2018 Arizona Statewide ITS Architecture

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Prepared for:
Arizona Department of Transportation
Multimodal Planning Division (MPD)

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1.0 ACRONYMS

Acronym	Description
AAMVA	American Association of Motor Vehicle Administrators
AASHTO	American Association of State Highway and Transportation Officials
ADEM	Arizona Division of Emergency Management
ADEQ	Arizona Department of Environmental Quality
ADMS	Archived Data Management Subsystem
ADOT	Arizona Department of Transportation
ALERT	Arizona Local Emergency Response Team
ALISS	Accident Location Identification Surveillance System
ANSI	American National Standards Institute
APTA	American Public Transportation Association
ARC-IT	Architecture Reference for Cooperative and Intelligent Transportation
ARIS	AZTech Regional Info System
ASTM	Advanced Public Transportation System
ASU	Arizona State University
ATMS	American Society of Testing and Materials
ATSPT	Arizona Tribal Strategic Partnering Team
AVI	Automated Vehicle Identification
AVL	Automatic Vehicle Location
BIA	Bureau of Indian Affairs
BQAZ	Building a Quality Arizona
BRT	Bus Rapid Transit
CAD	Computer-Aided Dispatch
CAG	Central Arizona Governments
CalTrans	California Department of Transportation
CBP	US Customs and Border Protection
CCM	County, City, Municipal Government
CCTV	Closed Circuit Television
CDC	Consolidated Dispatch Center
COF	City of Flagstaff
COG	Councils of Government
COSV	City of Sierra Vista
COY	City of Yuma
CYMPO	Central Yavapai Metropolitan Planning Organization
CV	Commercial Vehicle
CVAS	Commercial Vehicle Administration Subsystem
CVC	Commercial Vehicle Check
CVCS	Commercial Vehicle Check Subsystem
CVISN	Commercial Vehicle Information Systems and Network
CVO	Commercial Vehicle Operations
CVRIA	Connected Vehicle Reference ITS Architecture
CVS	Commercial Vehicle Subsystem
DEMA	Arizona Division of Emergency and Military Affairs
DMS	Dynamic Message Sign
DPS	Department of Public Safety
DSRC	Dedicated Short Range Communications
DUST	Dual Use Safety Technology

Acronym	Description
ECD	Enforcement Compliance Division
EM	Emergency Management
EMS	Emergency Medical Services
ESP	Emergency Service Patrol
ETC	Electronic Toll Collection
EVS	Emergency Vehicle Subsystem
FAST	Fixing Arizona's Surface Transportation
FHWA	Federal Highway Administration
FMPO	Flagstaff Metropolitan Planning Organization
FMS	Freeway Management System
FMSCA	Federal Motor Carrier Safety Agency
FTA	Federal Transit Administration
HAR	Highway Advisory Radio
HAZMAT	Hazardous Materials
HCRS	Highway Condition Reporting System
HPMS	Highway Performance Monitoring System
ICM	Integrated Corridor Management
IC	Incident Command
ICE	Immigration and Customs Enforcement
IDO	Infrastructure Delivery and Operations Division
IEEE	Institute of Electrical and Electronics Engineers
IFTA	International Fuel Tax Association
IP	Interconnect Protocol
IPAWS	Integrated Public Alert Warning System (International Registration Plan)
ISP	Information Service Provider
ITE	Institute of Transportation Engineers
ITS	Intelligent Transportation System
IVR	Interactive Voice Response
LHMPO	Lake Havasu Metropolitan Planning Organization
LRTP	Long Range Transportation Plan
MAG	Maricopa Association of Governments
MAP-21	Moving Ahead for Progress in the 21st Century Act of 2012
MCDOT	Maricopa County Department of Transportation
MCO	Maintenance and Construction Operations
MCM	Maintenance and Construction Management
MCV	Maintenance and Construction Vehicle
MOU	Memorandum of Understanding
MPD	Multimodal Planning Division
MPO	Metropolitan Planning Organization
MVD	Motor Vehicle Division
NACOG	Northern Arizona Council of Governments
NAIPTA	Northern Arizona Intergovernmental Public Transportation Authority
NAU	Northern Arizona University
NEMA	National Electrical Manufacturers Association
NOAA	National Oceanic and Atmospheric Administration
NTCIP	National Transportation Communications for ITS Protocol
PAG	Pima Association of Governments
PAPS	Public Safety Answering Point
PDT	Project Development Team

Acronym	Description
PMT	Project Management Team
POE	Port of Entry
PTZ	Pan-Tilt-Zoom
RAD-IT	Regional Architecture Development for Intelligent Transportation
RADS	Regional Archived Data System
RCRS	Road Condition Reporting System
RFP	Request for Proposal
RFS	Radar Feedback Sign
ROW	Right-of-Way
RTMC	Regional Traffic Management Center
RTMS	Remote Traffic Microwave Sensor
RTP	Regional Transportation Plan
RTS	Remote Traveler Support
RWIS	Road Weather Information System
SAE	Society of Automotive Engineers
SAFER	Safety Fitness Electronic Record
SCMPO	Sun Corridor Metropolitan Planning Organization
SDO	Standards Development Organization
SEAGO	Southeastern Arizona Governments Organization
SET-IT	Systems Engineering Tool for Intelligent Transportation
SHL	State Highway Log
STIP	State Transportation Improvement Plan
SPaT	Signal Phasing and Timing
SVMPO	Sierra Vista Metropolitan Planning Organization
TIP	Transportation Improvement Plan
TMA	Transportation Management Association
TMC	Traffic Management Center
TMS	Traffic Management Subsystem
TOC	Traffic Operations Center
TSMO	Transportation Systems Management and Operations
USDOT	United States Department of Transportation
VII	Vehicle Infrastructure Integration
VMS	Variable Message Signs
VSL	Variable Speed Limit
WACOG	Western Arizona Council of Governments
WIM	Weigh in Motion
YCAT	Yuma County Area Transit
YCIPTA	Yuma Country Intergovernmental Public Transportation Authority
YMPO	Yuma Metropolitan Planning Organization

2.0 INTRODUCTION

In 2013, Arizona Department of Transportation (ADOT) developed the Arizona Statewide Intelligent Transportation Systems (ITS) Architecture to provide a roadmap for transportation systems integration. The architecture was developed through a cooperative effort by the State's transportation and emergency management agencies, covering all modes of transportation on all highways within Arizona. It represented a shared vision of how each agency's systems would work together and share information and resources to provide safer, more efficient, and more effective transportation systems for travelers in the State of Arizona. The architecture provided an overarching framework that spans all the State's transportation organizations, emergency response, and individual transportation projects. Using the architecture, each transportation project could be viewed as a part of the overall transportation system, providing visibility into the relationships between individual transportation projects and ways to cost-effectively build an integrated transportation system over time. The 2013 Statewide ITS Architecture was developed based on the National ITS Architecture Version 7.0.

Since that time, the United States Department of Transportation (USDOT) initiated a major update that covers all the scope and contents from the National ITS Architecture and integrates the Connected Vehicle Reference ITS Architecture (CVRIA). **FIGURE 1. ARC-IT Venn Diagram**, shows the integrated relationship between these architectures. The merging of these two products, now referred to as the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT), provides a common framework for planning, defining, and integrating intelligent transportation systems. ARC-IT reflects the contributions of a broad cross-section of the ITS community including transportation practitioners, systems engineers, system developers, technology specialists and consultants.

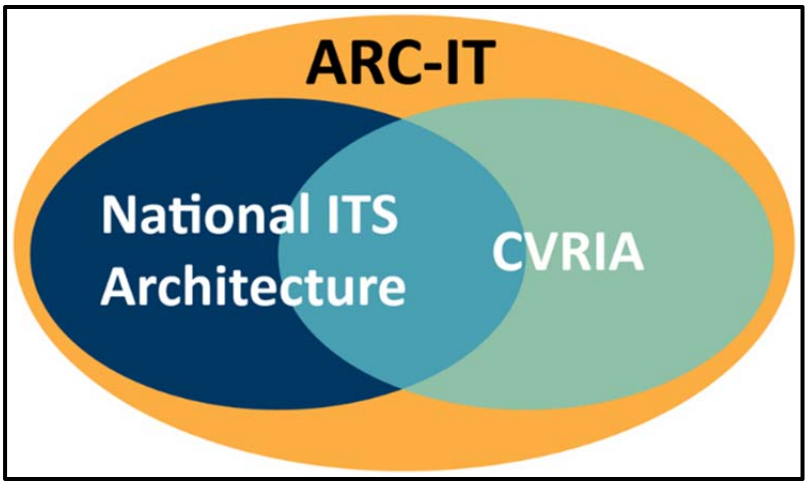

FIGURE 1. ARC-IT Venn Diagram

One of the Federal Highway Administration's (FHWA) main goals in the creation of ARC-IT was the development of a standardized nomenclature that could be used nationwide. Generic ITS service descriptions, Service Packages, were developed (e.g., traffic signal control, transit vehicle tracking) that provide desired services used throughout various regions in the United States. Within the boundaries of the ARC-IT structure, ITS planners, combined with stakeholder input, tailored ARC-IT to create the Arizona Statewide ITS Architecture that meet Arizona's specific needs. This standardization allows Arizona's ITS inventory components to be aligned with FHWA's standard terminology. Once Arizona's ITS inventory was mapped to ARC-IT, then the uniform National ITS standard requirements connected defined flows within the Arizona Statewide ITS Architecture to follow the provided framework.

ARC-IT is used when developing and deploying nationally compatible systems. By ensuring system compatibility, the USDOT hopes to accelerate ITS integration nationwide and develop a strong, diverse marketplace for related projects and services. Use of ARC-IT presents significant benefits as follows:

1. Provides assistance with technical design and saves considerable time because physical and logical architectures are already defined;
2. Defines information flows and process specifications, which accelerates the process of defining system functionality;
3. Identifies standards that will support interoperability now and into the future, but leaves selection of technologies to local decision makers; and
4. Offers a sound engineering framework for integrating multiple applications and services in a region.

ARC-IT includes a set of interconnected components that are organized into four views, focusing on the four different architecture perspectives.

1. Enterprise View considers ITS from an organization perspective. It identifies stakeholders and their organizations. It also defines roles and relationships between stakeholders.
2. Functional View looks at ITS from a practical perspective and defines the requirements needed to make a system work.
3. Physical View defines the physical objects and describes transportation systems and the information exchanges that support ITS.
4. Communications View defines how physical objects communicate and the communications standards, profiles, and security required to share information between the physical objects.

Security is paramount in the 21st Century of Intelligent Transportation Systems and ARC-IT addresses security concerns spanning all four views. Security concerns, related to ITS, are focused on protection of surface transportation information and infrastructure. Surface transportation is now, more than ever, relying on information technologies to sense, collect, process and disseminate information to improve the efficiency of moving goods and people, improve the safety of our transportation system and provide travel alternatives.

The 2018 Arizona Statewide ITS Architecture (AZ ITS Architecture) is a customized version of ARC-IT, including only the subsystems and functions that are planned for implementation within the State. The update included a review of goals and objectives of stakeholders, updated stakeholders list, documentation of actual inventory, interviews with stakeholders and mapping of inventory to system elements. This ITS architecture is a living document which is used for ITS project planning and development within the State for the next 10 years. While this report documents the process and results, the RAD-IT database is the AZ ITS Architecture.

2.1 Project Management Team

This ITS Architecture update is led by a Project Management Team (PMT). The role of the PMT is to provide technical guidance, support, advice, suggestions, recommendations, and to perform document reviews throughout the study process. PMT members include representatives from ADOT Multimodal Planning Division (MPD) and Transportation Systems Management and Operations (TSMO) Division in conjunction with the Consultant Team.

2.2 Purpose and Need

FHWA Highway Funds are based upon communications and agreements between transportation agencies to provide effective, integrated services. Simply stated, every public service related to intelligent transportation systems is described in one or more of the ARC-IT service packages; e.g., traffic monitoring, signal control, emergency response, emergency evacuation, connected and autonomous vehicle applications. The AZ ITS Architecture allows the state of Arizona and agency stakeholders to participate in Highway Trust Funds.

Federal regulations, 23CFR Parts 655 and 940 Intelligent Transportation System Architecture and Standards, require that federally funded projects must conform to the new ARC-IT standards, be guided by a regional architecture of geographic boundaries defined by stakeholder needs, and use a system engineering analysis that considers the total project life cycle. According to the regulations, every project must be included in a regional ITS architecture or have a specific project architecture for federal funding to be used on the project. As a result, ADOT determined that a comprehensive review, conforming to the federal guidelines, is needed to update and enhance the AZ ITS Architecture. ADOT believes this enhancement is necessary and will keep all statewide stakeholders involved in the process of keeping current and being proactive about technology.

The FHWA rule and the FTA policy contained in the federal regulations states that, “ITS projects shall conform to the National ITS Architecture and standards in accordance with the requirements contained in this part. Conformance with the National ITS Architecture is interpreted to mean the use of the National ITS Architecture to develop a regional ITS architecture, and the subsequent adherence of all ITS projects to that regional ITS architecture. Development of the regional ITS architecture should be consistent with the transportation planning process for Statewide and Metropolitan Transportation Planning.” (FHWA/FTA 2001)

A regional ITS architecture shall be developed to guide the development of ITS projects and programs and be consistent with ITS strategies and projects contained in applicable transportation plans. The National ITS Architecture shall be used as a resource in the development of the regional ITS architecture. Provision should be made to include participation from the following agencies, as appropriate, in the development of the regional ITS architecture: Highway agencies; public safety agencies (e.g., police, fire, emergency/medical); transit operators; Federal lands agencies; state motor carrier agencies; and other operating agencies necessary to fully address regional ITS integration. At a minimum, a regional ITS architecture shall include the following (Federal Highway Administration 2017):

1. A description of the region
2. Identification of participating agencies and other stakeholders
3. An operational concept that identifies the roles and responsibilities of participating agencies and stakeholders in the operation and implementation of the systems included in the regional ITS architecture
4. Any agreements (existing or new) required for operations, including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture
5. System functional requirements
6. Interface requirements and information exchanges with planned and existing systems and subsystems (for example, subsystems and architecture flows as defined in the National ITS Architecture)
7. Identification of ITS standards supporting regional and national interoperability
8. The sequence of projects required for implementation

To assist in the development of the Statewide ITS Architecture, the FHWA provides two software tools to apply ARC-IT to ITS elements (United States Department of Transportation 2018):

1. Regional Architecture Development for Intelligent Transportation (RAD-IT) is a database tool used to assist planners in creating a statewide or regional ITS Architecture. The database houses information such as the regional stakeholders, an inventory of technology, selected service packages, roles and responsibilities of stakeholders, technological standards and agreements between organizations.
2. Systems Engineering Tool for Intelligent Transportation (SET-IT) is a tool used for individual project guidance through the systems engineering process.

ARC-IT and RAD-IT were used to complete the AZ ITS Architecture.

FIGURE 2. Planning Lifecycle for Projects illustrates the planning and lifecycle of ITS projects. The planning process identifies the direction and guides the project development. The project development process provides the concept of operations and systems requirements so projects can

be implemented. SET-IT advances the project development process by integrating drawing and database tools to develop project architectures that align with ARC-IT. The SET-IT output includes the concept of operations, standards, and security measures for project implementation. Through monitoring and evaluation of implemented projects, information is supplied to the transportation planning process and the cycle repeats.

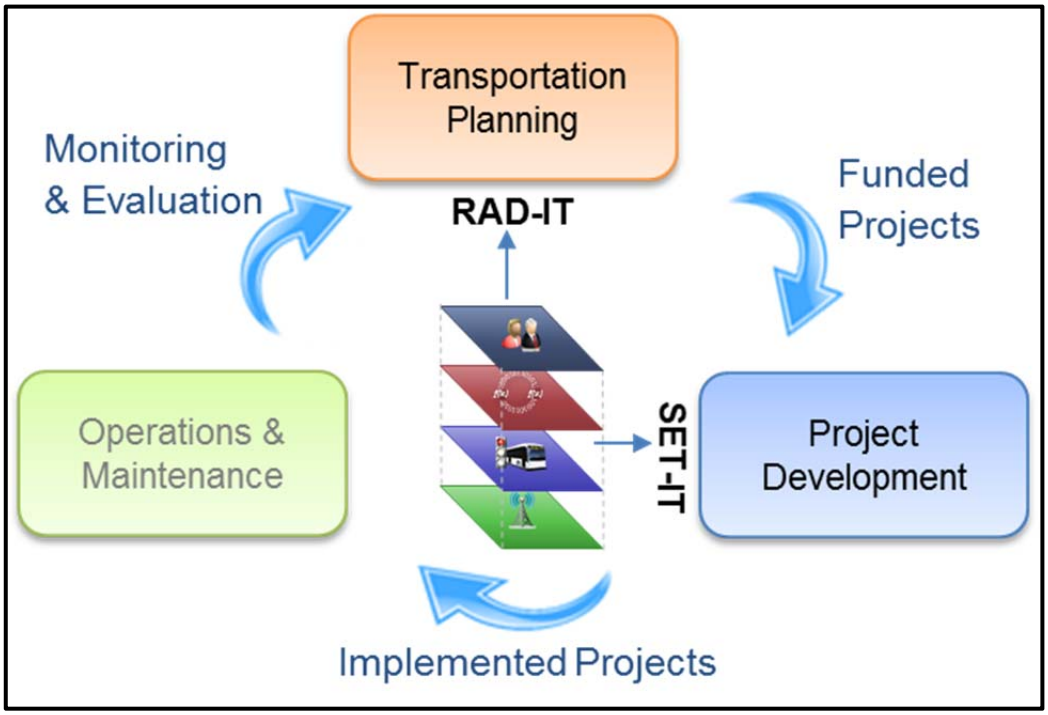

FIGURE 2. Planning Lifecycle for Projects

3.0 REGIONAL DESCRIPTION

This AZ ITS Architecture is an update to the 2013 Arizona Statewide ITS Architecture owned by ADOT. There are three existing ITS architectures within the State.

1. AZ Statewide ITS Architecture
2. Maricopa Association of Governments (MAG) Regional ITS Architecture, June 2013
3. Pima Association of Governments (PAG) Tucson Metropolitan Region Intelligent Transportation Systems Strategic Deployment Plan for the 21st Century, July 2004.

The AZ ITS Architecture interacts with the two regional architectures but is separate and focuses on ADOT-owned ITS elements and all other ITS elements outside of the two regional architectures. Some of the MAG and PAG regional architecture elements may be included in the AZ ITS Architecture, as required.

The statewide transportation planning strategy used to develop this AZ ITS Architecture represents multimodal transportation that supports the vision laid out in Building a Quality Arizona (BQAZ) combined with "What Moves You Arizona", the State's Long-Range Transportation Plan (which advances the BQAZ vision by defining a preferred investment strategy). The AZ ITS Architecture adopts the goals and strategies from these plans.

FIGURE 3. Study Boundary represents the geographic scope of the AZ ITS Architecture. The boundary includes the entire State of Arizona and its borders with Mexico and the States of California, New Mexico, Utah, and Nevada.

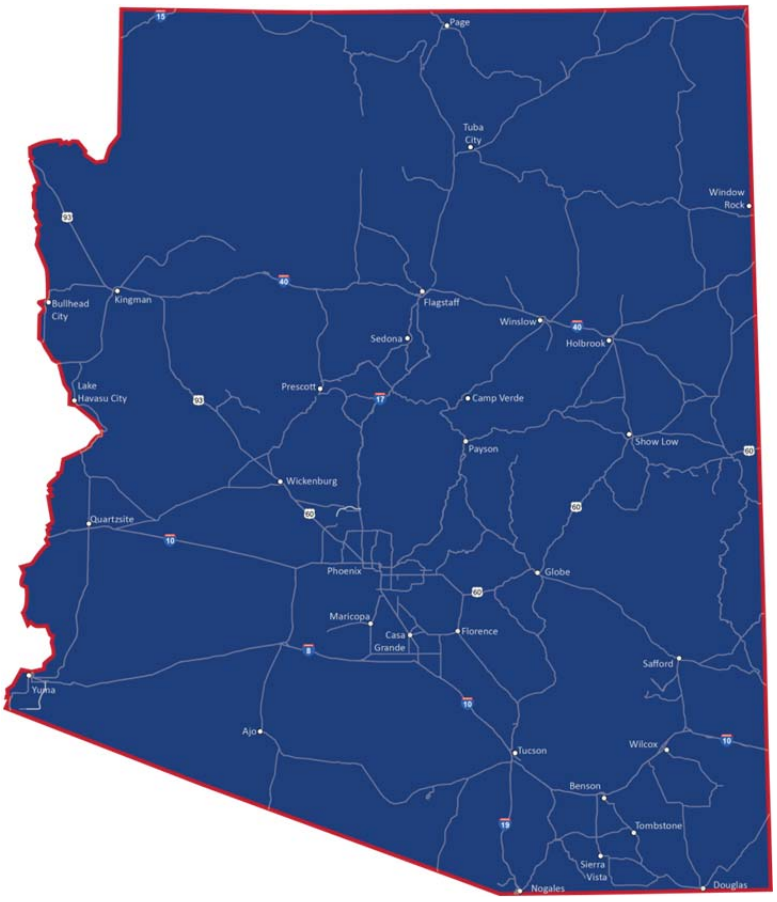

FIGURE 3. Study Boundary

4.0 RELATED ARCHITECTURES

In addition to the MAG and PAG ITS Regional Architectures, ADOT will share operations and data with surrounding states to varying degrees. Therefore, the statewide ITS architectures listed below are included in the AZ ITS Architecture and reflect a portal for connectivity, where appropriate.

1. California Statewide ITS Architecture (Caltrans 2017)
2. 2012 New Mexico Statewide ITS Architecture Update (Consystec 2012)
3. 2013 Southern Nevada Regional ITS Architecture (Nevada DOT 2013)
4. Utah Statewide ITS Architecture

5.0 PARTICIPATING AGENCIES AND OTHER STAKEHOLDERS

The development of this Statewide ITS Architecture is a collaborative process; therefore, the participation of key stakeholders is critical to its success. To develop a thorough understanding of the issues, deficiencies and needs, current and planned ITS projects throughout the State, the PMT identified an extensive group of stakeholders. **TABLE 1. Stakeholders** presents the participating agencies and other stakeholders that were relied upon to provide input, identify needs, and build consensus throughout the state.

TABLE 1. Stakeholders

Stakeholders			
ADOT	American Association of Motor Vehicle Administrators (AAMVA)	Archive Data Users	Arizona Cities and Towns
Arizona Counties	Arizona Department of Environmental Quality (ADEQ)	Arizona Department of Public Safety (DPS)	Arizona Division of Emergency and Military Affairs (DEMA)
Arizona MPOs and COGs	Arizona Tribal Strategic Partnering Team (ATSPT)	Arizona Universities	AZTech
Bureau of Indian Affairs (BIA)	Emergency Medical (EM) Transport Companies	Federal Highway Administration (FHWA)	Federal Motor Carrier Safety Agency (FMSCA)
Financial Institutions	GIS Mapping Designers	I-10 Corridor Coalition	Independent School Districts
International Fuel Tax Association (IFTA)	Maricopa Association of Governments (MAG)	Maricopa County Department of Transportation (MCDOT)	Media
Mexico Governmental Agencies	National Oceanic Atmospheric Administration (NOAA)	Pima Association of Governments (PAG)	Private Commercial Carriers
Private Container System Owners	Private Information Service Providers	Public and Private Transit Providers	Rail Organizations
State of California	State of Nevada	State of New Mexico	State of Utah
Time and Data Sources	Travelers	Tribal Governments - Statewide	US Customs and Border Protection (CBP)
US Immigration and Customs Enforcement (ICE)			

Source: AZ ITS Architecture RAD-IT Database

Appendix A. Stakeholders presents the Stakeholder, Stakeholder Description and Group Members as displayed in RAD-IT.

6.0 INVENTORY OF EXISTING AND PLANNED ITS RESOURCES

An important initial step in the ITS Architecture update process was to verify the existing inventory and add new or planned ITS elements.

Step 1: Stakeholders were provided with a list of their existing stakeholder agency description along with their ITS Architecture inventory in accordance with the 2013 ITS Architecture.

Step 2: Individual meetings were held with stakeholders to discuss their existing inventory and planned projects. Some of those meetings included but were not limited to:

1. Yuma Metropolitan Planning Organization and their member agencies
2. Flagstaff Metropolitan Planning Organization and their member agencies
3. Lake Havasu Metropolitan Planning Organization and their member agencies
4. Central Arizona Association of Governments and their member agencies
5. Sun Corridor Metropolitan Planning Organization and their member agencies
6. Western Arizona Council of Governments and their member agencies
7. Southeastern Arizona Government Organization and their member agencies
8. Sierra Vista Metropolitan Planning Organization and their member agencies
9. Northern Arizona Council of Governments and their member agencies
10. Central Yavapai Metropolitan Planning Organization and their member agencies
11. Arizona Department of Public Safety
12. US Customs and Border Protection
13. AzTech and Maricopa County Department of Transportation
14. University of Arizona
15. Northern Arizona University
16. Hopi Tribe

Step 3: Stakeholders completed an updated inventory using a comprehensive survey answering questions about existing, planned and future systems for incorporation into the AZ ITS Architecture.

Step 4: A comprehensive review of all existing plans throughout Arizona that identify ITS elements or functions that should be included in the ITS Architecture was completed.

TABLE 2. Inventory is a partial list of the stakeholder inventory of ITS components. The inventory represents the status of ITS deployments as of March 2018. Per the ITS Architecture Maintenance Plan, periodic updates of the inventory should be conducted to document the on-going deployment of ITS technology throughout Arizona. The complete inventory can be found in **Appendix B. Inventory**.

TABLE 2. Inventory

Stakeholder	Element Name	Element Description	Element Status	Associated Physical Objects
ADOT	ADOT 511 IVR	The interactive voice response (IVR) telephone system providing statewide traveler information for the State of Arizona. The 511 IVR system may include travel time information, construction information, roadway incidents, and special events.	Existing	Transportation Information Center
ADOT	ADOT 511 IVR	The interactive voice response (IVR) telephone system providing statewide traveler information for the State of Arizona. The 511 IVR system may include travel time information, construction information, roadway incidents, and special events.	Existing	Traveler Information Voice System
ADOT	ADOT 511 Website	ADOT's www.az511.gov website provides statewide traveler information systems for the State of Arizona. The system includes freeway video images, travel time information, and roadway incidents. Public access to the information is provided via the internet.	Existing	Transportation Information Center
ADOT	ADOT Alerts App	ADOT has an official App that provides real time information to travelers about unplanned major events that are impacting traffic so informed decisions can be made to avoid lengthy delays or potentially hazardous situations.	Existing	Media

Source: AZ ITS Architecture RAD-IT Database

6.1 ITS Planning for Operations

The traditional transportation planning process includes the development of regional goals, identification of alternative improvement strategies, evaluation and prioritization of strategies, development of the transportation plan and transportation improvement programs. Arizona developed the long-range transportation plan, titled *What Moves You Arizona 2040* and the *State Transportation Improvement Program* for 2018-2022 to guide the progress of the statewide network of highways, transit systems, airports, local roads and bicycle/pedestrian facilities.

Planning for technology-based operations activities is fundamentally different than planning for traditional capital improvement projects. However, the AZ ITS Architecture relies on Arizona's long-range transportation plan and transportation improvement program and must be compatible with the state goals and objectives**. FIGURE 4. Arizona Statewide ITS Architecture Use in Planning for Operations** provides a view of the statewide planning process and how the AZ ITS Architecture fits into that process.

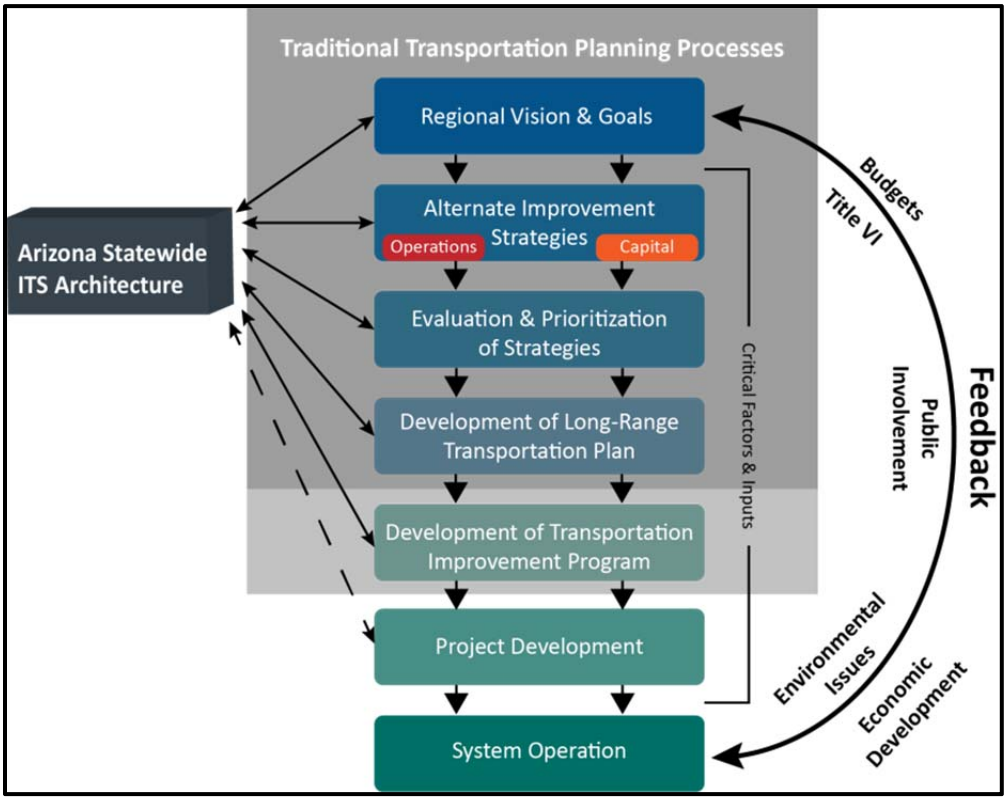

FIGURE 4. Arizona Statewide ITS Architecture Use in Planning for Operations

6.2 Operational Goals, Objectives and Performance Measures

The initial step in the objectives-driven, performance-based approach to statewide ITS architecture is to establish statewide goals and operations objectives. Goals and objectives that focus on the operational performance of the transportation system in the planning process are included in the previous statewide ITS architecture, the Statewide Transportation Implementation Plan (STIP), MPO transportation plans, or the statewide long-range transportation plan.

Operations objectives are specific, measurable, and agreed-upon statements of desired outcomes for regional system performance that support the plan's goals. They may be formed in response to input from ITS and operations staff, elected or appointed officials, or a significant event such as a dust storm, or major traffic incident that draws public attention to needed operational improvements.

Performance measures to track the achievement of operations objectives are identified during the development of the objectives and are typically embedded in operations objectives. For example: the operations objective—improve average travel time during peak periods by 5% by year 2025 on regionally significant arterials is tracked by the performance measure - average travel time. The ITS elements from the stakeholder inventory shows several archive databases that perform this task and track travel times. That information is shared statewide through the statewide performance measures HPMS. **FIGURE 5. Regional Vision and Goals** represents the portion of the traditional transportation planning process that addresses the vision, goals, and performance measures from traditional transportation planning process and shows how it is related to the AZ ITS Architecture.

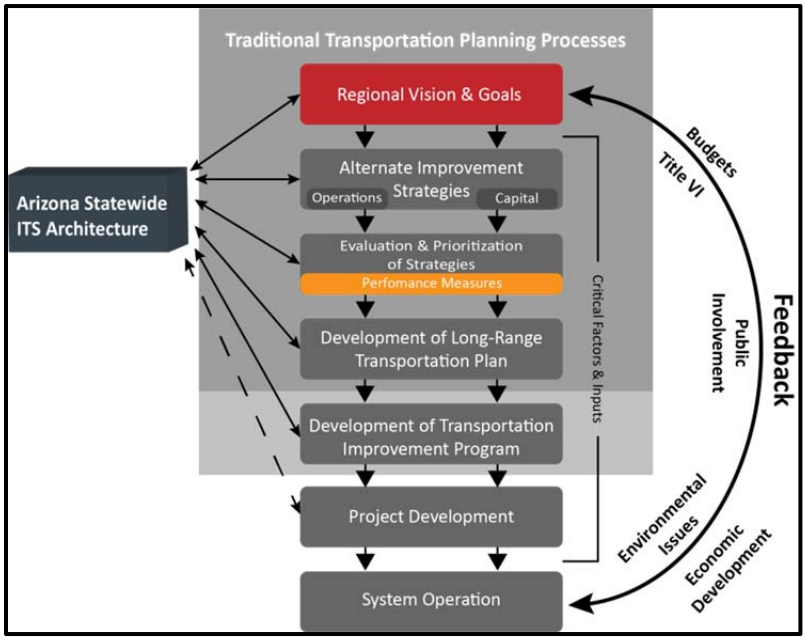

FIGURE 5. Regional Vision and Goals

The Federal Moving Ahead for Progress in the 21st Century Act of 2012 (MAP-21) and the Fixing Arizona's Surface Transportation (FAST) Act of 2015 established national performance goals for the federal aid highway program in seven areas:

1. **Safety** – reduce traffic fatalities and serious injuries on all public roads
2. **Infrastructure Conditions** – Maintain the National Highway System in a state of good repair
3. **Congestion Reduction** – Reduce congestion on the National Highway System
4. **System Reliability** – Improve the efficiency of the surface transportation system
5. **Freight Movement & Economic Vitality** – Improve the national freight network, strengthen rural access to national/international markets and support economic development
6. **Environmental Sustainability** – Enhance performance of the transportation system while protecting and enhancing the national environment
7. **Reduced Product Delivery Delays** – Reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion by eliminating delays in the project development and delivery process.

Using the requirements established by the federal government, Arizona developed their transportation vision and goals as presented in Arizona's 2040 Long Range Transportation Plan. The Statewide ITS Architecture can help stakeholders realize these goals and operations objectives by using them to organize supportive ITS capabilities and select service packages, functional requirements, and project concepts that move the objectives toward success. Conversely, architectures and regional ITS strategic plans can help planning organizations define operations objectives that reflect available data and the expertise of operations staff for metropolitan or statewide transportation plans.

6.3 Needs and Services

The fundamental foundation of the ITS Architecture's planning process is to establish collaboration and coordination among agencies involved with the operations of ITS in the state. It contains information about existing and planned systems to increase statewide visibility and coordination of all ITS deployments. Planners and implementing agencies should use the architecture to identify which agencies in the state need to be involved in a project; how ITS elements in a project should interface with neighboring systems; and how the project can leverage other deployments to lower costs and provide travelers with seamless service.

Connecting the already well-established planning practices in the state with identified needs and services, benefits Arizona. One of the important phases in developing the ITS architecture is to identify statewide needs and determine which ITS services should be implemented to address those needs. Arizona's 2040 Long Range Transportation Plan and the Transportation Improvement Plan 2018-2022 were relied on to identify Arizona's needs and services. Many of the long-term policies and goals in these plans will be fulfilled by the services contained in the AZ ITS Architecture. For example, if new major facilities are planned in the state, and; it is appropriate to incorporate ITS elements in to

the facility, the alternate improvement strategy for capital improvements may be included in this project. **TABLE 3. Relationship to Planning** shows the objectives, descriptions, and sources that were used to identify the needs. Performance measures are also listed to illustrate the success of the objective.

TABLE 3. Relationship to Planning

Objective	Description of Needs	Source	Performance Measure Category	Performance Measures
Improve Mobility, Reliability and Accessibility	The needs in this category focus on the application of control devices, such as traffic signals, signing, gates, to regulate the number of vehicles entering or leaving the freeway to achieve operational objectives. *Potential Policies/Strategies*: Access Management, Complete Streets, Methods, Models, and Data, Research and Integration of systems	AZ Long Range Transportation Plan (LRTP)	Mobility	Decrease Travel Delay Mitigate Congestion
			Safety & Security	Quick Clearance - Measure time it takes to clear crashes
			Strengthen Partnerships	Number of Meetings and Agreements Signed
Preserve and Maintain the System	Improve pavement and bridge deficiencies. Maintain the state roadway system. Manage the existing system efficiently and effectively. *Potential Policies/Strategies:* Expanded Maintenance and Operations Policy.	AZ Long Range Transportation Plan (LRTP)	Maintain State Transportation System	Resources available for State Highway Maintenance
			Mobility	Mitigate Congestion
			Strengthen Partnerships	Focus on Implementation Policies
Preserve and Maintain the System	The need is to maintain, preserve and extend the service life of the existing and future infrastructure. *Potential Policies / Strategies:* Context sensitive solutions Education and Outreach "Green" Certification	AZ Long Range Transportation Plan (LRTP)	Strengthen Partnerships	Focus on Implementation Policies
			Support Air Quality Improvement	Change in Vehicle-related emissions, level of environmental certification

Objective	Description of Needs	Source	Performance Measure Category	Performance Measures
Promote Fiscal Stewardship	Ensue responsible management of public resources and implement funding strategies to ensure long term balanced investment of the state transportation system. *Potential Policies/Strategies:* Job creation/retention Access Management Complete Streets Demand Management System Modernization (bottleneck reduction, system operations, traffic signal timing, effective transportation systems support job growth, job retention and economic growth).	AZ Long Range Transportation Plan (LRTP)	Strengthen Partnerships	Focus on Implementation Policies
			Support Economic Growth	Resources available for economic initiatives
Enhance Safety	The need is to continue to improve and advocate for transportation system safety for all modes. *Potential Policies/Strategies:* Congestion, speed and improved access management.	AZ Long Range Transportation Plan (LRTP)	Access Management	Increase and Measure Shared Access
			Mobility	Decrease Travel Delay Mitigate Congestion
Enhance Safety	The need is to continue to improve and advocate for transportation system safety for all modes. *Potential Policies/Strategies:* System Modernization (Rural Safety) Implement quick clearance measures; enhance safety and security for travelers and for incident responders.	AZ Long Range Transportation Plan (LRTP)	Mobility	Decrease Travel Delay Mitigate Congestion
			Safety & Security	Decrease Fatality and Serious Injury Rates Quick Clearance - Measure time it takes to clear crashes
			Strengthen Partnerships	Focus on Implementation Policies Number of Meetings and Agreements Signed

Objective	Description of Needs	Source	Performance Measure Category	Performance Measures
Strengthen Partnerships	The need to develop and nurture partnerships that support coordination, integration and preservation	AZ Long Range Transportation Plan (LRTP)	Strengthen Partnerships	Number of Meetings and Agreements Signed
Make Effective Investment Decisions	Better link to planning and programming through performance based decision making. *Potential Policies/Strategies:* methods, models and data, research, reporting, promotes fiscal stewardship	AZ Long Range Transportation Plan (LRTP)	Maintain State Transportation System	Resources available for State Highway Maintenance
			Mobility	Decrease Travel Delay Mitigate Congestion
			Safety & Security	Decrease in Fatalities and Serious Injuries
			Strengthen Partnerships	Focus on Implementation Policies

To help build consensus on statewide needs and ITS services priorities, the consultant team hosted meetings at various Metropolitan Planning Organizations (MPOs) and Councils of Government (COGs), as well as with statewide stakeholder member agencies. The main goal is to connect stakeholder visions with the visions and objectives of the statewide LRTP. The statewide ITS Architecture update allows stakeholders to expand the interaction of planning and operations.

7.0 ARCHITECTURE COMPONENTS

The service packages are defined using the 12 area groups:

1. Commercial Vehicle Operations
2. Data Management
3. Maintenance and Construction
4. Parking Management
5. Public Safety
6. Public Transportation
7. Support
8. Sustainable Travel
9. Traffic Management
10. Traveler Information
11. Vehicle Safety
12. Weather

Service packages are used to define functional requirements. ARC-IT defines service packages as slices of the physical view that address specific services like traffic signal control. A service package collects several different physical objects (systems and devices) and their functional objects and information flows that provide the desired service. For each service package, ARC-IT provides a brief description and a set of high level functional requirements, customized to reflect requirements of the Statewide ITS Architecture.

The Consultant Team screened the service packages contained in ARC-IT version 8.1 to identify those packages that are most applicable to the State of Arizona. **TABLE 4. Service Packages** presents a partial list of service packages. The full list of service packages selected for the AZ ITS Architecture is included in **Appendix C. Arizona Service Packages**.

TABLE 4. Service Packages

Service Package	Service Package Name	Service Package Description	Service Package Status
CVO01	Arizona Carrier Operations and Fleet Management	This service package manages a fleet of commercial vehicles. The Fleet and Freight Management Center monitors the vehicle fleet and can provide routes using either an in-house capability or an external provider. Routes generated by either approach are constrained by hazardous materials and other restrictions (such as height or weight). A route would be electronically sent to the Commercial Vehicle with any appropriate dispatch instructions. The location of the Commercial Vehicle can be monitored by the Fleet and Freight Management Center and routing changes can be made depending on current road network conditions.	Planned
CVO01	Carrier Operations and Fleet Management	This service package manages a fleet of commercial vehicles. The Fleet and Freight Management Center monitors the vehicle fleet and can provide routes using either an in-house capability or an external provider. Routes generated by either approach are constrained by hazardous materials and other restrictions (such as height or weight). A route is electronically sent to the Commercial Vehicle with any appropriate dispatch instructions. The location of the Commercial Vehicle can be monitored by the Fleet and Freight Management Center and routing changes can be made depending on current road network conditions. This service package also supports maintenance of fleet vehicles with on-board monitoring equipment. Records of vehicle mileage, preventative maintenance and repairs are maintained.	Planned
CVO03	Arizona Electronic Clearance	This service package provides for high speed weigh-in-motion with or without Automated Vehicle Identification (AVI) capabilities. This service package provides the roadside equipment that could be used as a stand-alone system or to augment the Electronic Clearance (CVO03) service package.	Existing

Source: AZ ITS Architecture RAD-IT Database

7.1 Subsystem and Terminator Inventory

Once the needs and service packages were identified, the next step in the development of the AZ ITS Architecture was to identify the subsystems and terminators that are necessary to work together to deliver transportation services. These subsystems, terminators, and the interconnections and information exchanges among them, are the primary foundation of the architecture.

Subsystems are individual pieces of the overall Intelligent Transportation System that perform specific functions such as managing traffic, providing traveler information, or responding to emergencies. Subsystems can be associated with particular organizations such as departments of transportation, information service providers, or public safety agencies. They are sources and/or users of information provided by other subsystems within or on the boundary of the ITS Architecture. Subsystems include

center systems, field components, vehicle equipment and traveler devices that participate in ITS (US Department of Transportation 2006).

Terminators are the physical objects that define the boundary of an architecture. In ARC-IT terminators represent the people, systems, and general environment that interface to ITS. The interfaces between terminators and the subsystems and processes within ARC-IT are defined, but no functional requirements are allocated to terminators. The functional and physical views of ARC-IT have the same set of terminators. The only difference is that functional view processes communicate with terminators using data flows, while physical view subsystems use information flows. (USDOT 2018)

One of the most recognized representations of the previous ITS Architecture, the ITS Sausage Diagram, has been replaced with **FIGURE 6. Arizona's Physical View V8 Subsystem Diagram**. Figure 6 shows the subsystems and how they interconnect with each other. This diagram illustrates ARC-IT's view of the possible interactions among ITS elements. Subsystems within the Physical View Diagram that are light in color are not yet established for the State of Arizona.

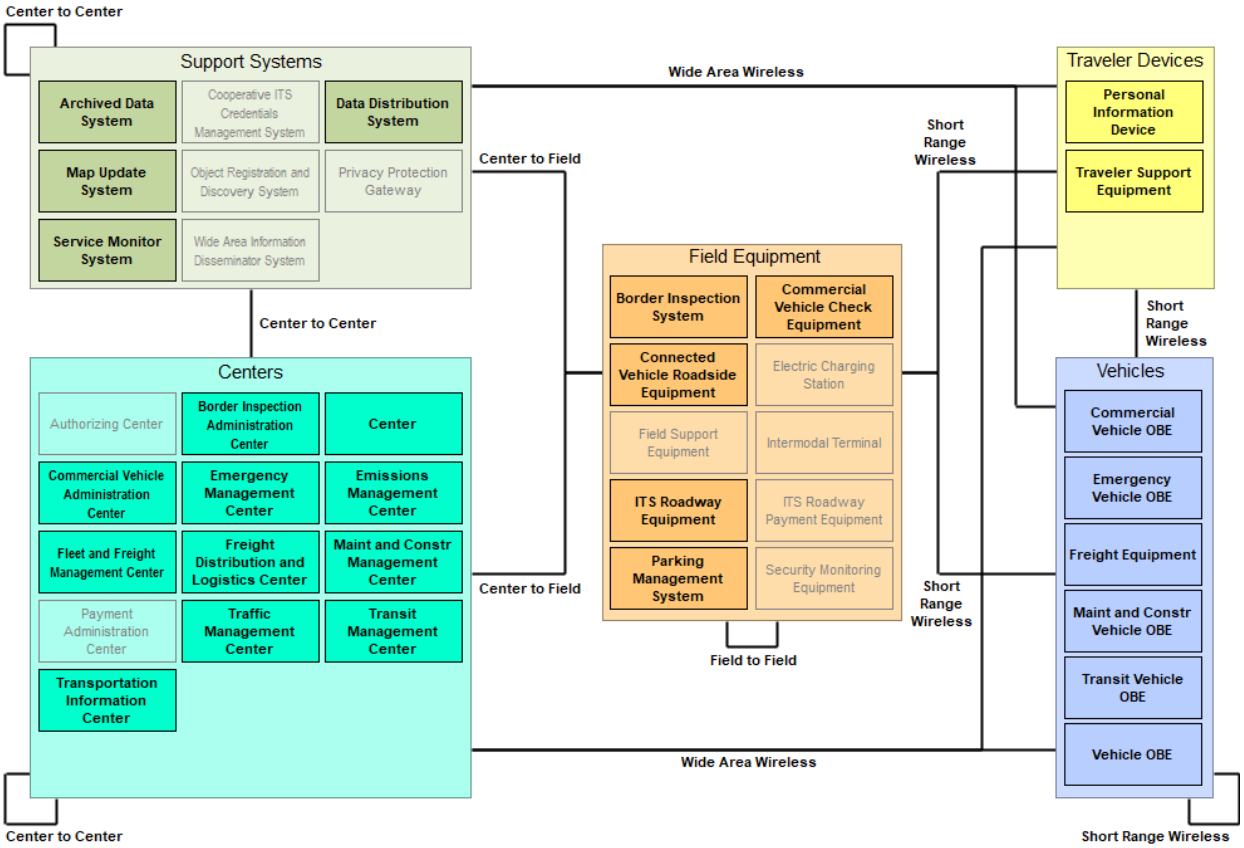

FIGURE 6. Arizona's Physical View V8 Subsystem Diagram

A subsystem can have multiple implementations; for example, ADOT Traffic Management and the District Field Offices could all operate traffic management centers. Each implementation is a distinct ITS element. ITS elements are considered the basic building blocks of the architecture and are the names used by stakeholders to describe components of their ITS operations. **TABLE 5. ITS Elements Within the Physical View (Subsystems)** depicts a list of stakeholder elements that are associated with each type of subsystem to highlight the types of elements that make up each subsystem. The table is color coded to help distinguish among the five basic classes of subsystems defined in the Physical View Diagram. **Appendix D** provides a complete list of all the subsystems and terminators and a definition of their role and functions.

TABLE 5. ITS Elements Within the Physical View (Subsystems)

SUPPORT SYSTEMS	
Archived Data System	
AAMVA Driver and Vehicle Verification Systems	ADOT ALISS Crash Data Archive
ADOT HazMat Response Data Archive	ADOT HCRS Data Archive
ADOT HCRS Traveler Information	ADOT HPMS Data Archive
ADOT Motor Vehicle Division (MVD) Database	ADOT TOC Data Archive
Cities and Towns Data Archive	AZTech RADS Data Archive
DEMA Data Archive	County Data Archive
MAG Planning Traffic Database	DPS Data Archive
NAIPTA Transit Data Archive	MPO-COG Planning Traffic Database
PAG Planning Traffic Database	POE Data Archive
State Universities Data Archives	Tribal Data Archive
Cooperative ITS Credentials Management System	
Data Distribution System	
ADOT Data Distribution System	ADOT Fiber Backbone
ADOT HCRS Traveler Information	Cities and Towns Fiber Backbone
Cities and Towns Wireless Radio	County Radio Systems
DPS Backhaul Communications System	DPS Radio System
MAG RCN Fiber	PAG RTDN Communications System
Public Private Traveler Information	Tribal Fiber for Communications
Map Update System	
Map Update System	
Object Registration and Discovery System	
Privacy Protection Gateway	
Service Monitor System	
ADOT Service Monitor System for Connected Vehicle	MCDOT Service Monitoring Sys for Connected Vehicles
Wide Area Information Disseminator System	
CENTERS	
Authorizing Center	
Border Inspection Administration Center	
ADOT ECD CVO Administration Center	POE Administration Center

Center	
ADOT DEOC-Dept EM Ops Center	ADOT ECD Dispatch
AZTech RADS Data Archive	ADOT TOC and EMC
DEMA CRT-HazMat Response	DPS Central Communications
DPS Network Operations Center	
Commercial Vehicle Administration Center	
AAMVA Driver and Vehicle Verification Systems	AAMVA IRP Clearinghouse
ADOT ECD CVO Check and Border Inspection	ADOT MVD Commercial Vehicle Administration
DPS Commercial Vehicle Enforcement	IFTA Clearinghouse
Safety Fitness Electronic Record (SAFER)	
Emergency Management Center	
ADOT Department Operations Center-EM	ADOT ECD Dispatch
ADOT TOC and EMC	ADOT Mobile EM Center
Cities and Towns EOCs and EMCs	CHP Dispatch
County EMCs and EOCs	Cities and Towns Police and Fire Dispatch
DEMA SEOC Arizona DEM Military Affairs	County Sheriff Dispatch
Maricopa County EOC	DPS and FSP Dispatch
Mexico Public Safety	Mexico Customs and Border Patrol
New Mexico State Police Dispatch	Nevada State Police Dispatch
US Border Patrol Dispatch	Tribal Public Safety Dispatch
Utah State Police Dispatch	
Emissions Management Center	
ADEQ Arizona Emissions Management	
Fleet and Freight Management Center	
Fleet Management Systems	
Freight Distribution and Logistics Center	
AAMVA IRP Clearinghouse	
Maint and Constr Management Center	
ADOT MCO Districts	ADOT Regional Traffic Operations
ADOT Systems Maintenance	Cities and Towns MCO Dispatch
Cities and Towns Public Works	Mexico Regional Maintenance Section
Tribal MCO Dispatch	County Public Works
Payment Administration Center	
Traffic Management Center	
ADOT District TOCs	ADOT Regional Traffic Operations
ADOT TOC and EMC	AZTech RADS Data Archive
Cities and Towns Traffic Operations Center	County TMCs - TOCs
Mexico Regional TMC	Tribal TMC and TIC
Transit Management Center	
City and Towns Transit Dispatch	Independent School District Bus Dispatch
Local Dial-A-Ride Transit Dispatchers	Mountain Lift Paratransit
NAIPTA Transit Management Center	Transit Providers - Public and Private
Tribal Transit Centers	Yuma County Area Transit (YCAT)
Transportation Information Center	
ADOT 511 Website	ADOT HCRS Data User Systems
ADOT HCRS Traveler Information	ADOT TOC Traffic Information Center
ATSPT Website	AZTech Regional Info System (ARIS)
BIA Western Regional Website	CBP Website
Cities and Towns TIC and Website	County Website and NIXAL
Mountain Line Website and FLGRide	POE Roadway Inspection Systems

Public Private Traveler Information	Tribal TMC and TIC
Wide Area Alerting Systems	YCAT Website
FIELD EQUIPMENT	
Border Inspection System	
POE Roadway Inspection Systems	US VISIT System
Commercial Vehicle Check Equipment	
ADOT Electronic Bypass Stations	ADOT WIM Stations
DPS Roadside Safety Inspection	
Connected Vehicle Roadside Equipment	
ADOT CV Roadside Equipment	ADOT Maintenance Work Zone Field Equipment
Electric Charging Station	
Field Support Equipment	
Intermodal Terminal	
ITS Roadway Equipment	
ADOT DUST System	ADOT ITS Field Equipment
ADOT Mainline Detection	ADOT Maintenance Work Zone Field Equipment
ADOT Roadside Comm Equipment	ADOT RWIS
Cities and Towns ITS Field Equipment	Cities and Towns Weather Flood Alerts
Cities and Towns Weather Flood Alerts	County Flood Warning System
County ITS Field Equipment	County Mobile App
NAIPTA ITS Field Equipment	NDOT ITS Field Equip
Rail Grade Wayside Warning Systems	Tribal ITS Field Equipment
ITS Roadway Payment Equipment	
Parking Management System	
ADOT Right of Way Parking	Mountain Line Bus Arrival System
Private Transit Routing Service Provider	YCAT Kiosks
YCAT Transit Passes	
Security Monitoring Equipment	
TRAVELER DEVICES	
Personal Information Device	
Personal Information Devices for Travelers	Private Transit Routing Service Provider
Social Networking Services	
Traveler Support Equipment	
County Transit Kiosks	
VEHICLES	
Basic Vehicle	
Basic Private Vehicle	
Commercial Vehicle OBE	
Commercial Vehicles	
Emergency Vehicle OBE	
ADOT ECD Vehicles	ADOT Mobile EM Center
Cities and Towns Police and Fire Vehicles	County Sheriffs Vehicles
DEMA National Guard Vehicles	DPS RMA Vehicles
DPS Vehicles	Emergency Medical Transport/Ambulances
Tribal Police and Fire Vehicles	US Border Patrol Vehicles
Freight Equipment	
Freight Containers	
Maint and Constr Vehicle OBE	
ADOT Construction Vehicles	ADOT Regional Traffic Ops Vehicles
ADOT Systems Maintenance Vehicles	Cities and Towns MCO Vehicles

County Public Works Vehicles	
Transit Vehicle OBE	
Cities and Towns Transit Vehicles	Independent School District Buses
Local Dial-A-Ride Transit Vehicles	Mountain Lift Paratransit Vehicles
Mountain Line Transit Buses	Transit Provider Vehicles
Tribal Transit Vehicles	YCAT Buses
Vehicle OBE	
Private Vehicles	

Source: AZ ITS Architecture RAD-IT Database

7.2 Interfaces

While it is important to identify the stakeholders and system inventory as part of the AZ ITS Architecture, a primary purpose of the architecture is to identify the connectivity among transportation, emergency management, maintenance and other systems in Arizona.

The physical view shown in figure 6 illustrates a high-level relationship of the classes and the subsystems. Within the subsystems, physical objects are shown that support the statewide ITS program. The ITS elements associated with each physical object represent services that can be deployed as an integrated capability and the physical diagrams show the information flows between those elements that are most important to the operation of the ITS elements.

Identifying the connections or interconnects between the ITS elements (physical objects) creates the framework for integration that will support the exchange of information. Interface requirements and information exchanges with planned and existing elements are a federal required component of any statewide or regional ITS architecture.

RAD-IT was designed to identify connections between physical objects in the system inventory that support selected services or service packages. Although RAD-IT identifies all potential connections between ITS elements based on ARC-IT, it pre-selects those connections required to support the desired services. A thorough and intense process, of evaluating interconnects and flows for all key agencies in the state, was required to confirm and/or eliminate connections. Once connections and flows were defined, a customized set of diagrams for the Statewide ITS Architecture were generated. Two types of graphics are produced: interconnect diagrams and information flow or context diagrams.

7.2.1 Interconnect Diagrams

Interconnect Diagrams illustrate how a specific element within the architecture connects to other relevant elements in the Statewide Architecture.

For example, **FIGURE. 7 Interconnect Diagram for Service Package TM01 – ADOT Infrastructure Based Traffic Surveillance** represents an interconnect diagram. This diagram shows the connectivity between field elements, the ADOT TOC and traveler information dissemination. Each block in the diagram represents an ITS element. The name of the stakeholder is in the top shaded portion of the block and the element name is below it. The interconnect lines between the elements are solid or

dashed indicating existing or planned connections. All the interconnect diagrams for service packages are presented in **Appendix E.**

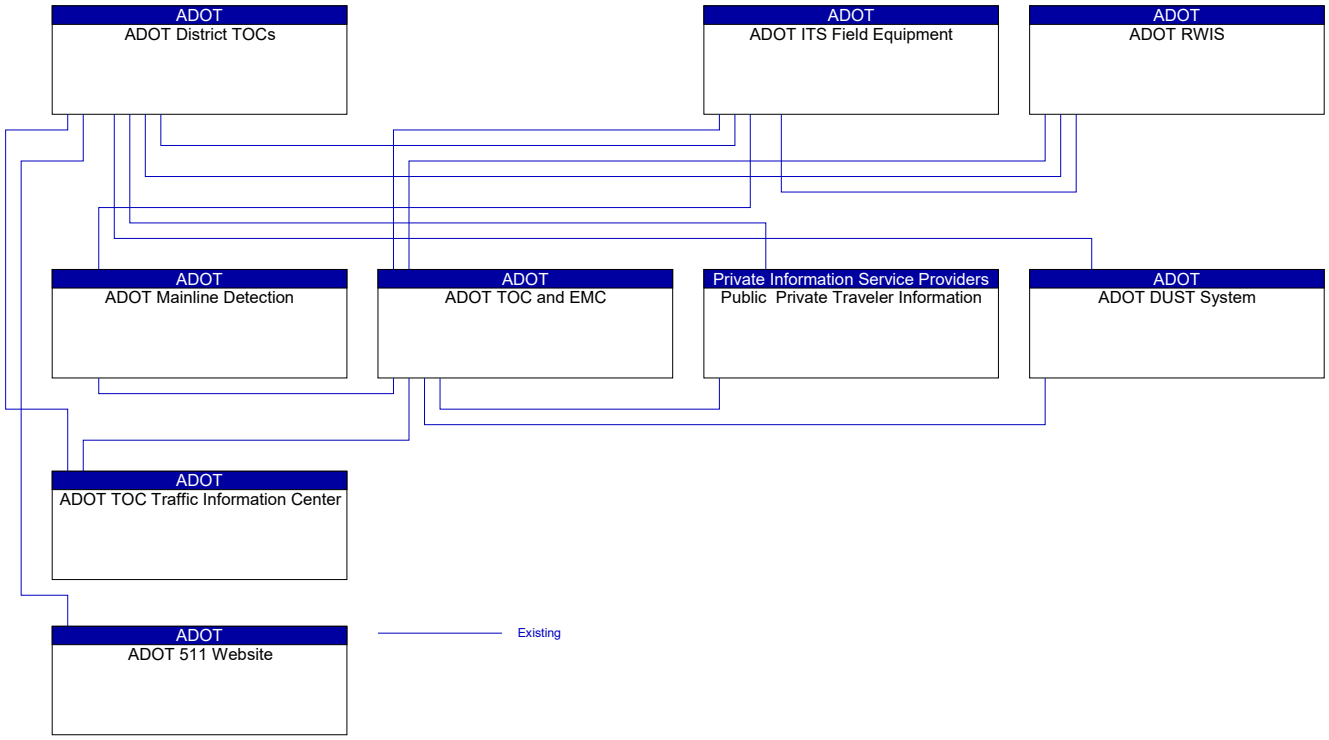

FIGURE 7. Interconnect Diagram for Service Package TM01 – ADOT Infrastructure Based Traffic Surveillance

In addition there are context diagrams that show how elements are connected. An example context diagram is shown in **FIGURE 8. Context Diagram for ADOT Dust System** context diagrams are shown in **Appendix F**. **Interconnect Context Diagrams** presents the context diagrams for each element.

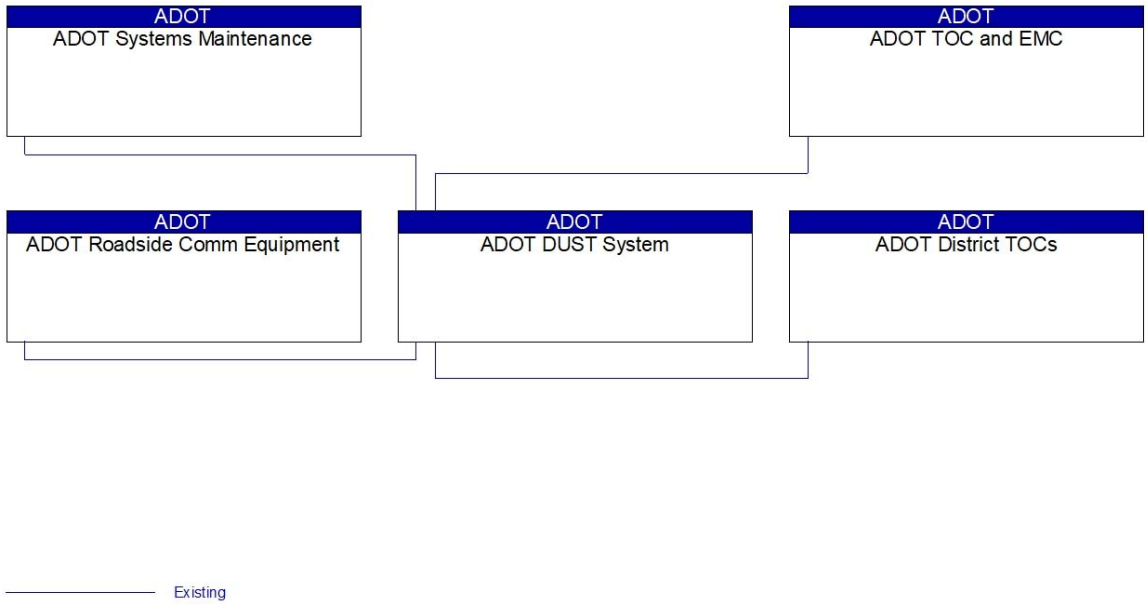

FIGURE 8. Context Diagram for ADOT Dust System

TABLE 6. Interconnects represents a partial list of the associated innerconnects with this AZ ITS Architecture.

TABLE 6. INNERCONNECTS

Element 1	Element 2	Status
AAMVA Driver and Vehicle Verification Systems	AAMVA IRP Clearinghouse	Existing
AAMVA Driver and Vehicle Verification Systems	ADOT ECD CVO Administration Center	Existing
AAMVA Driver and Vehicle Verification Systems	ADOT ECD Dispatch	Existing
AAMVA Driver and Vehicle Verification Systems	ADOT Electronic Bypass Stations	Existing
AAMVA Driver and Vehicle Verification Systems	ADOT Motor Vehicle Division (MVD) Database	Existing
AAMVA Driver and Vehicle Verification Systems	ADOT MVD Commercial Vehicle Administration	Existing
AAMVA Driver and Vehicle Verification Systems	Commercial Vehicles	Planned
AAMVA Driver and Vehicle Verification Systems	DPS and FSP Dispatch	Existing
AAMVA Driver and Vehicle Verification Systems	DPS Commercial Vehicle Enforcement	Existing
AAMVA Driver and Vehicle Verification Systems	DPS Data Archive	Existing
AAMVA Driver and Vehicle Verification Systems	DPS Roadside Safety Inspection	Existing
AAMVA Driver and Vehicle Verification Systems	Financial Institution	Planned
AAMVA Driver and Vehicle Verification Systems	Fleet Management Systems	Existing
AAMVA Driver and Vehicle Verification Systems	Freight Shipping System	Existing

Source: AZ ITS Architecture RAD-IT Database

Appendix G. Interconnects presents all of the interconnects between the elements and identifies the status for each path.

7.2.2 Information Flow Diagrams

Information Flow Diagrams graphically depict the types of information flowing between the subsystems. Flow definitions are presented in **APPENDIX H. Flow Definitions**. They represent the next level of detail to the Interconnect Diagram and depict ITS integration by illustrating the type of information shared. As with Interconnect Diagrams, Information Flow Diagrams are presented for both Service Packages and Context Diagrams. **FIGURE 9. Information Flow for Service Package CVO06 ADOT Freight Signal Priority** shows information flowing between the ADOT TOC and ITS Field Equipment. Each block represents an ITS inventory element, including the name of the stakeholder in the top shaded portion, with the information flows being solid or dashed indicating existing or planned connections. In addition, the information flow diagrams show the source and destination of information. **FIGURE 10. Flow Context Diagram for ADOT Construction Vehicles** illustrates the flows related to the element.

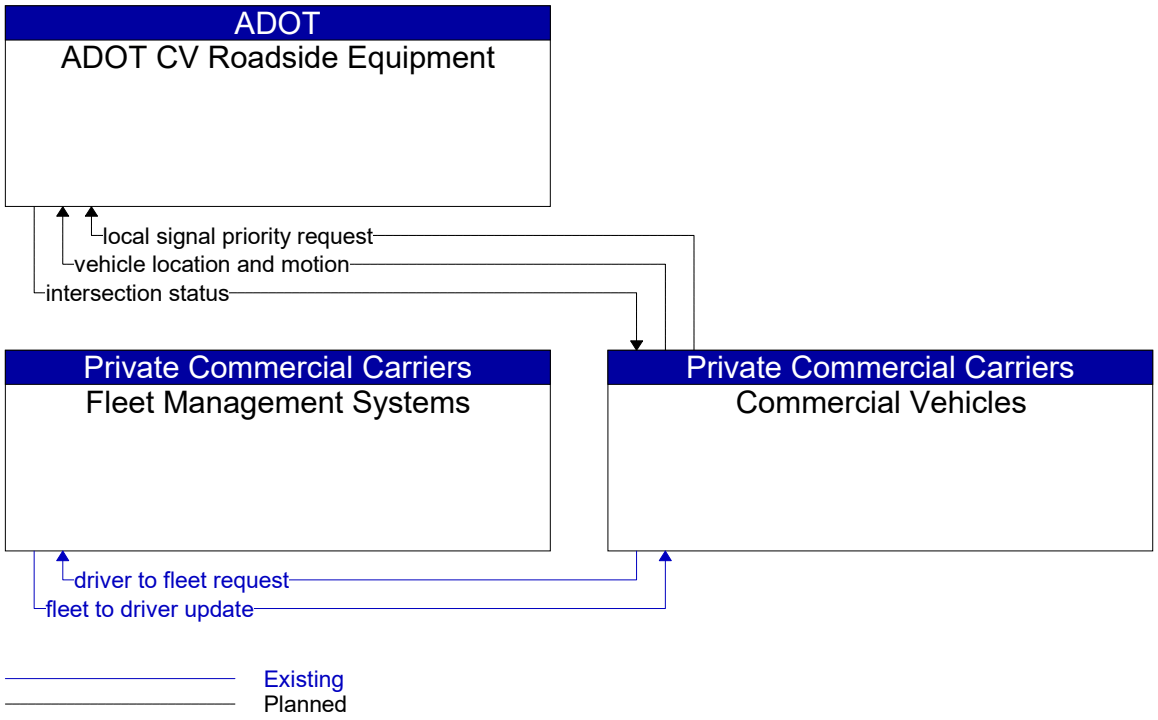

FIGURE 9. Information Flow for Service Package CVO06 ADOT Freight Signal Priority

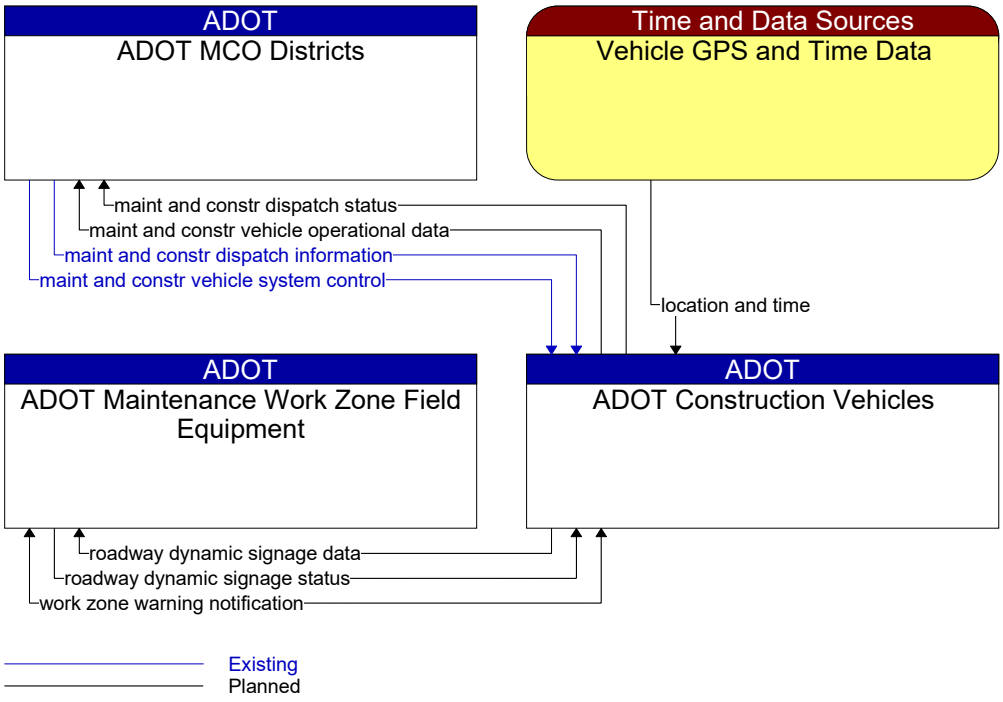

FIGURE 10. Information Flow for the ADOT Construction Vehicles

APPENDIX I. Flow Service Package Diagrams and **APPENDIX J. Flow Context Diagrams** illustrate all of the flows between services packages or elements.

TABLE 7. Information Flows represents a partial list of the associated information flows with this AZ ITS Architecture.

TABLE 7 . INFORMATION FLOWS

Source Element	Destination Element	Flow Name	Flow Status
AAMVA Driver and Vehicle Verification Systems	AAMVA IRP Clearinghouse	accident report	Planned
AAMVA Driver and Vehicle Verification Systems	AAMVA IRP Clearinghouse	archive requests	Existing
AAMVA Driver and Vehicle Verification Systems	AAMVA IRP Clearinghouse	archive status	Existing
AAMVA Driver and Vehicle Verification Systems	AAMVA IRP Clearinghouse	border clearance status	Existing

Source: AZ ITS Architecture RAD-IT Database

Appendix K. Information Flows lists all flows between the elements.

8.0 FUNCTIONAL REQUIREMENTS

Functional requirements define the tasks or activities that individual subsystems perform. For example, The TOC is responsible for traffic surveillance, freeway management and incident detection. Each of these activities involve numerous subtasks: traffic surveillance involves collecting and analyzing traffic sensor data, monitoring and controlling CCTV and distributing surveillance information to other entities. Therefore, high level functional requirements are defined for the selected subsystems.

TABLE 8. Functional Requirements shows the partial listing while the entire list is presented in **APPENDIX L. Functional Requirements.**

TABLE 8. FUNCTIONAL REQUIREMENTS

Element Name	Physical Object Name	Functional Object	Functional Object Description	Requirement Number	Requirement	Status
AAMVA Driver and Vehicle Verification Systems	Archived Data System	Archive Data Repository	Archive Data Repository' collects data and data catalogs from one or more data sources and stores the data in a focused repository that is suited to a particular set of ITS data users. It includes capabilities for performing quality checks on the incoming data, error notification, and archive to archive coordination. It supports a broad range of implementations, ranging from simple data marts that collect a focused set of data and serve a particular user community to large-scale data warehouses that collect, integrate, and summarize transportation data from multiple sources and serve a broad array of users within a region. Repositories may be established to support operations planning, performance monitoring and management, and policy and investment decisions.	1	The archived data system shall collect data from other centers.	Planned

Source: AZ ITS Architecture RAD-IT Database

9.0 OPERATIONAL CONCEPT

The operational concept defines the roles and responsibilities of participating key stakeholders in the implementation and operation of the state's transportation system. It is a high-level description of the ITS system and provides a big picture view of how the services will be performed in the state and the stakeholders' general responsibilities in providing the service.

ARC-IT uses the Enterprise Viewpoint, addressing the relationships between organizations and users, and the roles those entities play in the delivery and consumption of ITS services. Relationships between entities are dependent on the roles those entities take in the delivery of user services. **TABLE 9. Roles and Responsibilities** presents an example of roles and responsibilities. The complete list of roles and responsibilities is included in **APPENDIX M. Roles and Responsibilities.**

TABLE 9. ROLES AND RESPONSIBILITIES

RR Area Name	RR Area Description	Stakeholder	RR Description	RR Status
Commercial Vehicle Operations for Arizona	Arizona Commercial Vehicle Operations (CVO) statewide operate at one or more fixed locations within Arizona. The state CVO performs administrative functions supporting credentials, tax, and safety regulations. It issues credentials, collects fees and taxes, and supports enforcement of credential requirements. The Statewide CVO communicates with the Fleet Management Subsystems associated with the motor carriers to process credentials applications and collect fuel taxes, weight/distance taxes, and other taxes and fees associated with commercial vehicle operations. CVO also receives applications for, and issues special Oversize/Overweight and HAZMAT permits in coordination with other cognizant authorities. The subsystem coordinates with other Commercial Vehicle Administration Subsystems (in other states/regions) to support nationwide access to credentials and safety information for administration and enforcement functions. This subsystem supports communications with Commercial Vehicle Check Subsystems operating at the roadside to enable credential checking and safety information collection. The collected safety information is processed, stored, and made available to qualified stakeholders to identify carriers and drivers that operate unsafely.	ADOT	Participate in electronic credentialing and safety screening programs.	Existing

Source: AZ ITS Architecture RAD-IT Database

10.0 IMPLEMENTATION

10.1 Project Sequencing

ITS projects are implemented on a project-by-project basis, whether stand alone or as part of a larger transportation improvement. These projects must be coordinated between the services identified in the architecture and actual projects programmed in stakeholder Transportation Improvement Programs (TIP) throughout the state.

As part of the statewide architecture outreach, the team asked stakeholders to begin identifying preferred ITS services and the associated ITS projects to implement them. This process helped define operations objectives which defined projects. **TABLE 10. Project Sequencing by Stakeholder** links the projects to the Statewide ITS Architecture. It accomplishes this by describing the ITS services that it supports. The projects are then related to corresponding service packages. **APPENDIX N. Project V. Service Package Summary.**

TABLE 10. PROJECT SEQUENCING BY STAKEHOLDER

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT Active Traffic Management on I-17: SR101L to I-10	This project equips I-17 from SRL101L to I-10 with active traffic management methods and field elements to increase peak capacity, smooth traffic flows and enhance safety. Methods may include variable speed limits, adaptive ramp metering, queue protection, lane management, wrong way detection and traveler information. Source: FY2018 ADOT STIP 2017-2021.	SHORT: 2017-2021	I-17: SR101L to I-10	Active Traffic Management (ATM)
ADOT Active Traffic Management on US60: I-10 to Higley	This project equips US60 from I-10 to Higley with active traffic management methods and field elements to increase peak capacity, smooth traffic flows and enhance safety. Methods may include variable speed limits, adaptive ramp metering, queue protection, lane management, wrong way detection and traveler information. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	US60: I-10 to Higley	Active Traffic Management (ATM)

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT Adaptive Ramp Metering on SR101L	This project enhances the existing ramp metering capabilities to improve throughput and reduce congestion by controlling access onto the freeway using real-time data. Adaptive ramp metering balances traffic volumes on the local arterials, considers queues on the entrance ramps and monitors freeway conditions. The arterials, freeway, and ramps are equipped with detectors that collect traffic data which is processed using complex algorithms This project converts the existing system to adaptive ramp metering in the Phoenix Metropolitan Area. Source: Loop 101 Mobility Partnership funded by the Federal Highway Administration 2017 Advanced Transportation and Congestion Management Technologies Deployment Grant	SHORT: 2017-2021	SR101L Corridor	Adaptive Ramp Metering
ADOT Alternate Route Notification - Statewide	This project will develop a decision support system (DSS) for statewide integrated and proactive management to inform drivers of alternative route selections through instrumented and communicative infrastructure. This process also includes data warehousing such as data acquisition, storage, and archiving. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Statewide	Decision Support Systems (DSS) and data warehousing
ADOT Alternative Truck Routing on I-10	Arizona Department of Transportation in collaboration with the I-10 Corridor Coalition will develop an integrated corridor management (ICM) decision support system (DSS) for truck routing and operations using real-time traffic data on I-10. Source: I-10 Western Connected Freight Corridor Concept of Operations Study 2018.	MEDIUM: 2022-2025	I-10 Corridor throughout the state of Arizona	Decision Support System (DSS) for truck routing
ADOT CCTV Installation in Northcentral District	Arizona Department of Transportation plans to install CCTV cameras in the Northcentral District of Arizona. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Various locations throughout the Northcentral District	Install ITS Field Elements (CCTV)
ADOT Crash Ahead Warning System with Queue Protection on I-17	This project includes the installation of a crash ahead warning system on rural I-17 for southbound traffic on the downgrade to reduce secondary crashes within the Northcentral District Area. Equipment may include DMS, solar speed feedback signs and solar warning signs. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Rural I-17within the Northcentral District Area	Crash Ahead Warning System with queue protection

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT CVO Enforcement Applications	Arizona Department of Transportation in collaboration with the I-10 Corridor Coalition will develop smart roadside initiatives that may include electronic screening for vehicle and driver credentials, virtual weigh stations and additional inspection stations. Source: I-10 Western Connected Freight Corridor Concept of Operations Study 2018.	MEDIUM: 2022-2025	I-10 Corridor	CVO Enforcement
ADOT CVO Freight Traveler Information System on I-10	In order to improve trucking operations and give drivers the ability to make routing decisions, Arizona Department of Transportation in collaboration with the I-10 Corridor Coalition will develop and deploy a Freight Traveler Information System to provide real-time information on port congestion, weather conditions, roadway conditions and incidents. In addition, this system may provide routing for hazardous materials shipping with routing pre-clearance. Source: I-10 Western Connected Freight Corridor Concept of Operations Study 2018.	MEDIUM: 2022-2025	I-10 Corridor	Traveler Information System - freight operations
ADOT CVO Truck Parking Information and Management System on I-10	n order to improve efficiency, economic competitiveness, way-finding and safety, Arizona Department of Transportation in collaboration with the I-10 Corridor Coalition will develop and deploy a system to provide truck drivers with reliable real-time information to make smarter more efficient parking decisions. The system will identify available parking options and the capacity of truck parking lots using advanced parking technologies and communicate the parking availability to commercial vehicle operators in real-time. Source: I-10 Western Connected Freight Corridor Concept of Operations Study 2018.	SHORT: 2017-2021	I-10 Corridor	Smart Truck Parking Information and Management
ADOT CVO Truck Platooning on I-10	Arizona Department of Transportation in collaboration with the I-10 Corridor Coalition will integrate truck platooning technologies into the I-10 Corridor features. Truck platooning uses vehicle to vehicle communications allowing multiple trucks to closely follow the other. Source: I-10 Western Connected Freight Corridor Concept of Operations Study 2018.	SHORT: 2017-2021	I-10 Corridor	Truck Platooning

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT CVO Truck Queue Protection on I-10	Arizona Department of Transportation in collaboration with the I-10 Corridor Coalition will develop safety applications including the installation of a queue protection system on I-10 to reduce secondary crashes along the I-10 corridor. Equipment may include DMS, speed feedback signs, vehicle on-board equipment and warning signs. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	I-10 Corridor	Truck Queue Warning
ADOT DUST Installation	ADOT plans to install new DUST weather systems in various locations throughout the state. The DUST alerting system is designed to alert drivers of dangerous conditions in areas that are prone to blowing dust. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Various locations Statewide	Weather Information
ADOT FMS at locations TBD	ADOT is expanding their freeway management system (FMS) to include node buildings, fiber, CCTV, DMS, ramp meters, and mainline detection. Source: ADOT STIP 2017-2021 record number 16589	SHORT: 2017-2021	Phoenix Metropolitan Area	Freeway Management System (FMS)
ADOT FMS on I-10: Cotton Lane to Litchfield Road	ADOT is expanding their freeway management system (FMS) to include node buildings, fiber, CCTV, DMS, ramp meters, and mainline detection. Source: ADOT STIP 2017-2021	SHORT: 2017-2021	I-10: Cotton Lane to Litchfield Road	Freeway Management System (FMS)
ADOT FMS on I-10: I-19 to Colb Road	ADOT is expanding their freeway management system (FMS) to include node buildings, fiber, CCTV, DMS, ramp meters, and mainline detection. Source: Stakeholder Interviews	MEDIUM: 2022-2025	I-10: I-19 to Colb Road	Freeway Management System
ADOT FMS on SR303L: I-10 to Northern Avenue	ADOT is expanding their freeway management system (FMS) to include node buildings, fiber, CCTV, DMS, ramp meters, and mainline detection. Source: ADOT STIP 2017-2021	SHORT: 2017-2021	SR303L: I-10 to Northern Avenue	Freeway Management System (FMS)
ADOT FMS on SR303L: Lake Pleasant Pkwy to I-17	ADOT is expanding their freeway management system (FMS) to include node buildings, fiber, CCTV, DMS, ramp meters, and mainline detection. Source: ADOT STIP 2017-2021	SHORT: 2017-2021	SR303L: Lake Pleasant Pkwy to I-17	Freeway Management System (FMS)
ADOT FMS on SR303L: Northern Avenue to Clearview Boulevard	ADOT is expanding their freeway management system (FMS) to include node buildings, fiber, CCTV, DMS, ramp meters, and mainline detection. Source: ADOT STIP 2017-2021	SHORT: 2017-2021	SR303L: Northern Avenue to Clearview Boulevard	Freeway Management System (FMS)
ADOT FMS on US60: Crimson Road to Idaho Road	ADOT is expanding their freeway management system (FMS) to include node buildings, fiber, CCTV, DMS, ramp meters, and mainline detection. Source: ADOT STIP 2017-2021	SHORT: 2017-2021	US60: Crimson Road to Idaho Road	Freeway Management System (FMS)

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT FMS Preservation - Phase I	These types of projects include the preservation of existing FMS elements. ADOT has significant costs involved in preserving and/or replacing FMS elements. In addition, this project includes updating ITS elements to the current technology. Source: ADOT STIP 2017-2021	SHORT: 2017-2021	Phoenix Metropolitan Area	Freeway Management System (FMS)
ADOT FMS Preservation - Phase II	These types of projects include the preservation of existing FMS elements. ADOT has significant costs involved in preserving and/or replacing FMS elements. In addition, this project includes updating ITS elements to the current technology. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Phoenix Metropolitan Area	Freeway Management System (FMS)
ADOT FMS Preservation - Phase III	These types of projects include the preservation of existing FMS elements. ADOT has significant costs involved in preserving and/or replacing FMS elements. In addition, this project includes updating ITS elements to the current technology. Source: Stakeholder Interviews	LONG: 2026-2028	Phoenix Metropolitan Area	Freeway Management System (FMS)
ADOT FMS Rehabilitation	Design and construction of FMS rehabilitation for Phases II and III. Source: ADOT STIP 2017-2021 record numbers 16326, 16327 and 16328.	SHORT: 2017-2021	Phoenix Metropolitan Area	Freeway Management System (FMS)
ADOT Integrated Corridor Management on US60: I-10 to SR202L	This project will implement integrated corridor management (ICM) techniques on US60 from I-10 to SR202L to improve travel time reliability and predictability, help manage congestion, optimize throughput and provide travelers with improved information and routing options. In addition, this project will develop ICM deployment alternatives and identify ICM strategies for US60 and the available parallel alternative routes. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	US60: I-10 to SR202L	Integrated Corridor Management (ICM)
ADOT Main Trunkline Fiber Optic Expansion	Arizona Department of Transportation plans to expand the fiber optic communications on I-10 south toward Tucson and on I-8. These projects include the installation of conduit, pull boxes, fiber optic cable, power and node centers in Southcentral District. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	I-10 and I-18 in the Southcentral District	Communications - fiber trunk line
ADOT Radar Speed Feedback Signs	This project includes the installation of radar speed feedback signs at various locations Statewide. Source: Stakeholder Interviews	SHORT: 2017-2021	Statewide	Install ITS Field Elements

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT Roadway Lighting System	This Arizona Department of Transportation project will extend the LED roadway lighting operability pilot installation to enhance cost savings associated with LED roadway lighting conversions. Data is collected and stored including on-off status, power demand, and energy use for each fixture. This system allows the operator to turn fixtures on/off remotely and invoke dimming of individual fixtures. Source: Stakeholder Interviews	SHORT: 2017-2021	Phoenix Metropolitan Area	Roadway Lighting Management
ADOT Rural DMS Installation - Phase I	Arizona Department of Transportation will install rural Dynamic Message Signs (DMS) at various locations statewide. This project will allow for a greater distribution of traveler and emergency information to the public. Source: ADOT STIP 2017-2021 record number 15372	SHORT: 2017-2021	Various locations in rural areas throughout Arizona	Install ITS Field Elements (DMS)
ADOT Rural DMS Installation - Phase II	Arizona Department of Transportation will install rural Dynamic Message Signs (DMS) at various locations statewide. This project will allow for a greater distribution of traveler and emergency information to the public. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Various locations in rural areas throughout Arizona	Install ITS Field Elements (DMS)
ADOT Rural DMS Installation - Phase III	Arizona Department of Transportation will install rural Dynamic Message Signs (DMS) at various locations statewide. This project will allow for a greater distribution of traveler and emergency information to the public. Source: FY2018 ADOT P2P Master Project List - TSMO	LONG: 2026-2028	Various locations in rural areas throughout Arizona	Install ITS Field Elements (DMS)
ADOT Rural Traveler Communications	These projects give travelers additional information to make informed decisions on route selection by posting travel times on Dynamic Message Signs (DMS) throughout the rural areas of Arizona. Source: Stakeholder Interviews.	MEDIUM: 2022-2025	Rural areas of Arizona.	DMS Installation
ADOT RWIS Installation	Arizona Department of Transportation plans to install new roadway weather information systems (RWIS) at various locations throughout the state of Arizona. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Various locations Statewide	Roadway Weather Information Systems (RWIS)
ADOT RWIS Portable	Arizona Department of Transportation plans to construct portable trailer mounted roadway weather information systems (RWIS). Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Various location Statewide, as needed	Roadway Weather Information Systems (RWIS)

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT RWIS Upgrade	Arizona Department of Transportation plans to upgrade their existing roadway weather information systems (RWIS) at various locations throughout the State in order to bring technology up to current standards and maintain integrity of existing RWIS. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Various locations Statewide	Roadway Weather Information Systems (RWIS)
ADOT SPaT on Grand Avenue	ADOT to deploy dedicated short range communications (DSRC) equipment on Grand Avenue with signal phasing and timing (SPaT) broadcasts and MAP/GID data (a detailed data file that describes the physical intersection). The SPaT message will define the current intersection signal light phases and time remaining as well as any active pre-emption or priority. Source: Stakeholder Interviews	SHORT: 2017-2021	Phoenix Metropolitan Area	Signal Priority and Timing (SPaT)
ADOT Traffic Signal Interchange Integration	This project integrates interchange signal timing with ramp metering operations to provide optimized flow. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Phoenix Metropolitan Area	Traffic Signal Integration with Ramp Meter Characteristics
ADOT Travel Time	Once completed, these projects give travelers additional information to make informed decisions on route selection by posting travel times on Dynamic Message Signs (DMS) throughout the Phoenix Metropolitan Area. Source: ADOT STIP 2017-2021 record numbers 14600,15773, 15774, 16330 and 16590	SHORT: 2017-2021	Phoenix Metropolitan Area	Traveler Information - travel time
ADOT Vehicle Probe Data	ADOT will collect third party data	SHORT: 2017-2021	Statewide	Traveler information and distribution
ADOT VSL on I-40	Arizona Department of Transportation plans to install variable speed limits (VSL) on I-40 using decision support systems (DSS) for winter operations. Source: FY2018 ADOT P2P Master Project List - TSMO	MEDIUM: 2022-2025	Various locations on I-40	Variable Speed Limits using DSS for winter operations.
ADOT VSL on Urban Freeways	This project installs variable speed limits (VSL) and the associated systems on Urban Freeways within the Phoenix Metropolitan Area. Source: Stakeholder Interviews	MEDIUM:2022-2025	Phoenix Metropolitan Area	Install ITS Field Equipment
ADOT WIM - Phase I	This project installs Weigh in Motion (WIM) at various locations throughout the State Source: ADOT MPD/ECD/IDO	SHORT: 2017-2021	Various locations Statewide	Weigh in Motion (WIM)
ADOT WIM - Phase II	This project installs Weigh in Motion (WIM) at various locations throughout the State. Source: ADOT MPD/ECD/IDO	MEDIUM: 2022-2025	Various locations Statewide	Weigh in Motion (WIM)

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT WIM - Phase III	This project installs Weigh in Motion (WIM) at various locations throughout the State. Source: ADOT MPD/ECD/IDO	LONG: 2026-2028	Various locations Statewide	Weigh in Motion (WIM)
ADOT/MCDOT Adaptive Signal Control Technology on Bell Road	Arizona Department of Transportation and Maricopa County Department of Transportation in collaboration with others are partnered together to reduce congestion and improve safety on the Bell Road corridor. This Bell Road project will install vehicle detectors, purchase hardware, and acquire software licenses to deploy one to four real time Adaptive Signal Control Technology (ASCT) systems at specific locations along 15.6 miles (52 signalized intersections) of Bell Road to improve traffic operations in the Cities of Surprise, Peoria, Glendale, Phoenix and Scottsdale. MCDOT and ADOT intersections within these areas will also be included. Source: Stakeholder Interviews	SHORT: 2017-2021	4 project areas along the Bell Road Corridor that include the interchanges of SR303L, SR101L Glendale, SR101L Scottdale and I-17	Addaptive Signal Control Technology (ASCT)
ADOT/MCDOT Adaptive Traffic Signal Control on SR101L	Arizona Department of Transportation and Maricopa County Department of Transportation in collaboration with others will provide enhanced signal timing technologies to improve cross jurisdictional signal operations during integrated corridor management (ICM) or other events that generate atypical volumes or flows. This project will use new adaptive signal control technology (ASCT) to adjust the signal timing on pre-determined arterial corridors in response to real time traffic patterns and congestion near Loop 101 in the Phoenix Metropolitan Area. Source: Loop 101 Mobility Partnership funded by the Federal Highway Administration 2017 Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Grant	SHORT: 2017-2021	Phoenix Metropolitan Area	Adaptive Signal Control Technology (ASCT) for key arterial corridors

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT/MCDOT Arizona Connected Vehicle Program Expansion	Arizona Department of Transportation and Maricopa County Department of Transportation in collaboration with University of Arizona and others partnered together to develop the Arizona Connected Vehicle Program. This test bed includes all signalized intersections within the Anthem Community including the I-17/Daisy Mountain Drive Interchange. Multi Modal Intelligent Traffic Signal System (MMITSS) was selected as the signal priority/optimization system that operates in a connected vehicle environment to service all modes of transportation, including passenger vehicles, transit, emergency vehicles, freight fleets, bicycles and pedestrians. This project will expand connected vehicle applications along the existing test bed. New applications may include but are not limited to audible pedestrian times for walk/dont walk that are dependent upon pedestrian's location, freight priority, transit priority, work zone enhancements, incident alerting, data archive improvements, and overall testbed expansion including additional intersections and ADOT I-17 interchanges in the region. Source: Stakeholder Interviews	SHORT: 2017-2021	Phoenix Metropolitan Area	Signal Priority - Multimodal Intelligent Traffic Signal System (MMITSS)
ADOT/MCDOT CV Applications for Transit and Incident Response Vehicles on SR101L	Arizona Department of Transportation and Maricopa County Department of Transportation in collaboration with others will outfit transit vehicles with routes along Loop 101 or the adjacent arterials with connected vehicle technology to support transit priority along specific corridors. Connected Vehicle technologies will also be used for Regional Emergency Action Coordination Team (REACT) and Arizona Local Emergency Response Team (ALERT) vehicles to improve incident response and responder safety through intelligent priority for responders.	SHORT: 2017-2021	SR101L	Connected Vehicle Applications for Transit and Incident Response Vehicles
ADOT/MCDOT CVO Freight Signal Priority on I-10 and MC85	Provide truck priority connected vehicle applications on I-10 and MC 85 in the Phoenix Metropolitan Area. This connected vehicle application will assign freight signal priority to heavy vehicles moving goods between warehouses along the equipped corridors. Source: Stakeholder Interviews	SHORT: 2017-2021	I-10 and MC85 in the Phoenix Metropolitan Area	Signal Priority for Freight

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT/MCDOT CVO ITD on I-10 and SR85	Provide the Innovative Technology Deployment (ITD) Program (formerly known as CVISN), an electronic credentialing system, enforcement operation and WIM, on I-10 and SR85 to improve safety, efficiency and productivity of commercial vehicle operations through development of a unified national information technology (IT) architecture that Arizona can adapt to meet business conditions and operating environment. Source: Stakeholder Interviews	SHORT: 2017-2021	I-10 and MC85 in the Phoenix Metropolitan Area	CVO Electronic Credentialing
ADOT/MCDOT Decision Support System on SR101L	Arizona Department of Transportation and Maricopa County Department of Transportation in collaboration with others are partnered together to develop a decision support system (DSS) that will collect and use real time data from agencies and private sector partners to model, assess and recommend the best set of integrated corridor management (ICM) responses. It will also support performance measurement and evaluation of impacts of the DSS. Source: Loop 101 Mobility Partnership funded by the Federal Highway Administration 2017 Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Grant	SHORT: 2017-2021	SR101L	Decision Support System (DSS)
ADOT/MCDOT Integrated Traveler Mobility on SR101L	Arizona Department of Transportation and Maricopa County Department of Transportation in collaboration with others are partnered together to implement an integrated traveler mobility project that will improve data exchange between the transportaiton network and teh travelers that are interacting with it. The app will facilitate improved data and information exchanges between the app users and the overall ICM application and DSS in real-time and will include optimum route and travel time information based on the DSS recommendations. Loop 101 Mobility Partnership funded by the Federal Highway Administration 2017 Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Grant	SHORT: 2017-2021	SR101L	Traveler Information - app users in real time including optimum route and travel time information.

Project	Description	Timeframe	Geographic Area	Service Scope
ADOT/MCDOT RADS Expansion	Enhance and expand the Regional Archive Data System (RADS) database. RADS is the Phoenix Metropolitan Area data repository system and associated data processing engines that analyze existing data to create new information while providing new services to transportation operators and the traveling public. Source: Loop 101 Mobility Partnership funded by the Federal Highway Administration 2017 Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Grant	SHORT: 2017-2021	Phoenix Metropolitan Area	Archive Database - RADS Expansion
Casa Grande EOC	Upgrade Emergency Operations Center (EOC) to improve communications during wide area alerts, emergencies, disasters and other EOC activations. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Casa Grande Area	Emergency Operations Center (EOC)
Casa Grande ITS Field Equipment	Add ITS Field Equipment such as CCTV and DMS. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Casa Grande Area	Install ITS Field Elements
Casa Grande TMC	Construct a new Casa Grande TMC and install equipment/software. Connect to ADOT, police, fire, and transit Source: Stakeholder Interviews	LONG: 2026-2028	Casa Grande Area	Construct new TMC
Casa Grande Traveler Information	Develop a traveler information system for travel time, road closures, and weather alerts. Source: Stakeholder Interviews	LONG: 2026-2028	Casa Grande Area	Traveler Information
Casa Grande Weather System	This project will install weather systems to notify travelers of poor weather conditions such as flooding, low visibility and high winds. Source: Stakeholder Interviews	LONG: 2026-2028	Casa Grande Area	Install ITS Field Elements (Weather System)
CYMPO Transit Call Center	Construct a transit call center to improve mobility options and assist people in finding transportation in the Central Yavapai and Northern Arizona Areas. Source: Yavapai Regional Mobility Management Implementation Plan Final Report February 2017	SHORT: 2017-2022	CYMPO and NACOG Regions	Transit Call Center
DPS Backhaul Communications	Upgrade backhaul communications to improve radio coverage. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Statewide	Communications
DPS Console Interface	Upgrade console interface to be compatible with microwave backhaul communications Source: Stakeholder Interviews	LONG: 2026-2028	Statewide	Communications
DPS OBU	Upgrade subscriber OBU's as radio system is enhanced Source: Stakeholder Interviews	MEDIUM: 2022-2025	Statewide	Communications
DPS Radio System	Upgrade radio system that sends information from subscribers to backhaul Source: Stakeholder Interviews	MEDIUM: 2022-2025	Statewide	Communications

Project	Description	Timeframe	Geographic Area	Service Scope
Flagstaff Integration Project	Integrate ITS field equipment with the traffic management center (TMC. Integrate construction, weather information and maintenance information to the TMC. Add website to share information with travelers. Source: Stakeholder Interviews	MEDIUM: 2022-2025	City of Flagstaff	Traveler Information and system integration
Flagstaff ITS Field Equipment	Add ITS Field Equipment such as CCTV and DMS Source: Stakeholder Interviews	MEDIUM: 2022-2025	City of Flagstaff	ITS Field Equipment
Flagstaff Traffic Archive	Develop a Citywide traffic archive database. Source: Stakeholder Interviews	LONG: 2026-2028	City of Flagstaff	Archive database
Flagstaff Traffic Management Center	Construct a traffic management center (TMC) to manage ITS field equipment (e.g., traffic signal operations, CCTV and DMS). Source: Stakeholder Interviews	MEDIUM: 2022-2025	City of Flagstaff	Traffic Management Center
Kingman ITS Field Equipment	Add ITS Field Equipment such as CCTV and DMS Source: Stakeholder Interviews	MEDIUM: 2022-2025	City of Kingman	Install ITS Field Equipment
Kingman Traffic Management Center	Construct a traffic management center (TMC) to manage ITS field elements (e.g., traffic signal operations, CCTV and DMS). Source: Stakeholder Interviews	MEDIUM: 2022-2025	City of Kingman	Traffic Management Center (TMC)
Mohave County Active Traffic Management	This project equips county roads within Mohave County with active traffic management methods and field elements to increase peak capacity, smooth traffic flows and enhance safety. Methods may include speed management with variable speed limits, speed feedback, and queue protection; traffic signal management with emergency priority and DSRC capabilities; incident management; and traveler information using DMS, RWIS and websites. Source: Mohave County Public Works Memo dated September 6, 2017	LONG: 2026-2028	Mohave County	Active Traffic Management (ATM)
Mohave County Data Archive	Mohave County to create a data archive that will collect and store ITS field equipment data for use in real time monitoring of traffic conditions. This information could then be used to show travel time between destinations and re-route guidance. Source: Mohave County Public Works Memo dated September 6, 2017	LONG: 2026-2028	Mohave County Area	Data Archive

Project	Description	Timeframe	Geographic Area	Service Scope
Mohave County Integrated Corridor Management	Mohave County in coordination with Arizona Department of Transportation and others will partner to provide integrated corridor management (ICM) to the area. ICM may include alternate route planning using decision support systems (DSS) in rat time and sharing information for traffic re-routing, freight re-routing and corridor capacity monitoring. Source: Mohave County Public Works Memo dated September 6, 2017	LONG: 2026-2028	Mohave County Area	Integrated Corridor Management
Mohave County ITS Field Equipment	Add ITS Field Equipment such as CCTV and portable DMS. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Mohave County Area	Install ITS Field Equipment
Mohave County Traffic Management Center	Construct a TMC to manage traffic signal operations, CCTV and DMS. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Mohave County Area	Traffic Management Center (TMC)
Mohave County Detection and Surveillance	This project targets continuous traffic data (volume, speed, classification) collection and archiving for select regionally significant roads. It includes real time monitoring of traffic conditions, susceptible to unplanned events and origin destination data collection.	MEDIUM: 2022-2025	Mohave County Area	Detection and surveillance
NAIPTA Transit Center	Construct a Transit Management Center. Source: Stakeholder Interviews	MEDIUM: 2022-2025	NAIPTA Service Area	Transit Management
NAIPTA Transit Field and Vehicle Equipment	Add ITS Transit Field Equipment and equipment to the buses to allow for "next stop" services, and, cameras inside of buses for security, etc. Source: Stakeholder Interviews	SHORT: 2017-2021	NAIPTA Service Area	Transit next stop, transit security, transit tracking, transit fare collection.
Pinal County Integration Project	Integrate ITS field equipment with TMC. Integrate construction, weather information and maintenance information to the TMC. Add website to share information with travelers.	MEDIUM: 2022-2025	Pinal County	Integration of ITS field equipment
Pinal County ITS Field Equipment	Add ITS Field Equipment such as CCTV and portable DMS. Source: Stakeholder Interviews	Short: 2017-2021	Pinal County	Install ITS Field Equipment
Pinal County Traffic Management Center	Construct a TMC to manage traffic signal operations, CCTV and DMS. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Pinal County	Traffic Management Center
Sedona ITS Field Equipment	Add ITS Field Equipment such as CCTV and DMS. Source: Stakeholder Interviews	MEDIUM: 2022-2025	City of Sedona	Install ITS Field Equipment

Project	Description	Timeframe	Geographic Area	Service Scope
Sedona Smart Parking System	City of Sedona in collaboration with other will develop a smart parking system that informs visitors of parking areas, availability and rates. In addition, the system will provide traveler information, way finding and disseminate information to reduce congestion. Source: Verde Valley Master Transportation Plan Final Report by Jacobs Engineering (February2016) - Congestion Management Strategies (page 198)	SHORT: 2017-2021	City of Sedona	Smart Parking System
Sedona Traffic Management Center	Construct TMC to manage traffic signal operations, CCTV and DMS Source: Stakeholder Interviews	MEDIUM: 2022-2025	City of Sedona	Traffic Management for signals, DMS and CCTV
Sierra Vista Adaptive Traffic Signal Control	The City of Sierra Vista will enhance their signal control to provide enhanced signal timing technologies to improve signal operations.	SHORT: 2017-2021	City of Sierra Vista	Traffic Signal Control
Sierra Vista ITS Field Equipment	Add ITS Field Equipment such as CCTV and portable DMS Source: Stakeholder Interviews	MEDIUM: 2022-2025	Sierra Vista	Install ITS Field Equipment
Sierra Vista Traffic Management Center Upgrade	Upgrade the traffic management center (TMC) and install equipment/software. Connect to ADOT, police, fire, transit Source: Stakeholder Interviews	MEDIUM: 2022-2025	Sierra Vista	Traffic Management Center upgrade
Sierra Vista Weather Systems	Install weather systems as required. Source: Stakeholder Interviews	SHORT: 2017-2021	Sierra Vista	RWIS
Sierra Vista Wireless Radio Communications	Enhance Wireless Radio Communications. Source: Stakeholder Interviews	SHORT: 2017-2021	Sierra Vista	Communications (radio)
Tribal Fiber Mainline	Tribal communities plan to build fiber optic communications. These projects include the installation of conduit, pull boxes, fiber optic cable, power and node centers in the tribal regions. Source: Stakeholder Interviews.	SHORT: 2017-2021	Tribal regions of the Hopi Tribe, Navajo Nations, and Gila River Indian Community.	Build a communications backbone. Numerous fiber projects.
Tribal ITS Field Equipment	This project procures portable DMS for traveler information, speed feedback signs to warn drivers of excessive speeds, CCTV, and traffic signal coordination capabilities. Source: Stakeholder Interviews	SHORT: 2017-2022	Tribal Boundaries	Install ITS Field Equipment

Project	Description	Timeframe	Geographic Area	Service Scope
Tribal Traffic Management Center	Construct a TMC to manage traffic signal operations, CCTV and DMS. Source: Stakeholder Interviews	MEDIUM: 2022-2025	Tribal Boundaries	Traffic Management Center (TMC)
Yuma ITS Field Equipment	Add ITS Field Equipment such as CCTV, RWIS, DMS, signal systems and portable DMS Source: Stakeholder Interviews	MEDIUM: 2022-2026	City of Yuma	Install ITS Field Equipment
Yuma Traffic Management Center	Construct TMC to manage traffic signal operations, CCTV and DMS Source: Stakeholder Interviews	LONG: 2026-2028	City of Yuma	Traffic Management Center (TMC)

Source: AZ ITS Architecture RAD-IT Database

11.0 AGREEMENTS

Agreements between stakeholder organizations are necessary to facilitate the integration illustrated in the Statewide ITS Architecture. Any agreement, required for operations including at a minimum those affecting ITS project interoperability, utilization of ITS related standards, and the operation of the projects identified in the regional ITS architecture is required by FHWA Rule 940.9(d)4 and FTA National ITS Architecture Policy Section 5.d.4.

A sample of the agreements that were identified as a part of the stakeholder interviews are presented in **TABLE 11. Agreements**. All of the Agreements are included in **APPENDIX O. Agreements.**

TABLE 11. AGREEMENTS

Agreement Number	Agreement Title	Agreement Type	Agreement Status	Description	Lead Stakeholder	Associated Stakeholders
AG #KR98·052 1TRN	HCRS - ADOT and ADEM Interagency Agreement	Unspecified	Existing	Highway Closure and Road Restriction Subsystem Agreement	ADOT	ADOT
AG #KR98·052 1TRN	HCRS - ADOT and ADEM Interagency Agreement	Unspecified	Existing	Highway Closure and Road Restriction Subsystem Agreement	ADOT	Arizona Division of Emergency and Military Affairs (DEMA)
AG #KR98·052 1TRN	HCRS - ADOT and ADEM Interagency Agreement	Unspecified	Existing	Highway Closure and Road Restriction Subsystem Agreement	ADOT	Federal Highway Administration (FHWA)

Source: AZ ITS Architecture RAD-IT Database

RAD-IT does not include a copy of the agreement within the database. If an agreement is required, the lead stakeholder should be able to provide the agreement using the specified data within the database.

12.0 STANDARDS

For the AZ ITS Architecture to be compliant with the FHWA Rule/FTA Policy, a list of standards must be included for all information flows. A sample of the standards are shown in **TABLE 12. Standards**. All of the standards are included in **APPENDIX P. Standards**.

TABLE 12. STANDARDS

SDO	Document ID	Standard Title	Standard Type	Source Element	Destination Element	Flow Name
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/ Data	ADOT Department Operations Center-EM	City and Towns Transit Dispatch	emergency transit service request
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/ Data	ADOT Department Operations Center-EM	Independent School District Bus Dispatch	emergency transit service request
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/ Data	ADOT Department Operations Center-EM	Local Dial-A-Ride Transit Dispatchers	emergency transit service request
American Public Transportation Association	APTA TCIP-S-001 3.0.4	Standard for Transit Communications Interface Profiles	Message/ Data	ADOT Department Operations Center-EM	Mountain Lift Paratransit	emergency transit service request

Source: AZ ITS Architecture RAD-IT Database

ITS standards are fundamental to the establishment of an open ITS environment that achieves the goals originally envisioned by the USDOT, and are an important component of the information flows in the Statewide ITS Architecture. Standards facilitate deployment of interoperable systems at local, statewide, and national levels without impeding innovation as technology advances and new approaches evolve. The goal is to maintain open standards, which are characterized by:

1. **Interchangeability** – multiple brands of a device on the same communications channel.
2. **Interoperability** – many different types of devices on the same communications channel.
3. **Expandability** – ability to add more ITS devices in the future.

Establishing statewide and national standards for exchanging information among ITS deployments is important not only from an interoperability point of view; but reduces risk and cost since a state can select among multiple vendors for products and applications. Standards help create competition, better products, and lower prices.

There are currently over 100 ITS standards, but not all standards will be used. To conform to federal requirements, the Statewide ITS Architecture only references those standards that are applicable to the state's "pieces of the architecture" selected.

12.1 Standards Development Organizations (SDO)

The National ITS Architecture is a reference framework that spans all ITS standards activities and provides a means of detecting gaps, overlaps, and inconsistencies between the standards. The Logical and Physical Architecture provide a starting point for the standards development activities by identifying the applicable architecture flows and data flows to be standardized in ARC-IT and the way in which the information is exchanged across those interfaces. The following organizations participate in ITS standards activities:

1. American Association of State Highway and Transportation Officials (AASHTO)
2. American National Standards Institute (ANSI)
3. American Public Transportation Association (APTA)
4. American Society for Testing and Materials (ASTM)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. Institute of Transportation Engineers (ITE)
7. National Electrical Manufacturers Association (NEMA)
8. Society of Automotive Engineers (SAE)

The standards that are most widely applicable to ITS deployments are the National Transportation Communications for ITS Protocol (NTCIP) family of standards. NTCIP is a joint product of the National Electronic Manufacturers Association (NEMA), the American Association of State Highway and Transportation Officials (AASHTO), and the Institute of Transportation Engineers (ITE). NTCIP is a family of communication protocols and data definition standards that have been designed for use in all types of systems dealing with the transportation environment, including those for freeways, traffic signals, emergency management, traveler information, and data archiving. It has been adopted by the FHWA to meet the needs and requirements for ITS communication and to ensure that inter-network connectivity is done through industry standard interfaces.

NTCIP standards provide both the rules for communicating (protocols) and the vocabulary (objects) necessary to allow electronic traffic control equipment from different manufacturers to operate with each other as a system. NTCIP is the first set of standards for the transportation industry that allows traffic control systems to be built using a "mix and match" approach with equipment from different manufacturers.

12.1.1 Benefits of Using Standards

The proper use of NTCIP standards is important for several reasons. Standards influence design requirements such as interchangeability, interoperability, interconnect protocol (IP) addressability, and ease of integration. These are key reasons why standards were originally initiated along with these positive features:

1. Standards offer increased flexibility, and eliminate barriers to interagency coordination by reducing the need for reliance on specific equipment vendors and customized one-of-a-kind products.

2. Standards allow a management system to communicate with a mixture of device types over the same communications channel.
3. Standards allow the future expansion of the system to benefit from true competitive bidding, as well as allow other types of ITS elements to be added as exampled by the diagram.

12.1.2 Stages of Development of Standards

There are numerous levels of maturity or stages of development for standards. The process includes:

1. Draft Under Development - During this phase, there are significant changes likely to occur.
2. Draft for Ballot or in Balloting - Standards being voted upon by a committee or working group or are undergoing other SDO procedures.
3. Approved - Standards that have passed all necessary ballots and have been approved by an SDO, but have not yet published.
4. Published -Standards available for purchase and use.
5. Tested/Deployed Standard - Only minor changes are likely to occur in this phase of a standard development.

It is important to understand development phase of the standard especially if a stakeholder is considering the inclusion of specific standards in procurement specifications. Early in the development cycle, there are many changes before approval or publishing, and many standards have yet to undergo testing or initial deployment.

The maturity status of standards can be obtained from http://www.standards.its.dot.gov/ . Other information that can be obtained from this website include status charts for each ITS standard, web links, standards deployments, and standards training courses.

12.1.3 ITS Standards in Procurement Specifications

The use of ITS standards in procurement specifications often depends on how much risk can be afforded. There are often numerous changes to a standard in early development and even some risk of change in a balloted standard. Also, early ITS deployments will likely have suggested improvements to the standard that will require an update via an amendment to the standard (amendments typically pass through the process more quickly). Other information also available includes:

1. ITS Standards Testing shows which standards are being tested, test site information, testing approach, and status
2. ITS Standards Fact Sheets one page, easy to understand summaries of many of the ITS standards

12.1.4 Decision Making Strategies for Standards

Making the best choices for standards depends on multiple factors, including throughput (how much data must be transmitted or received on the interface), network topology (how the ITS systems are connected), and infrastructure (fiber optic lines, leased land lines, etc.), among others. The exact

process for making this decision statewide will be a function of the PDT for the Statewide ITS Architecture maintenance.

In determining when and how to incorporate ITS standards for a given interface, it is critical to understand the relative maturity of the standards. For each potential standard, consider asking:

1. Has the ITS standard been approved or published by the SDOs?
2. Has the ITS standard been adopted by multiple vendors?
3. Has the ITS standard been tested, whether informally by the vendor, or through the formal ITS Standards Testing Program funded by FHWA?
4. Is there an amendment to the ITS standard currently in the works, and if so, how much of the standard will change as a result?

Although the State should create a plan to migrate toward ITS standards conformance, stakeholders should reach consensus on an interim approach if the ITS standards applicable to the state's interfaces are not yet mature.

12.1.5 Relationship to ARC-IT

ARC-IT defines the interfaces and communications requirements for the information flows between physical subsystems. Therefore, ARC-IT is the key to providing a base for the standards needed to support national and statewide interoperability. ARC-IT provides the framework with which to design ITS. The Statewide ITS Architecture was specifically developed to allow multiple design approaches which can be tailored for specific environments and individual needs of the user by defining only required interfaces and their communications.

Interfaces must supply the components with the required data for functionality. In other words, the interface must be standard. The Statewide ITS Architecture supports open communications standards and requires that the interface can network with other communications media by utilizing open standards. The Statewide ITS Architecture also requires that the communications media provide the necessary coverage for each component. If an ARC-IT System is deployed, seamless communications must be available for each information flow. Standards are attached to information flows in ARC-IT. Therefore, RAD-IT contains all the currently relevant ITS standards for the State.