues to accurately represent the regional view of ITS Systems. The comprehensive update may include adding new stakeholders, reviewing transportation needs and services for the region, updating the status of projects, and reflecting new goals and strategies, as appropriate. Operational concepts, system functional requirements, project sequencing, ITS standards, and list of agency agreements may also be updated at this time.

***Between major updates of the architecture, the following interim update actions will be performed:***

- Accept comments as they come in and make ***minor updates every 6 months if needed***. Defer any major changes to the yearly update.
- ***Actively solicit changes on an annual basis*** from each key stakeholder a set of needed updates.
- ***Perform minor or major updates as needed*** based upon the inputs and any other change requests received.

The Maintenance Plan should also be reviewed at the previously discussed times for required changes. Use of the Regional ITS Architecture and modifications to it may differ from what was anticipated during the initial development of the Maintenance Plan. Revising the Maintenance Plan may ensure that the change management process defined is effective.

## *13.3. Architecture Baseline*

Establishing an architecture baseline requires clear identification of the architecture products that will be maintained, including specific format and version information. For the Toledo Metro Area Regional ITS Architecture the following outputs represent the architecture baseline:

- Architecture Document (this document)
- Turbo Architecture Database
- Regional ITS Architecture Web pages
- Change Request Database

Regarding the Architecture document, the source document, in Microsoft Word format, will be held by TMACOG, while a PDF version of the document can be created for general distribution. In addition, a version number and date should be included inside the cover page.

Regarding the Turbo Architecture Database, TMACOG will maintain a zipped version of the final delivered Toledo Metro Area Regional ITS Architecture database. The name, date, and size of the database file inside the zipped file should be entered into an architecture log as version 2.0 of the architecture.

## *13.4. Change Management Process*

Once the baseline is defined, the process for making changes to this baseline must be established. The change management process specifies how changes are identified, how often they will be made, and how the changes will be reviewed, implemented, and released. The basic process for change management is shown in Figure 9.

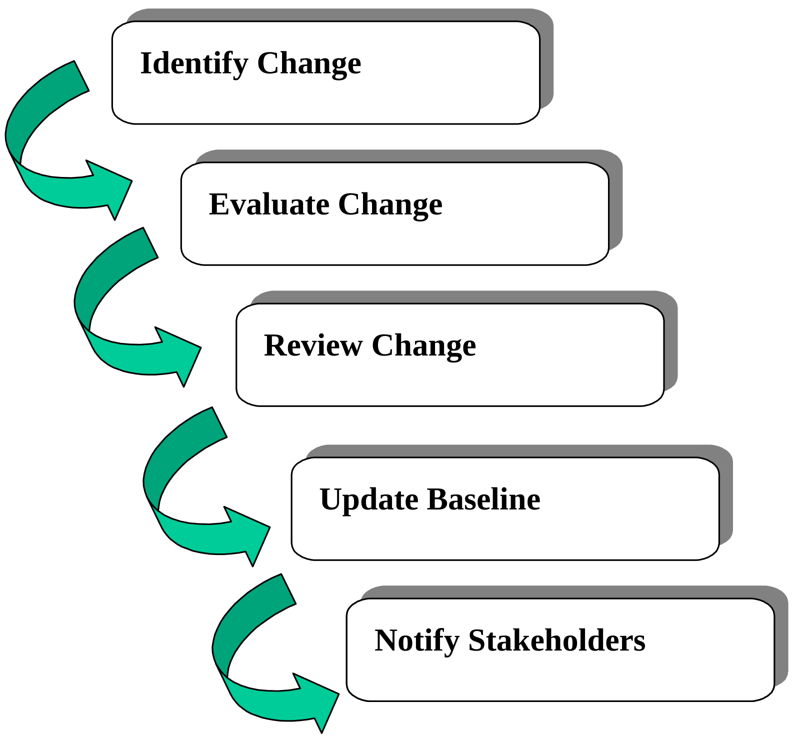



**Figure 9: Change Management Process**

**Identify Change**

This involves two issues-

- who can identify a change to the architecture and
- how will the change request be documented.

The question of who can make change requests is an important one. If literally anyone can input requests the region runs the risk of being overrun by requests that will tax scarce resources to review and decide upon. On the other end of the spectrum, if too much formality or paperwork is added to the process then many valid or needed changes may go unexpressed. The plan is that all changes should come through a voting member of the Maintenance Working Group. This effectively means that any change suggested has the approval of a member of the working group. This has the added benefit of spreading the resources needed to generate or evaluate changes among the group.

As to how the change request should be documented—a simple change request form should be created that contains at least the following information

- Name of change
- Description of change
- Part of baseline affected (could be check boxes for document, database, web site, and not known)
- Rationale for change
- Originator name or agency
- Date of origination

This information will ultimately be added to a change database (recommended to be maintained by TMACOG personnel) that will add the following additional fields of information

- Change number (some unique identifier)
- Change disposition (accepted, rejected, deferred)
- Change type (minor or significant)
- Disposition comment
- Disposition date

**Evaluate Change**

Upon receiving a Change Request by the Maintenance Manager, an initial evaluation of the Change Request is to be made for the impact to the overall architecture or the affected document. The purpose of the evaluation is two-fold:

- Verify that the Change Request form and supporting materials is complete and correct
- Compare with other Change Request forms and determine if there are any conflicts

If the proposal for architecture modification has an impact on other stakeholders, the evaluator(s) should contact the Stakeholders to confirm their agreement with the modification. All Stakeholders directly affected by the proposed change(s) must approve and sign-off the Change Request before the Maintenance Working Group considers the Change Request.
There are several options as to who performs the initial assessment, including:

- The Maintenance Manager
- Maintenance Working Group
- The person submitting the change
- A consultant, hired to support the maintenance activities of the architecture

Each of the above options has positive and negative implications, but the evaluator must have working knowledge of the architecture to evaluate the proposed changes.

**Reviewing the Change Request**
Upon completing the initial assessment, the Change Request form should be reviewed by the Maintenance Working Group (either at a Maintenance Working Group meeting or via some electronic means). Maintenance Working Group meetings are called by the Maintenance Manager (or their designated representative).

Maintenance Working Group meetings called by the Maintenance Manager will occur at least on an annual basis. On an annual basis, the Maintenance Manager will send a reminder to all Stakeholders to update their ITS Elements and Interfaces in the architecture, if necessary. If sufficient Change Request Forms are submitted, the Maintenance Manager may call a Maintenance Working Group meeting at more frequent intervals to review the Change Request forms. The Maintenance Manager will act as Chairperson for these meetings. The Maintenance Manager will distribute the Change Request forms and all supporting materials to all Stakeholders prior to the meeting for their review and assemble an agenda.
Maintenance Working Group meetings can also be requested by one of the stakeholders if there is an urgent need to update the architecture quickly.

The Maintenance Working Group should have sufficient time to review the Change Requests before the meeting. During the meeting, the Maintenance Working Group shall review the proposed changes and offer any comments.

After each Change Request is reviewed, if no further comments are offered by the Maintenance Working Group, the Change Request will be considered approved, and the Chairperson shall sign off on the Change Request.

If additional comments are made that require action, those comments should be noted on the Change Request form. Where comments (or changes required) are minor in nature they can be made by the submitter of the change Request form, or by resources designated by the Maintenance Manager and the change considered approved. In the case of major comments or changes to the Change Request, the approval of the change may be deferred until the next meeting of the Maintenance Working Group.

If a Change Request is to be withdrawn from consideration, the Chairperson or the Maintenance Manager must sign-off on the Change Request Form to close out the Change Request.
At the end of the meeting, the Maintenance Working Group shall agree if all the approved changes to the architecture necessitate a minor revision of the appropriate baseline documents or a major revision. The decision will be based on the number of Change Requests approved and the nature of the approved changes.

Minutes should be kept for all Maintenance Working Group meetings. Minutes should include, at a minimum, an attendance list, comments made on each Change Request, and the disposition of each Change Request Form (Approved/Withdrawn/Deferred/Request More Information). Minutes are to be distributed to all members of the Maintenance Working Group meeting no less than 5 working days after the meeting. Comments are due within 10 working days to the

Maintenance Manager.  Approved minutes shall be signed by the Chairperson and will be distributed to all Stakeholders and posted on the website.  The minutes provide a recording process for the change management process and provides traceability.

One additional procedure the region may want to consider is to streamline the review and approval process for minor Change Requests, handling via email rather than through face to face meetings.

**Update Baseline:** The decision is implemented.
If the decision is to accept the change, then the appropriate portions of the architecture baseline are updated and an updated architecture baseline is defined.  In addition to updating the baseline documents, databases, or other outputs, the configuration status should be updated.  In the discipline of Configuration Management this is known as Configuration Status Accounting.  This accounting is performed by having a document that defines the following information for each separate output of the architecture baseline:

- Output name;
- Output revision number;
- Date of latest revision;
- File Name; and
- Location/Point of Contact.

Periodically, the information in the various outputs of the architecture baseline should be audited to assure that the different representations of the architecture information (e.g. the database and document) are in sync.  This configuration auditing should be performed by someone independent of the staff or resources used to actually enter the changes.

**Notify Stakeholders**:  Point of Contacts for each stakeholder should be notified by e-mail from the Maintenance Manager when baseline documents have been updated.  All baseline documents shall also be available to stakeholders from a website or other electronic location, such as an ftp site.  It is the responsibility of the Maintenance Manager to ensure the most recent document is available from the website.  The Configuration Status Document should be one of those outputs that is available.

Request for copies or access to the baseline documents should be made to the Maintenance Manager.

After major revisions to the architecture or the baseline documents, the Maintenance Working Group may elect to also provide all baseline documents to members on CD-ROMs.

# Appendix A: Acronyms/Glossary

# Appendix A: Acronyms/Glossary

***ATIS* –** Advanced Traveler Information System

***ATMS* –** Advanced Traffic Management System

***AVL* –** Automated Vehicle Location

***CCTV* –** Closed Circuit TV

***DMS* –** Dynamic Message Sign

***GPS* –** Global Positioning System

***HAR* –** Highway Advisory Radio

***ITS* –** Intelligent Transportation Systems

***LEADS* –** Law Enforcement Automated Data System

***NCIC* –** National Crime Information Center

***LED* –** Light Emitting Diode

***MARCS* –** Multi-Agency Radio Communications System

***MDT* –** Mobile Data Terminal

***MPO* –** Metropolitan Planning Organization

***NITSA* –** National ITS Architecture

***NOAA* –** National Oceanic and Atmospheric Administration

***NTCIP* –** National Transportation Communications for ITS Protocol

***PSAP* –** Public Safety Answering Point

***TMC* –** Traffic Management Center

***TOC* –** Traffic Operations Center

***UTCS* –** Urban Traffic Control Systems

### *Amber Alert*

Immediately after a child has been kidnapped and is considered endangered, law enforcement officers launch an Amber Alert. An Amber Alert is a notice to motorists about a child who has potentially been kidnapped. Notices are disturbed by television, radio, the Internet, and highway signs, to notify the public when a child is abducted. Some people will also receive notices through their pagers or cellular phones. An Amber Alert notice provides details about the abducted child and, when possible, information about a suspect's vehicle.

### *Architecture Flow*

Information that is exchanged among Subsystems and between Subsystems and Terminators in the Physical Architecture view of the National ITS Architecture. Architecture Flows are the primary tool that is used to define the Regional ITS Architecture Interfaces. These Architecture Flows and their communication requirements define the Interfaces, which form the basis for much of the ongoing Standards work in the National ITS program. In this document, the terms "information flow" and "architecture flow" are used interchangeably.

### *Closed Loop System*

A closed loop system connects a series of traffic signals providing communications between the individual intersections.

### *Element*

This is the basic building block of a Regional (or Statewide) ITS Architecture. It is the name used by the Stakeholders to describe a system or piece of a system.

### *Entity*

Term used in the National ITS Architecture to describe the building blocks of the architecture, specifically Subsystems and Terminators.

### *Equipment Package*

Equipment Packages are the building blocks of the Physical Architecture Subsystems. Equipment Packages group like Processes of a particular Subsystem together into an "implementable" package. The grouping also takes into account the User Services and the need to accommodate various levels of functionality. Since Equipment Packages are both the most detailed elements of the Physical Architecture view of the National ITS Architecture and tied to specific Service Packages, they provide the common link between the interface-oriented Architecture definition and the deployment-oriented Service Packages.

### *Functional requirements*

Functional requirements are statements of the capabilities that a system must have ("functions"), geared to addressing the business needs that a system must satisfy.

### *Information Flow*

Information that is exchanged between Subsystems and Terminators in the Physical Architecture view of the National ITS Architecture. In this document, the terms "Information Flow" and "Architecture Flow" are used interchangeably.

### *Inventory*

See System Inventory.

### *Service Package*

Service Packages identify the pieces of the Physical Architecture that are required to implement a particular transportation Service. They provide an accessible, service oriented, perspective to the National ITS Architecture. They are tailored to fit - separately or in combination - real world transportation problems and needs. Service Packages collect together one or more Equipment Packages that must work together to deliver a given transportation Service and the Architecture Flows that connect them and other important external systems.

### *Multiplexer*

An electronic device which is used to combine several signals for transmission over one communications channel by varying the physical characteristics (frequency, amplitude or phase) or timing of the signals to prevent them from interfering with each other.

### *National ITS Architecture*

A common, established framework for developing integrated transportation systems. The National ITS Architecture is comprised of the Logical Architecture and Physical Architecture, which satisfy a defined set of User Services. The National ITS Architecture is maintained by the United States Department of Transportation (USDOT).

### *Probe*

Vehicle or mobile device used to derive speed and other parameters (e.g. origin and destination) for the network.

### *Process Specification (PSpec)*

The textual definition of the most detailed Processes identified in the Logical Architecture view of the National ITS Architecture. The Process Specification includes an overview, a set of functional requirements, a complete set of inputs and outputs, and a list of the User Service requirements that are satisfied by the PSpec.

### *Signal Preemption*

Traffic signal preemption is an optical communications system that allows preemption-equipped vehicles, typically police, emergency response vehicles, and/or transit vehicles, to alter the normal operation of preemption-equipped traffic signals. Such systems are designed to increase safety, reduce emergency response times and enhance public transit operations.

### *Subsystem*

The principal structural element of the Physical Architecture view of the National ITS Architecture. Subsystems are individual pieces of the Intelligent Transportation System defined by the National ITS Architecture. Subsystems are grouped into four classes: Centers, Roadside, Vehicles, and Travelers. Example Subsystems are the Traffic Management Subsystem, the Vehicle Subsystem, and the Roadway Subsystem. These correspond to the physical world: respectively traffic operations centers, automobiles, and roadside signal controllers. Due to this close correspondence between the physical world and the Subsystems, the Subsystem interfaces are prime candidates for standardization.

### *System Inventory*

The collection of all ITS-related Elements in an ITS Architecture.

### *Terminator*

Terminators define the boundary of an Architecture. The National ITS Architecture Terminators represent the people, systems, and general environment that interface to ITS. The Interfaces between Terminators and the Subsystems and Processes within the National ITS Architecture are defined, but no functional requirements are allocated to Terminators. The Logical and Physical Architecture views of the National ITS Architecture both have exactly the same set of Terminators.

### *User Service*

User Services document what ITS should do from the user's perspective. A broad range of users are considered, including the traveling public as well as many different types of system operators. User Services form the basis for the National ITS Architecture development effort. The initial User Services were jointly defined by USDOT and ITS America with significant Stakeholder input and documented in the National Program Plan (NPP). Over time, new or updated User Services will continue to be developed and the National ITS Architecture will be updated to support these User Service changes.

### *User Service Requirement*

A specific functional requirement statement of what must be done to support the ITS User Services. The User Service Requirements were developed specifically to serve as a requirements baseline to drive National ITS Architecture development. The User Service Requirements are not requirements to system/architecture implementers, but rather are directions to the National ITS Architecture development team.

# Appendix B: Comments and Disposition

## Comments and their Disposition

| Item # | Stakeholder | Date | Section | Description | Response |
|---|---|---|---|---|---|
| 1 | City of Toledo | 6/3/2016 | Inventory | Description-~540 signals. This should read 490 signals. UTCS pretimed system across ½ the City. This should read 90%. EAGLE system communicating with 100+ signals. This should read 400 signals. This is running on serial communication which all the intersections would need to be upgraded to Ethernet to have video feedback. Multiplexer @ Erie Street Building (237 S. Erie)-correct although being relocated this year to the corner of Erie & Market. The server for all the traffic signals is located in the Government Center. The COT has multiplexers located at 5 locations total: Government Center, 237 S. Erie (listed above), Collingwood & Detroit, Detroit & South and Dorr & Parkside. No plans for additional multiplexers. 4 locations where signals are within 200' of RR crossings. To my knowledge we only have 2 crossings that fit this description: Bennett & Laskey and Laskey & Lewis. | Description updated, but specific locations have been removed. In general, we have found that because of the 15 year time horizon it is best to leave the specific location of equipment generic, rather than specify specific locations. |
| 2 | City of Toledo | 6/3/2016 | Functional Requirements | TMC Traffic Metering: ODOT District Two is responsible for monitoring freeways. This needs to be addressed in this section. | This functional area has been removed |
| 3 | City of Toledo | 6/3/2016 | Functional Requirements | Comment : All these Functional Areas sound great and will take a lot of grant money to make happen. The concern however is the hours of operation need to be addressed. The COT only has a 24 hr trouble truck operation. We do not | Noted. The ITS Architecture is designed to be cost neutral - a plan of all the possibilities of what your agency might do rather |

| Item # | Stakeholder | Date | Section | Description | Response |
|---|---|---|---|---|---|
| | | | | have the personnel necessary to monitor these Functional Areas other than our normal hours of operation (7 am to 3:30 pm). | than what you will definitely do. |
| 4 | City of Toledo | 6/3/2016 | Services | ATMS20-Crossing Status should go directly from the operators' towers to emergency management, not through the COT Traffic Management System | Change made |
| 5 | City of Toledo | 6/3/2016 | Projects | Central Software Upgrade: We have upgraded from ACTRA to TACTICS (not Trafics). Change status from planned to completed. Due to computer/workstation upgrades we had to purchase TACTICS (ACTRA does not work with operating systems later than Windows 2000) to communicate with our intersections. However, a long term goal would be to overhaul the Central System with the latest software available that would fit our needs. This should be a long term goal with an approximate cost of $500,000. | Updated to project to reflect long-term status and to describe a complete overhaul, rather than a platform upgrade. Cost information was not added, as the architecture is designed to be cost-neutral. In addition, completed projects are generally not included in the architecture. |
| 6 | City of Toledo | 6/3/2016 | Projects | City of Toledo Adaptive Signal System: Project Status-Planned. This description should read "this project will upgrade two intersections on the outskirts of the COT coordinated system and allows signal timing optimization based on live traffic demands". | Description updated |
| 7 | City of Toledo | 6/3/2016 | Projects | City of Toledo Video to Central System: Project Status-Planned. Does this status mean funding has been made available? The cost to upgrade to Ethernet from serial with our existing timers is approximately $1000-$1500 per intersection. That amounts to approximately $750,000. This | This project reflects information gathered in the architecture team's interview with the City of Toledo. The architecture is funding neutral and as such |

| Item # | Stakeholder | Date | Section | Description | Response |
|---|---|---|---|---|---|
| | | | | timeframe may have to be changed to long term due to this amount of money. To the description add "use video to analyze traffic flow at intersections and adjust timing based on historical data obtained by the video. This video can also be utilized for traffic counts." | does not reflect the costs mentioned. The project description was updated according to comments made by the City of Toledo. |
| 8 | City of Toledo | 6/3/2016 | Projects | City of Toledo and Lucas County Coordination: add "to allow signal timing coordination across jurisdictional boundaries" | Description updated. |
| 9 | ODOT | 6/7/2016 | Services/Interfaces | Traffic signal flows between ODOT Statewide TMC and ODOT District 2 Field Equipment should be changed to "existing" status | Change made |
| 10 | ODOT | 6/7/2016 | Services/Interfaces | Video surveillance control and traffic images are provided through the Statewide TMC | Changes made |
| 11 | ODOT | 6/7/2016 | Services/Interfaces | Interfaces between ODOT District 2 Maintenance Garages and OH.GO Website changed to existing. All information is posted to Buckeye traffic and then automatically pushed to OH.GO. | Changes made |
| 12 | ODOT | 6/7/2016 | Services/Interfaces | "road weather information" from ODOT District 2 Office to ODOT Statewide TMC should be changed to existing | Change made |
| 13 | ODOT | 6/7/2016 | Services/Interfaces | All information is posted from Statewide TMC/District Offices/District Maintenance Garages to BuckeyeTraffic and is automatically populated onto OH.GO website and app. Includes predictive traffic, construction information, incidents, weather, road sensors-RWIS | Changes made |
| 14 | ODOT | 6/7/2016 | Services/Interfaces | All flows between Private Traveler Information Devices and OH.GO Mobile App changed to | Changes made |

| Item # | Stakeholder | Date | Section | Description | Response |
|---|---|---|---|---|---|
| | | | | existing EXCEPT parking information | |
| 15 | ODOT | 6/7/2016 | Services/Interfaces | Add "parking information" between ODOT Statewide TMC and Southeast Michigan Traffic Operations Center | Changes made |
| 16 | TMACOG | 7/22/2016 | Document | Change "Metro" to "Metropolitan" on page 5 | Change made |
| 17 | TMACOG | 7/22/2016 | Document | Architecture was updated to" on page 6 | Change made |
| 18 | TMACOG | 7/22/2016 | Document | Added "(consisting of Public Works Division and Engineering Division)" to Table 2 for City of Bowling Green | Change made |
| 19 | TMACOG | 7/22/2016 | Document | Added "Engineering, surveying, and design of City water, sewer, pavement, and sidewalks Inspect all work on City projects for compliance" to stakeholder description for City of Bowling Green Public Works | Change made |
| 20 | TMACOG | 7/22/2016 | Document | Removed "Distribution" from Stakeholder "City of Bowling Green Electric Distribution Division" | Change made |
| 21 | TMACOG | 7/22/2016 | Document | Changed "traffic equipment" to "traffic control equipment" in City of Bowling Green Electric Division Stakeholder description | Change made |
| 22 | TMACOG | 7/22/2016 | Document | Changed "City of Toledo Public Services" to "City of Toledo Department of Public Services" | Change made |
| 23 | TMACOG | 7/22/2016 | Document | *(would like to place Public Services above Division of Trans. Because Trans is contained in within Dept of PS). | Change made in the table, but these are listed alphabetically because they come out of a database. |
| 24 | TMACOG | 7/22/2016 | Document | Add stakeholder "City of Toledo Division of Public Utilities" | Change made, inventory item added and service added to MC08 |
| 25 | TMACOG | 7/22/2016 | Document | Change "region" to "Monroe County" in Lake | Change made |

| Item # | Stakeholder | Date | Section | Description | Response |
|---|---|---|---|---|---|
| | | | | Erie Transit stakeholder description | |
| 26 | TMACOG | 7/22/2016 | Document | Updated "Lucas County Fire Department" to "Lucas County Fire Departments" and update stakeholder description | Change not made - Represents only Lucas County FD - discussed at 8/3 Meeting |
| 27 | TMACOG | 7/22/2016 | Document | Added stakeholder description for Lucas County Sanitary Engineer | Change made |
| 28 | TMACOG | 7/22/2016 | Document | Update stakeholder description for Michigan State Police | Change made |
| 29 | TMACOG | 7/22/2016 | Document | Punctuation in stakeholder description for "Municipal Engineering Departments" | Change made |
| 30 | TMACOG | 7/22/2016 | Document | Update stakeholder description for Municipal Engineering Departments | Change made |
| 31 | TMACOG | 7/22/2016 | Document | Update stakeholder description for ODOT | Change made |
| 32 | TMACOG | 7/22/2016 | Document | Update stakeholder description for Ohio Turnpike Commission | Change made |
| 33 | TMACOG | 7/22/2016 | Document | Update stakeholder description for TMACOG. | Change made |
| 34 | TMACOG | 7/22/2016 | Document | Updated stakeholder description for Toledo - Lucas County Port Authority | Change made |
| 35 | TMACOG | 7/22/2016 | Document | Updated project name and description for OHGO Mobile App and changed to existing. | Change made |
| 36 | TMACOG | 7/22/2016 | Document | Corrected grammar and formatting | Change made |
| 37 | OITC | 6/1/2016 | Stakeholders and Inventory | Correct stakeholder name and element name for OITC | Change made |