March 2021

Mid-Ohio Regional Planning Commission

MORPC ITS Architecture User's Guide

Regional Architecture Update 2021

Mid-Ohio Regional Planning Commission

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1. Introduction

Intelligent Transportation Systems (ITS) refer to an assortment of technologies, systems, and transportation management concepts that collectively aim to save time, lives, and money.

The ITS Architecture identifies all entities (device types) and how they interface between agencies. The ITS architecture should be used to verify that all ITS projects fall in line with the existing structure. If the project includes a new interface that isn't already identified within a stakeholder's inventory, then the stakeholder should reference the Ohio Department of Transportation (ODOT) Traffic Engineering Manual (TEM) Part 1301-2 to identify the required steps that need to be taken to qualify for ITS funding. It is in the best interest of the project stakeholders to keep the ITS architecture updated, by communicating any changes to the MPO. Keeping the ITS architecture updated will minimize project risk and ensure that projects are completed in a timely manner. Having an updated ITS architecture also helps streamline the application process for ITS funding. By utilizing the steps outlined in the TEM, the amount of documentation may be minimized depending on the complexity of the project. For more information contact the MORPC or the ODOT Office of Traffic Operations. See the TEM for contact information online at: http://www.dot.state.oh.us/Divisions/Engineering/Roadway/DesignStandards/traffic/TEM/Pages/default.aspx.

As the MPO for the region, MORPC has assumed the role of developing and maintaining the Central Ohio Regional ITS Architecture. MORPC fits the role of champion based on the following characteristics:

- Understanding of the subject (regional ITS architecture including familiarity with the National ITS Reference Architecture);
- Knowledge of local ITS systems and projects;
- Vision for interconnectivity, partnership, and regional integration;
- Consensus builder (facilitator); and
- Executive level access to resources to gain support for various regional efforts.

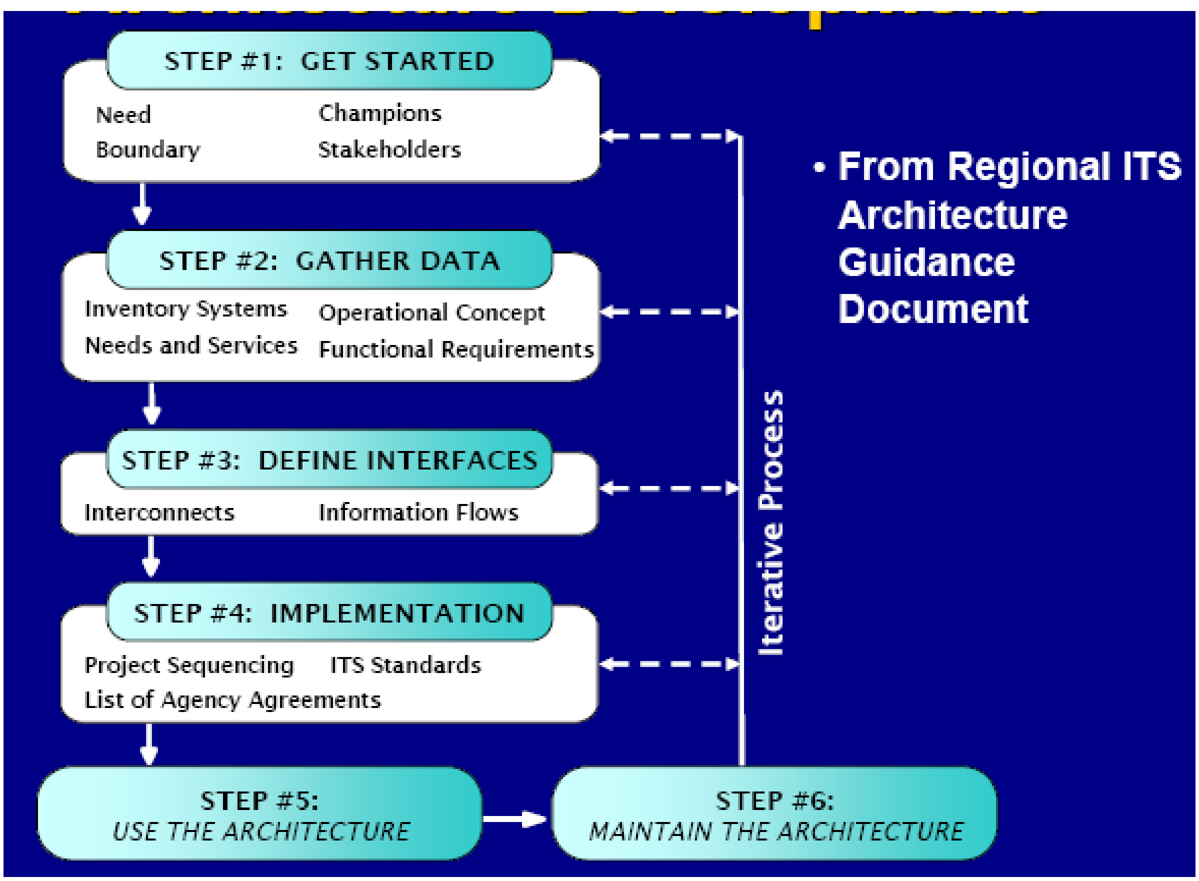
ITS has been and will continue to be an integral part of transportation planning in central Ohio. The goal of the planning process is to ensure that there is informed decision-making pertaining to the investment of public funds for regional transportation systems and services. The region's ITS architecture is a tool for MORPC and the region to make these decisions.

1.1 History of Central Ohio Regional ITS Architecture

In 1999, MORPC completed the first regional ITS architecture-type documentation for central Ohio, entitled I*TS Integration Strategy for Central Ohio*. The report was developed prior to FHWA's decision to require "architecture" documents for metropolitan areas implementing ITS projects. Paying close attention to federal recommendations made for the *Integration Strategy*, as well as to the needs of central Ohio, an updated ITS Architecture was developed. In April 2004, MORPC developed a formal regional ITS architecture that focused on integration strategies for central Ohio in compliance with the FHWA's requirements. The regional ITS architecture guidance document, *Developing, Using, and Maintaining an ITS Architecture for Your Region*, was used as a tool in establishing a process and ensuring that federal requirements were met. MORPC conducted a major update of the Central Ohio

ITS Architecture in 2010. At that time, the update was based on the National ITS Architecture Version 6.0. The information included in the 2010 Architecture update was collected via both stakeholder interviews and an extensive online survey. In 2014 and 2015, two ITS workshops were sponsored by the FHWA to assist MORPC in conducting minor update of the Regional ITS Architecture. In 2015, a minor update to the regional architecture was completed. MORPC utilized Turbo Architecture v7.0 to generate more detailed listings of system inventory and system interconnections. In 2020, DriveOhio, in collaboration with ODOT and transportation stakeholders statewide, developed a Statewide Connected and Automated Vehicle (CV/AV) Architecture for Ohio. With the assistance from DriveOhio and ODOT, MORPC conducted an update of the Regional ITS Architecture in 2021. The 2021 update was based on the National ITS Reference Architecture (also known as ARC-IT) Version 8.3. The update included adding ITS components of Smart Columbus and US 33 Smart Mobility Corridor into the Architecture, as well as incorporating the Statewide CV/AV Architecture into the Architecture. Regional Architecture Development for Intelligent Transportation (RAD-IT) software v.8.3 was used to update the details of the Architecture. This tool generated detailed listings of system inventory and system interconnections, and helped to identify relevant standards for the region. Also, an architecture user's guide was provided for stakeholders outlining how to utilize the ITS architecture and navigate the website.

Figure 1: Process of Regional ITS Architecture Development

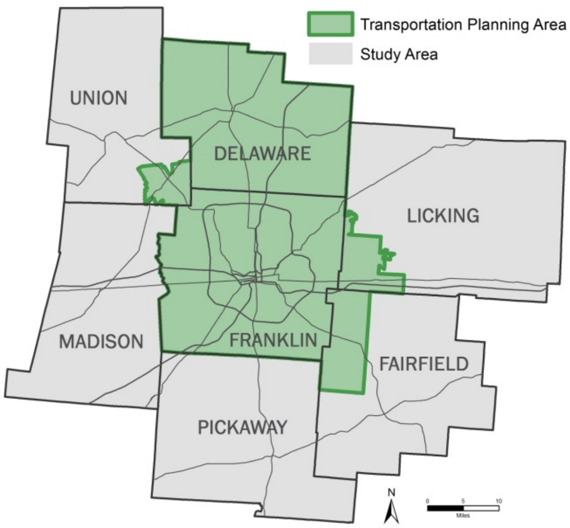


Source: FHWA, Regional ITS Architecture Guidance 2006

1.2 Geographic Scope and Service Ranges

The Regional ITS Architecture is applicable to the MPO transportation planning area. This area includes Franklin and Delaware counties as well as part of Licking, Fairfield, and Union counties, as shown in Map1. The major interstate and state routes through the region include I-71, I-70, I-270, I-670, and SR 315. However, the incorporation of ITS into projects expands beyond these boundaries to ensure that operational needs for integration and information sharing are met on a regional basis.

Central Ohio Geographic Boundaries



Source: MORPC, 2015

The architecture covers the broad spectrum of Intelligent Transportation Systems, including Traffic Management, Emergency Management, Maintenance and Construction Management, Public Transportation Management, Commercial Vehicle Operations, Connected and Automated Vehicles, and Data Management.

1.3 Regional Stakeholders

All members of the MPO planning area are considered immediate ITS stakeholders. Of these members there are four "core" stakeholders who have invested a large amount of time and money in local ITS efforts in the past and are integral to regional ITS integration. These agencies are: ODOT, the City of Columbus, Central Ohio Transit Authority (COTA), and Franklin County. The expansive group of stakeholders with existing or potential ITS needs include all other counties, cities, and villages, safety and security agencies, and the Columbus Regional Airport Authority (CRAA), among others.

1.4 Using the User's Guide

The user's guide provides guidance on how to navigate the Regional ITS Architecture website and search specific flows and definitions for each architecture service areas for Central Ohio ITS Architecture users. While all of the groups of users are not familiar with the ITS concepts and terminology use of the Regional ITS Architecture, it is suggested that they reference additional resources to understand the Regional ITS Architecture. Also, ITS stakeholder training will be provided as needed. Useful resources and definitions can be found at Appendix B of the User's guide. You can visit the most recent version of the Regional ITS Architecture online at: http://morpc.org/itsArchitecture/

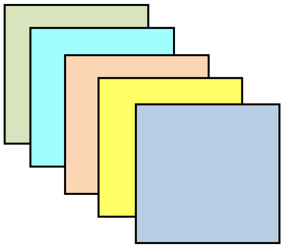
The National ITS Reference Architecture can be found at: http://itsarch.iteris.com/itsarch/.

2. ITS System Components and Terminology

2.1 The Subsystem Diagram

One of the most recognized architecture representations is the so-called *Subsystem Diagram*. This overview diagram depicts all possible ITS subsystems that can be deployed onboard a vehicle, at central locations, along the roadside, and at remote sites. The subsystem diagram provides a visual representation of ITS communications technologies and how subsystems in the architecture are connected. It is therefore also often referred to as the interconnect diagram that illustrates the five subsystems: Centers, Vehicles, Field, Personal, and Support. Each component of the diagram and its meaning is described in greater detail in Figure 2.

Figure2: Definition of the Subsystem Diagram



The Subsystem Diagram is made up of 5 classes. The classes are:

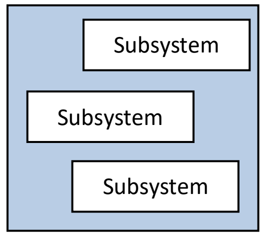
Center: An element that provides application, management, administrative, and support functions from a fixed location not in proximity to the road network.

Field: Infrastructure proximate to the transportation network which performs surveillance (e.g. traffic detectors, cameras), traffic control (e.g. signal controllers), information provision (e.g. Dynamic Message Signs (DMS)) and local transaction (e.g., tolling, parking) functions. Typically governed by transportation management functions running in centers.

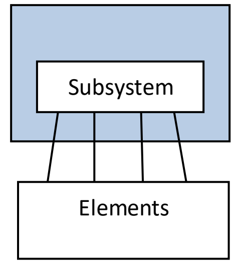
Support: A center that provides a non-transportation specific service. Typically these are enabling functions, such as communications facilitation, security or management.

Personal: Equipment used by travelers to access transportation services pre-trip and en route. This includes mobile/handheld as well as desktop equipment owned and operated by the traveler.

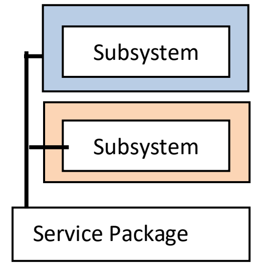
Vehicle: Vehicles, including driver information and safety systems applicable to all vehicle types.



Each class has several **subsystems or Physical Objects.** Subsystems can be defined as pieces of ITS that perform a particular function or provide a particular service.



Each subsystem consists of several **elements**. Elements are often referred to as the building blocks of ITS Architecture. They are pieces and technologies of the architecture that perform the function of their subsystem.

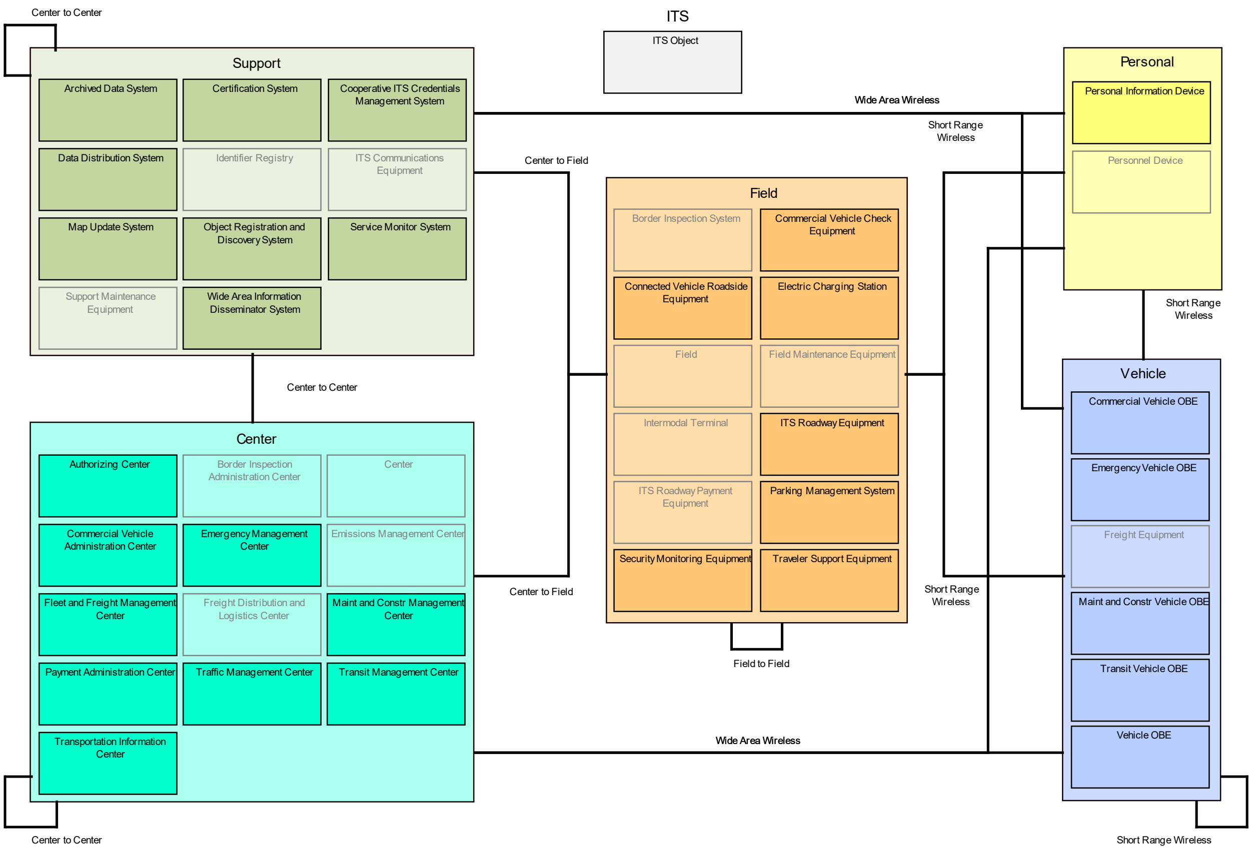


Different elements of the various subsystems communicate with each other to perform a specific function or transportation service. These are referred to as **Service Packages**.

Service Packages organize the various elements and information connections in such a way as to provide the most efficient transportation service.

Figure 3 is the Central Ohio Regional ITS subsystem diagram. The Central Ohio ITS subsystem diagram is a tailored version of the National ITS subsystem diagram, altered to custom fit the needs of the region. Connections developed provide a framework for the exchange of information between stakeholders. A complete list of all connections can be found on the Central Ohio Regional ITS Architecture website.

Figure 3: Central Ohio Regional ITS Subsystem Diagram



Source: Central Ohio Physical ITS Architecture Image

2.2 Service Packages

The service packages of the National ITS Reference Architecture were customized to reflect the unique systems and connections of the Central Ohio region. Each service package is shown graphically, with the service package name, the entity from the National ITS Reference Architecture, and the specific Central Ohio elements associated with the entity. In addition, the service packages show the information flows that move between elements. The service packages can be found on the ITS web page by visiting: http://morpc.org/itsArchitecture/services.html. The Central Ohio region's service packages are grouped by the following functional areas:

- Data Management (DM)
- Public Transportation (PT)
- Traveler Information (TI)
- Traffic Management (TM)
- Commercial Vehicle Operations (CVO)
- Public Safety (PS)
- Maintenance and Construction (MC)
- Parking Management (PM)
- Support (SU)
- Sustainable Travel (ST)

- Vehicle Safety (VS)
- Weather (WX)

Each set of customized service packages can be viewed by clicking on the service package identifier link under the service package heading.

2.3 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. Each of the individual element interfaces can be accessed on the Central Ohio Regional ITS Architecture web page (http://morpc.org/itsArchitecture/) by clicking on the “Inventory” tab on the top left of the page.

There are 172 different elements identified as part of the Central Ohio 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. Interfaces have been defined for each element in the architecture. For example, ODOT Statewide Traffic Management Center or Advanced Traffic Management System (ATMS) interfaces with 43 other elements in the region ranging from field equipment to transit centers. Some of the interfaces are far less complex. For example, the Columbus Regional Airport Authority (CRAA) CCTV has interfaces with only one other element (CRAA Communications Operations Center) in the architecture.

2.4 Using the Regional ITS Architecture for Projects

Transportation 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. Prior to the beginning of implementation, the details of the project must be developed. The detailed system definition will also include the interface with the systems or parts of systems which will make up the project, establish the interconnections the project entails, and define the informational flows across the system. The definition may go through multiple levels of detail, starting with a very high-level description of project functions and moving toward system specifications. By identifying the portions of the Regional ITS Architecture that relate to the project, the Regional ITS Architecture outputs can be used to create key aspects of the project definition.

A regional ITS architecture can assist in the following areas of project definition:

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

Table 1 provides examples of High-Risk, Low-Risk, and Exempt components that maybe part of a project. One of the project sponsor's responsibilities would be to ensure that a systems engineering process is used in addition to the architecture conformity requirement.

Table 1: Examples of High-Risk, Low-Risk, and Exempt projects

High-Risk	▪ New freeway management systems (FMS). ▪ Traffic signal systems that requires integration with other systems, e.g. FMS or RWIS. ▪ Ramp meter systems that require integration with adjacent traffic signal system(s). ▪ Regional traffic signal system (as opposed to an arterial traffic signal system) that as the potential to affect geographic areas outside of the maintaining agency. ▪ Regional transit systems. ▪ Any Low-Risk project that provides additional functionality than what is covered in the approved Functional Requirements document for that project category. ▪ Any project that requires new or unproven hardware, software or interfaces. ▪ Any project for which functional requirements and operations & management procedures have not been documented. ▪ Adaptive Traffic Signal Control system. ▪ Any project that contains Autonomous or Connected Vehicle Technology ▪ Any project not considered Exempt or Low-Risk under the Programmatic Agreement.
Low-Risk	▪ Closed loop arterial traffic signal system. ▪ Centrally controlled arterial traffic signal system. ▪ Highway Rail/Traffic Signal pre-emption. ▪ Traffic signal system with Emergency Vehicle Pre-emption. ▪ Traffic signal system with Transit Priority. ▪ Ramp Meter system. ▪ Adaptive Traffic Signal Control system.
Exempt	▪ Changes and/or upgrades to an existing traffic signal system, including signal timing revisions, additional phases (vehicle or pedestrian) or detector installation. ▪ Routine maintenance and operation of an existing ITS system. ▪ Expansion of an existing traffic signal, ITS or freeway management system (FMS) that does not change or add to the original needs and requirements of the system. This type of project does not change any existing hardware, software or interfaces. It simply adds equipment (DMS, DDMS, CCTV, RWIS, etc.), software, locations or intersections to an existing system. The new equipment and software must be compatible with the existing. ▪ Installation of an isolated traffic signal. This is a single traffic signal, not connected to any type of external signal control, nor likely to be connected in the future due to its isolation. ▪ Installation of traffic signals which are part of a Time-Based Coordinated system. ▪ Installation of traffic signals which are part of a hardwired or wireless interconnected system that is locally controlled, i.e. where the timing patterns are controlled by the local controller and not by centrally controlled software. ▪ Installation of cameras that are not functionally integrated into other types of systems; for example, cameras solely for the purpose of traffic data collection or surveillance cameras.

Source: ODOT Traffic Engineering Manual 2021

Because projects with ITS components involve systems and their interconnections, it is very important to follow a systems engineering approach in designing and implementing the project. The exact process followed is at the discretion of the local agency,

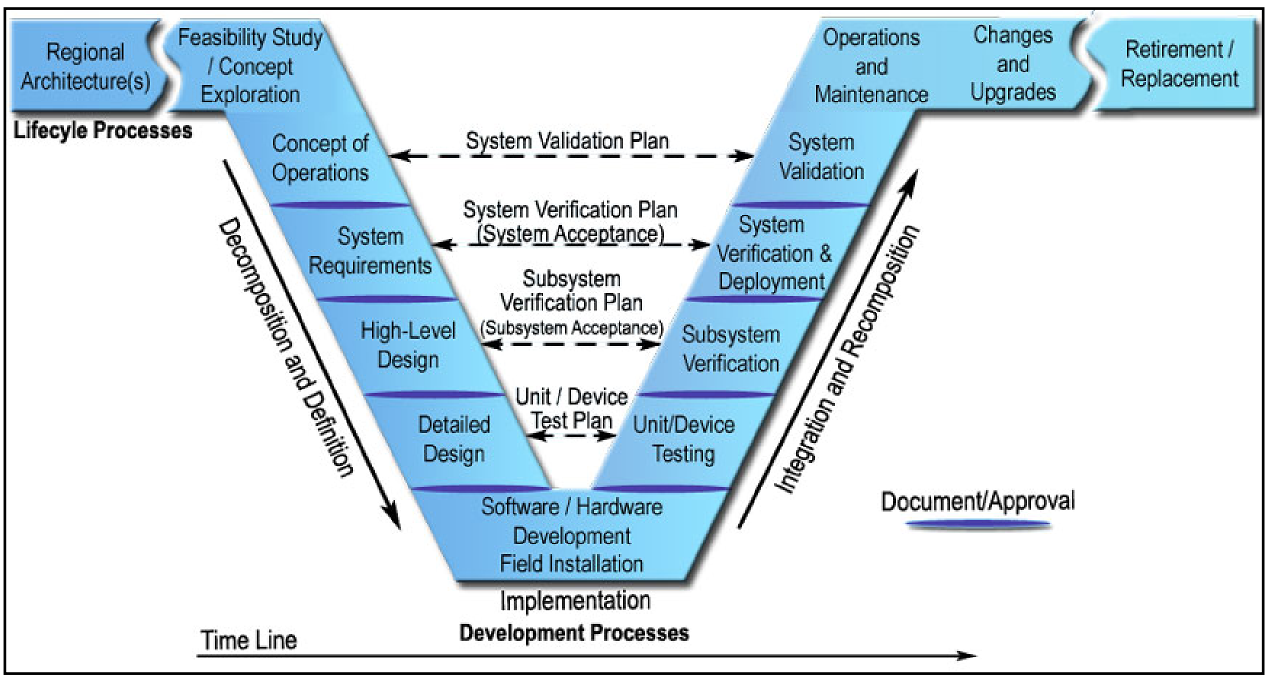
The systems engineering analysis steps are:

- Identifications of portions of the Regional ITS Architecture being implemented
- Identification of participating agencies' roles and responsibilities
- Requirements of definitions
- Analysis of alternative system configurations and technology options to meet requirements
- Procurement options
- Identification of applicable ITS standards and testing procedures
- Procedures and resources necessary for operations and management of the system

The Regional ITS Architecture represents a detailed plan for the evolution of the ITS systems in the region and will be used to support regional transportation planning efforts and project development efforts.

Projects that emerge from the planning process can benefit from the use of the regional ITS architecture in their definition and development. Project implementation should follow a systems engineering process. Figure 4 shows a typical project implementation process for deploying ITS projects, called a systems engineering process. It is a process that can be used to systematically deploy ITS while reducing the risks associated with deployments. The process recognizes that many projects are deployed incrementally and expand over time. US DOT Rule 940 requires that the systems engineering process be used for ITS projects that are funded with federal funds. Applying the systems engineering process to ITS project development is a new key requirement that must be addressed by stakeholders using federal funds.

Figure 4: ITS Project Implementation Process



There are similarities between the systems engineering process and the project development process generally used by transportation agencies. The project development process is probably similar to the following:

1) Project Selection
2) Authorization to Proceed
3) Project Definition
    a) Purpose and Need
    b) Project Scoping
    c) Conceptual Design
4) Project Design
    a) Preliminary Plan Development
    b) Semi-Final Plan Development
    c) Final Plan Development
5) Construction
    a) Testing
6) Operation and Maintenance

The ITS architecture can be used to support development of the concept of operations, requirements, and high-level design in the systems engineering process. In deploying ITS components, the ITS architecture should be used as the starting point for developing a project concept of operations (not to be confused with an operational concept, which defines the roles and responsibilities of the stakeholders). The concept of operations shows at a high level how the systems involved in a project operate in conjunction with the other systems of the region. According to the National Highway Institute course "Introduction to Systems Engineering for Advanced Transportation", a concept of operations includes the following information: **A.** Identification of stakeholders; **B.** Development of a vision for the project; **C.** Description of where the system(s) will be used; **D.** Description of organizational procedures or practices appropriate to the system(s), definition of critical performance parameters associated with the systems(s); **E.** Description of the utilization environment (conditions under which various parts of the system(s) will be used); **F.** Definition of performance measures used to evaluate the effectiveness of the system(s); **G.** Considerations of life cycle expectations; and **H.** Conditions under which the system(s) must operate (e.g. environmental conditions). The Regional ITS Architecture provides inputs to a number of the systems engineering analysis steps as shown in the table below.

Systems Engineering Requirements	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 (this relates to the Concept of Operations described earlier)	Use operational concepts 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

Systems Engineering Requirements supported by ITS Architecture

System Engineering Review Form (SERF) and usable ITS projects forms are provided ODOT website at: http://www.dot.state.oh.us/Divisions/Operations/Traffic/Pages/Forms.aspx

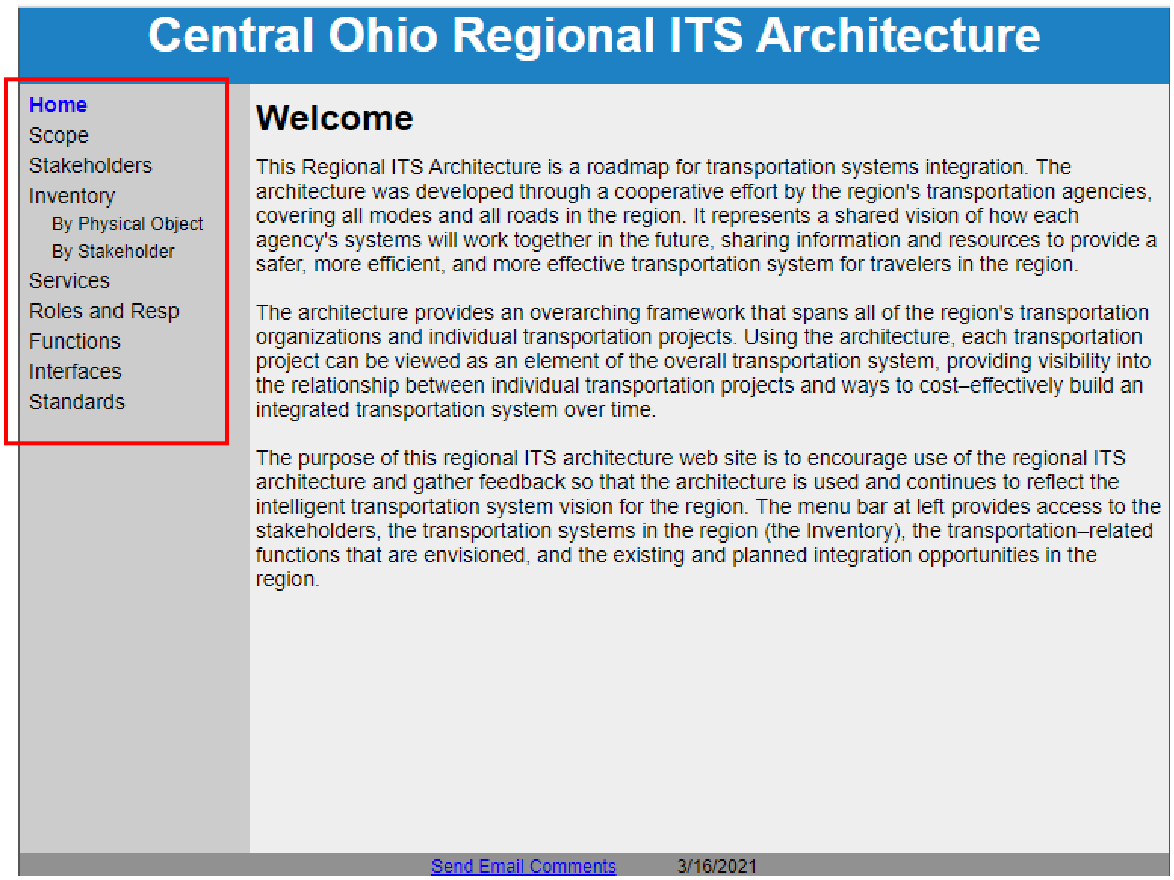
The FHWA System Engineering Technical Report Documentation can be found at: http://ops.fhwa.dot.gov/publications/seitsguide/index.htm

3. Using the Website

3.1 Description of Menu Bar

You can visit the most recent version of the Central Ohio Regional ITS Architecture online at: http://morpc.org/itsArchitecture/ The menu at the top left in the ITS website provides access to the overview, specific flows, and definitions for each architecture service areas for Central Ohio ITS Architecture users. Each of the individual element interfaces can be accessed on the Central Ohio Regional ITS Architecture web page by clicking on the "Inventory" tab in Figure 5. If users are looking for particular elements in the architecture, go to "Inventory" and select the element you wish to explore. These are the most informative pages on the website. Each inventory element page contains the systems or elements that are connected with followed by the Interface or Information Flow diagrams. The menu bar will highlight as blue where a hyperlink has taken the user to find an additional description and information.

Figure 5: ITS Architecture Menu Bar



Hyperlinks in the Website

A regional ITS architecture website has various hyperlink menu bars so that you can easily navigate from one component to another component to find what you need. Each component represents a possible information connection between ITS technology, information, services, and stakeholders.

The website menu bar contains the following types of information:

- **Home:** This menu option takes the user to the homepage for the ITS Architecture. The homepage describes the purpose of the architecture.
- **Scope:** Provides the geographic scope, service scope, and planning time frame for the ITS architecture.
- **Stakeholders:** The organizations that have some ownership or direct involvement with an ITS system or architecture element.
- **Inventory:** This menu option contains the individual pieces or elements of the architecture. These functional components of the architecture are identifiable with ITS systems or devices in the transportation system.
    - **Inventory by Physical Object:** This menu option presents the inventory of ITS elements arranged by Physical Object (subsystems and terminators). This allows all elements with related functions to be viewed simultaneously. Clicking on an element name opens a detail page that provides more information about the element, including a listing of all interfacing elements.
    - **Inventory by Stakeholder:** This menu option presents the inventory of ITS elements arranged by stakeholder. This allows all the elements owned by a single stakeholder to be viewed simultaneously. Clicking on an element name leads to a detail page that provides more information about the element, including a listing of all interfacing elements.
- **Service Packages:** Service Packages identify the pieces of the physical ITS Architecture required to implement a particular service. Services consider all the elements and information connections and organize them to provide the most effective transportation service. Service packages are organized by the service they provide. Those roles and responsibilities are supported by the functionality provided by the systems they own and/or operate.
- **Roles and Responsibilities:** Roles and Responsibilities, also known as Operational Concept, lists the roles and responsibilities that each stakeholder must take on to provide the ITS services included in the ITS Architecture. These roles and responsibilities are supported by the functionality provided by the systems owned and/or operated by the stakeholders.
- **Functions:** This menu option provides high-level functional requirements related to the functionality of the architecture elements defined in them. Each ITS system must perform certain functions to effectively deliver the desired ITS services. The high-level requirements are grouped into functional areas that identify requirements associated with each selected ITS service. These requirements are a starting point for requirements generation in project development process using systems engineering.
- **Interfaces:** This menu option defines the interfaces, or connections, between each ITS element in the Architecture. These interfaces demonstrate how these elements are and will be connected with one another so information can be exchanged and transportation services can be coordinated.
- **Standards:** Standards define the form, fit, and function of individual ITS systems within an ITS Architecture. ITS Standards also serve to facilitate deployment of interoperable systems

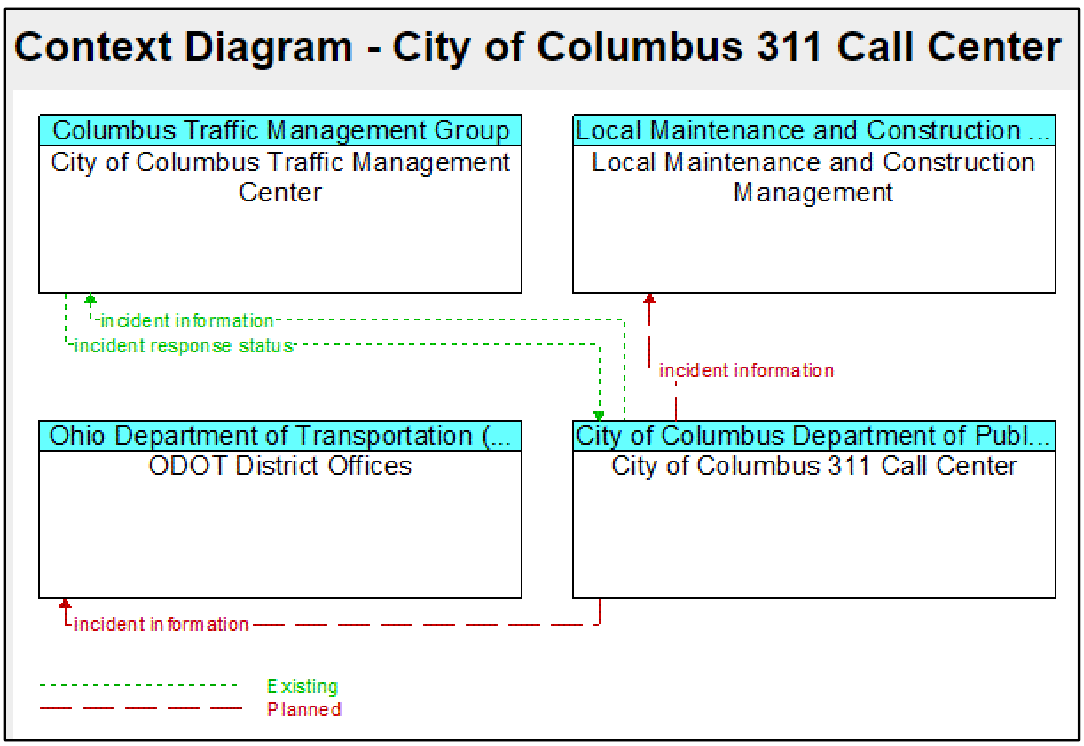
at local, regional, and national levels without impeding innovation as technology advances and new approaches evolve.

In addition to the above menu option information, there is "Send Email Comments" link in the bottom of the website front page. Users can submit any comments or questions about the architectures to MORPC.

3.2 Example of an Information Flow Diagram

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. There are 172 different elements identified as part of the Central Ohio Regional ITS Architecture. City of Columbus 311 Call Center in Figure 6 is one of the elements in the architecture.

Figure 6: Flow Diagram of City of Columbus 311 Call Center



The following table will provide users step-by-step instructions for searching the City of Columbus 311 Call Center context diagram.

Step 1 of 4: Go to "Inventory" menu option on the left

Home
Scope
Stakeholders
Inventory
By Physical Object
By Stakeholder
Services
Roles and Resp
Functions
Interfaces
Standards

Step 2 of 4: Click on the City of Columbus 311 Call Center element under the "Element" column

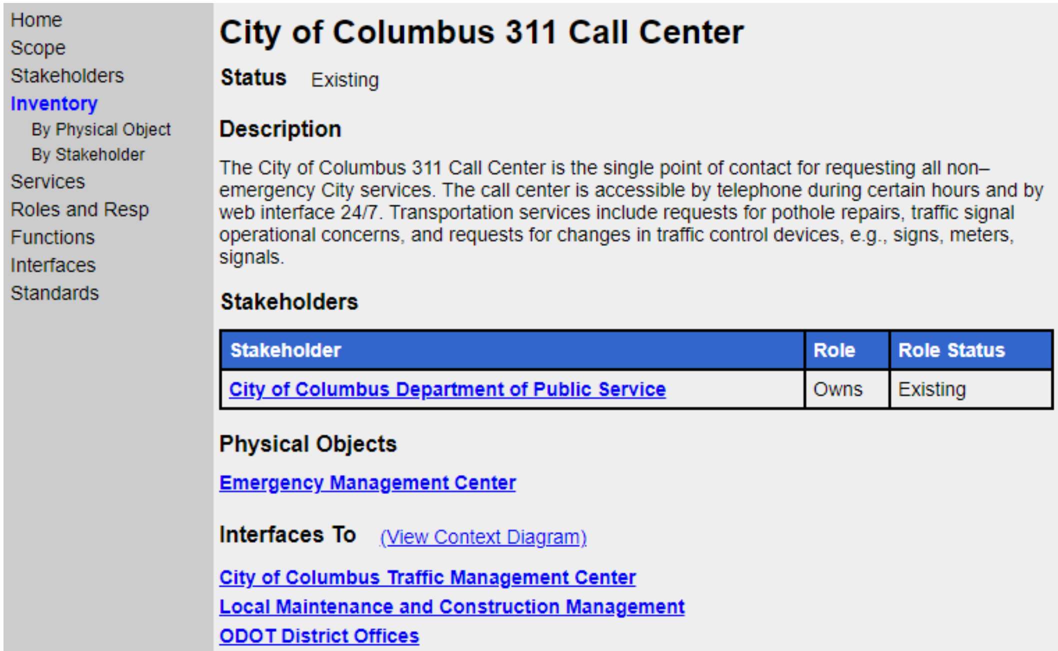
Home
Scope
Stakeholders
Inventory
By Physical Object
By Stakeholder
Services
Roles and Resp
Functions
Interfaces
Standards

Inventory

Each stakeholder agency, company, or group owns, operates, maintains or plans ITS systems in the region. The 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.

Element	Description
Archived Data User Systems	Agencies and systems that use archived data
Autonomous Shuttles	Smart Columbus autonomous shuttles
Basic Vehicles	This represents basic vehicles that do not have connected vehicle technology.
Central Ohio Multi–Modal Traveler Information System	A regional multi–modal transportation information system would provide information related to transportation, emergency, and weather. This system shall display all types of travel–related information so that travelers can make informed decisions about the best transportation mode, route, time, and costs for each of their trips. The system shall also serve as a clearinghouse for information on incidents, emergencies, and evacuations.
City of Columbus 311 Call Center	The City of Columbus 311 Call Center is the single point of contact for requesting all non–emergency City services. The call center is accessible by telephone during certain hours and by web interface 24/7. Transportation services include requests for pothole repairs, traffic signal operational concerns, and requests for changes in traffic control devices, e.g., signs, meters, signals.
City of Columbus 911 Call Center	The 911 Call Center is responsible for the handling of all calls for Police, Fire, and Rescue service. This center is staffed by highly trained civilian employees 24 hours a day, seven days a week. The 911 Call Center for the City of Columbus utilizes CAD technology, Ali mapping, and enhanced 911. The call center also receives all cellular 911 calls in the region.

Step 3 of 4: Once you are in City of Columbus 311 Call Center page, click (View Context Diagram) link



Home
Scope
Stakeholders
Inventory
By Physical Object
By Stakeholder
Services
Roles and Resp
Functions
Interfaces
Standards

City of Columbus 311 Call Center

Status Existing

Description

The City of Columbus 311 Call Center is the single point of contact for requesting all non–emergency City services. The call center is accessible by telephone during certain hours and by web interface 24/7. Transportation services include requests for pothole repairs, traffic signal operational concerns, and requests for changes in traffic control devices, e.g., signs, meters, signals.

Stakeholders

Stakeholder	Role	Role Status
City of Columbus Department of Public Service	Owns	Existing

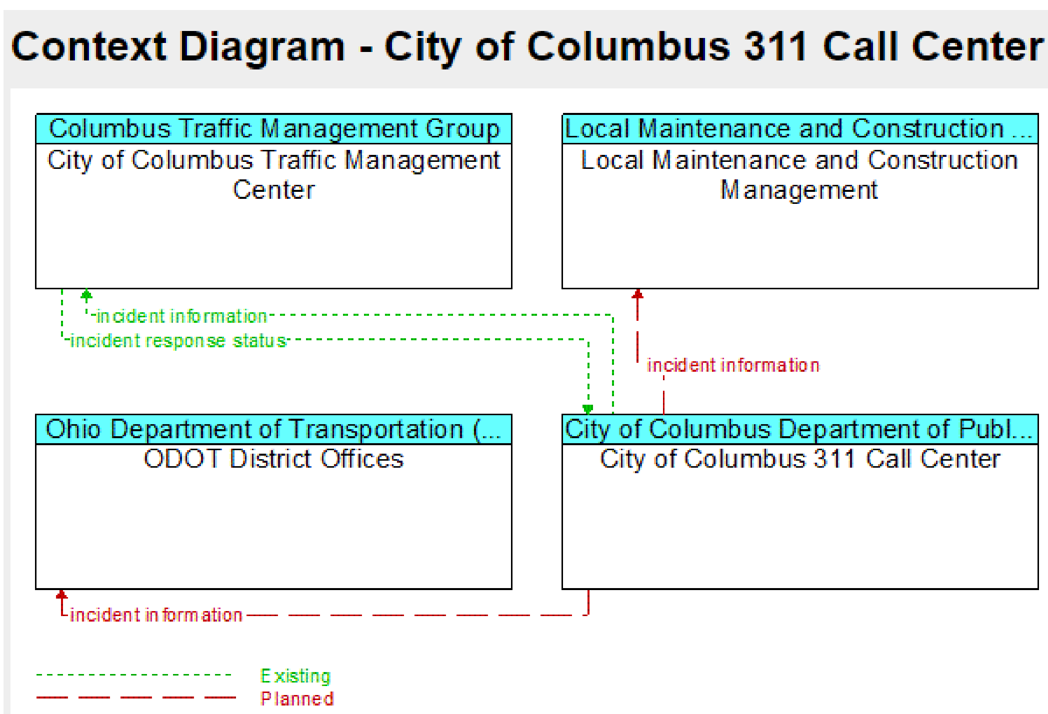
Physical Objects

Emergency Management Center

Interfaces To (View Context Diagram)

City of Columbus Traffic Management Center
Local Maintenance and Construction Management
ODOT District Offices

Step 4 of 4: The flow diagram for the City of Columbus 311 Call Center should now open and be displayed for your review; This diagram provides insight into the information that is exchanged between pairs of architecture elements

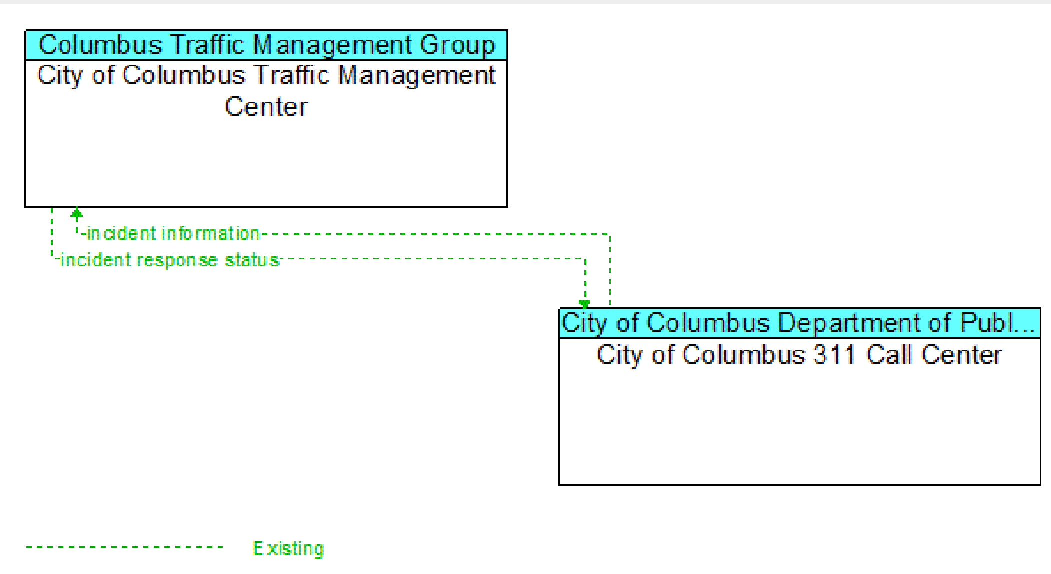


3.3 Example of Architecture Flows Between Elements

Architecture flows between the elements define specific information that is exchanged by the elements. Each architecture flow has a direction, name, and definition. An example of the architecture flows between two elements is detailed below. All individual element interfaces can be accessed on the Central Ohio Regional ITS Architecture web page (http://morpc.org/itsArchitecture/) by clicking on the "Interfaces" tab at the left. Once on the ITS element interface detail page, you can select a specific interfacing element in the second column of interface table. An example of architecture flows between elements is shown in Figure 7.

Figure 7: Architecture Flows and Definitions Between Elements

Interface: City of Columbus Traffic Management Center - City of Columbus 311 Call Center



Architecture Flow Definitions

incident information (Existing) Applicable ITS Standards

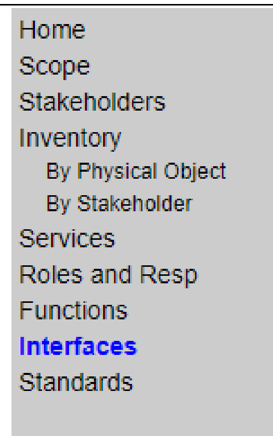
Notification of existence of incident and expected severity, location, time and nature of incident. As additional information is gathered and the incident evolves, updated incident information is provided. Incidents include any event that impacts transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) through large–scale natural or human–caused disasters that involve loss of life, injuries, extensive property damage, and multi–jurisdictional response. This also includes special events, closures, and other planned events that may impact the transportation system.

incident response status (Existing) Applicable ITS Standards

Status of the current incident response including a summary of incident status and its impact on the transportation system, traffic management strategies implemented at the site (e.g., closures, diversions, traffic signal control overrides), and current and planned response activities.

Each associated architecture flow definition is found at the bottom of the page. In this interface, the flows that go between the City of Columbus 311 Call Center and the City of Columbus Traffic Management Center are shown. The architecture flows for this interface are shown as existing, signifying that these two elements currently share information. Clicking on an element listed in the “Interfaces” menu of any ITS element page will lead to a set of interfaces to that element similar to the example diagram shown above. Each architecture flow is defined, and any standards associated with that architecture flow are noted.

The following table will provide users step-by-step instructions for searching the City of Columbus 311 Call Center's specific flows and flow definitions between elements.

Step 1 of 3: Go to "Interfaces" menu option on the left	

Step 2 of 3: Click on the City of Columbus Traffic Management Center under the "Interfacing Element" column

Central Ohio Regional ITS Architecture

Home
Scope
Stakeholders
Inventory
By Physical Object
By Stakeholder
Services
Roles and Resp
Functions
Interfaces
Standards

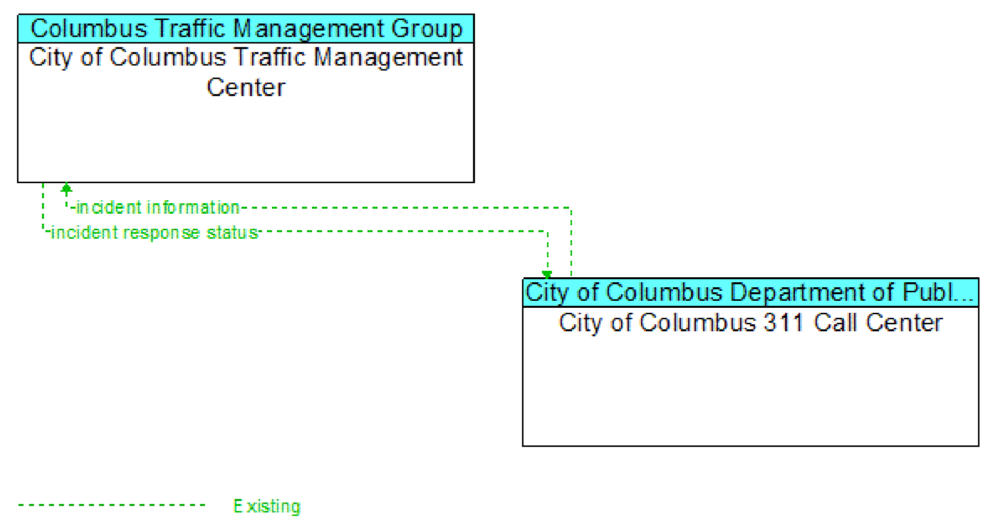
Interfaces

A primary purpose of the Regional ITS Architecture is to identify the integration opportunities among transportation systems (the "ITS elements") in the region. The following table identifies every interface defined for the Region. Each entry in the "Interfacing Element" column is a link to more detailed information about the particular interface.

Element	Interfacing Element	Status
Archived Data User Systems	COTA Transit Database	Planned
	Local Traffic Database	Planned
	MORPC Air Quality Website	Planned
	MORPC Traffic Count Database	Planned
	ODOT Traffic Data Archive System	Existing
	ODPS Crash Database	Existing
	OSU Traffic Research	Existing and Planned
	Smart Columbus Operating System	Planned
Autonomous Shuttles	Drivers	Existing and Planned
Basic Vehicles	COTA Paratransit Vehicles	Planned
	COTA Transit Fixed–Route Vehicles	Planned
	DATA On–Demand Transit Vehicles	Planned
	DATA Transit Fixed–Route Vehicles	Planned
	Freight Truck Vehicles	Planned
	Vehicles	Planned
Central Ohio Multi–Modal Traveler Information System	County EMA Emergency Operations Centers (EOC)	Planned
	Franklin County EMA Emergency Operation Center (EOC)	Planned
	Media Channels	Planned
	OSU TPS Dispatch Facility	Planned
	Traveler Information Devices	Planned
City of Columbus 311 Call Center	City of Columbus Traffic Management Center	Existing
	Local Maintenance and Construction Management	Planned
	ODOT District Offices	Planned

Step 3 of 3: Detailed flows and definitions between the Columbus Traffic Management Center and the City of Columbus 311 Call Center should now open and be displayed. Also, any ITS standards associated with that architecture flow are noted

Interface: City of Columbus Traffic Management Center - City of Columbus 311 Call Center



Architecture Flow Definitions

incident information (Existing) Applicable ITS Standards

Notification of existence of incident and expected severity, location, time and nature of incident. As additional information is gathered and the incident evolves, updated incident information is provided. Incidents include any event that impacts transportation system operation ranging from routine incidents (e.g., disabled vehicle at the side of the road) through large–scale natural or human–caused disasters that involve loss of life, injuries, extensive property damage, and multi–jurisdictional response. This also includes special events, closures, and other planned events that may impact the transportation system.

incident response status (Existing) Applicable ITS Standards

Status of the current incident response including a summary of incident status and its impact on the transportation system, traffic management strategies implemented at the site (e.g., closures, diversions, traffic signal control overrides), and current and planned response activities.

4. Architecture Maintenance Plan

4.1 Roles and Responsibilities for Maintenance

The responsibility for maintaining the Central Ohio ITS Architecture lies with MORPC since they are the primary planning organization for the region and can easily work with the different ITS stakeholders on updating the architecture. A group of core stakeholders will act as an "institutional framework" to review proposed changes to the architecture. This group of core stakeholders is important because the Regional ITS Architecture is a consensus framework for integrating ITS systems. As it was a consensus driven product in its initial creation, so it should remain a consensus driven product as it is maintained. This section defines the stakeholders and their roles and responsibilities for the maintenance of the Central Ohio Regional ITS Architecture.

<u>Stakeholders</u>

Stakeholders are any government agency or private organization that is involved with or has an interest in providing transportation services in the region. Each stakeholder owns, operates, and/or maintains one or more ITS element(s) in the region and therefore has a role in the maintenance of 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 their ITS systems and properly updating the architecture, the change management process will not succeed and the usefulness of the architecture will diminish over time.

<u>Central Ohio ITS Committee</u>

The Central Ohio ITS Committee has the following responsibilities:

- Guide and advise MORPC in updating the regional ITS architecture every four years
    - Suggest, review, and evaluate proposed changes and updates to the architecture.
    - Recommend revisions to the architecture for Transportation Policy Committee (TPC) approval.
- Guide and advise MORPC in maintaining the regional ITS architecture
    - Review proposed changes to ensure they conform to the regional ITS architecture
- Facilitate collaboration and coordination to ensure compliance with the ITS architecture
- Develop ITS strategies to be included in the Metropolitan Transportation Plan (MTP)
- Coordinate ITS related projects, studies, and plans
- Guide and participate in MORPC ITS activities.

The ITS committee will allow for collaboration and coordination between various stakeholders on regional traffic operations investments and practices in the central Ohio region. Its main purpose is to coordinate ITS activities in central Ohio and assist MORPC in maintaining and updating the regional ITS architecture and ensuring compliance with it.

The committee consists of FHWA, ODOT, COTA, Franklin County, City of Columbus, MORPC, and other local agencies that employ or use ITS technologies. The committee will meet on a quarterly basis or as needed and be chaired by a member of the Transportation Advisory Committee (TAC).

<u>Responsible Agency</u>

The Responsible Agency is MORPC as it formally maintains the architecture. MORPC assigns resources for making the physical changes to the architecture baseline and for coordinating the maintenance of the architecture.

4.2 Timetable for Maintenance

<u>Comprehensive Updates</u>

A comprehensive architecture update will occur every four years, concurrent with the formal update of the Transportation Plan since the Central Ohio Regional ITS Architecture is 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 lists of agency agreements may also be updated at this time.

<u>Event-Driven Updates</u>

The Regional ITS Architecture should be continuously maintained to provide the most up-to-date information to the stakeholders. Two components of the Regional ITS Architecture to be maintained are the Regional Architecture Development for Intelligent Transportation (RAD-IT) Database and the associated Architecture User's Guide. Of the two components, maintaining the RAD-IT Database is the most crucial task to make an architecture useful since it provides foundation of the architecture. A stakeholder may submit a change to MORPC and request that the ITS committee review and approve the change request prior to the next scheduled update of the Regional ITS Architecture. This may be necessary if a stakeholder suddenly requires federal funding for a previously unplanned ITS project and needs the ITS project to be included in the Regional ITS Architecture.

4.3 Architecture Baseline

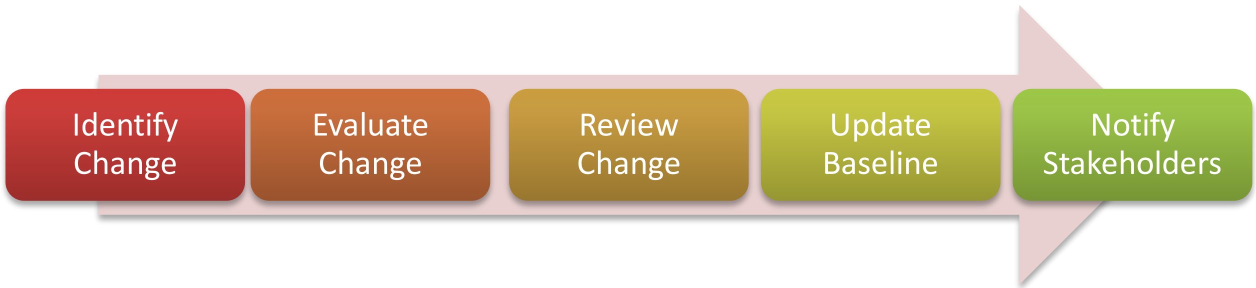
Establishing an architecture baseline requires clear identification of the architecture products to be maintained, including specific format and version information. For the Central Ohio Regional ITS Architecture, the following are identified as the architecture baseline:

- Central Ohio Regional ITS Architecture Web Pages (http://morpc.org/itsArchitecture/)
- MORPC Regional ITS Architecture User's Guide (this document)
- RAD-IT Architecture Database (www.morpc.org/its)

4.4 Change Management Process

This change management process specifies how changes are identified, how often changes will be made, and how the changes will be reviewed, implemented, and released. The 5-step basic process for change management is shown in Figure 8.

Figure 8: Change Management Process



Appendix A:

Resources & Definitions

Definitions

Elements

Elements are the basic building blocks of the overall ITS Architecture and represent pieces of each subsystem. An element is defined as a physical entity that performs a particular function, such as a 511 call center or dynamic message signs. The different stakeholders own, maintain, and operate each element.

Functional Objects

Functional objects are the building blocks of the physical objects of the physical view. Functional objects group similar processes of a particular physical object together into an "implementable" package. The grouping also takes into account the need to accommodate various levels of functionality.

Functional Requirements

Functional requirements are high-level functions, tasks, activities, or services to be performed by systems to address the needs or problems of the region. The stakeholders define the level of detail.

Information or Architecture Flows

Information or architecture flows are developed based on service packages. The flow diagrams define the information shared between elements and subsystems and show specifically how that information should flow between them in order to provide the most efficient and effective transportation service.

Operational Concept

The operational concept provides for a “big picture” view of the goals, objectives, and desired capabilities of each system (existing or planned) in a region, without indicating how the systems will or can be implemented. An operational concept documents the stakeholders’ *roles and responsibilities* in the implementation and operation of regional ITS elements and services.

Physical Objects

Physical objects are systems or devices that provide ITS functionality that makes up the ITS and the surrounding environment. They are defined in terms of the services they support, the processes they include, and their interfaces with other physical objects.

Sequencing of Projects

The scheduling of projects is necessary to successfully implement the regional ITS architecture. The sequencing recognizes that in order to initiate some projects, other projects may have to be completed first. Understanding project sequencing also helps stakeholders to visualize how the region’s ITS projects will fit together over time, and to visualize their interdependencies.

Service Packages

Service Packages identify the pieces of the physical ITS Architecture required to implement a particular service. Market packages consider all the elements and information connections and organize them to provide the most effective transportation service. Service packages are organized by the service they provide.

Subsystems

Subsystems are pieces of the ITS Architecture that provide a particular transportation service, such as managing traffic or responding to emergencies. They are not physical entities such as Traffic Management Centers; instead, they are groupings of *elements* that all provide a particular service.

Subsystem Diagram

A subsystem diagram represents an overview diagram which depicts all possible ITS subsystems that can be deployed onboard a vehicle, at central locations, along the roadside, and at remote sites. The subsystem diagram provides a visual representation of ITS communications technologies and how subsystems in the architecture are connected.

Terminators

Terminators are physical entities, representing people, systems, and the general environment that interface with intelligent transportation systems. A terminator defines the architecture boundaries, meaning it is either the beginning or the end of the line for the information or service that is being conveyed by the system. Terminators communicate with the system, provide and/or receive data, but are not themselves part of the system. Examples could be the weather service, which would provide data to the Highway Traffic Management Center for incident management but doesn't request data from the center.

Acronyms

AASHTO	American Association of State Highway and Transportation Officials
APC	Automatic Passenger Counter
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ATIS	Advanced Traveler Information System
ATMS	Advanced Traffic Management System
AV	Automated Vehicle
AVL	Automatic Vehicle Location
CAD	Computer-Aided Dispatching
CCTV	Closed-Circuit Television
CMAQ	Congestion Management and Air Quality Program
CMFMS	Columbus Metropolitan Freeway Management System
COMBAT	Central Ohio Management Based Applied Technology Program
COTA	Central Ohio Transit Authority
CRAA	Columbus Regional Airport Authority
CTSS	Columbus Computerized Traffic Signal System
CV	Connected Vehicle
DATA	Delaware Area Transit Agency
DMS	Dynamic Message Signs
DDMS	Destination Dynamic Message Signs
DOT	(United States) Department of Transportation
EMA	Emergency Management Agency
ESP	Event Streaming Platform
FCEO	Franklin County Engineers Office
FHWA	Federal Highway Administration
FIRST	Columbus Freeway Incident Response Service Team
FMS	Freeway Management System
FSP	Freeway Service Patrol
GIS	Geographic Management System
GPS	Global Positioning System
HAR	Hazard Advisory Radio
HazMat	Hazardous Materials
HOV	High Occupancy Vehicle
HRI	Highway Rail Intersection
ISAP	Isolated Signal Assessment Project
ISTEA	Intermodal Surface Transportation Efficiency Act
ITS	Intelligent Transportation Systems

JPO	Joint Programs Office for Intelligent Transportation Systems
LCATS	Licking County Area Transportation Study
MMTPA/CPS	Smart Columbus Multimodal Trip Planning Application/Common Payment System
MORPC	Mid-Ohio Regional Planning Commission
MPO	Metropolitan Planning Organization
MAP-21	Moving Ahead for Progress in the 21st Century
MSA	Columbus Metropolitan Statistical Area
ODOT	Ohio Department of Transportation
ODPS	Ohio Department of Public Safety
OEPA	Ohio Environmental Protection Agency
ORDC	Ohio Rail Development Commission
OSC	Ohio Supercomputing Center
OSHP	Ohio State Highway Patrol
OSU	Ohio State University
PUCO	Public Utilities Commission of Ohio
RAD-IT	Regional Architecture Development for Intelligent Transportation
RWIS	Road Weather Information System
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SOV	Single Occupancy Vehicle
STIP	Statewide Transportation Improvement Plan
T&P	Transportation and Parking
TEA 21	Transportation Efficiency Act for the 21st Century
TENS	Franklin County EMA Telephone Emergency Notification System
TERT	City of Columbus Traffic Emergency Response Team
TIP	Transportation Improvement Plan
TMC	Traffic Management Center
TPIMS	Truck Parking Information and Management System
TTI	Texas Transportation Institute
VMT	Vehicle Miles Traveled