Akron Regional Intelligent Transportation Systems (ITS) Architecture Report

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A. Executive Summary

1. Introduction

The Akron Regional Intelligent Transportation Systems (ITS) Architecture is a roadmap for the deployment and integration of ITS in the Akron Metropolitan Area Transportation Study (AMATS) planning area for the next fifteen years. The AMATS planning area, defined as the region in this Architecture, geographically covers Portage and Summit counties and the Chippewa and Milton Township areas of Wayne County in northeast Ohio. The Akron Regional ITS Architecture provides a framework for institutional agreements and technical integration of ITS implementation projects in the region. It describes the "big picture" for ITS deployment in terms of individual ITS components that will perform the functions necessary to deliver the desired needs. It supports effective and efficient deployment of transportation and ITS projects that address the transportation problems and needs in the region.

The Akron Regional ITS Architecture is an open and integrated ITS architecture that is compliant with the Federal Highway Administration (FHWA) Final Rule and Federal Transit Administration (FTA) Policy on ITS Architecture and Standards. The Architecture has been developed through a cooperative effort by the highway, transit, law enforcement, emergency management, commercial vehicle, and freight management agencies. It represents a shared vision of how each agency's systems work together by sharing information and resources to enhance transportation safety, efficiency, capacity, mobility, reliability, and security.

2. Purpose

The purpose of the Akron Regional ITS Architecture is to illustrate and document the integration of regional ITS systems to allow planning and deployment to occur in an organized and coordinated process. The Architecture helps guide the planning, implementation, and integration of ITS devices deployed and managed by multiple types of agencies that provide transportation services within the region.

The Architecture helps to accomplish the following objectives for ITS deployment in the region:

- Facilitate stakeholder coordination in ITS planning, deployment and operations;
- Reflect the current state of ITS planning and deployment within a region;
- Provide high-level planning for enhancing regional transportation systems using current and future ITS technologies; and
- Conform with the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) and FHWA Final Rule 940 and FTA Final Policy on ITS Architecture and Standards.

3. Akron Regional ITS Architecture

The Akron Regional ITS Architecture describes coordination of overall system operations by defining interfaces between equipment and systems which have been, or will be, deployed by different organizational or operating agencies in the region. The Architecture identifies the current ITS deployment and how these systems interact and integrate with each other. It also builds on the existing systems and addresses the additional components deemed necessary to grow the ITS systems in the region over the next 15 years to accommodate specific needs and issues of participating stakeholders.

A high-level interconnect diagram for the Akron Regional ITS Architecture, often referred to as a "subsystem diagram" as shown in Figure 1, illustrates the architecture subsystems and primary types of interconnections (or communications) between these subsystems. The subsystem diagram was customized to reflect the systems of the Akron Regional ITS Architecture. The areas highlighted with red boxes indicate the functions and services that currently exist or will likely be deployed over the next 15 years in the region.

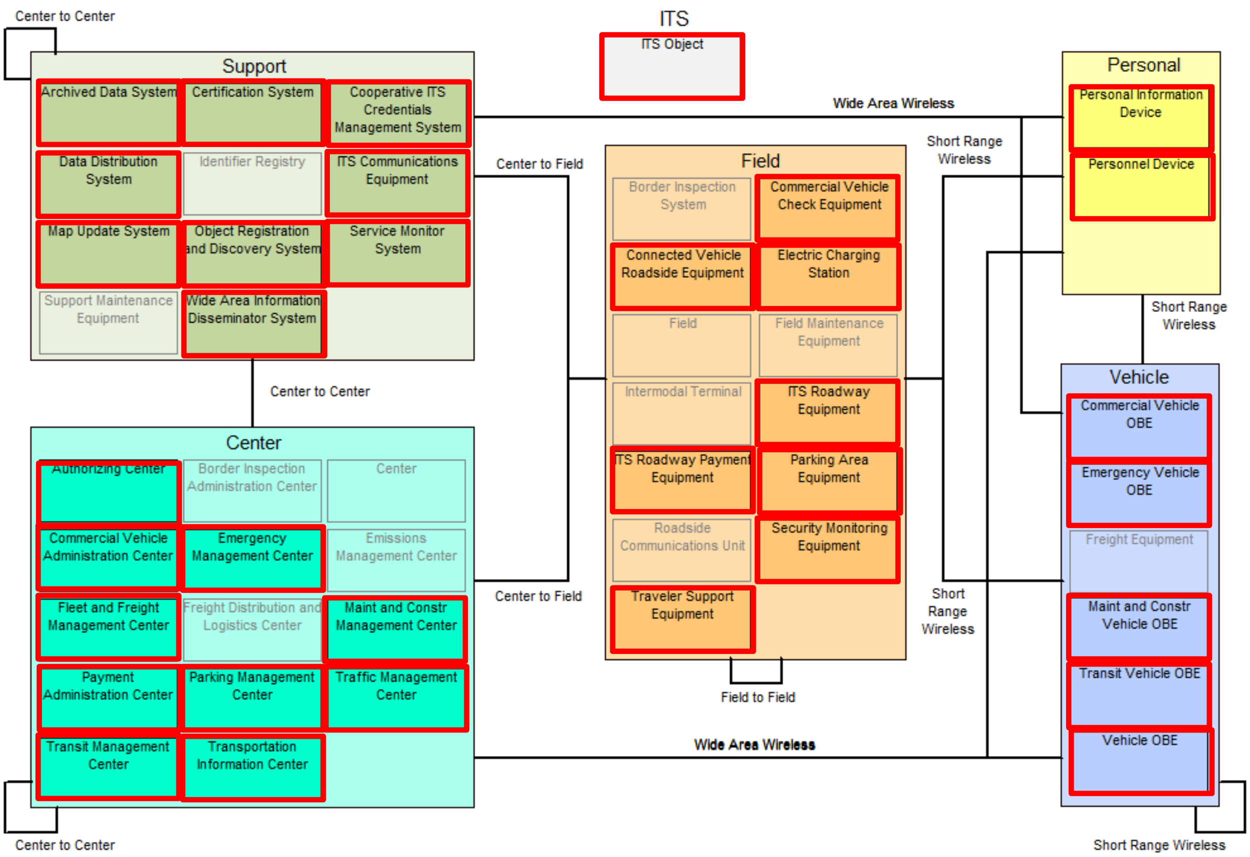

Figure 1. High-Level Interconnect Diagram

4. Stakeholder Involvement and Needs

Stakeholders are commonly considered to be those who own or operate ITS systems in the region as well as those who have an interest in regional transportation issues. Stakeholders provide crucial input regarding the region's transportation investment and ITS deployments; therefore, stakeholder participation and coordination is critical to the success of the ITS architecture development.

The Akron Regional ITS Architecture includes a wide range of stakeholders, and key stakeholders were identified at the beginning of the architecture development process. Stakeholder engagement activities were carried out through the duration of the architecture development process. Surveys were distributed to gather stakeholders' input on their current ITS inventory as well as transportation issues and needs they faced. Two stakeholder meetings were held. The first stakeholder meeting focused on providing background information on ITS and ITS architecture, confirming current ITS capabilities, and identifying and discussing transportation problems and issues within the region. The second stakeholder meeting provided an overview of the Akron Regional ITS Architecture, demonstrated the usage of the architecture website, and reviewed recommended ITS projects and their implementation timeframe.

5. Applicable ITS Standards

ITS Standards are fundamental to the establishment of an open ITS environment that achieves the goals originally envisioned by the United States Department of Transportation (USDOT). Standards facilitate deployment of interoperable systems at local, regional, and national levels without impeding innovation as technology advances and new approaches evolve. Standards can be thought of as the glue that holds the various pieces of an ITS architecture together. They define how the communications within an ITS environment take place.

While the Akron Regional ITS Architecture includes various ITS applications, it does not cover every conceivable ITS technology. As such, not all ITS standards will be applicable to the existing ITS component and future deployment. Applicable ITS standards were identified within the Akron Regional ITS Architecture to support communications solutions for ITS projects in the region.

It is important that stakeholders are aware of the importance of ITS standards, especially with respect to cost, risk, and interoperability issues both within the region and when connecting with other ITS architecture regions. These standards can save money in the long run, and make sure that various devices and systems "play well together".

6. Recommended ITS Projects and Implementation Sequencing

The Akron Regional ITS Architecture identifies a list of ITS projects for considering and recommends a sequence in which those projects may be implemented. The project implementation sequence is based on a combination of two factors:

- **Prioritization of projects based on existing conditions and stakeholder needs.** ITS projects were prioritized to reflect a deployment path (sequence) of stakeholder needs. As technology, funding opportunities and requirements continue to evolve, it is expected that stakeholders will reevaluate and reprioritize projects periodically.
- **Project dependencies, based on how successive ITS projects can build upon one another.** Project dependencies influence the project sequencing. It is beneficial to identify the information and functional dependencies between projects.

7. Documentation of ITS Architecture

The Akron Regional ITS Architecture is documented in three forms. The first is this report which provides high-level summaries regarding various aspects of the Architecture. The second form is an Architecture website that provides detailed architecture outputs in an organized web environment. The third is the Architecture database that is prepared using the Regional Architecture Development for Intelligent Transportation (RAD-IT) software, which is developed by FHWA for developing ITS architectures. The details of the Akron Regional ITS Architecture, including definitions of stakeholders, ITS inventory, projects, stakeholder roles and responsibilities, ITS services, interfaces among ITS systems, functional requirements, communications solutions and agreements, are captured in the RAD-IT database and the Architecture website. Documentation of the Akron Regional ITS Architecture can be accessed through the AMATS ITS Architecture web page at https://amatsplanning.org/its-architecture/.

8. Architecture Maintenance

By its nature, an ITS architecture is not a static set of outputs. The Akron Regional ITS Architecture is a living document and should be modified as plans and priorities change, ITS projects are implemented, and ITS needs and services evolve in the region. An architecture maintenance plan is developed to address the needs for maintenance and updates.

AMATS will be responsible for housing and maintaining the ITS Architecture. The general steps for architecture maintenance are:

1. Stakeholders identify changes, notify AMATS of changes, or complete the annual survey and submit it to AMATS. If the initial information is gathered via the annual survey, AMATS contacts the stakeholder for more information.
2. AMATS reviews the proposed changes, offers comments, and/or asks for additional information.
3. AMATS, in coordination with the appropriate stakeholders affected by the proposed changes, evaluates the changes and determine what impact they may have on the Architecture and/or associated documentation.
4. Upon its evaluation, AMATS makes a decision to accept the change, reject it, or ask for additional information.
5. If the decision is to accept the change, then the appropriate portions of the architecture baseline are updated by AMATS staff. AMATS may procure consultant services to perform the update if needed.
6. Once the ITS Architecture has been updated, AMATS staff presents the Technical Advisory Committee (TAC) of the changes made to the Architecture for comments and approval.
7. Upon TAC approval, AMATS publishes the updated architecture documentation, database and website.
8. AMATS notifies all stakeholders of architecture updates and provides information on how to obtain the latest version of the ITS Architecture.

B. Technical Report

1. Regional ITS Architecture Overview

An ITS architecture describes the “big picture” for ITS deployment in terms of individual components (i.e., subsystems) that will perform the functions necessary to deliver the desired needs. It describes what is to be deployed but not how those systems are to be deployed. An ITS architecture defines the components and subsystems that must interface with each other, the functions to be performed by those subsystems, and the data flows among those subsystems.

The region covered by the Akron Regional ITS Architecture is the Akron Metropolitan Area Transportation Study (AMATS) planning area in northeast Ohio. As illustrated in Figure 2, the AMATS planning area covers Portage and Summit counties and the Chippewa and Milton Township areas of Wayne County, encompassing local, regional and state transportation agencies and transportation stakeholders.

The Architecture is a roadmap for the deployment and integration of transportation systems in the region over the next 15 years. The architecture has been developed through a cooperative effort by the transportation, transit, law enforcement, emergency management, commercial vehicle and freight management agencies. It represents a shared vision of how each agency’s systems work together by sharing information and resources to enhance transportation safety, efficiency, capacity, mobility, reliability, and security. The collaboration and information sharing among transportation stakeholders in the region helps illustrate integration options and gain consensus on systematic and cost-effective implementation of ITS technologies and systems in the region. It should also be noted that the Akron Regional ITS Architecture is a living document and will evolve as needs, technology, stakeholders, and funding streams change.

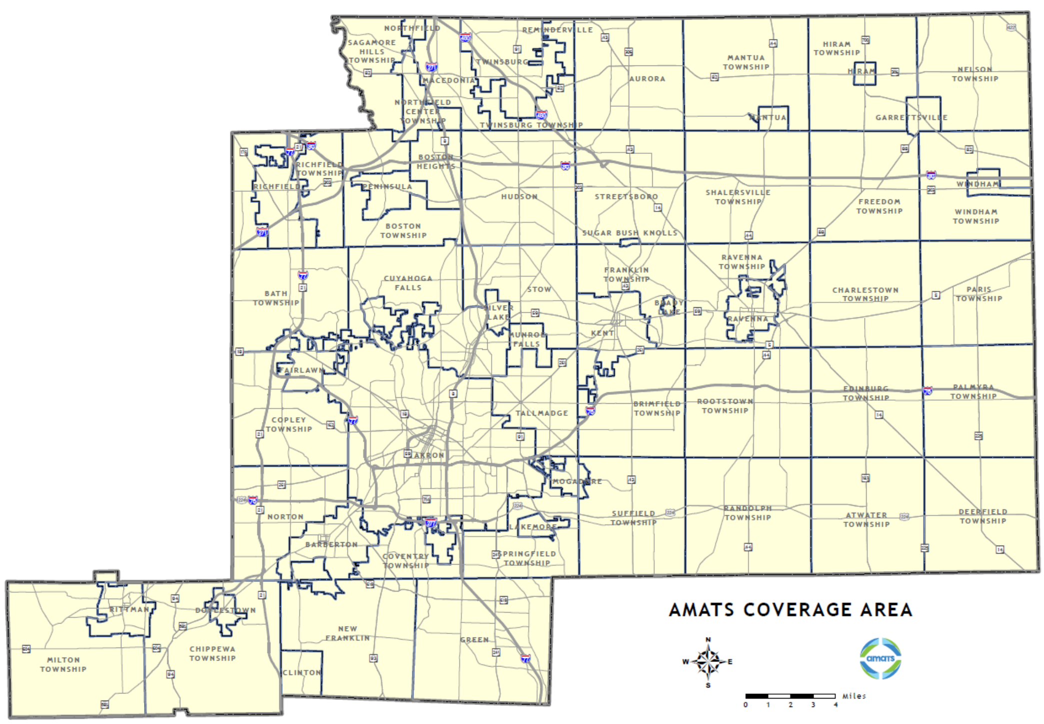

Figure 2. AMATS Planning Area

1.1 Purpose of a Regional ITS Architecture

The purpose of the Akron Regional ITS Architecture is to illustrate and document the integration of regional ITS systems to allow planning and deployment to occur in an organized and coordinated process. The Architecture helps guide the planning, implementation, and integration of ITS devices deployed and managed by multiple types of agencies that provide transportation services within the region. More specifically, the Architecture helps to accomplish the following objectives for ITS deployment in the region:

- Facilitate stakeholder coordination in ITS planning, deployment and operations;
- Reflect the current state of ITS planning and deployment within a region;
- Provide high-level planning for enhancing regional transportation systems using current and future ITS technologies; and
- Conform with ARC-IT and the FHWA Final Rule 940[1] and the FTA Final Policy on ITS Architecture and Standards.

The Final Rule and the Final Policy provide policies and procedures for implementing Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA–21), pertaining to conformance with ARC-IT and Standards. The Final Rule and the Final Policy ensure that ITS projects carried out using funds from the Highway Trust Fund including the Mass Transit Account conform to ARC-IT and applicable ITS standards.

ARC-IT is a tool to guide the development of regional ITS architectures. It is a common framework that guides agencies in establishing ITS interoperability and helps them choose the most appropriate strategies for processing transportation information, implementing and integrating ITS components and systems, and improving operations. The Akron Regional ITS Architecture is a specific application of the framework specified in ARC-IT, tailored to the needs of the transportation stakeholders in the AMATS planning area.

1.2 Architecture Development Process

The process used to develop the Akron Regional ITS Architecture is illustrated in Figure 3. This figure shows six general steps in the “life-cycle” of an ITS architecture. In the first four steps, the ITS architecture components are developed and then these components are used and maintained in steps 5 and 6. The development process begins with basic scope definition and team building and moves through increasingly detailed steps, culminating in specific architecture outputs and documents that will guide the “implementation” of the ITS architecture.

The key to the ITS architecture development process is to identify stakeholder needs, identify ITS projects to address those needs, and define project sequencing. The project definition outlines the project concepts and the associated details including project title, stakeholder, project scope, costs, benefits and the service packages defined in the Akron Regional ITS Architecture. The project sequencing provides an approximate timeframe in which an ITS project may be implemented based on the understanding of the projects, project dependencies of the project, as well as other existing or planned ITS systems.

[1] FHWA Final Rule 940 is available at http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf

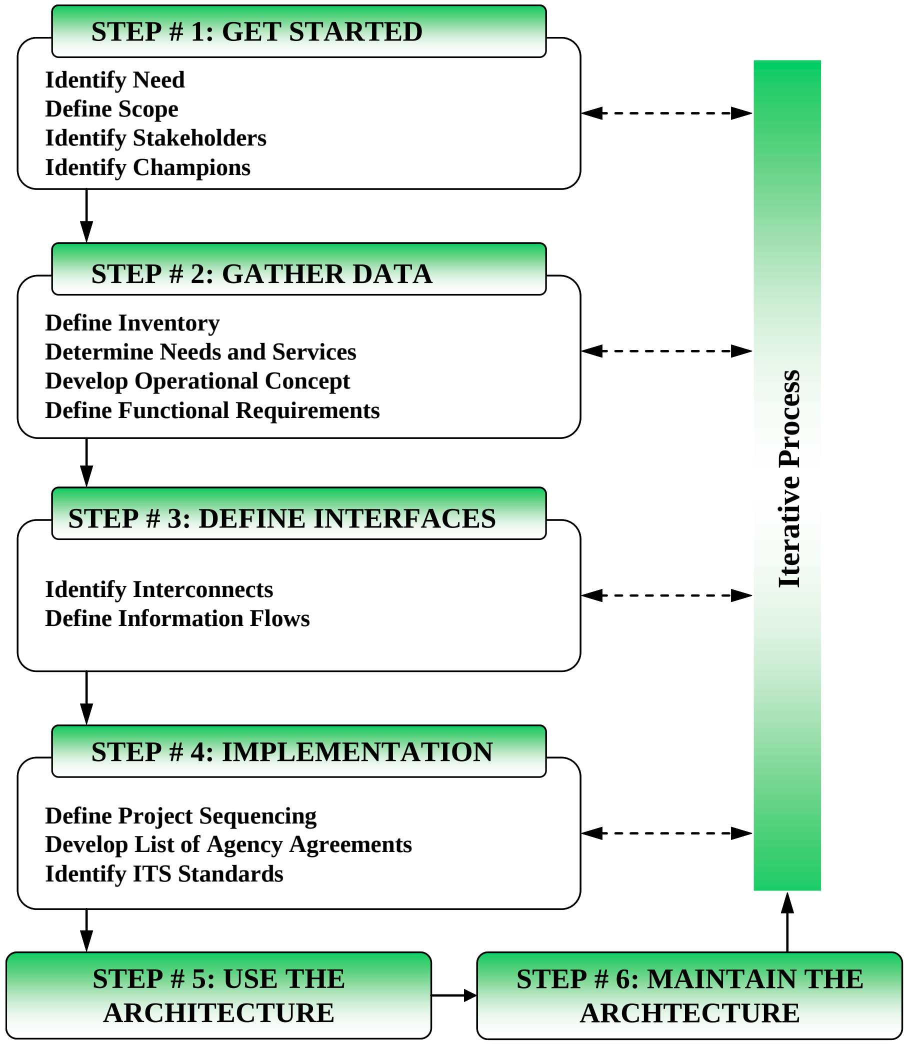

Figure 3. ITS Architecture Development Process

1.3 Systems Engineering

Systems Engineering is a phrase used to describe a cyclical process of planning, designing, implementing, testing, operating, and maintaining an ITS system. Essentially, this process covers the entire useful life of the system. Systems Engineering is a multi-step process that requires agencies to ask critical questions about how the technical aspects of the system will work together. This is often overlooked in complex systems. Figure 4 graphically illustrates the Systems Engineering process in what is often referred to as the "Vee" diagram. The purpose of a "V" in the diagram is to show how the final deliverables relate back to the early decisions (the right side relates directly back to the left side). That way there are no surprises when the system is finally delivered. For example, while a system is being designed, the various functions are documented as requirements, and then when the system is being built, these same functional requirements are compared to what was actually delivered.

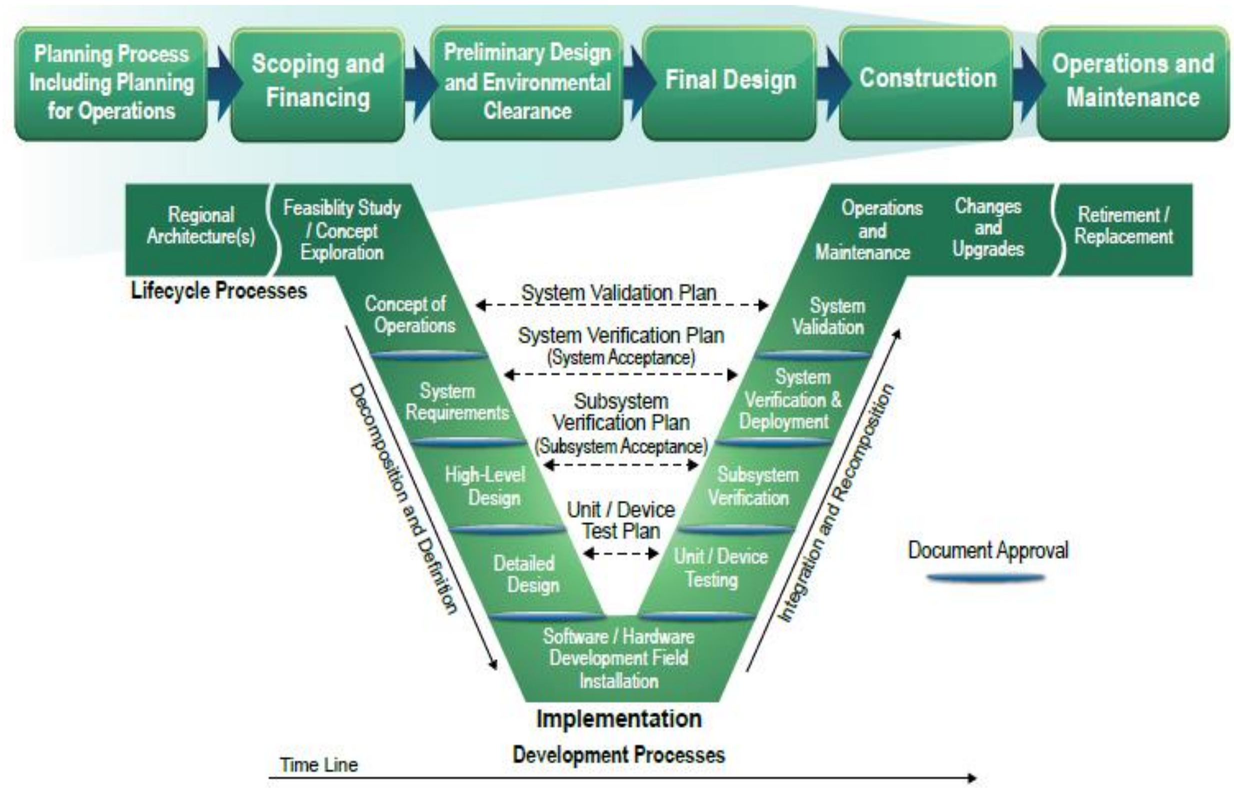

Figure 4. Systems Engineering V-Diagram

The Systems Engineering process shows how each step of the process builds on the previous one and is reliant on a system of back checking to ensure that the project is being designed and constructed based on its originally intended purpose. Systems Engineering is a risk management tool that sets expectations and then verifies that those expectations are met. It also enables a change management system so that unexpected issues can be incorporated into the process.

1.4 FHWA and FTA Requirements on ITS Architectures

FHWA Rule 940 (http://ops.fhwa.dot.gov/its_arch_imp/docs/20010108.pdf) provides policies and procedures for implementing Section 5206(e) of the Transportation Equity Act for the 21st Century (TEA–21), Public Law 105–178, 112 Stat. 457, pertaining to conformance with ARC-IT and Standards. The rule states, in part, that the final design of all ITS projects funded with Highway Trust Funds must accommodate the interface requirements and information exchanges as specified in the regional ITS architecture.

For federally funded ITS projects, several steps need to be followed as part of the systems engineering analysis and Rule 940 requirements. Rule 940 states that the systems engineering analysis shall include, at a minimum:

- Identification of portions of the regional ITS architecture being implemented (or if a regional ITS architecture does not exist, the applicable portions of ARC-IT)
- 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
- Procedures and resources necessary for operations and management of the system

The rule requirements are applicable for all ITS projects funded through the Highway Trust Fund account. Conformity with the Rule 940 requirements is required for both routine and non-routine projects. However, with routine projects, the effort and the scope of systems engineering analysis should be minimal. For non-routine projects, the scale of the systems engineering analysis depends on the scope of the project.

While the use of the architecture and the systems engineering approach is mandatory for federally funded projects, project developers are encouraged to use this approach for any ITS project using state or local funds, especially for projects that integrate with other systems in the region.

The Akron Regional ITS Architecture is a specific application of the framework specified in ARC-IT, tailored to the needs of the transportation stakeholders in the region. The Architecture was developed following the systems engineering approach and the requirements set forth in FHWA Final Rule 940.

2. Existing Conditions

The region's population is expected to grow by 2.4% between 2010 and 2045, based on the *Transportation Outlook 2045* published by AMATS. Summit County is expected to remain stable, with an expected 0.2% growth, while Portage County is expected to grow by 9.8%. Portage County is expected to see the most population growth in Northwest Portage (12%), Northeast Portage (9.9%), and Southwest Portage (9.2%). In Summit County, the Southern portion is expected to see the most growth (3%). The population growth in the region can have an impact on the transportation network. It is anticipated that the areas of population growth may have more needs for safety and congestion improvements while areas of slower growth may need to focus on the preservation of the existing roadway network.

AMATS considers improving safety as one of the most important goals for the region. Illustrated in the following tables are the top 10 roadway segments and intersections throughout the region that have demonstrated the most significant crash issues for the years of 2016-2018.

There are numerous areas of the roadway network experiencing traffic congestion problems throughout the region. The roadway segments that have experienced the most significant congestion issues are provided in Figures 5 and 6.

Significant investments in the deployments of ITS have been made in the region to address safety and congestion issues, among others. The Ohio Department of Transportation (ODOT) has a dedicated Statewide Traffic Management Center (TMC) that operates and manages multiple programs and technologies to facilitate the movements of people and goods on the ODOT managed roadway network. ODOT provides real time traveler information through dynamic message signs (DMS), travel time signs, the traveler information website (OHGO) and mobile app, and the 511 telephone system. ODOT also operates various ITS field devices, such as traffic cameras, road weather information systems (RWIS), and traffic signals to assist with monitoring and managing traffic along the ODOT roadway network.

The Ohio Turnpike and Infrastructure Commission (OTIC) has implemented an electronic toll collection system along with other advanced technology, including connected vehicle technology, to provide better services to the turnpike users.

Table 1. High Crash Roadway Segments (2016-2018)

Rank	Roadway Section	From	To	Avg. Daily Traffic	Total Crashes	Crashes Per Mile Per Year	Crash Rate	Severity Index
1	E Main St (SR-59)	Willow St	Luther Ave	18,195	86	69	10.46	1.53
2	S Cleveland-Massillon Rd	IR-77	Rosemont Blvd / Elgin Dr	21,780	65	41	5.15	1.71
3	Medina Rd (SR-18)	IR-77	Cleveland-Massillon Rd (CR-17)	30,889	149	71	6.34	1.54
4	W Market St (SR-18)	Cleveland-Massillon Rd	Smith Rd	24,530	95	56	6.21	1.53
5	Copley Rd (SR-162)	St Michaels	S Hawkins Ave	9,328	39	26	7.78	1.62
6	S Prospect St	Ravenna SCL	Lake Ave	9,640	11	21	5.84	2.09
7	E Aurora Rd (SR-82)	Olde Eight Rd	SR-8	15,150	76	31	5.61	1.50
8	Canton Rd (CR-66)	Sanitarium Rd (CR-136)	Waterloo Rd (US-224)	14,870	85	28	5.19	1.56
9	Ghent Rd	W Market St (SR-18)	Smith Rd	9,230	36	31	9.31	1.44
10	SR-14	SR-303 (W)	SR-303 (E)	25,578	51	48	5.10	1.47

Table 2. High Crash Intersections (2016-2018)

Rank	Street	Intersecting Street(s)	Approach Avg. Daily Traffic	Total Crashes	Crash Rate	Severity Index
1	S Maple St (SR-162)	Rhodes Ave	13,195	43	2.98	1.84
2	S Maple St (SR-162)	W Cedar St	13,820	36	2.38	1.83
3	SR-14 / SR-303	SR-43	41,044	135	3.00	1.47
4	Darrow Rd (SR-91)	Graham Rd	34,456	80	2.12	1.53
5	S Broadway St	E Miller Ave	16,680	40	2.19	1.65
6	Portage Trail	2nd St	29,350	61	1.90	1.56
7	W Market St (SR-18)	Smith Rd	24,604	44	1.63	1.77
8	Vernon Odom Blvd (SR-261)	Superior Ave	13,265	32	2.20	1.75
9	E Tallmadge Ave (SR-261)	Home Ave	29,800	57	1.75	1.56
10	SR-14	Brook Valley Trail / Shady Lake Dr	31,551	49	1.42	1.94

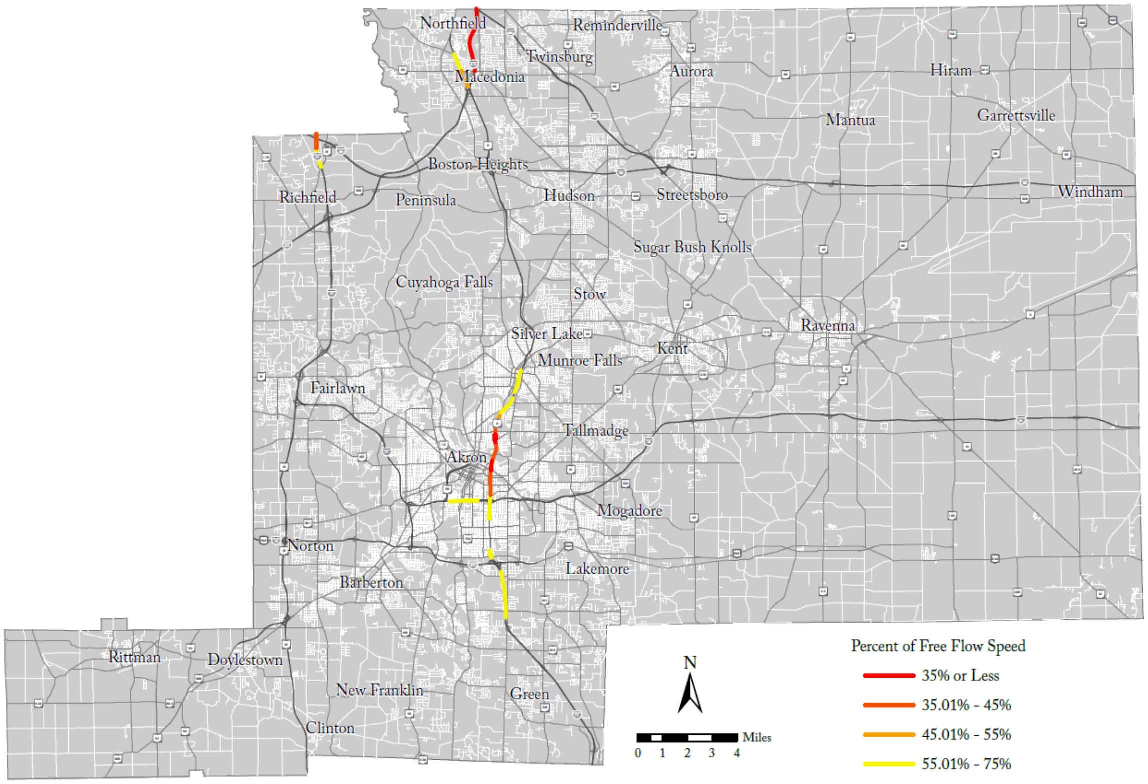

Figure 5. Congested Freeway Segments in AMATS Planning Area

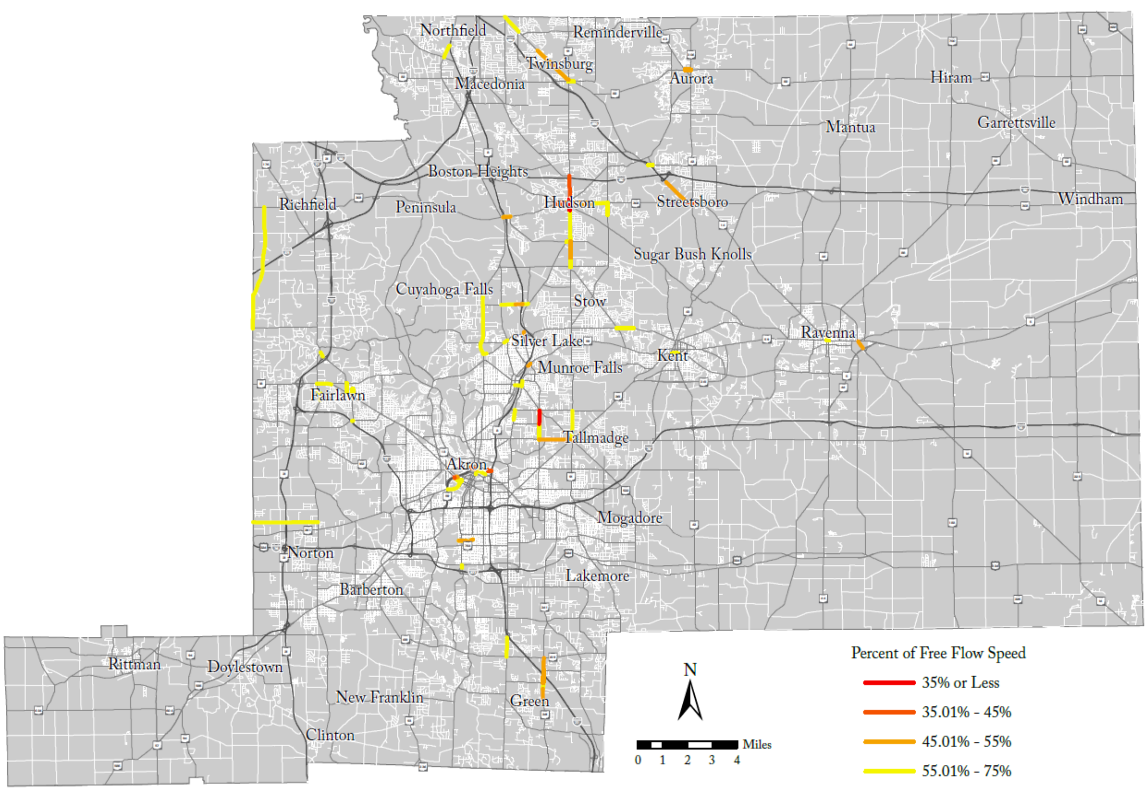

Figure 6. Congested Arterial Segments in AMATS Planning Area

Many cities and counties within the region have traffic management systems to facilitate traffic movements along the surface streets. Major cities within the region have implemented centralized traffic control systems. Some cities also have deployed vehicle detection systems and closed-circuit television (CCTV) cameras. Portable message signs are used by counties, cities and townships for managing traffic and delivering traveler information in and around work zones or for special events. Automated Vehicle Location (AVL) systems have been implemented on snowplows and maintenance vehicles by selected cities.

METRO Regional Transit Authority (RTA) and Portage Area Regional Transit Authority (PARTA) are the regional transit authorities in the region. METRO RTA and PARTA have implemented advanced transit technology to assist with service efficiency and performance. Transit technologies implemented in the region includes, but is not limited to: computer-aided scheduling software, AVL systems, Automated Passenger Counters (APCs), mobile fare payment systems, on-board security cameras, on-board annunciators, and real-time bus arrival/department signs.

3. Stakeholder Involvement and Needs

Stakeholders are commonly considered to be those who own or operate ITS systems in the region as well as those who have an interest in regional transportation issues. Stakeholders provide crucial input regarding the region's transportation investment and ITS deployments; therefore, stakeholder participation and coordination is critical to the success of the ITS architecture development.

The Akron Regional ITS Architecture includes a wide range of stakeholders, and key stakeholders were identified at the beginning of the architecture development process. Information on current and potential ITS deployment was gathered through a survey distributed to stakeholders in November 2021. The survey presented stakeholders with a list of common transportation issues/needs that can be addressed through the use of ITS technologies, and asked stakeholders to rank the severity of the issue as High, Medium, Low, or Not Applicable in the region. The survey also asked stakeholders to list the top 3 to 5 needs and challenges that they would like to see addressed by the update to the Akron Regional ITS Architecture. A total of 24 surveys were completed by stakeholders.

Stakeholders were invited to a stakeholder meeting in May 2022 where they were presented with the draft architecture. In addition, facilitators guided stakeholders through a listing of recommended ITS projects that were identified based on stakeholder needs and an analysis of current ITS capabilities in the region. Stakeholders were encouraged to review, provide comments and add missing information to the architecture and the recommended ITS projects.

Upon reviewing the survey responses, high priority needs for the region were identified by stakeholders through the needs survey and the discussion between stakeholders at the workshop. A total of 27 high priority needs were identified and categorized into nine areas: safety and security, traffic operations, traveler information, transit, incident & emergency management, ITS communications, parking management, work zone management and data management. High priority needs for the region and their respective service areas include the following, as provided below:

Safety and Security

- Reduce vehicle crashes at intersections
- Security and safety monitoring in public spaces (for public safety / crime deterrent)

- Reduce safety incidents on curves or ramps
- Reduce rear-end collisions due to traffic backup / queues
- Improve safety and security of transit passengers on vehicles and at transit stops / platforms / park and ride lots

Traffic Operations

- Improve traffic signal timing and coordination
- Enhance/upgrade traffic signal controller capabilities to support signal timing adjustments based on traffic flow (e.g. traffic-responsive control, adaptive control)

Traveler Information

- Provide information on roadway closures / lane restriction / work zones on roadways / turnpike to the public
- Provide information about weather and surface conditions / location on roadways / turnpike to the public
- Provide alternate route information to the traveling public during major roadway incidents
- Provide special event traffic information to the public

Transit

- Improve safety and security of transit passengers on transit vehicles
- Transit signal priority for transit vehicles

Incident & Emergency Management

- Provide expanded traffic signal preemption for emergency vehicles
- Identify alternate/quickest routes for emergency vehicles using real-time information
- Improved incident detection on major routes
- Implement/improve evacuation procedures for large scale disasters or emergencies
- Provide real-time traffic incident information to regional agencies

ITS Communications

- Improved staffing and resources for proper maintenance of communications network
- Expand fiber optic network
- Improve security of communications network

Parking Management

- Implement parking management systems in downtown area and for special events (e.g. providing real-time parking space availability, directions to parking)

Work Zone Management

- Improve temporary maintenance work zone safety for maintenance crew
- Reduce crashes in and around roadway work zones
- Provide maintenance/construction staff remote controlling / programming / managing capabilities for traffic control devices (i.e. message boards, temporary traffic signals, etc.)
- Improve temporary maintenance work zone safety for travelers

Data Management

- Implement or enhance data storage and management capabilities

4. Regional ITS Architecture Components

This section describes the following processes that were followed in developing the Akron Regional ITS Architecture through the use of RAD-IT software. Details of the architecture are presented on the website for the Akron Regional ITS Architecture that can be accessed through the AMATS ITS Architecture web page at https://amatsplanning.org/its-architecture/.

4.1 Inventory

The inventory of the Akron Regional ITS Architecture contains all of the existing and future elements of ITS technology within the region. The inventory of elements were identified based on a review of planning and study documents for the region, the information gathered through stakeholder survey responses, and follow-up discussions with AMATS staff and stakeholders.

ITS elements within the Inventory represent the range of ITS devices and systems. Figure 7 displays the five types of inventory elements that can exist within an ITS Architecture (represented by the five colored boxes in the figure). ITS elements can exist:

- On vehicles (i.e., police cars, snow plows, etc.)
- In the field (i.e., traffic signals)
- At a center (i.e., Traffic Management Center)
- Personally in the hands of travelers (i.e., computers, smartphones, etc.)
- As support systems (i.e., back-office map systems, etc.)

The technical functions that each of these elements perform are defined by ARC-IT as Subsystems and illustrated in Figure 7.

In addition to Subsystem elements, there are additional elements added to the Inventory defined by ARC-IT as Terminators. These represent the people, systems, and general environment that interface with the Subsystem elements. Terminators typically represent the beginning or end of a flow of information in the ITS Architecture. No technical or functional requirements are assigned to terminators because they are the points outside the system boundaries where the architecture "plugs in" to the outside world.

A detailed listing of all the ITS elements in the region can be found in the Architecture website. Each ITS element is documented by the associated stakeholder(s), its status (e.g. existing, planned, or future), and a brief description for each element. Based on its functionalities, each element is also mapped to the various types of subsystems and terminators defined by ARC-IT.

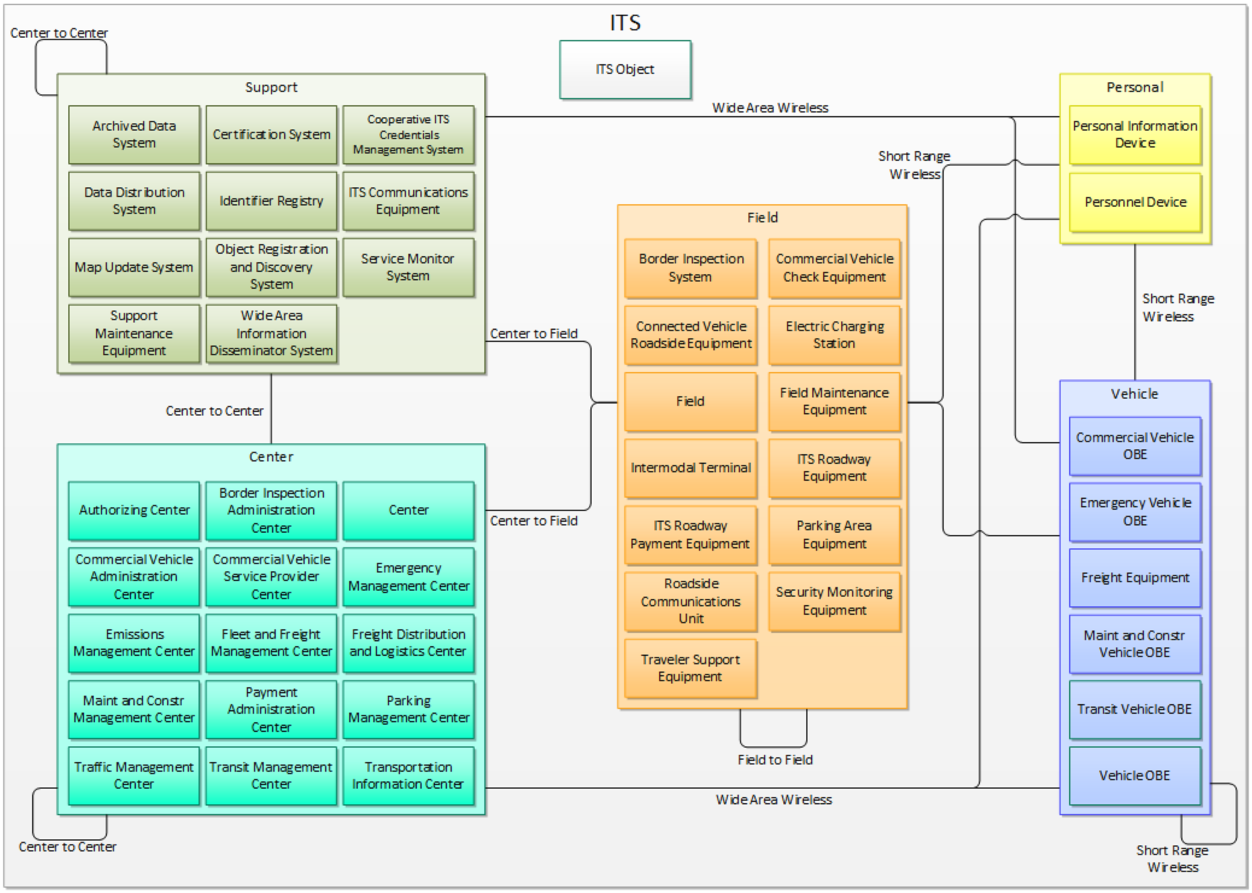

Figure 7. ARC-IT Subsystems and Interconnections

4.2 Service Packages

Service packages of an ITS architecture define a “service-oriented” perspective of how an ITS architecture can be structured. Service packages are a convenient way to assemble ITS components to address frequently needed services without having to itemize the components. This can be compared to buying a car. In one purchase you acquire a complex set of systems such as engine, drive train, suspension, cargo handling, etc.) In the same way, service packages present how the ITS elements (and their assigned subsystems and terminators) work together to deliver a given ITS service, as well as the flows of information that connect those ITS elements with other important external systems. They are tailored to fit real world transportation problems and needs. Service packages enable transportation planners and decision makers to select appropriate ITS services and solutions that satisfy local and statewide needs.

All 150 service packages in ARC-IT (Version 9.0) were considered for their applicability to the region. Table 3 summarizes the status of ITS deployment with respect to service packages that were applicable to the region. A detailed list of applicable service packages is presented in the Architecture website.

Table 3. Service Packages for the Akron Regional ITS Architecture

Service Package	Service Package Name	Service Package Status
CVO03	Electronic Clearance	Future
CVO05	Commercial Vehicle Parking	Future
CVO06	Freight Signal Priority	Future
CVO08	Smart Roadside and Virtual WIM	Existing
CVO09	Freight-Specific Dynamic Travel Planning	Future
CVO10	Road Weather Information for Freight Carriers	Future
DM01	ITS Data Warehouse	Existing
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Existing
MC02	Maintenance and Construction Vehicle Maintenance	Existing
MC04	Winter Maintenance	Existing
MC05	Roadway Maintenance and Construction	Existing
MC06	Work Zone Management	Existing
MC07	Work Zone Safety Monitoring	Future
MC08	Maintenance and Construction Activity Coordination	Existing
MC09	Infrastructure Monitoring	Existing
PM01	Parking Space Management	Existing
PM03	Parking Electronic Payment	Existing
PM04	Regional Parking Management	Future
PM06	Loading Zone Management	Future
PS01	Emergency Call-Taking and Dispatch	Existing
PS02	Emergency Response	Existing
PS03	Emergency Vehicle Preemption	Existing
PS07	Incident Scene Safety Monitoring	Future
PS08	Roadway Service Patrols	Existing
PS09	Transportation Infrastructure Protection	Existing
PS10	Wide-Area Alert	Existing
PS11	Early Warning System	Existing
PT01	Transit Vehicle Tracking	Existing
PT02	Transit Fixed-Route Operations	Existing
PT03	Dynamic Transit Operations	Existing
PT04	Transit Fare Collection Management	Existing
PT05	Transit Security	Existing
PT06	Transit Fleet Management	Existing
PT07	Transit Passenger Counting	Existing
PT08	Transit Traveler Information	Existing
PT09	Transit Signal Priority	Future
PT11	Transit Pedestrian Indication	Future
PT12	Transit Vehicle at Station/Stop Warnings	Future
PT13	Vehicle Turning Right in Front of a Transit Vehicle	Future
PT16	Route ID for the Visually Impaired	Future
PT17	Transit Connection Protection	Future
ST05	Electric Charging Stations Management	Existing

Service Package	Service Package Name	Service Package Status
ST08	Eco-Approach and Departure at Signalized Intersections	Future
SU01	Connected Vehicle System Monitoring and Management	Future
SU02	Core Authorization	Future
SU03	Data Distribution	Future
SU04	Map Management	Future
SU05	Location and Time	Future
SU06	Object Registration and Discovery	Future
SU08	Security and Credentials Management	Future
SU09	Device Certification and Enrollment	Future
SU12	Vehicle Maintenance	Future
TI01	Broadcast Traveler Information	Existing
TI02	Personalized Traveler Information	Existing
TI06	Dynamic Ridesharing and Shared Use Transportation	Future
TI07	In-Vehicle Signage	Future
TM01	Infrastructure-Based Traffic Surveillance	Existing
TM02	Vehicle-Based Traffic Surveillance	Existing
TM03	Traffic Signal Control	Existing
TM04	Connected Vehicle Traffic Signal System	Future
TM05	Traffic Metering	Future
TM06	Traffic Information Dissemination	Existing
TM08	Traffic Incident Management System	Existing
TM10	Electronic Toll Collection	Existing
TM13	Standard Railroad Grade Crossing	Existing
TM14	Advanced Railroad Grade Crossing	Future
TM17	Speed Warning and Enforcement	Existing
TM19	Roadway Closure Management	Future
TM21	Speed Harmonization	Future
TM22	Dynamic Lane Management and Shoulder Use	Future
TM25	Wrong Way Vehicle Detection and Warning	Existing
VS01	Autonomous Vehicle Safety Systems	Future
VS02	V2V Basic Safety	Future
VS03	Situational Awareness	Existing
VS05	Curve Speed Warning	Future
VS06	Stop Sign Gap Assist	Future
VS07	Road Weather Motorist Alert and Warning	Existing
VS08	Queue Warning	Future
VS09	Reduced Speed Zone Warning / Lane Closure	Future
VS11	Oversize Vehicle Warning	Future
VS12	Pedestrian and Cyclist Safety	Future
VS13	Intersection Safety Warning and Collision Avoidance	Future
VS14	Cooperative Adaptive Cruise Control	Future
VS15	Infrastructure Enhanced Cooperative Adaptive Cruise Control	Future
VS16	Automated Vehicle Operations	Existing
WX01	Weather Data Collection	Existing

Service Package	Service Package Name	Service Package Status
WX02	Weather Information Processing and Distribution	Existing
WX03	Spot Weather Impact Warning	Existing

4.3 Stakeholders' Roles and Responsibilities

An operational concept defines each stakeholder's current and future roles and responsibilities within the ITS systems. Defining the roles and responsibilities of the participating stakeholders in the region is an important step in realizing the common goal of an interoperable ITS system throughout the region.

A list of the stakeholders' operational roles and responsibilities is contained in the Architecture website. These roles and responsibilities have been defined based on existing documents (for existing ITS systems), as well as recommended future ITS projects (for proposed systems). Together, these roles and responsibilities define the Operational Concept for the ITS Architecture, and provide an overview how ITS services operate within the region.

4.4 Functional Requirements

A functional requirement is a task or activity that is currently performed or will be performed by each system in the region to provide the required regional ITS services. The ARC-IT has pre-defined all possible functional requirements that are associated with respective subsystems in each service package. The regional architecture is created through selecting those functional requirements that apply from this master list of functional requirements.

The process of selecting the functional requirements for the Akron Regional ITS Architecture began with the mapping of functional areas (Functional Objects) to service packages and associated ITS elements. The functional requirements of each functional object were then tailored to represent the specific local agency functions performed. RAD-IT software is then used to produce lists and requirement definitions that can be interpreted by the end users.

A detailed listing of the Functional Requirements of all ITS Inventory elements in the region is contained in the Architecture website.

4.5 Interfaces

While it is important to identify the various ITS systems and stakeholders as part of the Architecture, a primary purpose of the Akron Regional ITS Architecture is to identify the connectivity between systems. The two ways to describe this connectivity are:

- **Architecture Interconnects** define the connections between equipment and systems which may be deployed by the agencies throughout the region. In other words, what entities interact with each other.
- **Architecture (Information) Flows** define a high-level information exchange associated with each interconnect between equipment and systems. In other words, what information is passed along the interconnect paths.

An example of an interconnect diagram is illustrated in Figure 8.

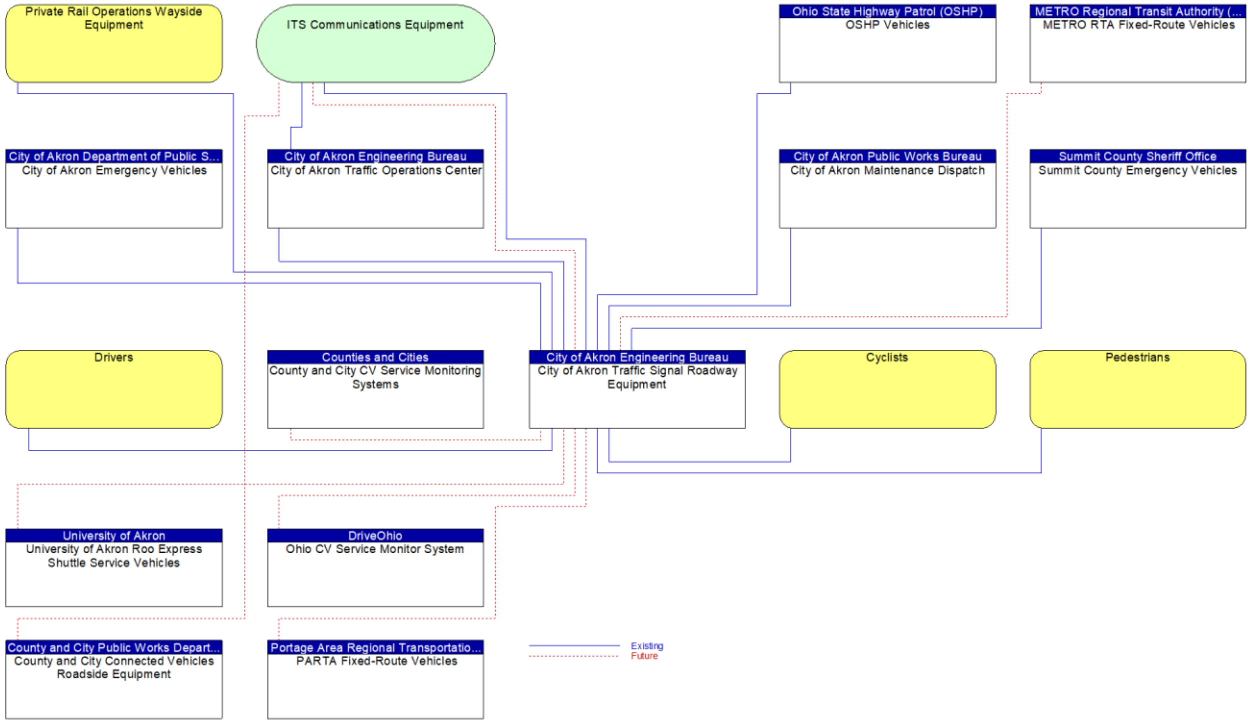

Figure 8. Interconnect Diagram Example: City of Akron Traffic Signal Roadway Equipment

Figure 9 illustrates the architecture flow diagram between the City of Akron Traffic Operations Center and the City of Akron Traffic Signal Roadway Equipment in the Akron Regional ITS Architecture. Architecture (information) flows provide a high-level description of information exchanges associated with each interconnect path between equipment and systems. From these diagrams the stakeholders can easily identify the existing or potential information exchange between agencies and systems. This provides a framework for analyzing how elements are related and thus identifies the areas for potential coordination and cooperation among agencies. Quite often from these diagrams, agencies can identify missing communication flows that should occur, leading to refinements during the lifecycle of the system.

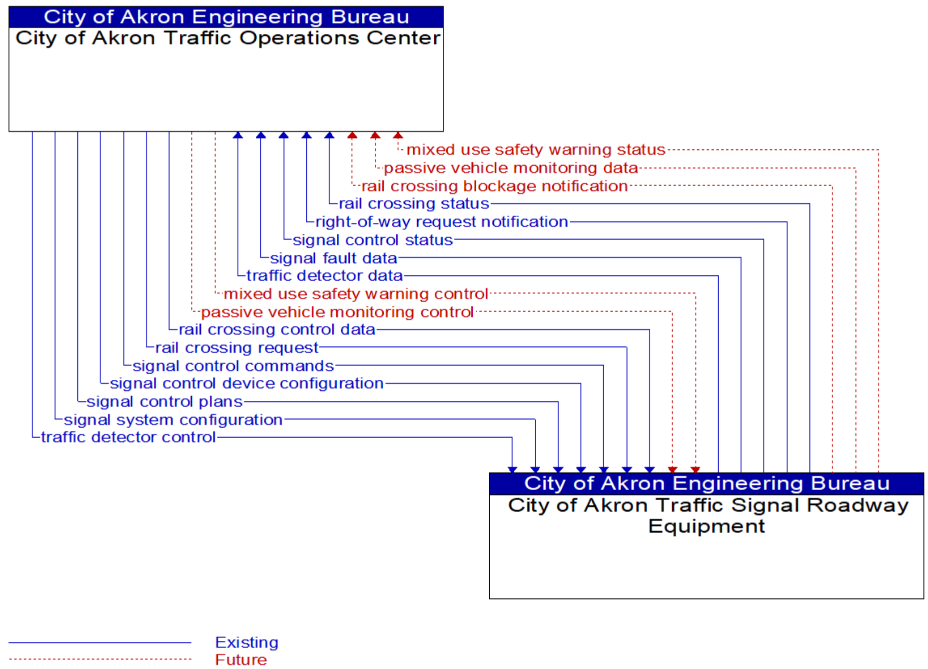

Figure 9. Architecture Flow Diagram: City of Akron Traffic Operations Center and Traffic Signal Roadway Equipment

The ARC-IT provides guidance in identifying potential information to be exchanged between commonly used ITS elements in the Inventory, and the RAD-IT software is used to generate the architecture flow diagrams between ITS elements in the Inventory.

A detailed listing of the interconnects and architecture flows of all ITS Inventory elements in the AMATS planning area is contained in the Architecture website.

4.6 Communications Solutions

Communication solutions are composed of a collection of ITS standards that are needed to implement interfaces/information flows between a source and destination. Identification of ITS technical standards that support interfaces in the regional ITS architecture are often not understood by stakeholders, so ARC-IT was created to provide the stakeholders with easy access to appropriate ITS standards that can be specifically applied to an ITS project. A summary of this task process is as follows:

- Using information flows identified in Step 3, identify relevant ITS standards for the region.
- Assess the ITS standard maturity and develop agreements for use of interim standards when determined necessary.
- Identify other regional and/or statewide standards that might apply.

As previously noted, it is important that stakeholders are aware of the importance of ITS standards, especially with respect to cost, risk, and interoperability issues both within the region and when connecting with other ITS architecture regions. These standards can save money in the long run, and make sure that various devices and systems “play well together”.

A list of ITS Standards identified by the RAD-IT as applicable to the region is contained in the Architecture website.

4.7 Agreements

The Akron Regional ITS Architecture also provides an institutional framework for the deployment of ITS in the region. Institutional interoperability involves cooperation and coordination between various agencies and jurisdictions to achieve seamless functionality, regardless of agency boundaries or differences in neighboring agency systems. Because the regional architecture identifies systems that require agencies to contribute resources and manpower to operate, inter-agency agreements are often needed to define the roles and responsibilities of each party.

There are several types of arrangements associated with the interfaces identified in the Akron Regional ITS Architecture:

- Information sharing and exchanges between systems require knowledge of the transmission protocol and data formats to ensure compatibility.
- Coordinating field device operations owned by different agencies requires defined procedures for submitting message requests and rules governing when such requests can be honored. Such coordination may be done with informal arrangements such as a Memoranda of Understanding (MOU).
- Sharing control of field devices operated by different agencies sometimes involves liability issues, which leads to more formal agreements.
- Coordinated incident response may also require formal agreements, but also requires group training of personnel from various agencies.

In general, agreements may be obtained for data sharing, establishing common procedures, supporting regional operations, cost effective maintenance arrangements, and personnel training.

Some common types of agreements are listed in Table 4. The agreement process may begin with something as simple as a handshake agreement. However, once interconnections and integration of systems begin, agencies may want to have more formalized agreements in place. A documented agreement will aid agencies in planning their operational costs, understanding their respective roles and responsibilities, and build trust for future projects. Formal agreements may be necessary where funding or financial arrangements are defined or participation in large regionally significant projects is required. Formal agreements also provide a means for sustaining the stakeholders' expectations when personnel and administration changes occur.

Table 4. Common Types of Agreements for ITS

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

5. Recommended ITS Projects and Implementation Sequencing

The ITS projects included in the Akron Regional ITS Architecture were identified based on the following sources:

- Stakeholder surveys, inputs and feedback
- Transportation Outlook 2045 (TO2045)
- AMATS Transportation Improvement Program (FY2021 – FY2024)
- Documents and reports of ongoing studies and projects within the region
- Grant applications for ITS project funding submitted by cities and counties within the region
- ODOT Statewide Transportation Improvement Program

A project sequence defines the order in which ITS projects may be implemented. A good sequence is based on a combination of two factors:

- **Prioritization of projects based on existing conditions and stakeholder needs.** The ITS projects were prioritized to reflect a deployment path (sequence). Although the information collected through stakeholder surveys and meetings was the basis of the ITS Architecture, real world conditions of changing technology, funding opportunities and public demand continue to evolve. It is expected that the stakeholders will reevaluate and reprioritize projects frequently to keep up with these imposed changes.
- **Projects often depend on prior projects being completed.** For example, a fiber optic network would need to be in place before a set of detectors are constructed to provide a means to communicate with the detection system. These project dependencies influence the project sequencing. Therefore, it is important to identify these dependencies between projects during the planning stages.

In most cases, the sequence of currently planned projects has already been programmed and can simply be extracted from existing transportation plans. Successive projects will then be added to the sequence based on the project dependencies and other planning factors.

The project timeframes provide a means to position each project along the architecture's lifetime. This enables the scheduling of funds and resources to deliver the projects in an appropriate sequence. Three timeframe categories are used, and their definitions are described below:

Table 5. Project Implementation Timeframes

Category	Time Frame	Year of Deployment
Short Term	0 – 4 years	2023 – 2027
Medium Term	5 – 10 years	2028 – 2033
Long Term	11 years and beyond	2034 and beyond

The Akron Regional ITS Architecture represents a roadmap for transportation systems deployment and integration in the region over the next 15 years. A list of ITS projects that have currently been planned or considered over the next 15 years is identified in Table 6. Through the above process, the recommended ITS project sequencing was determined. The list was further refined to establish which projects were allocated to the short term (within 5 years), medium term (6 to 10 years), and long term (over 10 years). This provided a priority for the list of projects denoting a general order for project implementation.

Table 6. List of Future ITS Projects and Initiatives

Project	Project Description	Project Timeframe	Lead Agency
Short Term Projects			
City of Akron North Main Street Complete Streets	This project includes various upgrades to the North Main Street corridor in the City of Akron, including roadway improvements (i.e., pavement reconstruction) as well as the addition of the following ITS elements: (1) Traffic signals (upgrades to signal equipment and coordination/ interconnecting of signals), (2) Wayfinding signage, and (3) Fiber optic cable. Fiber Optic lines are proposed to create the backbone of the future implementation of Smart City technology along the corridor (PID# 112716).	Short (2025)	City of Akron
City of Cuyahoga Falls Wyoga Lake Road Improvements and Traffic Signal Upgrade	This project includes upgrades to the Wyoga Lake Road corridor in the City of Cuyahoga Falls, including pavement reconstruction as well as the installation of a traffic signal at the intersection of Wyoga Lake Road and the Walsh High School main entrance. Pedestrian hybrid beacons may also be considered for this project. (PID# 116742)	Short (2026)	City of Cuyahoga Falls
City of Hudson Downtown Adaptive Signals Improvement	This project will upgrade the existing traffic signal system in the City of Hudson downtown area to an adaptive traffic signal system. Upgrades include replacing or upgrading traffic signals, controllers, and other equipment to support an adaptive central traffic signal system, pedestrian signals, CCTV cameras, and specialized loop detectors at intersections for bicycle detection. This project will also install emergency vehicle preemption (EVP) equipment on City of Hudson Police vehicles. (PID# 116924)	Short (2026)	City of Hudson
City of Hudson SR-91 and Terex Road Turn Lane Improvements	This project includes upgrades to the State Route 91 and Terex Road intersection in the City of Hudson, including pavement reconstruction as well as signal timing updates. (PID# 116929)	Short (2026)	City of Hudson
City of Kent East Main Street Improvements (POR-59-2.14)	This project includes various roadway improvements and traffic signalization upgrades at 3 signalized intersections along East Main Street (State Route 59) in the City of Kent. ITS upgrades also include RRFB signage (PID# 112026).	Short (2025)	City of Kent

Project	Project Description	Project Timeframe	Lead Agency
City of Macedonia Highland Road and Valley View improvements and Traffic Signal Upgrade	This project will include various roadway intersection improvements and the installation of a new traffic signal at the intersection of Highland Road (County Route 111) and Valley View Road in the City of Macedonia. This includes installation of EVP, video detection, and pedestrian signals with countdown timers (PID# 113161).	Short (2025)	City of Macedonia
City of Macedonia Ravenna Road/Shepard Road Intersection Traffic Signal Coordination and Interconnects	This project includes various roadway improvements and the interconnection of the traffic signals at Ravenna Road/Shepard Road and Broadway Avenue/Pettibone Road (PID# 113165). The coordination of the traffic signals can reduce congestion and delays in the area.	Short (2025)	City of Macedonia
City of Stow Darrow Road (SR 91) Corridor Signal Operations Improvement	This project includes upgrades to the Darrow Road (State Route 91) corridor in the City of Stow, including various roadway improvement as well as upgrading traffic signals to a coordinated system and installing PCM display boards. (PID# 102745)	Short (2025)	City of Stow
City of Stow Graham Road and Fishcreek Road Intersection	This project includes upgrades to the Graham Road and Fishcreek Road intersection in the City of Stow, including pavement reconstruction, signal timing updates, and pedestrian signals (PID# 111728).	Short (2023)	City of Stow
City of Stow Kent Road (SR 59) Corridor Signal Operations Improvement	This project includes upgrades traffic signals along the Kent Road (State Route 59) corridor in the City of Stow, including replacing and upgrading existing traffic signal equipment with new controllers and signal infrastructure, as well as installing pedestrian signals, video detection, and EVP. (PID# 116990)	Short (2025)	City of Stow
City of Streetsboro SR 303/14 Traffic Signal Upgrade	This project includes upgrades to the State Route 303 / State Route 14 / Ranch Road (County Route 111) intersection in the City of Streetsboro, including the removal of the westbound slip lane, installation of a new traffic signal, vehicle detectors, and pedestrian signals. (PID# 117173)	Short (2026)	City of Streetsboro

Project	Project Description	Project Timeframe	Lead Agency
METRO RTA Bus Transit Signal Priority Study	This project will study key BRT corridors in Summit County to analyze the effectiveness of these corridors in enhancing travel for bus passengers in the area. A number of roadway improvements and ITS technology upgrades will be considered for this project that will benefit both transit and other vehicular travel throughout BRT corridors, including transit signal priority (TSP).	Short	METRO RTA
METRO RTA Electric Bus Replacement	This project will include the replacement of 2 existing CNG buses with 2 new battery-powered electric buses as well as the installation of an electric vehicle (EV) charging station at METRO RTA's transit bus facility. (PID# 117253)	Short (2026)	METRO RTA
OTIC ITS Cameras	OTIC will install ITS cameras to monitor mainline traffic. Cameras will be installed at 8 maintenance building locations, 14 service plaza locations and toll plazas.	Short	OTIC
OTIC Weigh-in-Motion Scales	This project will Install fixed weigh–in–motion (WIM) stations at selected mainline locations along the Ohio Turnpike to measure the weight of passing commercial vehicles in real–time and alert law enforcement of violations. This project will also include procurement of portable WIM scales.	Short	OTIC
PARTA Clean Diesel Bus Replacement	This project will replace 3 of PARTA's existing diesel buses with 3 new low floor Clean Diesel buses. The new buses will be equipped with a number of ITS technologies including automatic vehicle location (AVL) devices and mobile bus fare ticket validation. (PID# 116416)	Short (2026)	PARTA
Stow Silver Falls Cuyahoga Falls Bikeway Connector	This project will include the addition of 2 pedestrian signals and the relocation/reconstruction of a bike path that will be located in the cities of Stow and Cuyahoga Falls and the Village of Silver Lake near Graham Road (PID# 113016). The relocation of the bike path and inclusion of pedestrian signals will separate users from the roadway and help improve pedestrian safety in the area.	Short (2025)	City of Stow
ODOT CCTV Upgrades and Expansion	This represents replacing or upgrading existing as well as installing new CCTV cameras and lowering units along ODOT roadways within the region.	Short to Long	ODOT
ODOT DMS Upgrades and Expansion	This represents replacing or upgrading existing as well as installing new DMS along ODOT roadways for disseminating traveler information.	Short to Long	ODOT

Project	Project Description	Project Timeframe	Lead Agency
DriveOhio CV/AV Initiatives (Statewide CV/AV Architecture)	This represents smart mobility initiatives and advancements under DriveOhio's leadership for the state of Ohio. The Ohio Statewide Connected / Automated Vehicle (CV/AV) Architecture provides a roadmap for the deployment and integration of smart mobility technologies throughout the state of Ohio for the next 15 years. It supports effective and efficient deployment of CV/AV projects that address the transportation problems and needs in the state.	Short to Long	DriveOhio
Medium Term Projects			
City of Akron East Market Street Traffic Signal Upgrade	This project includes upgrades to the East Market Street corridor in the City of Akron, including roadway improvements as well as the reconstruction of 5 traffic signals and the installation of fiber interconnect between the signals. (PID# 116462)	Medium (2028)	City of Akron
City of Akron Rubber City Heritage Trail Phase 3	This project includes upgrades to the Rubber City Heritage Trail in the City of Akron, including pavement reconstruction as well as the addition of the following ITS elements: (1) Wayfinding signage and (2) HAWK Pedestrian Signal. The HAWK pedestrian signal will be added at the trailhead start, which intersects with East Exchange Street.	Medium	City of Akron
City of Hudson Adaptive Signals Improvement Outside Downtown	This project will upgrade the existing traffic signal system in the City of Hudson that are outside of the downtown area to an adaptive traffic signal system. This is a second phase of the citywide adaptive signals improvement initiative for the City. Upgrades include replacing or upgrading traffic signals, controllers, and other equipment to support an adaptive central traffic signal system, as well as installing interconnect between the signals, pedestrian signals, CCTV cameras, and specialized loop detectors at intersections for bicycle detection. This project will also install EVP equipment on City of Hudson Police vehicles.	Medium	City of Hudson
ODOT Rest Area Truck Parking Availability System	ODOT has implemented a rest area truck parking availability system along I-70, I-75 and US 33 in other parts of the state. This project will upgrade the rest areas along I-76, I-77 and I-271 in Summit and Portage counties by adding truck parking spaces and modernizing amenities. This project will also install a rest area truck parking availability system at those rest areas.	Medium	ODOT

Project	Project Description	Project Timeframe	Lead Agency
AVL on Maintenance Vehicles	This represents procurements and installations of AVL systems on roadway maintenance and construction vehicles, including snowplows, for county, city and other local agencies within the region that don't currently have AVL systems or wish to add AVL to additional vehicles. Remote vehicle health monitoring and diagnostic capabilities may be included in this project.	Medium to Long	City of Cuyahoga Falls and Municipalities
City of Akron Traffic Signal Upgrade and Timing Optimization	This project represents the City of Akron's effort for traffic signal upgrade/modernization and signal timing optimization. The traffic signal upgrade and modernization effort include upgrades, installation or reconstruction of traffic signals, controllers, detection systems, EVP, interconnects, pedestrian signals and other improvements for traffic signal operations and safety. This project also includes developing and implementing optimized signal timing plans, reprogramming the City's existing traffic signal control system software to optimize traffic signal timing and coordination between signals, as well as developing and implementing TSP plans to improve the speed and reliability of transit services.	Medium to Long	City of Akron
City of Cuyahoga Falls Traffic Signal Upgrade	This represents various roadway improvement and traffic signalization upgrade projects on various routes within the City of Cuyahoga Falls. Projects may include installation or reconstruction of traffic signals, fiber interconnect, pedestrian hybrid beacons and other improvements for traffic signal operations and safety. This includes but is not limited to the following projects: (1) Portage Trail Extension West Widening Project and (2) State Road Phase II Improvements.	Medium to Long	City of Cuyahoga Falls
City of Stow Traffic Signal Upgrades	This represents a group of future projects that will modernize the City of Stow's traffic signal system through replacements or upgrades of traffic signals and signal operations improvements. This includes replacing or upgrading traffic signals, controllers, and other equipment as well as interconnecting traffic signals for coordinated operations. Traffic signal controllers will be upgraded to support advanced features, including signal actuation and EVP. Other project upgrades include pedestrian signals, detection systems, and various roadway improvements.	Medium to Long	City of Stow

Project	Project Description	Project Timeframe	Lead Agency
City of Twinsburg Traffic Signal Upgrades	This project will modernize existing traffic signals through replacements or upgrades in the City of Twinsburg. Other upgrades include pedestrian signals and interconnect, as well roadway intersection improvements. This project includes but is not limited to the following projects: (1) SR-91 Center Turn Lane (Ravenna to Tinkers Plaza) Minor Arterial and (2) SUM-91-19.12 (I-480/SR 91 Interchange).	Medium to Long	City of Twinsburg
METRO RTA Electric Bus Replacement Program	METRO RTA plans to purchase addition battery-powered electric buses to replace older buses in the future. This project represents procurement of additional electric buses for METRO RTA beyond 2027. This may also include installation of additional electric vehicle charging stations at METRO RTA's transit bus facility to accommodate the increasing size of electric vehicle fleet.	Medium to Long	METRO RTA
Municipal Traffic Signal Upgrades and Coordination	This represents a group of roadway improvement and traffic signalization upgrade projects on various routes within the municipalities and townships that are not specifically called out in the Architecture. Projects may include installation or reconstruction of traffic signals, fiber interconnect, EVP, video detection systems, loop detectors, pedestrian signals, traffic signal controller upgrades, signal timing optimization and coordination, and other improvements for traffic signal operations and safety. This includes but is not limited to the following projects: (1) SR-82-700-305 Intersection Improvement (Village of Hiram); (2) Munroe Falls Avenue Reconstruction Project (City of Munroe Falls); (3) Cleveland Massillon Road Phase 3 (City of Norton); (4) State Route 303 / State Route 176 Intersection Improvement (City of Richfield); and (5) Wheatley Road Improvement Project (City of Richfield).	Medium to Long	Municipalities
Mobile Weather Sensors on Snowplows	This represents installation of mobile weather sensors on snowplows that are operated by local agencies. Mobile weather sensors are mounted on snowplows and are typically integrated with AVL systems to gather location-specific road weather conditions data to assist in winter maintenance operations. Agencies expressed desire for such installation include Akron, Barberton, Green, Hudson, and Richfield.	Medium to Long	City of Akron, City of Barberton, City of Green, City of Hudson, and City of Richfield

Project	Project Description	Project Timeframe	Lead Agency
Overheight Vehicle Detection Systems	This represents the deployment of overheight detection systems that can provide warnings to trucks of low clearances ahead that could be hit by the trucks. Alternate routes for the trucks could be recommended to trucks so they can alter the travel around the low clearance overpasses. Agencies expressed needs for such systems include Barberton, Cuyahoga Falls, Hudson, Lakemore and Ravenna.	Medium to Long	City of Barberton, City of Cuyahoga Falls, City of Hudson, and Municipalities
Parking Space Availability and Wayfinding Systems	This project will install smart parking management systems in parking facilities. Smart parking management systems will include technology to monitor and manage parking spaces and provide information on available parking spaces to drivers approaching the facilities. Parking availability information and wayfinding/route guidance can be provided to drivers through dynamic signages. The information can also be provided through websites and mobile apps. Several agencies including Akron, Cuyahoga Falls and Hudson, have expressed a need for such systems.	Medium to Long	City of Akron, City of Cuyahoga Falls, and City of Hudson
RWIS Stations at Strategic Locations	This project will install Road Weather Information System (RWIS) stations at strategical locations along primary roadways within the region. This project may also consider testing mobile RWIS units. Several agencies have expressed the desired to have or expand their road weather data collection capabilities, including Akron, Barberton, Green, Hudson, Kent and Portage County.	Medium to Long	City of Akron, City of Barberton, City of Green, City of Hudson, City of Kent, and Portage County
Summit County Traffic Signal Upgrades	This represents various roadway improvement and traffic signalization upgrade projects on various routes within Summit County. Projects may include installation or reconstruction of traffic signals, pedestrian signals, vehicle detectors, EVP and other improvements for traffic signal operations and safety. This includes but is not limited to the following projects: (1) SUM-OLDE 8 (CH 16) & E Highland Rd (CH 111); (2) SUM-Valley View Rd (CH 25) & Chaffee Rd (CH 159) Intersection; (3) SUM-Valley View Rd; (4) SUM - Valley View at Olde Eight Road Intersection; (5) SUM - South Main Street Phase IV; (6) SUM - Cleveland Massillon Road at Ridgewood Road - North Intersection and (7) SUM - Cleveland Massillon Road at Ghent Road.	Medium to Long	Summit County

Project	Project Description	Project Timeframe	Lead Agency
Traffic Cameras at Strategic Locations	This represents future deployment of CCTV cameras by various municipal and county agencies in the region. CCTV cameras will be installed at strategical locations for traffic surveillance, traffic flow monitoring and traffic incident detection and verification. Several agencies have expressed the desire to have or expand their camera coverage areas, including but not being limited to Aurora, Barberton, Green, Kent, Lakemore, Richfield, Twinsburg, and Portage County.	Medium to Long	City of Barberton, City of Green, City of Kent, Portage County, and Municipalities
Long Term Projects			
ODOT Active Traffic Management Implementation	This project will implement the recommendations from the ODOT Statewide Active Traffic Management (ATM) Study conducted in 2016. The ATM Study recommends two ATM strategies - dynamic ramp metering and dynamic hard shoulder running – along I-76 and I-77 in the Akron metropolitan area.	Long	ODOT
ODOT RWIS Station Expansion	This project will install additional Road Weather Information System (RWIS) Stations at strategical locations along ODOT roadways within the region. This project may also consider testing mobile RWIS units.	Long	ODOT

C. User Reference Guide

1. Glossary of Terms

Adaptive Traffic Signal System
A system that automatically adjusts traffic signal green times to improve the flow of vehicles as conditions change. The system monitors current traffic conditions, demand and capacity.

Architecture Flow
Architecture Flows (also referred to as "information flows") refer to information that moves between the components of the physical architecture view of ARC-IT. Architecture flows are the primary tool that is used to define the Regional ITS Architecture interfaces. These architecture flows define what types of information is transferred and how that transfer should occur. For example, one architecture flow would be a dispatcher communicating information to an emergency vehicle responding to an incident.

Architecture Interconnect
Interconnects are communications paths that carry information between components of the physical architecture view of ARC-IT. Several different types of interconnects are defined in ARC-IT to reflect the range of interface requirements in ITS. Some common examples are vehicle to vehicle, point to point, and roadside to vehicle links.

Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT)
ARC-IT is a reference architecture that reflects the contributions of a broad cross-section of the ITS community (transportation practitioners, systems engineers, system developers, technology specialists, consultants, etc.). It provides common basis for planners and engineers with differing concerns to conceive, design and implement systems using a common language as a basis for delivering ITS, but does not mandate any particular implementation.

Automated Vehicle (AV)
A vehicle in which at least some aspects of a safety-critical control function (e.g., steering, throttle, or braking) occur without direct driver input. Vehicles that provide safety warnings to drivers but do not perform a control function are, in this context, not considered automated.

Automatic Vehicle Location (AVL)
AVL systems track the approximate location of vehicles moving within a transportation network. The most common applications of AVL technology are for dispatching emergency vehicles, tracking transit vehicles and providing passengers with arrival time estimations through information displays.

Computer-Aided Dispatch (CAD)
"Intelligent" interactive mapping and data entry systems that assist in the process of dispatching, monitoring, and managing emergency services. Emergency-dispatching hubs use computers to store, use, and report on information such as incident histories, manpower activities, and other tasks in ways that are logical and simplify the dispatchers' tasks.

Commercial Vehicle Operations (CVO)
Automated and semi-automated systems that support administrative functions for processing many of the functions required of commercial vehicle operators. This includes acquiring credentials, paying taxes, complying with enforcement and safety regulations as well as oversize/overweight permits.

Connected Vehicle (CV)
A vehicle (car, truck, bus, etc.) that is equipped with a wireless communication device. A CV uses any of the available wireless communication technologies to communicate with other cars on the road (vehicle-to-vehicle), roadside infrastructure (vehicle-to-infrastructure), and other travelers and the cloud.

Dedicated Short Range Communications (DSRC)
A wireless communications channel used for close-proximity communications between vehicles and the roadway devices. It enables communications to occur between devices that are very near each other, usually within just a few feet. Examples include automated toll collection, transit vehicle electronic fare payments and equipment maintenance reporting. These systems can also deliver information to drivers and provide electronic transactions for automated vehicle operations.

Dynamic Message Sign (DMS)
Electronic signs that display traffic conditions, alerts or other useful information to motorists or pedestrians. The term is used interchangeably with previous terminology such as variable message signs (VMS) and changeable message signs (CMS).

Element
This is the basic building block of Regional and Project ITS Architectures. It is the name used by stakeholders to describe a system or piece of a system.

Emergency Vehicle Preemption (EVP)
This technology allows emergency vehicles (police, fire trucks, ambulances, etc.) to get priority treatment as they approach traffic signals. These systems can sense the location of the emergency vehicles and adjust the green times so they arrive at the incident sites faster and safer.

Fixed-Point to Fixed-Point Communications
A communication link serving stationary devices. It may operate using a variety of public or private communication networks and technologies. Examples include twisted pair, coaxial cable, fiber optic, microwave relay networks, and spread spectrum radio.

Functional Object
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. Since functional objects are both the most detailed components of the physical view and tied to specific service packages, they provide the common link between the interface-oriented architecture definition and the deployment-oriented service packages.

Incident Detection
Incident Detection provides the capability for traffic managers to detect and verify that incidents have occurred. This includes analyzing data from traffic surveillance equipment, monitoring alerts from external reporting systems, collecting special event information, and responding to reports from their agency personnel in the field.

Incident/Emergency Management
Incident/Emergency Management enables communities to quickly identify any conditions that interrupt normal traffic flow such as crashes, vehicle breakdowns and debris in the roadway. The system also supports agency coordination to minimize clean-up and medical response time.

Intelligent Transportation Systems (ITS)
ITS applies state-of-the-art and emerging technologies to provide more efficient and effective solutions to current multimodal transportation problems. Some examples of ITS are dynamic message signs, closed-circuit television monitoring systems, and traffic signal systems.

ITS Architecture
A common framework for planning, defining, and integrating intelligent transportation systems. An architecture functionally defines what the pieces of the system are and the information that is exchanged between those pieces. Architecture is defined functionally and does not prescribe particular technologies. This allows the architecture to remain effective over time as technologies evolve. It defines "what must be done," not "how it will be done."

Maintenance and Construction Operations (MCO)
These are functions that support monitoring, operating, maintaining, improving and managing the physical condition of roadways, roadside equipment, and required resources.

On Board Security Monitoring System
On board security system for transit vehicles. This includes surveillance and sensors to monitor the on-board environment, silent alarms that can be activated by transit user or operator, and a remote vehicle disable function. The surveillance equipment includes video (e.g. CCTV cameras), audio systems and/or event recorder systems.

Ops Concept or Operational Concept
An Operational Concept describes the roles and responsibilities of stakeholders in providing the ITS services included in the ITS Architecture. For example, one of the roles and responsibilities of the LFUCG Traffic Engineering Division is to operate and maintain the traffic signal system.

Physical Object
Physical objects are systems or device that provide ITS functionality that makes up the ITS and the surrounding environment. They are defined in terms of the services they support, the processing they include, and their interfaces with other physical objects. They are grouped into six classes: Centers, Field, ITS, Support, Travelers, and Vehicles. Example physical objects are the Traffic Management Center, the Vehicle Onboard Equipment, and the ITS Roadway Equipment. These correspond to the physical world: respectively traffic operations centers, equipped connected automobiles, and roadside signal controllers. Due to this close correspondence between the physical world and the physical objects, the interfaces between them are prime candidates for standardization.

Public Transportation (PT)
A variety of technology applications that make public transportation more efficient and convenient. Some examples include automated fare payment systems, enunciators to inform people inside and outside the transit vehicles, smart phone APP's to track bus arrival times, and many other applications.

RAD-IT Software
The Regional Architecture Development for Intelligent Transportation (RAD-IT) is an automated software tool used to build and maintain an ITS Architecture. It provides a means to input and manage system inventory, service packages, architecture flows and interconnects with regard to a Regional ITS Architecture and/or multiple Project ITS Architectures.

Regional ITS Architecture
A local version of the ITS National Architecture that is tailored for a specific region. It can be used to produce project architecture reports for specific federally funded projects.

Road Weather Information System (RWIS)
A system consisting of roadside meteorological components strategically located to provide information about weather issues affecting transportation. The principal components of RWIS include pavement sensors, atmospheric sensors, remote processing units (RPU), and central processing units (CPU).

Security Sensors and Surveillance Equipment
This technology includes cameras and sensors to monitor transportation infrastructure (e.g., bridges, tunnels and management centers) to detect potential threats. Such equipment includes acoustic, environmental threat (nuclear, explosive, chemical), motion and object sensors, and video and audio surveillance devices.

Service Package
Service packages are a combination of ITS architecture components tailored to provide a specific ITS service. For example, the Traffic Incident Management System Service Package combines incident detection systems, roadside surveillance devices, and coordination of traffic management centers to fulfill a number of useful needs related to the rapid clearing of incidents.

Standards
Documented technical specifications sponsored by a Standards Development Organization (SDO) to be used consistently as rules, guidelines, or definitions of characteristics for data transactions.

Subsystem
The principle elements of the physical architecture view of ARC-IT. Subsystems are individual pieces of the Intelligent Transportation System defined by ARC-IT. Subsystems are grouped into five classes: Center, Field, Vehicle, Support, and Personal.

Terminator
Terminators define the boundary of an architecture. The ARC-IT terminators represent the people, systems, and general environment that connect to Intelligent Transportation Systems.

Traffic Management (TM)
A broad category of systems that collect and process information from sensors and CCTV cameras along major roadways. Once processed, the information is then used to manage traffic control devices such as ramp meters, traffic signals and other control devices. These systems are also the source of much of the data used to inform motorists through the Traveler Information systems listed below.

Transit Signal Priority
Transit signal priority refers to systems that usher transit vehicles through traffic-signal controlled intersections. Transit signal priority modifies the normal signal operation to better accommodate transit vehicles. Transit Signal Priority is similar to Emergency Vehicle Pre-emption, but is less invasive to the signal operation.

Traveler Information (TI)
A system, which distributes information to the traveling public over a variety of methods such as dynamic message sign, kiosks, Internet, cable television, smartphones, etc.

2. How to Navigate the Website

The purpose of the Akron Regional ITS Architecture website is to organize the details of the architecture into a form that is more readily accessible to stakeholders. It provides a method for stakeholders to access the architecture information in order to encourage use of the architecture in both transportation planning and project implementation. The Akron Regional ITS Architecture website can be accessed via the AMATS ITS Architecture web page at https://amatsplanning.org/its-architecture/.

The menu bar at the left of the Architecture website provides access to different pages of the architecture. The pages to which each of these buttons lead are described below.

Home: This button takes the user to the homepage for the Akron Regional ITS Architecture. The homepage describes the purpose of the architecture.

Scope: This page provides the geographic scope and service scope of the architecture. It also provides the planning time frame for the architecture.

Stakeholders: This page presents the full list of regional stakeholders, along with descriptions for each.

Inventory: This page presents the inventory of ITS elements along with a brief description of each. The inventory of ITS elements is arranged in an alphabetic order. The list of inventory can also be viewed by entity (subsystems and terminators as defined by ARC-IT) or by stakeholder.

> **Inventory by Physical Objects:** This page presents the inventory of ITS elements arranged by physical objects (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 page 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.

Services: This page presents a list of relevant service packages for the region and their deployment status. Clicking on the service package name links to the definition of the service package, its deployment status in the region, and a list of ITS elements associated with the service package.

Roles and Responsibilities: This page presents a table of relevant ITS service areas for the region. Clicking on a service area links to a detailed page with a list of stakeholders providing the service and their roles and responsibilities in the operations of the relevant ITS systems in the region.

Functions: The page presents a list of ITS functional areas for the region. Clicking on a functional area leads to a detailed page that provides a description of the functional area, a list of regional ITS elements supporting the functions, and a list of functional requirements.

Interfaces: This page presents a table that identifies interfaces among ITS elements for the region. Clicking on an element in the "Element" column leads to a context diagram that shows how the element interfaces with other elements in the region. Clicking on an element in the "Interfacing Element" column brings up a detailed page that shows an interface diagram between the two elements, along with the definitions of the architecture/information flows.

Communications: This page provides a list of communications standards that are applicable to the region. Clicking on the title of a communications solution opens a page that identifies the standard(s) can be applied to facilitate communications and electronic information exchanges in the region.

Agreements: This page presents a list of agreements that support ITS in the region.

Projects: This page presents a list of potential ITS projects for the region, along with recommended implementation time frame and brief project descriptions. Clicking on a project title opens a detailed page that provides additional information on the project.

3. Uses for the Architecture

3.1 Project Planning

AMATS will be responsible for housing and maintaining the ITS Architecture. Being responsible for the architecture requires AMATS to be able to deliver a subset of the regional architecture that relates to specific projects. In other words, they must be able to produce a project architecture when a local agency is pursuing an ITS project. Typically, a Project Architecture can be created as an extract from the Regional Architecture if the elements were included in the Regional Architecture. The flow diagram in Figure 10 provides guidance on that process.

In order to produce a project architecture, the first step is to identify the type of service package(s) (e.g. transit, traveler information, emergency management, etc.) that are related to the project. Depending on the scope of the project, multiple types of service packages could be relevant and they should all be identified. For example, for a project involving the installation of dynamic message signs, the relevant service package types would be traveler information and emergency management. After service package types are identified, the specific service package(s) that describe the project must be identified. In continuing the example, the specific service packages that relate to dynamic message sign installation would be TM06 Traffic Information Dissemination, PS10 Wide-Area Alert, and MC06 Work Zone Management.

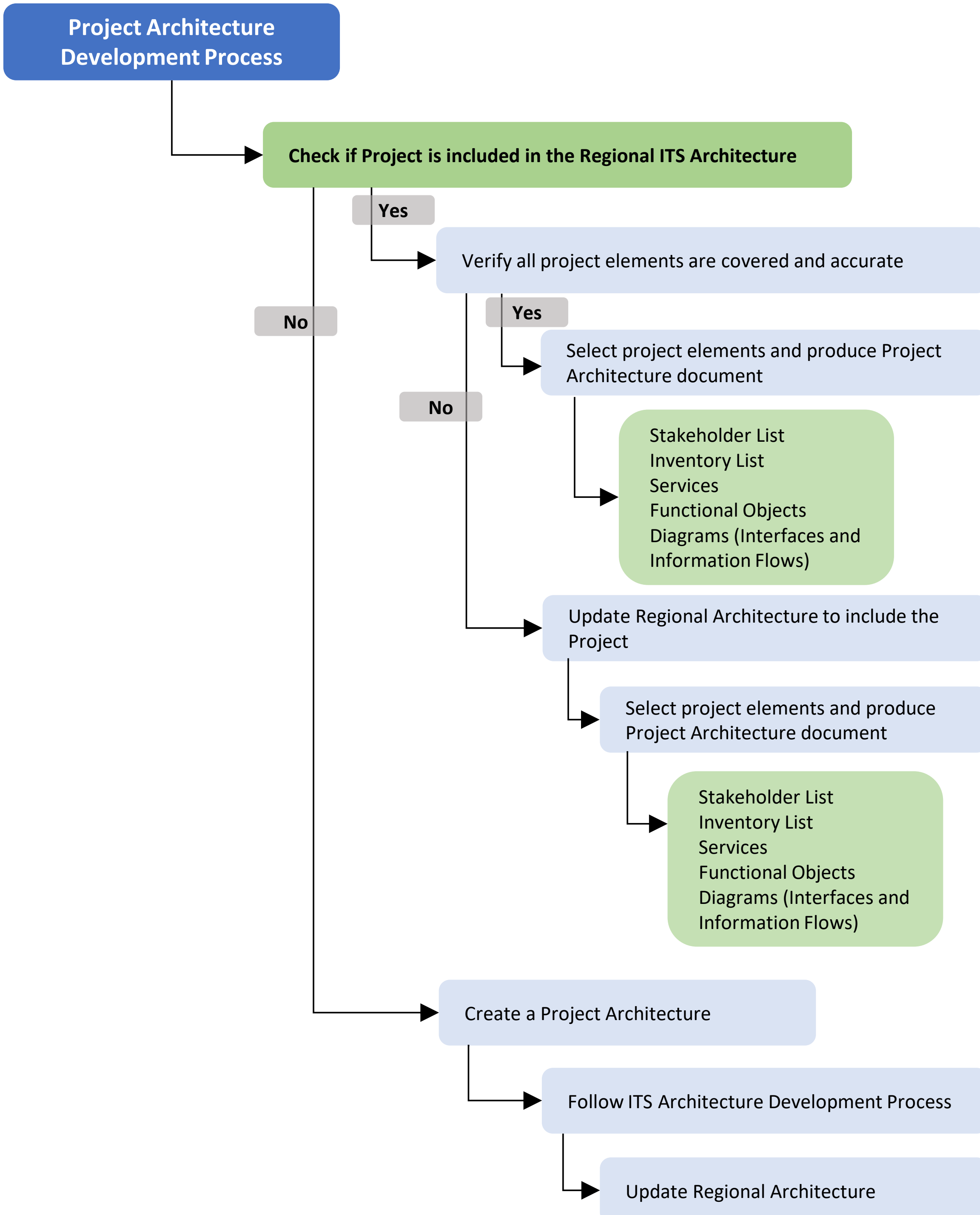

Figure 10. Project Architecture Development Process

Once specific service packages have been identified, the service package diagrams must be reviewed to make sure they are correct and not duplicating functionality with another service package. For each project, the following items should be considered and inputted into RAD-IT:

- Make sure all specific service packages that relate to the project are identified (i.e., TM06, PS10, MC06, etc.);
- A specific service package may be relevant to multiple agencies. In this case, create multiple instances of that service package if they have not already existed (i.e., a MC06 for City of Akron and a MC06 for Summit County, etc.);
- Select the appropriate inventory items that are related to each specific service package;
- Select the appropriate stakeholder that owns the inventory item; and
- Check whether the data flow is existing or planned (i.e., future).

Following review of the service package diagrams, the updated diagrams should be passed along to the agencies who are implementing the project to ensure all stakeholders are involved and they have the proper information to determine if it will impact other projects.

3.2 Project Programming

An up-to-date regional ITS architecture is important because projects must be aligned with the area's regional ITS architecture to receive federal funds. This section discusses how stakeholders can determine if a project is consistent with the architecture.

In order to use the Akron Regional ITS Architecture to support project development, the agency must identify how the project contributes to or aligns with a portion of the architecture. This is a key step when using the architecture because it requires the agency to view the ITS project in the broader context of the entire architecture. Having an agency consider the wider architecture while the project's scope is being defined, enables them to consider the services, functionality, and integration opportunities that are envisioned by the region as a whole. This step is also required to meet the FHWA Architecture Rule/FTA Architecture Policy.

The ITS Architecture should be used as early in the project development lifecycle as possible so that integration opportunities are considered. The architecture should be reviewed before firm project cost estimates are established so there is still opportunity to adjust the scope in order to accommodate the regional functionality and interfaces identified. This opportunity may occur before or after programming/budgeting, depending on how specifically the ITS project is defined in the programming/budget documents.

3.3 Funding for ITS Projects

ITS projects proposed for the Akron region would qualify for several categories of federal highway and transit funding. Each of these categories is discussed below with additional information on the location of these sources.

Highway-related ITS initiatives would likely be funded with Surface Transportation Program (STP) funding dedicated to the Akron region or Congestion Mitigation and Air Quality (CMAQ) funds. Transit-related ITS initiatives would be funded with 5307 and CMAQ funds. The AMATS Transportation Improvement Program (TIP) includes "Grouped Projects" that allow these types of initiatives to be added to the TIP (and thus become eligible for federal funding) by Administrative Modification.

Increasingly, ITS elements are included as a component of broader-purposed ODOT sponsored highway improvement projects. In these cases the ITS elements would be included with the National Highway Performance Program (NHPP), STP, or Highway Safety Improvement Program (HSIP) funded project, and such projects would be added to the TIP by Update, Amendment, or Modification procedures, as appropriate.

ITS projects and components may also be funded with, or included with projects funded with, state or local funds. State and locally funded projects are not required to be listed in the TIP unless they are deemed to be "regionally significant" (refer to the TIP for more discussion). It should also be noted that a re-authorization of federal transportation funding beyond the year 2021 will be required to support many of the grant programs described in this section.

Infrastructure Investment and Jobs Act (2021)

The Infrastructure Investment and Jobs Act (IIJA) was signed into law in November 2021 for fiscal years 2022 through 2026. The previous federal transportation authorization program (Fixing America's Surface Transportation (FAST)) Act included provisions to help make the delivery of transportation projects more streamlined and timelier while still meeting the requirements for planning, public outreach and engagement, and environmental review processes. The IIJA builds on the efforts of the FAST Act and FHWA's *Every Day Counts* program to continue the acceleration of the delivery of complex but vital transportation projects.

The IIJA authorizes a significant amount of funding for programs related to research, development, technology, and education. It continues to build on the FAST Act to transform the national transportation program to a performance and outcome-based program. The emphasis on performance management is intended to provide a means to more efficient investment of Federal transportation funds by focusing on national transportation goals, increasing the accountability and transparency of the Federal highway programs, and improving transportation investment decision making through performance-based planning and programming as DOTs incorporate performance goals, measures, and targets into the process of identifying needed transportation improvements and project selection. States will invest resources in projects to achieve individual targets that collectively will make progress toward national goals.

Federal Transportation Programs

The utilization of federal funds is a likely scenario to pay for the implementation and operation of ITS projects in the region. Federal transportation authorization bills, including the IIJA, continued or established a number of programs which are applicable to the deployment or operation of ITS technologies. Programs such as National Highway System (NHS) and STP can be used to support ITS solutions. In addition to those broader programs, there are several specific programs with potential to fund ITS projects:

- **Intelligent Transportation Systems (ITS) Program** – The ITS Program provides $100 million annually (FY2022-2026) for the research, development, and operational testing of ITS aimed at solving congestion and safety problems, improving operating efficiencies in transit and commercial vehicles, and reducing the environmental impact of growing travel demand (80% federal share).
- **Advanced Transportation Technologies and Innovative Mobility Deployment (ATTIMD) Program** – This program provides competitive grants for the deployment of ITS projects that improve and expand the mobility of people and goods, increase durability and lifespan of

transportation infrastructure, and preserve the environment, including vehicle-to pedestrian (V2P) technology deployments, among others (80% federal share).

- **Congestion Mitigation and Air Quality (CMAQ) Improvement Program** – The IIJA continues the CMAQ program from the FAST Act. This program funds projects that help reduce emissions and traffic congestion in areas designated as nonattainment or maintenance areas for carbon monoxide, ozone or particulate matter. Eligible projects include projects to improve mobility such as through real-time traffic, transit and multimodal traveler information, or otherwise reduce demand for roads through means such as telecommuting, ridesharing, carsharing, pricing, bikesharing, and shared scooter systems. The IIJA also makes eligible the purchase of zero emission vehicles (ZEVs) and all related charging infrastructure, vehicle-to-infrastructure communications equipment, electric vehicle and natural gas vehicle infrastructure, and adds priority for infrastructure located on the corridors designated under 23 U.S.C. 151.
- **Surface Transportation Block Grant (STBG) Program –** Program provides flexible funding that may be used by States and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals. Other eligible ITS initiatives include the installation and deployment of electric vehicle (EV) charging and vehicle-to-grid infrastructure, and connected vehicle technology.
- **National Highway Performance Program (NHPP)** - NHPP funds may be obligated for a project on an eligible facility that supports progress toward the achievement of national performance goals for improving infrastructure condition, safety, congestion reduction, system reliability, or freight movement on the NHS. Eligible projects include highway safety improvements on the NHS, which may also include truck parking per 23 U.S.C. 148. This program also provides funding eligibility for projects that improve cybersecurity protection measures for the NHS.
- **National Highway Freight Program (NHFP)** – The NHFP provides formula funds to States to improve the condition and performance of the National Highway Freight Network under 23 U.S.C. 167(i)(5)(C). Eligible activities include truck parking facilities and real-time traffic, truck parking, roadway condition, multimodal transportation information systems, and freight intermodal or freight rail projects. States may use up to 30% of NHFP funding on freight intermodal or freight rail projects on the National Highway Freight Network, subject to certain restrictions.
- **Highway Research and Development (HRD) Program** – The HRD Program funds strategic investment in research activities that address current and emerging highway transportation needs, including activities to improve highway safety; activities to reduce congestion, improve highway operations, and enhance freight productivity; and exploratory advanced research.
- **Technology and Innovation Deployment Program (TIDP)** – The TIDP is focused on funding efforts to accelerate the implementation and delivery of new innovations and technologies, including new construction technologies, that result from highway research and development to benefit all aspects of highway transportation.
- **Nationally Significant Multimodal Freight and Highway Program (NSMFHP)** – The NSMFHP provides competitive grants, known as Infrastructure for Rebuilding America (INFRA) grants, or credit assistance to nationally and regionally significant freight and highway projects (maximum 80% federal share through this program). This also includes projects that improve or enhance the resilience of freight infrastructure to natural hazards or disasters such as high winds, heavy snowfall, flooding, rockslides, mudslides, wildfire, or steep grades.
- **Highway Safety Improvement Program (HSIP)** – The HSIP provides grant funds to eligible States for efforts that improve overall safety and reduce traffic fatalities and serious injuries on public roads, including modernization of data collection systems and other data-based strategies.

- **Railway-Highway Crossings Program (RHCP)** – The IIJA authorized $1.2 billion over five years for this program (FY2022-2026), which promotes reductions in the number and severity of injuries at public highway-railroad crossings (100% federal share).
- **Training and Education Program** – Funding for training, education, and workforce development activities that promote and support national transportation programs and activities.
- **Transportation Alternatives Set-Aside (TASA) Program** – This program provides funding that may be used by States and localities to help fund various transportation asset improvement initiatives, including on- and off-road pedestrian and bicycle facilities, environmental mitigation, and recreational trails and paths.
- **Bridge Investment Program** – This program provides funding to Federal, State, local, and Tribal governments for ITS projects that rehabilitate or replace bridges and culverts.
- **Bicycle Transportation and Pedestrian Walkways** – This program provides funding to eligible entities for ITS projects that expand and improve upon bicycle, pedestrian, and shared micro-mobility facilities, such as electric bicycles and public trails.
- **Carbon Reduction Program (CRP)** – This program provides funding to States and local entities for ITS projects that reduce CO2 emissions throughout the transportation network, including alternative fuel vehicle deployments, V2I communications equipment installations, and micro-mobility facilities, among others. Under the CRP, States must also develop carbon reduction strategies in consultation with local MPOs to identify projects and strategies tailored to reduce CO2 emissions in their states, although States and localities may begin using the CRP funds even before plans are developed and reviewed.
- **Congestion Relief Program** – This program provides funding to States, local governments, and MPOs for ITS projects in urban areas with populations of greater than one million that reduce highway congestion, economic and environmental costs related to congestion, and optimize existing highway capacity and usage of transit systems that provide alternatives to highways. Eligible projects include the deployment and operation of mobility services, integrated congestion management systems, and systems that implement or enforce high-occupancy vehicle (HOV) toll lanes, cordon pricing, parking pricing, or congestion pricing.
- **Promoting Resilient Operations for Transformative, Efficient and Cost Saving Transportation (PROTECT) Program** – This program provides formula funds established through Community Resilience and Evacuation Route Grants to States for ITS projects that improve and protect existing transportation infrastructure against potential impacts of severe weather events and natural disasters, including upgrades to evacuation routes and communications and other ITS equipment and infrastructure upgrades.
- **Safety Data Initiative (SDI)** – The SDI enables the DOT to conduct and fund demonstration projects that develop new data visualization and sharing tools that Federal, State, local, and Tribal governments can use to enhance surface transportation safety. Eligible projects aim to reduce barriers to the efficient integration and analysis of relevant datasets by safety professionals and to establish procedures to ensure the confidentiality of sensitive data through data-sharing between transportation agencies at various levels.
- **Clean School Bus Program** – This program provides funding to eligible State and local governments, contractors, and nonprofit school transportation associations to replace existing school buses and other with alternative fuel and zero-emission models, such as electric and alternatively-fueled (i.e., hydrogen fuel cell) buses. Funds would be split 50/50 between alternative fuel and zero-emissions buses.

Federal Grants

The principal purpose of an award of financial assistance is to transfer a thing of value from a federal agency to a recipient to carry out a public purpose of support or stimulation authorized by a law of the United States. A grant differs from a contract, which is used to acquire property or services for the Federal government's direct benefit or use. Federal grant information is available electronically at www.grants.gov.

- **Rebuilding American Infrastructure with Sustainability and Equity Discretionary Grant Program (RAISE)** – This program provides grant funding for ITS projects that improve and expand surface transportation infrastructure, such as upgrades to highways and bridges, passenger and freight rail facilities, and port facilities. For each grant, the funds would be split 50/50 between urban and rural project areas.
- **Rural Surface Transportation Grant Program** – This program provides funding to eligible entities for ITS projects that expand and improve the surface transportation infrastructure in rural areas, including integrated mobility management systems, transportation demand management systems, and on-demand mobility initiatives.
- **Strategic Innovation for Revenue Collection Program** – This program provides grant funding to States or groups of States, local governments, and MPOs for projects that test the feasibility of road usage fees and other user-based alternative revenue mechanisms to address the long-term solvency of the Highway Trust Fund.
- **National Infrastructure Project Assistance Program** – This program provides single or multi-year grant funding to ITS initiatives likely to generate national or regional economic, mobility, or safety benefits, such as improvements to highways and bridges, intermodal or freight rail facilities, and connectivity and automation technology deployments.
- **Safe Streets and Roads for All (SS4A) Grant Program** – This program provides grant funding to MPOs and local and Tribal governments to develop or update comprehensive safety plans (i.e., Vision Zero) and implement the strategies identified in the plans to prevent death and serious injuries on roadways.
- **Strengthening Mobility and Revolutionizing Transportation (SMART) Program** – This program provides grant funding for ITS projects that improve transportation efficiency and safety through the incorporation of advanced transportation technologies or uses of data, such as coordinated automation, connected vehicles, and sensor-based ITS infrastructure.
- **Innovative Technology Deployment (ITD) Grant Program** – The Federal Motor Carrier Safety Administration (FMCSA) offers additional funding opportunities through its Innovative Technology Deployment (ITD) Grant program. The program supports the deployment, operation, and maintenance aspects of the ITD program across the US.
- **Motor Carrier Safety Assistance Program (MCSAP) Grants** – The goal of the program is to improve motor carrier, commercial motor vehicle, and driver safety to support a safe and efficient surface transportation system. The program funds are eligible for deployment activities and activities to develop new and innovative advanced technology solutions that support commercial motor vehicle information systems and networks and for the operation and maintenance costs associated with innovative technology.

Public/Private Partnerships (P3)

A public-private partnership (commonly called a P3) is a contractual agreement between a public agency and a private entity that allows for greater private sector participation in the delivery and financing of a project. P3 arrangements provide the public sector with a proven tool to accelerate infrastructure delivery and contain costs. P3s provide a role for the private sector in solving public challenges, provide a variety of contract structures and financing, and are performance-based and outcome-focused. P3 delivery methods commonly fall into the following categories: design-build (DB), operate-maintain (OM), design-build-operate-maintain (DBOM), design-build-finance (DBF), and design-build-finance-operate-maintain (DBFOM). Each method can offer advantages or disadvantages, depending on the specific project and parties involved. Every transportation project is different and may or may not benefit from innovative delivery methods such as P3s.

Transit Funding

Federal transit funding is appropriated annually. Programs include: Urbanized Area Formula Program (5307), Rural Area Formula Program (5311, includes rural, small urban, and intercity bus), Enhanced Mobility of Seniors and Individuals with Disabilities Formula Program (5310), Metropolitan and Statewide Non-metropolitan Transportation Planning Formula Program (5303, 5304, 5305), State of Good Repair Grants (5337), and Bus and Bus Facilities Formula Grants (5339(a)).

The IIJA continues several important goals established in the FAST Act, including safety, state of good repair, and performance. It adds funding eligibility for the deployment of low or no emission vehicles, zero emission vehicles, or associated advanced technology. It continues to fund BRT projects in defined corridors that demonstrate substantial investment in fixed transit facilities including transit stations, ITS technology, traffic signal priority, and off-bard fare collection.

Transportation Security Funds

Transportation security funds are another opportunity for funding projects with security applications, such as surveillance cameras or communications devices. Transportation enhancements and ITS projects can address security concerns by detecting threats, maximizing the movement of people, goods, and services, and supporting response activities. Security funds could be available through the Department of Homeland Security, Department of Agriculture, or the Department of Energy, as well as other agencies.

One example of these sources through the Department of Homeland Security is through preparedness grants to improve the nation's readiness in preventing, protecting against, responding to, recovering from and mitigating terrorist attacks, major disasters and other emergencies. ITS technologies can be used for monitoring and surveillance of transportation infrastructure (e.g., bridges, tunnels and management centers) and help to mitigate the impact of an incident if it occurs. CCTV cameras are a common technology used by transportation agencies for this purpose, and thus preparedness grants through the department of homeland security are a potential funding source for this activity.

3.4 Project Design Concerns

When designing a project, functionality and ITS standards provide guidance and criteria to identify how the project will relate to the region's overall operations. As projects grow in size, the functions and standards become complex and sometimes require agreements between agencies. It is beneficial to identify the agencies involved and the type(s) of agreement(s) needed early on in the project design.

How ITS components are shown in the architecture

The ARC-IT uses service packages to depict the current and future functions of ITS systems. Entities that represent sources of information are called "subsystems", which are grouped into four classes: centers, fields, vehicles, and travelers as shown in Table 7 on the next page. Table 7 provides descriptions from ARC-IT for each subsystem and identifies examples of those subsystems in the region.

Table 7. Subsystem Definitions

Subsystem	Definition	Examples in AMATS Planning Area
Center	Provides management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions.	Traffic Operations Centers Emergency Operations Centers 911 Centers
Field	Intelligent infrastructure distributed along the transportation network which perform surveillance, information gathering, and information dissemination and whose operation is governed by the center subsystem.	Traffic Signals CCTV Cameras Dynamic Message Signs Vehicle Detection
Vehicle	Covers ITS related elements on vehicle platforms such as automatic vehicle location equipment and operations capabilities for portable field equipment.	Maintenance and Construction Vehicles Public Safety Vehicles Incident Response Vehicles Transit Vehicles
Personal	Equipment used by travelers to access ITS services prior to a trip, including information service providers.	Smartphones Personal Computers Transit Fare Smart Cards

How to find general functional requirements related to a proposed project

Functional requirements explain how an inventory item provides the services described in their equipment packages. Equipment packages group inventory items together based on what overall function they serve and are listed in deployment-sized pieces (for example: emergency dispatch, roadway basic surveillance, traffic data collection, and transit center fixed-route operations).

The functional requirements can be found on the ARC-IT website (https://www.arc-it.net/). The following process should be followed to access requirements for specific inventory items:

- Under the "Architecture" drop-down arrow in the top left corner of the Home Page of the ARC-IT website, select "Physical" that appears under "Views"
- Then click on the "Physical Objects" hyperlink that appears in the text on the Physical architecture web page
- Click on the "Subsystems" tab that will present all of the subsystems in ARC-IT, and then select the subsystem for which you are seeking functional requirements
- Click on the "Functionality" tab that will present the functional objects associated with the subsystem
- Click on the desired "Functional Object" to view its description
- Click on the "Requirements" tab, which will present a list of functionalities for each functional object.

How to obtain specific functional requirements from the Akron Regional ITS Architecture

The need to obtain specific functional requirements from the Akron Regional ITS Architecture related to a specific project can be found on the ITS Architecture website, following the instructions in Part C, Section 2 of this report.

A complete listing of functional requirements for the Akron Regional ITS Architecture can be found on the ITS Architecture website.

How to select communication standards that apply to the project

ITS standards define how system components interact within the overall framework of ARC-IT. The use of standards ensures interoperability amongst various functions of an ITS project so that components or technologies from various vendors and at different scales (local, regional, and national) are still compatible. Standards also facilitate innovation in technology development without necessitating replacement of hardware or software systems that are needed to operate the new technology. Other purposes for ITS standards include:

- ITS standards used in a deployment can greatly reduce component development costs;
- ITS standards are open and non-proprietary, helping state and local transportation managers avoid costly single-source procurements and locked-in maintenance relationships with vendors;
- ITS standards support the deployment of interoperable ITS systems, helping agencies link together different types of ITS technologies and making system expansions easier to plan and implement; and
- ITS standards are being developed for many different types of ITS technologies and their use in project deployment is a key aspect of conformity with the FHWA Final Rule 940.

New standards that are developed go through an approval process before they are included in documents as formalized standards. Existing standards are amended and modified as needed based on new standards development or new technology development. Several national and international standards organizations are working toward developing ITS standards for communications, field infrastructure, messages and data dictionaries, and other areas. A listing of ITS standards that are pertinent to the Akron Regional ITS Architecture is contained in the ITS Architecture website.

Why agreements may be needed to support a proposed project

Institutional agreements can support ITS functionality and project development in the region. Agreements allow agencies to document the roles and responsibilities of the particular service or function that is being agreed to, as well as any obligations each agency has for maintenance, operations, or financial support.

A listing of agreements based on the types of interfaces identified in the Akron Regional ITS Architecture is contained in the RAD-IT database and the Architecture website. It is important to note that as ITS services and systems are implemented or expanded in the region, part of the planning and review process for those projects should include a review of potential agreements that would be needed for implementation or operations. These additional agreements are not listed in the ITS Architecture for specific projects because the possibility of coordination/sharing/joint operations is unique and should be evaluated for every project.

4. Architecture Maintenance Plan

The Akron Regional ITS Architecture has been created as a consensus view of what ITS systems the stakeholders within the architecture boundary already have in place and what systems they plan to implement in the future. By its nature, the architecture is not a static set of outputs. The Architecture should be modified as plans and priorities change, ITS projects are implemented, and the ITS needs and services evolve in the region. There are many actions that may cause a need to update the architecture, including:

- **Changes in Project Definition.** When actually defined, a project may add, subtract or modify elements, interfaces, or information flows of the ITS Architecture. Because the architecture is meant to describe not only ITS planned, but also the current ITS implementations, it should be updated to correctly reflect the deployed projects.
- **Changes due to Project Addition/Deletion**. Occasionally a project will be added, deleted or modified during the planning process. When this occurs, the aspects of the ITS Architecture associated with the project should be added, deleted or modified.
- **Changes in Project Status.** As projects are deployed, the status of the architecture elements, services and flows that are part of the projects will have to be changed from planned to existing. Elements, services and flows should be considered to exist when they are substantially complete.
- **Changes in Project Priority.** Due to funding constraints, technological changes or other considerations, a project planned may be delayed or accelerated. Such changes should be reflected in the ITS Architecture.
- **Changes in Regional Needs.** Transportation planning is done to address regional transportation needs. Over time these needs change and the corresponding aspects of the ITS Architecture that addresses these needs should be updated.
- **Changes in Participating Stakeholders.** Stakeholder involvement can also change over time. The ITS Architecture should be updated to reflect the participating stakeholder roles in the statewide view of ITS elements, interfaces, and information flows.
- **Changes in Other Architectures.** The ITS Architecture includes not only elements and interfaces within the architecture boundary, but also interfaces to elements in adjacent and other areas. Changes in the Statewide ITS Architecture and ITS Architectures in adjacent areas may necessitate changes in the Akron Regional ITS Architecture to maintain consistency. A Regional ITS Architecture may overlap with the Statewide ITS Architecture, and a change in one architecture may necessitate a change in the other.
- **Changes in ARC-IT.** ARC-IT will be expanded and evolved from time to time to include new user services or refine existing services. These changes should be considered as the ITS Architecture is updated. Updates to ARC-IT and RAD-IT will be publicized on the ITS Joint Program Office (JPO) Architecture website: https://www.its.dot.gov/index.htm.

4.1 Who Is Responsible for Architecture Maintenance?

Responsibility for maintaining the ITS Architecture will lie with AMATS. AMATS should coordinate the maintenance activities and be the point of contact, including collecting, reviewing and evaluating change requests, tracking change requests, requesting additional information from stakeholders, distributing documentation, as well as calling meetings, making meeting arrangements, assembling an agenda, leading the meetings, and approving minutes.

4.2 What Will Be Maintained?

The following should be reviewed and updated at regular intervals:

- Description of the region
- Participating agencies and other stakeholders, including key contact information
- Inventory of existing and planned ITS systems in the region

- Operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems
- Agreements for operations and interoperability
- System functional requirements
- Interface requirements and information exchanges with existing, planned and future systems and subsystems
- Applicable ITS standards and communications solutions supporting regional and national interoperability
- Sequence of projects for implementation

There are several different components that make up the ITS Architecture. Some may require more frequent updates than others, but the entire architecture will need periodic review to ensure that it is consistent with the regional goals. The most current version of the Akron Regional ITS Architecture shall be the baseline architecture upon which future revisions are conducted as necessary.

The Akron Regional ITS Architecture updated in 2022 was created based on ARC-IT Version 9.0 using RAD-IT Software Version 9.0. The Architecture was documented and stored in the following forms:

- Akron Regional ITS Architecture Report
- Akron Regional ITS Architecture Website
- Electronic RAD-IT database

The RAD-IT database can generate a set of outputs including various reports, tables, diagrams, and the architecture webpages. Such outputs include interconnect and architecture flow diagrams, inventory lists, stakeholder lists, service package lists, functional requirements, and other diagrams and reports. A generic ITS architecture report can also be generated directly from RAD-IT. At a minimum, the architecture should be maintained through updates in the database using the RAD-IT software.

4.3 How Changes Are Identified

Changes to the ITS Architecture may be identified by two channels. One is that stakeholders submit a request, and the second channel is actively soliciting changes from each stakeholder on an annual basis.

Stakeholders can contact AMATS to propose changes to the ITS Architecture. AMATS will perform an initial assessment of the proposed change for the impact to the ITS Architecture and/or the affected documentation. If the proposed change has an impact on other stakeholders, AMATS should contact those stakeholders to confirm their agreement with the proposed modification.

The second channel is for AMATS to distribute an annual survey to stakeholders to proactively solicit the need for updating the ITS Architecture. This survey will contain a few basic questions for stakeholders to answer. A sample survey can be found in Table 8. If additional information is needed, AMATS will contact the stakeholder(s) to identify the need for updating the Architecture.

Table 8. Sample Architecture Maintenance Survey Questionnaire

Akron Regional ITS Architecture Maintenance Survey Questionnaire

1. Did your agency implement (including upgrade) any technology and communications related projects for transportation systems or emergency management in the past 12 months?

☐ Yes ☐ No

If YES, please describe the project(s) and/or provide project name(s) and available documentation source(s).

____
____
____
____
____
____

2. Do you plan to implement any technology or communications related projects in the next 5 years?

☐ Yes ☐ No

If YES, please describe the project(s) and/or provide project name(s) and available documentation source(s).

____
____
____
____
____
____

3. Please provide your contact information:

Name: ____________________________________
Agency: ____________________________________
Phone: ____________________________________
Email: ____________________________________

Please submit this form to: XXXXXXXX, Email: XXXX, Phone: XXXX, Fax: XXXX. Thank you!

4.4 How Often Changes Are Made

It is recommended that a comprehensive, formal update of the ITS Architecture Baseline is performed concurrently with the region's long-range transportation plan, Transportation Outlook 2045 (TO2045), updates to ensure the Architecture continues to accurately represent the regional goals. It is further recommended that a comprehensive update of the architecture baseline is performed within 6 months prior to or in conjunction with the long-range transportation plan update.

Between major updates of the ITS Architecture, minor or informal modifications may be made at the discretion of AMATS. AMATS will solicit changes from stakeholders of needed updates. AMATS will contact stakeholders, via e-mail, written correspondence, and/or by telephone, and inquire if the stakeholder has any changes to the ITS Architecture. The change requests will be collected and reviewed by AMATS staff for consideration in the next minor update.

In addition, this Maintenance Plan should also be reviewed and evaluated periodically for required changes to the maintenance process. The actual maintenance process and procedures may differ from those anticipated during the initial development of this Maintenance Plan. Revising the Maintenance Plan will ensure both an effective architecture maintenance process and a change management process.

4.5 Change Review, Implementation and Release

The general steps in the change management process are described below:

1. Stakeholders identify changes, notify AMATS of changes, or complete the annual survey and submit it to AMATS. If the initial information is gathered via the annual survey, AMATS contacts the stakeholder for more information.
2. AMATS reviews the proposed changes, offers comments, and/or asks for additional information.
3. AMATS, in coordination with the appropriate stakeholders affected by the proposed changes, evaluates the changes and determine what impact they may have on the Architecture and/or associated documentation.
4. Upon its evaluation, AMATS makes a decision to accept the change, reject it, or ask for additional information.
5. If the decision is to accept the change, then the appropriate portions of the architecture baseline are updated by AMATS staff. AMATS may procure consultant services to perform the update if needed.
6. Once the ITS Architecture has been updated, AMATS staff presents the Technical Advisory Committee (TAC) of the changes made to the Architecture for comments and approval.
7. Upon TAC approval, AMATS publishes the updated architecture documentation, database and website.
8. AMATS notifies all stakeholders of architecture updates and provides information on how to obtain the latest version of the ITS Architecture.