MAG Regional ITS Architecture

Regional ITS Architecture

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1. INTRODUCTION

The purpose of this project is to update the Intelligent Transportation Systems (ITS) Architecture for the Maricopa Association of Governments (MAG) Region. A Regional ITS Architecture (RIA) is a useful tool for planning and implementing ITS within the MAG Region. From a planning perspective, the regional ITS architecture defines the ITS that the stakeholders wish to realize over a given timeframe. The ITS architecture properly and efficiently defines projects so that they build upon one another to be able to achieve the goals and objectives of the Region. The MAG Regional ITS Architecture can identify opportunities for making ITS investments in a more cost-effective fashion, by utilizing inter-agency cooperation during planning, implementation, and operation of these ITS projects.

MAG developed a RIA as part of an ITS Strategic Plan in 2001 which summarized the existing and planned ITS infrastructure as well as the ITS "roadmap" that intended to guide ITS projects and programs in the MAG region for the next 20 years. Since the completion of that project, the amount of ITS infrastructure and level of communications in the MAG Region has increased significantly, as has the integration among agency systems. Furthermore, the National ITS Architecture has been updated to include new services (including expanded emergency management, traffic management and maintenance and construction operations focused services) which need to be reviewed for applicability to the MAG Region. The Federal Highway Administration (FHWA) Final Rule 23 CFR 940 (Rule 940) was adopted which requires that ITS projects, for highways/streets as well as transit, conform to the Rule 940 to be able to receive federal funding.

Along with the ITS infrastructure and communications developing in the Region, the transportation system as a whole has seen significant growth, including an expanded freeway network, additional arterials, and transit services expanding to meet the demands of the Region's growing population and geographic expansion of the metropolitan area. Section 2 of this technical memorandum describes the multimodal transportation network in the MAG Region. MAG is taking this opportunity to capture the expanded deployment and integration of ITS in the Region, and provide a valuable tool for continued project deployment and integration among the MAG member agencies.

The ITS Architecture is intended to serve as a planning tool that is technology-neutral, explains the use of the system from the perspective of various stakeholders, and helps to set goals and expectations for ITS projects. MAG's vision for this RIA update is to go beyond identifying functionality within the ITS architecture, but to also link the RIA to existing and planned systems and ITS infrastructure in the Region. In doing so, the architecture will become a much more tangible and valuable tool for stakeholders as they develop projects, and establish their project requirements through Systems Engineering processes. By linking the RIA more closely to ITS infrastructure (and status of ITS infrastructure), it will provide for a more complete picture of deployment and integration within the MAG Region.

1.1 Input to the Architecture Development

For the MAG RIA, stakeholders from state, regional, county, city and transit operations agencies were involved in the architecture development and review. In order to accurately capture the breadth of deployment and integration in the Region since the last ITS Architecture was developed, the consultant team obtained input directly from MAG member agencies through an inventory survey as well as follow-up discussions with some stakeholders for more specific information. The consultant team provided periodic updates to the MAG ITS Committee and made all project deliverables available via a project web site and e-mail. A stakeholder workshop in November 2008 served as a comment discussion/resolution forum with the ITS architecture

development team and key stakeholders so that physical architecture elements and connectivity could be discussed among participating agencies.

In order to capture key functional priorities and needs to support the RIA development, the team used the ITS plans that have been developed by various agencies in the Region over the last several years. Many of these plans identify priority functions and services, connectivity needs, strategic priorities that ITS can help to address, as well as map out deployment and integration scenarios. Goals and priorities were extracted from these plans and incorporated into the RIA development process. These plans and projects reviewed by the team are included in Section 3 of this document.

Another important input to the RIA development is the MAG Regional Transportation Plan (RTP), which is a comprehensive multi-modal plan to prioritize transportation system enhancements and guide investment in the Region's transportation network through FY 2028 (the July 2007 Update expanded the RTP to FY2028 to maintain a 20-year planning horizon for the Regional Transportation Plan). The RTP covers freeway, arterial and public transportation systems, and lays out a detailed sequence of projects that will expand the current transportation networks as well as provide for the needed enhancements to existing transportation facilities throughout the Region. Also included in the RTP is a chapter on Systems Operations and Management, which identifies ITS as a critical component in member agencies being able to effectively monitor, manage and operate transportation networks (freeway, arterial and transit) to promote safe and efficient travel throughout the Region.

In addition to those ITS projects that are included in the TIP, important regional initiatives, including the Regional Community Network (RCN) and Center-to-Center (C2C) System, are also reflected in the architecture concepts.

1.2 Methodology to Develop the MAG ITS Architecture

Figure 1 shows the process of developing the architecture and the many inputs and review sessions that are required to establish a consensus-based regional ITS architecture. The process of developing the RIA for the MAG Region has a foundation in stakeholder involvement and information gathering. Stakeholder needs and regional focus areas were combined with local knowledge of existing systems to develop a comprehensive inventory of existing, programmed and future ITS infrastructure. The regional inventory is captured in the architecture databases.

Using this information, a logical ITS architecture was developed which defines what ITS systems and devices should do from the user's (public) perspective rather than the operations perspective. The logical architecture is represented in terms of user requirements and processes that would be required to implement those requirements.

The next step in the RIA development process was to develop the physical view of the ITS architecture. This is where stakeholders, subsystems, information and data flows, connectivity among subsystems and infrastructure were documented and diagrammed. The physical architecture defines how ITS systems and devices are currently being operated and which agencies are currently coordinating operations to provide those user services defined in the logical architecture. The physical architecture gives a detailed and comprehensive picture of what agencies are doing in the MAG Region with ITS, and uses Service Packages and Equipment Packages to illustrate functionality and connectivity. The National ITS Architecture Version 7.0 is being used as the basis to develop the physical architecture for the MAG RIA. Elements within the MAG Region are being customized to reflect actual agency and system names, as well as to clearly identify the status of various elements and connectivity. This customization may also

extend to expanding what is currently available within the National ITS Architecture to more accurately depict system operations and connectivity within the MAG Region.

Turbo Architecture is a software application used to develop a Regional ITS Architecture based on the National ITS Architecture, and it was used to build the MAG RIA Update. Turbo Architecture focuses on the physical view of the RIA and will store the information about stakeholders, the regional ITS inventory, services (service packages), requirements and allow the team to assign information/data flows among the entities and infrastructure within the architecture. This was the first time that the MAG RIA was developed using Turbo Architecture, and it provides for a solid foundation for future reviews and updates.

A stakeholder workshop held during the project was used to review developed material and provide feedback to more accurately depict each agency and the communications they have within the RIA.

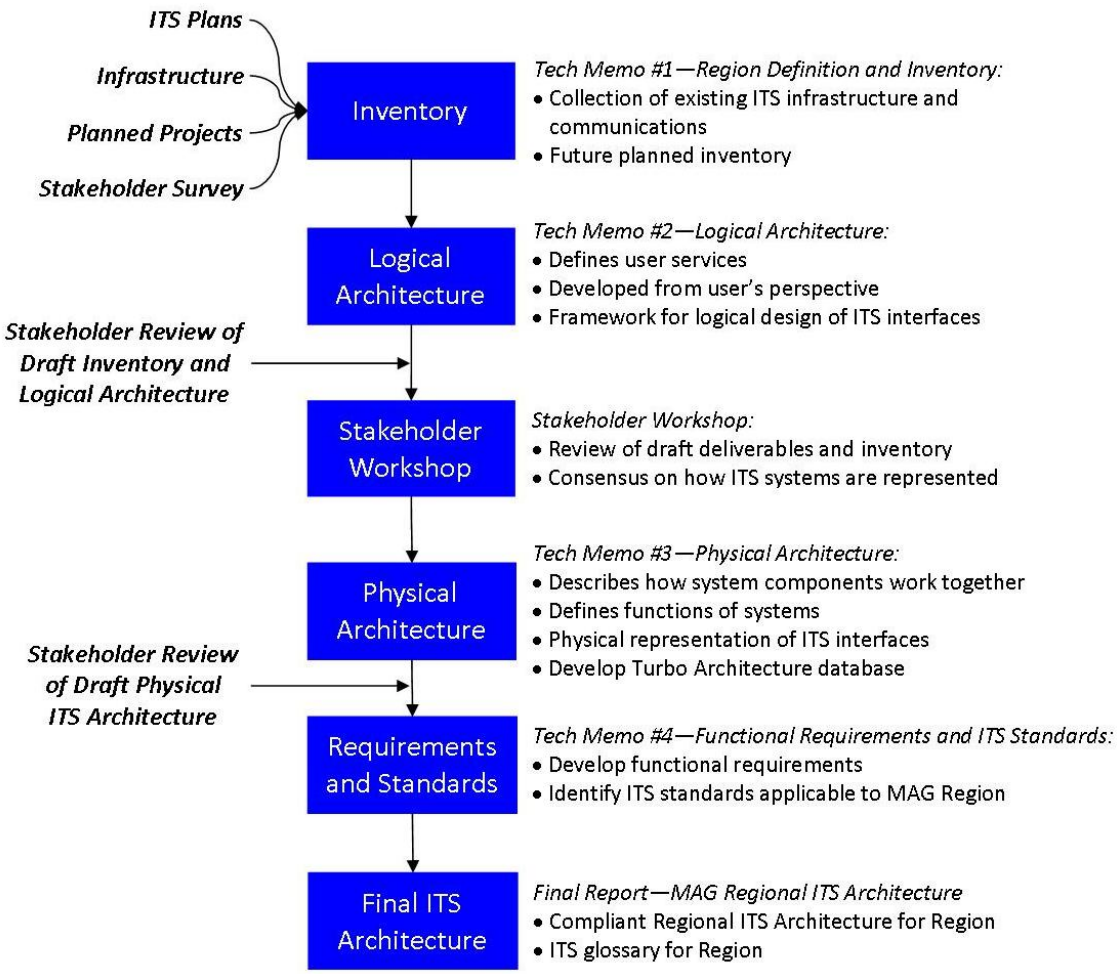


Figure 1 – ITS Architecture Development Process

The existing and planned ITS systems for each member agency in the MAG Region are comprised of devices, centers, and systems that help to manage the area's transportation network more efficiently. Each of these components of the agencies' ITS systems have been input into an ITS architecture database called Turbo Architecture Version 4.0. Turbo Architecture builds and documents information flows, usable standards for development, customized service packages,

and definitions of devices, systems, stakeholders, and services. Turbo Architecture draws from the updated National ITS Architecture Version 6.0 by providing standards and guidance to developing user-defined information flows and communications for the specific region for which the architecture is being developed. This tool provides consistency with the National ITS Architecture in accordance with FHWA Rule 940.

An architecture website has been developed to show the inventory, interconnects, and customized service packages by stakeholder agency. The website is accessible at the address: www.consystec.com/mag/web/, and also through a link from the MAG ITS Committee web page. Stakeholders are able to view the customized service packages specific to their agency and comment directly to the architecture developers. Agencies can also see what other service packages have been identified for other agencies as well to illustrate regional ITS integration. This provides a beneficial tool in reviewing the complete ITS architecture that has been developed for this region.

An ITS glossary has also been defined for the MAG Region which includes key terms and descriptions applicable to this architecture. This glossary is provided in **Appendix G**.

1.3 Mapping to Rule 940 Requirements

A list of requirements for an ITS architecture to be compliant with the FHWA Final Rule/FTA Policy compared to the MAG RIA are provided in **Table 1**. This table shows that through the scope of work for this project, the end result is a compliant Regional ITS Architecture for the MAG Region. The table also identifies where specific components are located.

Table 1 – ITS Architecture Requirements

Rule 940 Requirement	Analysis to Address Requirement	Section within MAG RIA
Description of region, participating agencies, and other stakeholders.	Textual description in Final Report and Turbo Architecture database.	MAG RIA Website Technical Memorandum 1 RIA Final Report Section 2
Identification of participating agencies' roles and responsibilities.	Agency roles and responsibilities are defined within the tabular list on the web site as well as detailed in two sections of the RIA.	MAG RIA Website RIA Final Report Sections 2 and 5
An operational concept that identifies the roles and responsibilities of stakeholders in the implementation and operation the systems.	This discussion of the roles and responsibilities for transportation and ITS operations in the MAG Region.	Technical Memorandum 1 RIA Final Report Section 2 and 5
Agreements, procedures, and resources necessary for operations and maintenance of the system.	The listing of existing and planned agreements is included within the Final Report. Recommended agreements were developed based on interfaces identified in the RIA.	RIA Final Report Section 5
Functional requirements definitions for ITS system.	Functional requirements are based upon the equipment packages selected for each element in the inventory.	MAG RIA Website (Inventory-Equipment Packages) RIA Final Report Section 5 and RIA Appendix E
Interface requirements and information exchanges with planned and existing systems and subsystems.	The detailed description of stakeholder physical elements, at the level of subsystems and terminators, and information flows between these elements is held in Turbo Architecture. Customized service packages with specific agency and system names within the data flow diagrams are included in the Final Report.	MAG RIA Website RIA Final Report Section 5 and RIA Appendix D
Identification of applicable ITS standards supporting regional and national interoperability.	This identification is contained in the Turbo Architecture database and is included as an Appendix to the Final Report.	RIA Final Report Section 5 and RIA Appendix F
The sequence of projects required for implementation.	ITS projects currently in the MAG TIP (2009-2013) are included in the Final Report. Projects are mapped to service packages on the MAG RIA Website.	MAG RIA Website RIA Final Report Section 3
Develop and implement procedures and responsibilities for maintaining the architecture as needs evolve within the region.	Defines what elements of the architecture are maintained, who maintains it, and identifies a timeframe and process for updating and maintaining the architecture.	RIA Final Report Section 7

In addition to addressing the Rule 940 requirements, the MAG RIA also includes guidance for stakeholders in the region for how to use the RIA to support project identification and development, as well as systems engineering documentation for ITS projects. Section 6 describes how to use portions of the RIA to develop specific project concepts, identify required interfaces, identify where there needs to be coordination with other agencies, and how to use the high-level functional requirements to develop more detailed design requirements.

1.4 Updates Since the Previous Strategic Plan

The 2001 ITS Strategic Plan Update included an ITS Architecture that reflected the priorities of stakeholders at the time it was developed. Since the 2001 Strategic Plan Update, the ITS infrastructure deployed by agencies in the MAG Region has increased substantially. The previous Plan Update provided a "roadmap" that intended to guide ITS projects and programs in the MAG Region for the next 20 years, with a strong emphasis on infrastructure deployment for arterials, freeways and transit. Supporting activities, including recommended resources, training needs, and operational strategies, were also developed with a strong link back to the identified projects and priorities outlined in the ITS architecture by stakeholders.

In addition to the ITS architecture, in 2001 a significant emphasis was put on developing an ITS Implementation Plan to outline ITS project recommendations through 2021. In many cases, functionality within the projects have been implemented or are programmed as part of the MAG TIP; in some cases, specific projects may have been modified from what was identified in the Strategic Plan, but key functionality desired by stakeholders was ultimately implemented or incorporated into other projects. Advances in the region with traveler information, freeway management system (FMS) expansion, transit/public transportation systems and technologies, arterial ITS instrumentation, special event management and public safety computer aided dispatch (CAD) and traffic management center (TMC) integration have addressed several of the 'near term' project types identified in the 2001 Strategic Plan Update.

There were, however, priorities that were identified that ultimately were not addressed, mainly because the focus of the Region's investments have shifted in other directions. Some of these included:

- Personalized traveler information and route guidance;
- Electronic tolling and payment services;
- Maintenance vehicle tracking; and
- Fleet management.

Some of these concepts and priorities were dependent on private sector involvement and leadership to develop, implement and operate. The Region has had varying levels of private sector involvement, particularly with traveler information applications. As the business models have shifted for the private sector, their roles have evolved and changed. Others, such as tolling or parking management, posed additional constraints for implementation. Tolling would require legislative approval before any pricing projects could be implemented. In the case of parking or fleet management, necessary institutional agreements or cooperative deployments would be needed.

At the time the 2001 ITS Strategic Plan Update and ITS Architecture were developed, existing control and operations centers included the Arizona Department of Transportation Traffic Operations Center (ADOT TOC), the Maricopa County Department of Transportation (MCDOT) TMC, and TMCs in the Cities of Phoenix, Scottsdale, and Chandler. Today, there are traffic management centers in Glendale, Goodyear, Mesa, Gilbert, Surprise, Tempe, Peoria, Avondale, and Queen Creek. Transit operations and management has also undergone some significant system enhancements, and with the addition of METRO Light Rail in the metropolitan area, there is an even stronger focus on coordinating multimodal systems.

Although implementing and enhancing traffic management and operations centers remains a priority, there is a strong focus today on how to utilize these centers and their systems to more effectively manage and operate the regional networks. Establishing systems to share data among

centers in real time, as well as utilizing systems and infrastructure for more effective real-time operations are priorities that continue to evolve in the Region.

The ITS Architecture developed with the 2001 plan was based on an earlier version of the National ITS Architecture. Since the Plan Update, FHWA has issued guidance on regional ITS architecture development as well as established the FHWA Rule 940/FTA Policy on architecture conformity and standards. In the 2001 Plan Update ITS architecture development process, there was a strong emphasis on service package prioritization and recommended timeframes for service package priorities. These priorities may have corresponded to maturity of technology, dependency on other ITS systems or programs, overall likelihood of implementation and ability of the service package to address a specific need.

The National ITS Architecture has also evolved to include new and expanded functionality to respond to needs driven by trends and events at the national scale. In 2001 there were 63 service packages in the National ITS Architecture. With Version 7.0 of the National ITS Architecture (current version), there are 97 service packages. Over the last several years, the National ITS Architecture has been expanded to include additional incident and emergency management functions, expanded transit functionality, expanded traveler information functionality, maintenance and construction operations, active traffic management services, tolling functionality, and connected vehicle functionality. Similarly, standards have also been updated to correspond to the current status of key standards development activities.

1.5 1201 Compliance

Section 1201 of the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETE-LU) (Rule 23 CFR 511) required establishment of a Real-Time System Management Information Program (RTSMIP). The RTSMIP establishes minimum requirements for reporting travel and road conditions, with timeliness and information quality requirements for: construction activities impacting travel conditions, roadway or lane-blocking traffic incident information; roadway weather observations; and travel times or speeds for limited access roadways in metropolitan areas.

The Rule also includes requirements for Regional ITS Architectures to address real-time highway and transit information needs and the methods to meet those needs. The MAG Regional ITS Architecture includes interfaces and architecture flows that support the real-time information exchanges for incident information to central systems and traffic management centers; for agency center-to-center information exchanges through the Regional Archived Data Server and the ADOT FMS, County and City TMCs and future Transit data exchange link; as well as real-time data exchanges to support traveler information, including data feeds from the Regional Archived Data Server and ADOT HCRS to media and information service providers, 511 and az511.gov.

2. REGION DEFINITION

2.1 Overview of the MAG Region and Stakeholders

In 2004, Maricopa County contained approximately 60 percent of the population in Arizona, as well as eight of the nine cities in Arizona with populations greater than 100,000 people. The MAG Region has grown from a population of 1.5 million people in 1980 to 3.8 million people in 2010. For the past several decades, the MAG Region has been one of the fastest growing regions in the country.

MAG member agencies proactively plan for the growing population and its effects on the transportation network. In 1985, Proposition 300 implemented a half-cent sales tax in Maricopa County over 20 years specifically for transportation. That funding enabled the build-out of the freeway network within the Region, including the Loop System, State Route 51, and provided for expansion of the existing freeway corridors to better meet the needs of regional growth. A major funding source to be able to expand the current transportation network to respond to the growing population was the passing of Proposition 400 in 2004, which authorized the continuation of the half-cent sales tax for transportation in the region (Maricopa County Transportation Excise Tax). This action provided a 20-year extension of the half-cent sales tax through 2025 to implement projects and programs identified in the MAG RTP. Proposition 300 in 1985 was focused on expanding the Regional Freeway System, and revenues collected from the Proposition 400 half-cent sales tax extension are now allocated among freeway/highway, arterial street projects, and public transit programs and projects. These monies must be applied to projects and programs consistent with the MAG RTP.

There are plans to expand the current transportation network to be able to accommodate more travelers. The following summarizes the planned growth of the network:

- **MAG RTP –** The 2010 Update of the MAG Regional Transportation Plan is the comprehensive, performance based, multi-modal, and coordinated regional plan that addresses all major modes of transportation and key transportation related activities through fiscal year 2028. The RTP is funded through various federal, state, and local revenue streams, including the half-cent sales tax extension provided by Proposition 400. Regional funding is allocated in the RTP as follows: 57.7% identified for freeway/highway programs; 29.9% for transit; 10.9% for arterial street improvements; and 1.5% for other programs (including safety planning, non-motorized transportation projects, and other regional programs).
- **Freeway/Highway System –** The freeway/highway system is a focus of transportation planning and implementation in the MAG Region. The RTP calls for new freeway/highway corridors, added travel lanes on existing facilities (including HOV and general purpose lanes), new interchanges with arterial streets on existing freeways, and direct connections between HOV lanes at freeway-to-freeway interchanges. A total of 621 centerline miles are in the freeway/highway network in the MAG Region as identified in the current RTP.
- **Arterial Street System –** The current arterial street system consists primarily of roadways on a one-mile grid system which provides a high level of accessibility and mobility to the regional freeway system serving multi-modal transportation facilities. Expansion of the arterial network in the Region includes widening existing arterials, construction of new arterials following the one-mile grid pattern, arterial capacity improvements through intersection redesign, and closing gaps in the arterial network in

both developed and developing areas. The current RTP identifies $24.2 billion in arterial projects and enhancements.

- **Public Transportation System –** Fixed route bus service in the MAG Region represents an increasingly important component of the regional transportation network. New routes will be added to the existing transit system, METRO Light Rail opened in December 2008 and expansion plans are ongoing, and bus services including vanpool, ride share, and dial-a-ride services also will be expanded.
- **Intelligent Transportation Systems –** Over the last decade, ADOT, MAG, MCDOT, cities, and transit have been actively investing and deploying systems and infrastructure which have significantly enhanced the capability of agencies in the Region to operate and manage the transportation network. The RTP allocates funding to assist in the implementation of projects identified in the regional ITS Plan. The MAG Region is a relatively robust area in terms of ITS deployment and integration. There has been a concerted effort to direct funding and resources toward instrumenting urban freeway corridors as well as major arterials with detection, closed-circuit television (CCTV) camera monitoring, traveler information capabilities, as well as transit technology enhancements. Furthermore, centralized hubs for traffic management and operations coordination (such as traffic operations and management centers) greatly enhance transportation agencies' ability to control and manage traffic. MAG has helped to guide these efforts through collaborative development of the 2012 ITS Strategic Plan, 2003 Regional Concept of Transportation Operations, and now with the 2013 Regional ITS Architecture Update. As identified in the 2012 MAG Strategic Plan, regional funds for ITS will be focused mainly on strategies, systems and technology applications that address issues of regional impact while still supporting local agencies in addressing local ITS program needs. The recommended allocation targets are Arterial ITS (50%), ITS to Improve Safety (20%), Integrated Corridor Management (25%), and Local ITS Plans (5%).

Considering the planned expansion of the transportation network, it is the responsibility of MAG member agencies to be able to monitor and manage the network that is expanding in their jurisdiction to provide the public with safe and efficient travel. The two primary components of planning for this expansion are 1) document existing conditions and 2) plan for future deployment and interactions necessary to respond to changing conditions. Developing this ITS Architecture for the MAG Region will address the first component of planning for this growth in the MAG Region in regards to ITS development. The ITS Architecture identifies what is currently available on the transportation network to monitor and manage traffic as well as the coordination between agencies that facilitates faster incident management and real-time traffic management. The ITS Strategic Plan developed as a separate project will address the second component which will guide the future planning of ITS in the Region to be able to respond to the changing conditions of the roadways.

This section will discuss the stakeholder agencies in the MAG Region that have either directly or indirectly provided input to this project, the coordination teams established to facilitate communication between agencies on a regional level, and the operational roles and responsibilities of the MAG member agencies. **Figure 2** shows the various stakeholder agencies and their jurisdictions in the MAG Region.

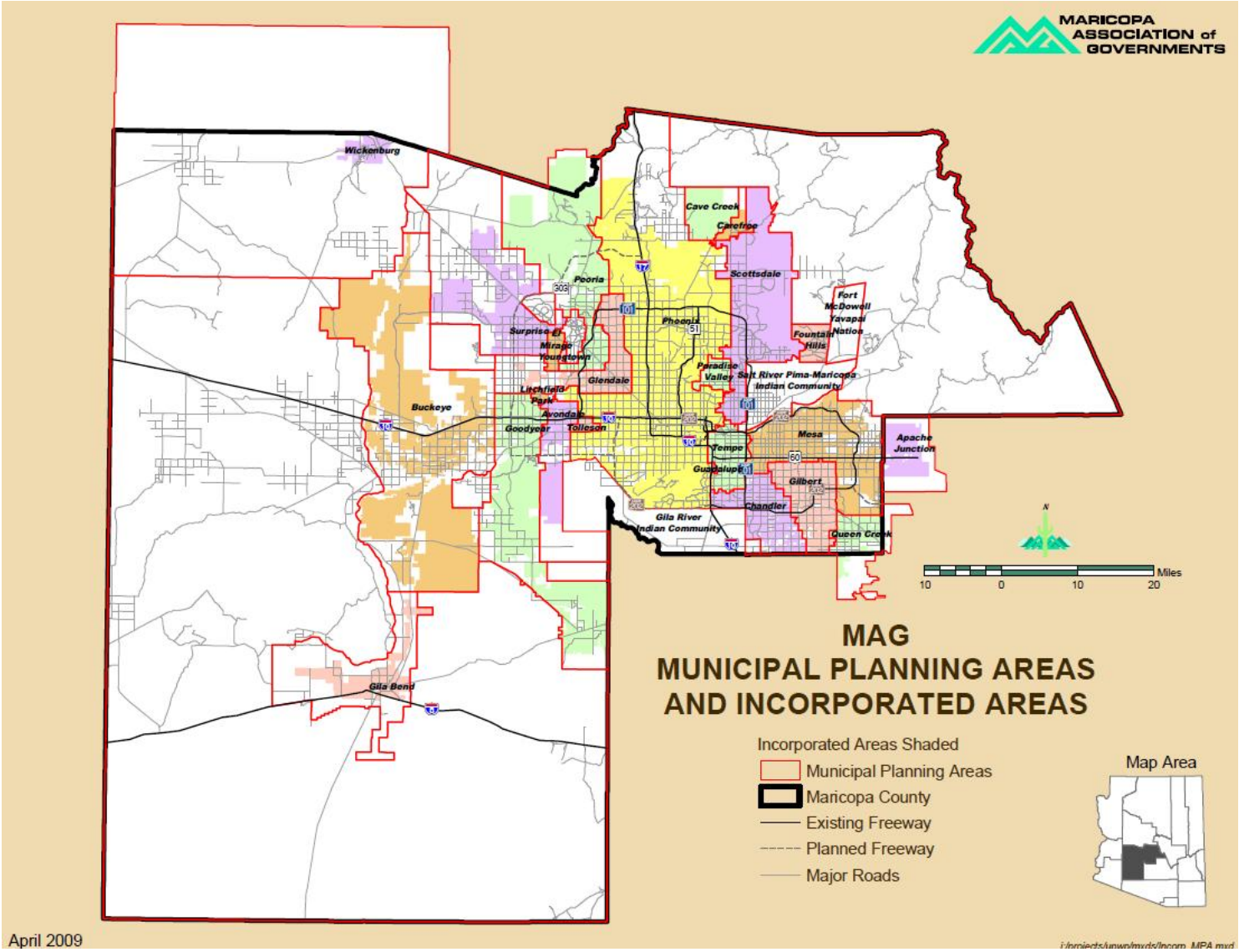


Figure 2 – MAG Member Agency Jurisdictions Map

2.1.1 Current Regional Operations

This section provides an overview of the various transportation networks and modes within the Region, as well as summarizes some of the agency stakeholders that have an active role in managing and operating transportation systems within those networks.

Regional Freeway Network

ADOT operates and maintains the regional freeway network. Freeway construction and enhancements throughout the Region have been accelerated in order to meet the demands of the Region's growing population, and was funded through revenues generated from the Proposition 300 sales tax. Widening of existing freeways, including I-10 in the West Valley, Loop 101 from Chandler to Scottsdale, and I-17 in north Phoenix are helping to increase capacity on these vital corridors. High-occupancy vehicle lanes are being extended on SR-51 and I-17, and I-10 in the West Valley and Loop 202 in the East Valley. The RTP identifies HOV lane construction on additional segments of Loop 101, 202 and US 60 as part of future projects.

ADOT operates an FMS on approximately 150 miles of the Phoenix metropolitan area freeway system that travels through many local jurisdictions. Primary components of the FMS include vehicle detectors, CCTV surveillance, dynamic message signs (DMS) for traveler information, and ramp meters. Fiber telecommunications provides the communications and control infrastructure for ADOT staff to monitor and implement management and control strategies from the ADOT TOC, which is staffed 24/7/365. Current FMS plans indicate a complete build-out of the Phoenix FMS by 2023. For many local jurisdictions, the ADOT FMS ITS devices and fiber communications are important for their local operations whether it be viewing ADOT's cameras or utilizing ADOT fiber/conduit space to communicate with another department or agency. Ramp metering capability is provided at many on-ramps to the freeway network and is a time-based operated system. ADOT utilizes data from system detectors to monitor freeway speeds, and this data is also used to calculate travel times for DMS posting and to support other traveler information programs. ADOT has been providing travel times on DMS during the weekday AM and PM commute periods.

The Arizona Department of Public Safety (DPS) is responsible for incident management on freeways and highways throughout the state. In the metro area, two key services provide for enhanced incident management, response and clearance: ADOT's Arizona Local Emergency Response Teams (ALERT) are dispatched from ADOT's TOC to respond to freeway incidents to support traffic control and detours; and the Freeway Service Patrol (operated by DPS) provides assistance to motorists on freeways who require support or help with stalled vehicles, minor collisions or other impact.

Arterial Street Network and Operations

The metropolitan area is characterized by a network of four-lane (or more) arterials on a one-mile grid system, supplemented with local and collector streets. Travelers in the Region are very dependent on the Region's arterial roadway system, and it is estimated that the Region's arterial network carries over half of the total vehicle-miles traveled in the Region. The Region has several key east-west and north-south arterial corridors that traverse multiple jurisdictions, and these cross-jurisdictional arterial corridors can include two, three or even four different traffic signal systems operated by different cities in the Region, and in some cases include two or more interchanges with freeways.

Local agencies recognize that improved traffic signal operations are a significant factor in overall regional mobility. Each jurisdiction in the Region operates independent traffic signal systems, which pose several challenges to the vision of a 'seamless' arterial network. MAG's Traffic Signal Optimization Program (TSOP) provides funding for coordinating signals on arterials, and encourages partnerships among agencies to address these multi-jurisdictional corridors.

The Bell Road ITS project is an example of interjurisdictional cooperation between City of Peoria, City of Surprise, and MCDOT. These three agencies meet every two months to discuss issues specific to this corridor and work together to provide collaborative traffic management of the state's busiest arterial corridor.

To meet the growing demands of arterial management and mobility, agencies in the MAG Region have been actively implementing ITS technologies to support their arterial traffic and incident management, travel information, day-to-day operations and maintenance of their systems. TMCs are becoming an integral part of Street or Transportation Departments in cities in the MAG Region. At present, TMCs are operational in several jurisdictions, including the Cities of Glendale, Goodyear, Phoenix, Scottsdale, Peoria, Mesa, Tempe, Queen Creek, Avondale, Chandler, Surprise and Maricopa County DOT. These TMCs provide a central location for the cities and county to manage their regional traffic signal systems, monitor arterial devices (including detection, CCTV and arterial DMS) and coordinate with other agencies for traffic and incident management, as well as for managing traffic during planned special events.

Arterial ITS projects within the MAG TIP including expanding fiber and wireless telecommunications, upgrading and expanding detection and monitoring equipment (including CCTV), expanding traveler information on arterials with additional dynamic message signs, and constructing or enhancing local TMCs.

Incident management on arterials is provided largely through local agency police and fire/EMS, Maricopa County Sheriff's office. The Regional Emergency Action Coordination Team (REACT) Incident Management Program at MCDOT has partnered with a few local cities. REACT teams are dispatched as requested by City police and County sheriff to provide incident traffic management support. State, City and County TMCs are able to support incident management on those corridors where traffic signals are connected to the TMC as well as on corridors that are instrumented with CCTV monitoring.

Public Transportation Systems

Transit services have grown and expanded significantly in the last decade, and approximately one-third of the Proposition 400 revenues from the half-cent sales tax for transportation are being focused on mass transit.

Transit service is a cooperative effort through contracted arrangements among the Regional Public Transportation Authority (RPTA), local cities and transit operators, and it is provided under the 'brand' of Valley Metro. The RTP identifies transit funding for expanded local service, as well as for expanded Bus RAPID Transit service on both freeways and arterials. There is envisioned to be substantial growth in geographic area covered by fixed-route public transportation over the next two decades. It is important to note that several local tax initiatives also fund transit service within their respective jurisdictions.

As a summary of fixed-route services, there are two major public transportation services in the Phoenix metropolitan area: Valley Metro and Phoenix Public Transit. Both function as

separate services but are under the Valley Metro name to display uniformity to travelers in the Valley. Both provide traveler information to the public via the Valley Metro website and are on the same vehicle management software to be able to manage their vehicle location, status, etc. There is an existing service in the City of Tempe that is using that same vehicle management software, and more cities are planned to implement citywide transit services on the same vehicle management software in the future. Fixed-route transit services in the Region include local bus service, express bus service, and circulator/shuttle services. The majority of existing routes (local and express) primarily serve arterials; RAPID Commuter service is currently provided on freeway routes within the City of Phoenix, and there are plans to implement a Bus RAPID Transit on key arterial corridors. The Transit Operations and Control Center (OCC) manages the regional transit system, including vehicle management system, and voice communications with each transit vehicle. Regional fixed-route vehicles are equipped with GPS AVL systems. The region also includes several park-and-ride facilities and transit centers.

In December 2008, the METRO Light Rail commenced operations of the first 20-mile segment of LRT service in the Valley, which will include a line through Phoenix, Tempe and Mesa. The initial LRT fleet includes 50 trains. Each LRT train is equipped with automated vehicle location, passenger counting systems, and on-board vehicle diagnostics/monitoring as well as security systems. METRO Light Rail is also looking at future extensions of service routes to include potential expansion into Glendale and west on I-10, as well as expanding the initial line in Phoenix, Tempe and Mesa.

Table 2 describes the ITS operations and communications between the various stakeholder agencies in the MAG Region at a very high level. Later tasks in the RIA will further define the operational roles of stakeholders in the Region.

Table 2 – Operational Roles and Responsibilities of Agencies in the MAG Region

Agency / Organization Type		Planning and Operations Roles and Responsibilities
Regional	Maricopa Association of Governments	MAG serves as the MPO for the Phoenix metropolitan area. The MAG Committee structure includes an ITS Committee that is comprised of traffic and transportation professionals from MAG member agencies. MAG is responsible for all planning decisions for regional transportation and provide a Regional Transportation Plan, which includes ITS as one of many components.
Freeway Management	Arizona Department of Transportation	Operates and maintains the freeway network. Responsible for freeway management system devices/communications, including the 24/7 Traffic Operations Center. Supports the Arizona Local Emergency Response Team (ALERT) to assist with traffic incidents on the freeway network. There are freeways in the east and northeast portions of the Valley that are located on Tribal lands, which requires consultation with the respective Tribal governments for operations.
	Arizona Department of Public Safety	Public safety and law enforcement on state highways and freeways. Operates the Freeway Service Patrol (FSP) which assists stranded motorists and disabled vehicles. An interface was established between DPS and ADOT and MCDOT to share information about incidents on freeways.
Arterial Management	City TMC/Transportation Department	Operates and maintains the arterial network within their city/town jurisdiction including the traffic signal system and network of arterial DMS, CCTV. Many signals at freeway interchanges are operated/maintained by the local jurisdiction. Incident management on arterials is coordinated with the local public safety agencies. Cities have been actively establishing traffic operations and management centers to better operate their own infrastructure, as well as support incident management and special event traffic operations, and coordinate with neighboring agencies on incidents and events that impact multi-jurisdictional corridors.
	Maricopa County Department of Transportation	Maricopa County DOT operates and manages arterials in unincorporated areas of the Maricopa County region including CCTV, DMS, and traffic signals as well as having shared control of ITS devices in two cities for multi-jurisdictional corridor management. Maricopa County DOT operates and manages a REACT team which is an arterial incident responder service provided primarily within a few cities in the West Valley. Facilitates development of regional systems including Regional Archived Data Server (RADS) and Arterial Advanced Traveler Information System (ATIS). Provides leadership in the traffic operations for regional corridors such as Bell Road.
	City Fire Department	The City of Phoenix Fire Department dispatches for 18 local city fire department jurisdictions. They are first responders to arterial and freeway incidents. Phoenix Fire department has established a link to the Maricopa County TMC. Local Fire Departments typically do have established links to the local police department, but does not necessarily have established links to their local traffic operations center for traffic management support during incident operations.
	City Police Department	Local Police Departments are typically responsible for public safety on arterial streets within their jurisdiction. Local police and emergency services respond to traffic incidents on roadways within their jurisdiction, although there is a high degree of cooperation among emergency responders as part of current mutual aid agreements.
	Maricopa County Sheriff's Office	Public safety and law enforcement on arterials within unincorporated Maricopa County and agencies for which it is contracted including City of Litchfield Park.
Transit	Valley Metro	Responsible for regional transit planning, transit public information, the management and operation of regional bus (local, Express and RAPID) and dial-a-ride services, the Regional Ridesharing program, and a regional vanpool program.
	Phoenix Public Transit	The regional transit system is managed through the Transit Operations and Control Center, including a vehicle management system for automated vehicle location.
	METRO Light Rail	METRO is the brand name for Valley Metro Rail Inc., a non-profit, public corporation charged with the design, construction and operation of the Valley's light rail system. The first phase of light rail launched in December, 2008.

2.1.2 Stakeholder Agencies

MAG member agencies include 25 incorporated cities and towns, three Native American Indian communities, and Maricopa County. ADOT serves as an ex-officio member for transportation-related issues. Many of these MAG member agencies provide traffic management operations and serve in key roles for helping to plan for traffic and transportation programs at the local and regional levels. Emergency management agencies and transit agencies utilize the transportation network to perform their operations. Each one of these agencies have key needs in the operation and use of ITS equipment and communications between agencies that will support the development of the Regional ITS Architecture.

A survey was distributed in 2009 to all MAG member agencies to gather ITS and agency coordination data as well as document the ITS deployment and integration in the MAG Region. This survey included questions for each agency regarding the number of devices, types of information sharing, and locations of devices where it is feasible to gather that information. There are many regional initiatives and plans that have been developed within the last few years which provide a substantial foundation for existing coordination and ITS infrastructure. **Table 3** summarizes the types of stakeholders whose communications and device-ownership is represented in various plans and/or have participated in the survey for inventory to help build this Regional ITS Architecture. Relevant local public safety/law enforcement elements will be identified from existing documents and planned projects and included in this ITS architecture to show interaction with other elements and other agencies.

Table 3 – Summary of Stakeholder Agencies

Category	Agency	Surveyed	TMC / Central Dispatch?	Owns ITS Devices?
MAG Member Agencies	Arizona Department of Transportation	Yes	Yes	Yes
	City of Avondale	Yes	Yes	Yes
	City of Chandler	Yes	Yes	Yes
	Town of Gilbert	Yes	Yes	Yes
	City of Glendale	Yes	Yes	Yes
	City of Goodyear	Yes	Yes	Yes
	Maricopa County	Yes	Yes	Yes
	City of Mesa	Yes	Yes	Yes
	City of Peoria	Yes	Yes	Yes
	City of Phoenix	Yes	Yes	Yes
	City of Scottsdale	Yes	Yes	Yes
	City of Surprise	Yes	Yes	Yes
	City of Tempe	Yes	Yes	Yes
	City of Apache Junction	Yes	No	Yes
	Town of Buckeye	Yes	No	No
	Town of Carefree	Yes	No	No
	City of El Mirage	Yes	No	No
	Town of Fountain Hills	Yes	No	Yes
	Town of Gila Bend	Yes	No	No
	Gila River Indian Community	Yes	No	No
	Town of Guadalupe	Yes	No	No
	City of Litchfield Park	Yes	No	Yes
	Town of Paradise Valley	Yes	No	Yes
	Town of Queen Creek	Yes	Yes	Yes
	Salt River Pima-Maricopa Indian Community	Yes	No	No
	City of Tolleson	Yes	No	Yes
	Town of Wickenburg	Yes	No	No
	Town of Youngtown	Yes	No	No
*State/Regional Emergency Management/ Public Safety	Arizona Department of Public Safety	No	Yes	Yes
	Maricopa County Sheriff	No	Yes	No
	Phoenix Fire	No	Yes	No
Transit Management	RPTA/Valley Metro	Yes	Yes	Yes
	METRO Light Rail	Yes	Yes	Yes
	Phoenix Public Transit	Yes	Yes	Yes

* The emergency management technologies/systems inventory information have been coordinated through the respective traffic management/operations contacts at State, County and City agencies surveyed.

2.1.3 Regional Stakeholder Coordination

State, regional and local agencies in the Phoenix metropolitan area have been moving toward more coordinated and integrated transportation operations for several years. There is strong support for continued physical integration and connectivity among transportation management, transit, public safety, and other key agencies to better share information, in real time, to support key traffic, transit, and incident management strategies. This move encompasses both localized projects as well as regional integration projects. Cities and towns are focusing on integrating their localized transportation and ITS networks, and in parallel the Region is working toward combining those efforts into a regional cooperative strategy. The cooperative partnerships and systems described in this section facilitate multi-agency coordination for traffic, transit, and incident management.

MAG Regional Council

The MAG Regional Council is the final decision-making body of MAG and is composed of elected officials appointed by each MAG member agency. For the majority of members, the city or town Mayor serves as the Regional Council member. Regional Council meetings are open to the public and discuss regional initiatives that move beyond just transportation into public policy related topics such as land use, census, schools, and homeless assistance programs. The Executive Committee consists of at least three Regional Council members who are elected at the annual meeting to serve for one year (until the next annual meeting). The Executive Committee is required to include the Chair, Vice Chair and Treasurer of the Regional Council as ex-officio members. In June 2002, the Executive Committee was expanded to seven members to allow for additional participation by the member agencies. The MAG By-Laws indicate that the business that arises between meetings of the Regional Council can be conducted by the Executive Committee. The Executive Committee also serves as the Finance Committee.

The Regional Council approves the Regional Transportation Plan, MAG TIP, and makes decisions on the recommendations from the TRC and TPC each year. Recommendations for the RTP and TIP come from other groups and committees within MAG; however, the final approval on funding priorities is with the MAG Regional Council.

Transportation Policy Committee (TPC)

Members of this committee include elected officials and private sector representatives from the Region, appointed by the MAG Regional Council, to help develop policy recommendations for Regional Council consideration on transportation issues, including the Regional Transportation Plan and MAG TIP. This Committee hears consent items on any proposed updates or modifications to the MAG TIP and RTP, and has responsibility for overseeing the implementation of Proposition 400.

Transportation Review Committee (TRC)

This group was formed by the Regional Council to encourage the development of the telecommunication infrastructure and applications in the MAG Region. The members of the TRC include one representative from each MAG member agency that could be from various departments within each agency. This committee also discusses transportation initiatives, major regional projects, funding allocation for MAG Federally Funded Program, federal propositions for taxes and projects, and transit initiatives, among other high profile topic areas.

MAG ITS Committee

The MAG ITS Committee is one of several Technical Advisory Committees at MAG. The ITS Committee is made up of federal, state, and local transportation agencies in the Phoenix metropolitan region, and includes representation from DPS, the Federal Highway Administration (FHWA), and Arizona State University (ASU) in addition to local, county, transit and state transportation operations representatives from MAG member agencies. The primary role of the MAG ITS Committee is to plan all regional ITS infrastructure and recommend regional investments in ITS for consideration by the Transportation Review Committee, Transportation Policy Committee and Regional Council. The meetings of the ITS Committee, which occur every month, also provide a formal avenue for interagency cooperation and coordination on matters pertaining to ITS and regional traffic management.

Under the leadership of MAG, a Regional Concept of Transportation Operations was developed in 2003. MAG will continue to have a long-term role in planning for operations. The MAG ITS Committee includes a strong multimodal focus, and is responsible for making recommendations on regional ITS infrastructure investments for the Phoenix metropolitan region.

MAG also leads working groups that support various projects and regional coordination activities. The MAG Telecommunications Advisory Group (TAG) was formed to encourage the development of telecommunication infrastructure and applications which increase multiagency cooperation and improves access to public information by travelers. The Regional Communications Network (RCN) Working Group was formed as a venue for stakeholders of the RCN program to discuss the status and the evolution of the program in the Phoenix metropolitan area. The RCN Working Group is comprised of members from the MAG Technical Advisory Group (MAG TAG) and MAG ITS Committee.

AZTech™

The AZTech™ was initially established in 1996 for the express purpose of implementing the Federal Model Deployment Initiative (MDI). AZTech™ brings together decision makers and practitioners with a consensus-based approach to planning, implementing, integrating and operating multimodal transportation systems in the region. The goals of AZTech™ are to integrate the existing ITS infrastructure into a regional system, establish a regional integrated traveler information system, and expand the transportation management system for the Phoenix metropolitan area. Members include ADOT, MAG, Valley Metro, Maricopa County, Cities and Towns, and private partners. Members represent state and county traffic management and operations, regional transit operations, regional planning, municipal traffic and transportation agencies, state and regional law enforcement and public safety, emergency services, and private partners.

AZTech™ is the name of the consortium, although systems are owned and operated by individual partner agencies. For example, the traffic management system in the City of Scottsdale and ADOT's Freeway Management System are both referred to as part of the regional AZTech™ system, yet they are owned and operated by separate agencies.

The AZTech™ partnership has grown since the last ITS strategic plan update and has been successful in obtaining additional federal grants to improve collaboration between transportation and public safety, including the design of the Regional Community Network. AZTech™ is primarily a voluntary regional forum for discussing issues related to transportation operations. There are specific AZTech™–led initiatives that benefit the

region including center-to-center standards development and center-to-center guidelines for device management.

This forum is led by the AZTech™ Executive Committee that has been co-chaired by ADOT and Maricopa County since inception. Working groups address specific focus areas, including Traffic Operations, Traveler Information, and Incident Management. These groups meet on a regular basis to address regional integration and promote interjurisdictional collaboration to enhance operations (signals, traveler information, and incident management) to deliver seamless real-time traffic management services to the public. The committee also facilitates development of regional contracts, and developed C2C data exchange standards. Recommendations generated at the AZTech™ forum can feed into the regional ITS planning process at MAG, provided they are sponsored by a MAG member agency, and meet regional planning criteria. While AZTech™ has an indirect link to the regional planning process, there is no direct role in the formal decision making process for regional ITS planning. The MAG Regional Concept of Transportation Operations identified AZTech™ as leading many of the operations-focused initiatives.

2.2 Summary of Current Regional Transportation Goals and Objectives

Substantial planning has occurred in the MAG Region for goals and objectives of the roadway and ITS investment. MAG's 2001 ITS Strategic Plan and the 2003 Regional Concept of Transportation Operations provide an important foundation for establishing a regional benchmark for goals and strategic priorities developed by partner agencies as part of these processes. Also important are the more localized ITS plans that have been developed by MAG member agencies over the last five or more years, as these provide a basis for specific agency objectives that must be captured within the regional ITS Architecture.

As a means of establishing the operational framework for the Region, the study team has reviewed and summarized these plans in terms of key ITS goals or services that would need to be incorporated into the updated Regional ITS Architecture. This section contains a summary of those findings from both regional ITS planning and more localized planning documents.

2.2.1 MAG Regional ITS Plans

Goals and objectives are summarized in **Table 4** that were developed for the *2001 MAG ITS Strategic Plan Update* and the *2003 MAG Regional Transportation Concept of Operations.* Both of these efforts brought together stakeholders from throughout the Region to establish priorities for ITS deployment, integration and operations, and to define key needs that ITS could support or address.

As a starting point for the RIA update, the study team reviewed the goals established for these prior plans for applicability to the current state of ITS in the Region, as well as to factor in how priorities may have changed or accelerated since those efforts. The goals and objectives that were included in this table apply to today's current operations and strategic planning for ITS, and represent a summary of the applicable goals and objectives that were developed as part of the previous efforts. For example, in the ITS Strategic Plan, call boxes along freeways were identified as a priority; however, the Region is not pursuing this as a strategy for implementation. To help consolidate goals into functional categories that could be translated into the RIA, **Table 4** includes categories for freeway and arterial operations, incident and emergency management, transit operations, and traveler information. In some instances, associated objectives were also identified to support the goal or strategy identified in the previous plans, and these have been identified where applicable. Specific

performance measures were identified in the *2003 MAG Regional Transportation Concept of Operations* that define how the agencies in the Phoenix metropolitan area will achieve their goals. The goals and objectives from this planning effort document the purpose of the focused performance measures, rather than the performance measure itself. These are categorized in the same manner as those from the MAG ITS Strategic Plan Update for a comprehensive view of regional goals in each service area. Stakeholders were asked to review this table for consistency in current operational planning and objectives of regional initiatives.

Table 4 – Consolidated Goals and Objectives for MAG Region

Operational Categories	Goals and Objectives	2001 MAG ITS Strategic Plan Update	2003 MAG RCTO
Traffic Management	Increase automated traffic data collection and archiving ability	X	X
	Establish integrated freeway-arterial corridor operations for major arterial corridors		X
	Enhance traffic management capabilities for normal conditions and special events	X	X
	Provide advanced warning at railroad/street crossings	X	
	Coordinate signal systems within single jurisdictions and across jurisdictional boundaries		X
	Increase ITS device shared operation partnerships along key arterial corridors		X
	Establish center-to-center communications between traffic management agencies in the region		X
Incident / Emergency Management	Improve incident detection capabilities and reduce incident clearance times	X	
	Increase real-time incident information sharing between traffic management and public safety agencies for cooperative freeway and arterial incident management	X	X
Transit Operations	Improve bus progression using traffic signal priority	X	X
	Enhanced transit service (routes, frequency, hours, security, payment, and real-time transit information)	X	X
	Coordinate roadway closure/construction information with transit agencies		X
Traveler Information	Improve accuracy, timeliness, and availability of real-time, multi-modal traveler information to the public	X	X
	Increase the use of DMS for more types of traffic, work zone and incident information, including travel times		X
	Integrate transit information with traveler information services		X

2.2.2 Local Agency ITS Plans

Several of MAG's member agencies have developed or are in the process of developing plans to guide ITS deployment and integration within their jurisdiction. **Table 5** provides a brief overview of existing plans developed by agencies in the Region, as well as pivotal goals or outcomes from these efforts that may be factored in to the Regional ITS Architecture development.

These plans are important for several reasons. First, they represent localized ITS planning processes that have identified specific issues, and corridor-specific deployment priorities within jurisdictions in the Region. Second, many of these localized plans also identify where connectivity to external or regional programs will provide benefits to the agency as well as travelers on a broader scale. They help to map out funding priorities within these agencies for ITS deployment, and can provide valuable input to priorities that should be captured and identified within the RIA.

Table 5 – Summary of Local ITS Plans

Agency Plan	Key Goals and Objectives
Avondale ATMS Plan	• Identifies strategies that allow the City to maximize traffic operation, use and safety through design and implementation of ITS • Establish a Traffic Operations Center to centrally control Avondale's ITS devices, and maps out a preliminary concept for telecommunications communications and devices. Avondale's telecommunications strategy includes both fiber and wireless communications systems • Recognizes need for more detailed ITS Strategic Plan to plan ITS funding and implementation
Chandler TMC Plans	• The Chandler TMC Future Vision plan reviews the communications configuration and technologies connecting to and within the current TMC and identifies potential changes and upgrades to the TMC • The Chandler TMC Maintenance Concepts and Recommendations plan reviews the City's current maintenance practices as they impact the TMC focusing on traffic signal systems and the deployment of additional ITS elements and communications network
Glendale ITS Master Plan	• Strategies for using permanent and portable ITS devices (CCTV cameras, DMS, communications) during special event management in the University of Phoenix stadium area
Goodyear ITS Strategic Plan	• Focus on citywide ITS priorities and functional areas to deploy ITS devices, communications to devices, communications with other departments within the City, and communications with other agencies • Identified priority ITS deployment projects to utilize existing MAG programmed funding for Goodyear and plan for future MAG TIP project requests • Established feasible timeline for projects based on comprehensive funding and implementation plan
MCDOT ITS Strategic Plan	• Advance regional traveler information systems by enhancing arterial connection and information to 511 • Continue ITS infrastructure deployment of CCTV, DMS, detection as well as TMC operation of those devices • Expand TMC operations to operate devices from other jurisdictions, facilitate regional traveler information and reporting systems, coordinate with public safety and emergency management agencies • Expand REACT program to increase presence in cities and reduce response time • Integrate signals on MCDOT and multi-jurisdictional corridors
Mesa ITS Strategic Plan	• Efficient and reliable traffic management tools that support real-time management through central control of all field devices and regional and interdepartmental connectivity • Fast, informed, coordinated incident management and emergency response through shared CAD information, traffic data sharing with public agencies, and sharing CCTV camera images • Highway quality and quantity of information available to travelers via arterial DMS, incident reporting, and regional traveler information communications • Effective, multi-modal transit management through sharing information with transit
Mesa ITS Deployment Plan	• Plan for key ITS infrastructure projects to add to existing and implement new ITS deployments in Mesa to address goals defined in Mesa ITS Strategic Plan • Streamline ITS planning with planned capital improvement projects • Prioritization and implementation strategy for ITS projects
Scottsdale ITS Strategic Plan	• Create reliable travel times and reduce traffic incident delay on arterials through signal coordination and incident detection capabilities • Communicate traveler information rapidly to vehicle drivers via arterial DMS and other traveler information services such as 511 • Communicate with other departments within Scottsdale and other partner agencies such as Police, Emergency Services, ADOT, and Fire

2.2.3 Multi-Agency ITS Plans and Current Planning Efforts

In addition to local plans, there have been several key initiatives whereby multiple agencies in the Region have collaborated on specific ITS planning efforts to address very specific corridors or sub-regions. These typically involve two or more arterial traffic management agencies, and potentially County DOT and ADOT partners. These represent efforts by partners to address specific deployment, integration and operations requirements, and the major impact of these efforts on the RIA are envisioned to be agency and system connectivity strategies. **Table 6** provides an overview of multi-agency ITS plans and planning efforts, as well as collaborative efforts to address agency information sharing and provision of information to travelers. These projects/systems in this section will be captured in the RIA either as a comprehensive stand-alone service area or identified within other service areas for which it is being used.

Table 6 – Multi-Agency Collaborative Planning Efforts

Planning Effort	Description
I-10 Integrated Corridor Management System	• Integrated plan to manage and reduce congestion in the I-10 corridor in the West Valley, with a focus on the near-term construction improvements • Comprehensive system of urban interstate freeway facilities, local urban arterial streets, and express and local transit routes • Project consisted of recommended strategies for integrating ITS projects and system operations to help transportation coordination along the I-10 corridor through the I-10 widening project and other key growth considerations • Coordination with MAG, City of Goodyear, ADOT, City of Avondale, Town of Buckeye, City of Phoenix, MCDOT, and Valley Metro
Bell Road ITS Concept of Operations and ITS Operations Plan	• Bell Road ITS Phase I design project installed fiber, arterial DMS, and CCTV cameras along Bell Road between Loop 101 and Grand Avenue and the project area fell within the jurisdiction of three different agencies: City of Surprise, Maricopa County, and City of Peoria • Concept of Operations was developed by MCDOT to provide roles and responsibilities in the operation of the system for each of the services that the ITS equipment will provide • Describes roles or agencies coordinating during specific scenarios • Bell Road ITS Operations Plan was developed originally in 2006 and updated in 2013 by MCDOT to document the agreed-upon procedure and prioritization for ITS device operations and management during these scenarios from the perspective of the six jurisdictions involved in Bell Road across the Phoenix metropolitan area
Regional Community Network (RCN)	• In 2004, ADOT proceeded with the design of the MAG Regional Community Network (RCN) concept which would establish a fiber communications network through a topology of three sub-rings (West of I-17 Region, Northeast Region, and Southeast Region). The first phase of the project has been funded by MAG and is under implementation. The initial design of the RCN was funded through an AZTech™ grant • The RCN links multiple agencies throughout the MAG Region to facilitate the sharing of traffic management information and video conferencing capabilities between all linked agencies • The RCN network consists of the conduit, fiber optic cable, routers, switches, and other communications hardware necessary to provide a path between network nodes • The first phase of fiber deployment and physical connection of 15 agencies utilized mostly existing agency-owned fiber and the hardware/software – expansions to include fiber connectivity to other agencies have begun and are planned in future funding programming
ADOT Highway Conditions Reporting System (HCRS)	• HCRS is ADOT's closure and restriction information central server which consolidates planned event, construction, and incident information for the statewide highway system on scheduled and unscheduled state roadway closures • HCRS is essentially an internal multi-agency information sharing system, but the information input to HCRS is used to populate the public website (www.az511.com) and the 511 system • ADOT primarily populates the HCRS with roadway condition/closure information; however, there are numerous other agencies that are authorized users to the HCRS to post local arterial information • HCRS was recently expanded to include arterials in the Phoenix Metropolitan area.

Table 6 – Multi-Agency Collaborative Planning Efforts (continued)

Planning Effort	Description
AZTech™ Center-to-Center (C2C) Information System	• The AZTech™ Transportation and Public Safety C2C Needs Assessment and Concept of Operations project developed the system configuration, concept of operations, and functional requirements for the system that will make use of the RCN infrastructure, as well as other communications means such as leased lines or the Internet • C2C System does not provide any physical links between centers or agencies, but instead establishes the protocols that the various software platforms within each of the centers will use to exchange information over the RCN or other networks. • C2C system will facilitate the sharing of traffic signal timing (initially) and in the future is planned to support DMS, CCTV and potentially other information sharing in the MAG Region • Currently the software protocol has been developed to view the i2TMS and TransSuite traffic signal software, and may be expanded to other types of traffic signal software in the future • Through the C2C system, cities are also able to share CCTV camera images • Once the RCN is put into place, the C2C system will function on direct fiber paths between agencies rather than the web-based program. Through the AZTech™ grant, last-mile links were provided for agencies to connect to the communications network that the RCN is planned to utilize
AZTech™ Regional Archived Data Server (RADS)	• AZTech™ RADS provides and maintains valid, classified ITS-derived regional data for use in transportation system planning, modeling, and real-time operation applications • RADS collects and stores data from the various systems in Maricopa County, Arizona, including the ADOT freeway management system, ADOT HCRS, AZTech™ SMART Corridors, Signal Systems, Phoenix Fire, C2C, and transit operations (future) • The main system design goal for the system is to take ITS data from systems throughout the Phoenix metropolitan area, store the data in a centralized archive data server, and then make the data available for a variety of data users through a common Web interface • Data stored includes traffic volumes, speeds, closures, incidents, public transit operations, and other data collected by AZTech™ partner agencies
MCDOT Public Agency Video Distribution System	• This system facilitates the sharing of CCTV camera images managed by transportation management agencies throughout the Phoenix metro area with public safety agencies (Department of Public Safety, Maricopa County Sheriff, Phoenix Fire Dispatch, and local public safety agencies) • The system is internet-based and accessible via username/password
Traveler Information Programs	• Local television channels and radio provide local traffic alerts and construction/work zone information, as well as special event traffic information • Information about incidents, closures, delays, or other real-time traffic condition information are shared with the traveling public via the 511 telephone service or az511.gov website as well as public-agency owned DMS (freeway and arterial) • MAG and ADOT collaborated on a mobile traffic information portal that makes freeway speed and travel time information accessible via internet-enabled cellular phones and PDAs • ADOT's HCRS is populated with road condition and traveler information from state and local agencies that are disseminated via the 511 telephone and az511.gov web site services • Travel times are displayed on ADOT DMS that provides travelers with an estimation of freeway travel times during AM and PM peak commute hours • Information about public transportation services is available from www.valleymetro.org as well as Valley Metro's customer service center • AZTech™ establishes partnerships with the private sector such as Traffic.com ITIP sensors to collect vehicle detection information on selected roadways • AZTech™ Sky Harbor Rental Car Center (RCC) Traveler Information System • MCDOT ATIS which provides arterial data collection and real-time reporting under Maricopa County jurisdiction, arterial information made available through 511 phone and web, and automated data exchanges between MCDOT/ADOT

3. ITS INVENTORY

ITS infrastructure is not only the physical devices and telecommunications networks that are deployed throughout the transportation network – it is the communications and coordination that occurs as a result of that infrastructure. This initial task of the ITS Architecture focuses on the physical ITS infrastructure that is deployed and used by each agency to operate their respective freeway or arterial transportation networks. The later tasks of this project will define the communications and coordination that occurs in the MAG Region currently and moving forward into the future.

3.1 Inventory Data Collection

The process of creating an inventory of ITS devices, communications, and future developments starts with collecting existing inventory information from existing plans, studies, and project documentation as well as stakeholder input. An inventory of existing and planned 'ITS elements' supports development of interface requirements and information exchanges with these ITS elements. A variety of resources were used to support the data collection efforts, as described in Section 3, including local agency ITS planning documents, regional multi-agency coordinated projects, and regional concept of operations plans.

A survey was prepared and distributed to MAG member agencies in 2009 to be able to gather ITS and agency coordination data to develop the MAG RIA, as well as document the ITS deployment and integration in the MAG region. The survey included questions for each agency regarding the number of devices, types of information sharing, and locations of devices where it is feasible to gather that information. Status of various devices and systems throughout the MAG region was also requested from agencies in the following categories:

- **Existing** - infrastructure/devices that are already installed, or will be in place by February 2009.
- **Planned** - infrastructure, devices or systems that agencies will be installing or deployed and have funding identified or already allocated or are envisioning implementing in the future, but funding is not yet identified or secured.

The ITS inventory is a valuable list for several reasons. First, it provides a baseline of existing and planned ITS projects and systems in the MAG Region. Second, it outlines which agencies are currently deploying and operating ITS as well as those planning to implement ITS programs. Third, it provides a foundation for identifying potential connectivity to develop the ITS architecture. Status of ITS deployments and communications in the survey is important to differentiate because the MAG ITS Strategic Plan that will be developed in a later project will evaluate the existing capabilities and the plans for the future for each agency against capabilities that support that regional growth in the future. Multi-agency projects such as the RCN and C2C support agency cooperation across jurisdictional lines, but it will be important for the ITS Strategic Plan to assess other cooperative efforts on the arterial network and from an interdepartmental standpoint as well.

3.2 Existing ITS Infrastructure

This section includes a summary description of the types of ITS infrastructure that currently exists in the MAG Region. **Table 7** provides an overview of the agency-owned infrastructure and communications that was captured as part of the survey that was given to each agency updated for 2013 functionality. **Appendix A** provides surveys that were distributed to each of the MAG member agencies and completed for this project.

Table 7 – Summary ITS Inventory by Agency (Freeway/Arterial)

	Centers	Devices						Communications		
Agency	**TMC/TOC**	**CCTV**	**DMS**	**Traffic Signals**	**Traffic Signal System**	**VID**	**Other Detection**	**Fiber**	**Wireless**	**Leased Lines**
ADOT										
Avondale										
Chandler										
Fountain Hills										
Gilbert										
Glendale										
Goodyear										
MCDOT										
Mesa										
Peoria										
Phoenix										
Queen Creek										
Scottsdale										
Surprise										
Tempe										

Existing capability – could be expanded in future

Planned capability – currently programmed or planned for future

3.3 Planned ITS Infrastructure

Existing infrastructure is a key focus area for this ITS Architecture because it is the foundation for ITS development and communications for the MAG Region moving forward. There are improvements to ITS infrastructure development and regional communications planned for the various agencies in the Region. These future improvements are collected as part of this project to assess the progress of implementation toward those goals as well as to identify any potential streamlining of agency planning efforts to minimize funding impacts and capital improvement requirements.

This section will review both programmed projects from the MAG TIP as well as planned projects that agencies have identified as future in the survey.

3.3.1 MAG TIP Programmed Projects

Planned infrastructure and deployment projects from the MAG TIP (2013-2017) are provided in **Table 8** by their respective timeframes. The purpose of summarizing these projects is to highlight key areas of the application of ITS that are focus areas for many jurisdictions.

Table 8 – MAG TIP (2013-2017) Programmed ITS Projects

Agency	Year	Project
ADOT	**2014**	Freeway Service Patrol (a DPS service identified under ADOT in the MAG TIP)
	2014	Dynamic Message Signs (DMS), Travel Times
	2015	Extend fiber communications coverage on I-10, as part of the ADOT FMS Phase 11A project, to expand Regional Community Network to link two West Valley agencies.
Avondale	**2013**	McDowell Rd from 99th Ave to Avondale Blvd plus 99th Ave from McDowell Rd north to the first signalized shopping center location - Furnish and install fiber optic cable, conduit, interdict, associated equipment at 9 traffic signals and 1 CCTV camera.
	2015	Connect eight signals to increase traffic flow, streamlined and more efficient signal coordination and fault diagnosis for transportation applications, including public safety communications at Dysart Road between Rancho Santa Fe Boulevard to Indian School Road. Support Regional traffic initiatives including Integrated Corridor Management Systems (ICMS) along I-10 West.
	2016	Connect two existing signals and two future signals to increase traffic flow, streamlined and more efficient signal coordination and fault diagnosis for transportation applications including public safety communications along McDowell Road between Dysart Road and Avondale Boulevard. Support Regional traffic initiatives including Integrated Corridor Management Systems (ICMS) along I-10 West.
Buckeye	**2013**	Miller Rd: Hazen Rd to I-10 and Monroe Rd (MC-85): Miller Rd to Apache Rd - Interconnect traffic signals
Chandler	**2014**	Provide fiber optic communications from traffic signals in the project area back to the TMC.
	2015	To improve traffic flow and reduce delays by upgrading 201 new signal controller equipment to be compatible with the latest software
	2016	Purchase and install 652 four-section flashing yellow arrow signal heads at 114 signalized intersections in City of Chandler.
El Mirage	**2014**	Phase I, various arterial traffic signal enhancements to upgrade the existing signalized intersections for computerized signal control, closed circuit video, improved pedestrian control, improved signage and better signal preemption.
Fountain Hills	**2014**	Provide an initial deployment of ITS for traffic signals on Shea Blvd and in the downtown area. Provide monitoring/control sites at Town Hall and the Street Yard.
Gilbert	**2014**	This project installs 3-mile fiber optic communication lines in existing conduits; The project will also add new CCTV cameras, traffic signals video detection, and controllers near Baseline Rd & Val Vista Dr.
	2015	Installation of count stations and travel time data collectors at key intersections and locations throughout the city.
	2015	This project will connect 8 traffic signals to the Town of Gilbert's fiber optic network and install approximately 3.5 miles of fiber optic cable in existing and new conduit, 3 CCTV cameras, 5 Controllers and other associated equipment.
	2016	This project will connect 7 traffic signals to the Town of Gilbert's fiber optic network and install approximately 3.5 miles of fiber optic cable in existing and new conduit, 5 CCTV cameras, 3 signal controllers and other associated equipment.

Table 8 – MAG TIP (2013-2017) Programmed ITS Projects (continued)

Agency	Year	Project
Glendale	2013	59th Ave between Northern and Bethany Home, Glendale Ave between 51st Ave and 67th Ave, Peoria Ave between 47th Ave and 67th Ave - Variable message signs; ITS conduit and fiber.
	2014	Connect 7 intersections to the city's central signal system and install 4 CCTV cameras along 67th Avenue to allow for remote monitoring and management of traffic along the corridor. Additionally, connect the fiber communications infrastructure to existing fiber and add equipment to a public safety building so that redundant pathways between node buildings for city and RCN communications are created.
	2015	Installation of count stations and travel time data collectors at key intersections and locations throughout the city.
	2015	Install four lane control signal bridges with overhead signs to allow for dynamic assignment of lanes along Maryland Avenue between 95th and 99th Avenue. Install dynamic message signs for both east and westbound traffic on two of the structures.
	2016	Installation of conduit, fiber optic cable, communications equipment and CCTV cameras at intersections. Additionally, 7 new CCTV cameras will be installed to allow for real time traffic monitoring located along Olive between 47th Ave. to 59th Ave., along 51st Ave. between Glendale Ave and Peoria Ave., and along Northern Ave. between 47th Ave. and 51st Ave.
Goodyear	2013	Citywide - Design and construct fiber optic interconnect in existing conduit for traffic management through video surveillance and data collection.
	2014	This project will provide traffic signal connectivity to three existing and one future traffic signal. In addition, CCTV cameras will be provided at key intersections.
	2015	Expand Traffic Management Center (TMC) traffic surveillance and monitoring capability by connecting to existing CCTV cameras at Indian School Road and Camelback Road traffic signals at SR 303L; Facilitate the adjustment of traffic signal timing adjustments at these locations in response to real-time traffic conditions.
	2016	Expand Traffic Management Center (TMC) traffic surveillance and monitoring capability by connecting to seven existing traffic signals along Cotton Lane and Yuma Rd.
Maricopa County	2013	Regionwide - Develop a multi-agency Operations Plan that will support coordinated arterial operations, freeway/arterial coordination, incident management and traveler information
	2013	Regionwide - Develop and implement arterial ATIS enhancements, building on the previous Phase I efforts, 511 enhancements, and other key projects
	2013	Sun Valley Parkway: I-10 to Bell Rd Connection - Implement a wireless communications system and CCTV on Sun Valley Parkway. Traffic signals will already be in place, and the wireless communications will provide interconnect and coordination capability.
	2013	DMS installations at McDowell Rd/Avondale Blvd, McDowell Rd/Estrella Pkwy, MC85/Avondale Blvd, MC85/Estrella Pkwy. Install DMS, associated conduit, pull boxes, fiber optic cable, comm. eqpt & electrical service eqpt. Joint project with Avondale & Goodyear
	2014	Upgrade the Regional Archive Data Center Equipment and Systems to enhance archiving capacity and the utility (performance monitoring. research, sharing. planning capabilities) of real time traffic data.
	2014	Extend traffic management capabilities along MC 85, implement ITS corridor improvements recommended in the MCDOT ITS Communications Plan; provide interconnection among area traffic signals; improve traffic monitoring and traffic signal control in the MCDOT and Avondale TMC's; expand AZTech regional traffic information database.
	2015	Install 52 adaptive signal control technology at 52 locations - Bell Road & L303 & Grand Ave from Cotton lane to 114th Avenue, Bell Road L101 from 99th Avenue to 73rd Avenue, Frank Lloyd Wright & L101 from Scottsdale Rd to Thompson Peak Pwky, Bell Rd & I-17 from 35th Avenue to 19th Avenue

Table 8 – MAG TIP (2013-2017) Programmed ITS Projects (continued)

Agency	Year	Project
Maricopa County	**2016**	Install 3.5 miles of new fiber and conduit infrastructure to connect MCDOT traffic signals and 2 new CCTV cameras to existing City of Chandler fiber infrastructure to be centrally controlled from the MCDOT TMC through the RCN network and eliminate need for leased lines.
	2017	Install Last Mile fiber optic connections and new fiber and conduit infrastructure along Indian School Road, McDowell Road, and in Anthem
Mesa	**2013**	West side mid-city (initial deployment), West city limits to Country Club, University to Broadway - Upgrade central traffic control system software to accommodate a lite version of adaptive control.
	2013	10 intersections with highest crash rates within Mesa. Implement video & acoustic sensors with communications facilitated using existing traffic controller cabinets to detect and alert traffic operations staff of suspected crash or traffic impeding events.
	2015	Purchase 4 access points per radio tower on 12 existing radio towers for a total of 38 access points. Purchase 40 remotes to support field device communications back to the radio towers.
	2016	Integrate Mesa 9-1-1 Call Center Computer Aided Dispatch (CAD) data into the Regional Archive Data System (RADS).
	2016	Purchase and install 91 Anonymouse Re-identification (ARID) devices in existing traffic signal cabinets throughout the East Valley along with centeral control software for each partnering agency's TMC.
Peoria	**2013**	83rd Ave beginning at Lone Cactus Dr and continuing north to Jomax Rd - Installation of conduit, pull boxes, fiber, and CCTV cameras to connect signals to Central, and monitor traffic and provide real-time traffic management on this segment of 83rd Avenue
	2014	To upgrade the existing cabinets, traffic controllers and also upgrade the existing loop detection to video detection on selected corridors, upgrade the hardware and software with the changing technologies in ITS. Upgrade the hardware and software technology within the City's Traffic Signal Control System.
	2015	Expand TMC traffic surveillance and monitoring capability by installing CCTV cameras with peer-to-peer control.
	2017	Replace legacy TMC equipment, including switches, servers, workstations, video screens, wall encoders, firewall.
Phoenix	**2014**	To extend Phase B Fiber Optic Backbone, To provide Traffic Signal interconnect to the City of Phoenix TMC.
	2014	Develop the City of Phoenix's first ITS Strategic Plan.
	2015	Procure, install and provision the CCTV Pan, Tilt, Zoom (PTZ) traffic monitoring cameras at 65 locations Citywide
	2015	Procure, install and provision the Dynamic Message Signs along 7th Avenue at Northern Ave., Glendale Ave., Camelback Rd., and McDowell Road and along 7th Street at Bell Rd., Thunderbird Rd., Camelback Rd., and McDowell Rd.
	2017	The City of Phoenix Police use the existing Downtown Traffic Management System (DTMS) extensively to control traffic after large special events held downtown.
Queen Creek	**2013**	Various locations townwide - Establish ten wireless traffic signal connections.

Table 8 – MAG TIP (2013-2017) Programmed ITS Projects (continued)

Agency	Year	Project
Scottsdale	2013	Citywide - Last mile connections from city fiber network
	2014	To identify traffic adaptive signal systems that have been deployed and returned successful outcomes in reducing traffic delay on stated corridors across the country. 2. Deploy the selected system on FLW and complete before and after delay studies 3. Evaluate if the Adaptive System can minimize delay.
	2015	Highway Advisory Radio (HAR) uses low power, short range, AM broadcast radio to advise the public on a variety of important travel and safety related information.
	2016	Replace standard Signal Cabinets with Advanced Hybrid Cabinets.
	2017	Replace standard Signal with Advanced Hybrid Cabinets.
Surprise	2013	Cotton Lane from Peoria Ave to Bell Rd - Optical Fiber interconnect of signals, TV cameras, dynamic message signs, and connection to ITS Fiber Backbone
	2017	Install fiber optic backbone in existing conduit and install DMS to enhance the ability to manage traffic during incidents and special events.
Tempe	2013	Citywide - Procure and install traffic control cabinets and hardware - Phase 1 of 3
	2013	Installation of Pedestrian ITS devices
	2013	Design and Install Fiber Optic Communications
	2014	Installation of Pedestrian ITS devices
	2014	This project proposes to use an existing conduit along Elliot for fiber optic communication to the signals. Wireless radios will be used to provided communication to signals along Guadalupe & Warner. CCTVs will be placed at the major intersections for traffic monitoring.
	2014	Install new/upgrade modular traffic signals
	2015	The project will install new conduit and make use of existing conduit to provide fiber connection from ADOT's node 12 building to the signals. The project also includes procuring and installing 22 Closed Circuit Television (CCTV) cameras for each interchange intersection in Tempe
	2016	The project will install conduit and fiber in the Rural Rd. corridor from US 60 north.
	2017	The project will install conduit and fiber in the Rural Rd. corridor from US 60 south.

4. LOGICAL ARCHITECTURE

The MAG RIA update includes both a logical architecture component and a physical architecture component. A logical architecture focuses on the processes and activities to deliver specific ITS services. It describes what various systems and agencies need to do to meet the needs of users (for travelers as well as system operators and managers). The physical architecture links to specific centers, infrastructure and system components, and focuses on how systems and agencies are linked and connected to share specific information or control various elements of the ITS systems and networks.

The logical ITS architecture was the second major step in developing the RIA update for the MAG Region. Although not required as part of the FHWA Final Rule/FTA Policy on Architecture Conformity and Standards, the logical architecture provides a tangible link to specific ITS User Services (processes) that can then be traced to the infrastructure and systems in the physical architecture. This logical architecture maps the user needs and inventory with applicable User Services from the National ITS Architecture, as well as defines User Service Requirements for those user services. The MAG RIA provides a link to the physical architecture through the use of equipment packages.

MAG's goal for focusing on the logical architecture component is to provide a level of traceability between User Services and the physical elements and infrastructure that comprise the functionality identified in the physical architecture. The logical architecture also helps to describe what ITS does from a user's perspective. The goal of this logical architecture is to:

- Identify applicable User Services and User Service Requirements from the National ITS Architecture for the MAG Region;
- Identify appropriate subsystems from the National ITS Architecture that can guide the development of the physical architecture in the next task;
- Identify a preliminary set of equipment packages that can be further refined during the physical architecture development; and
- Provide a means for establishing traceability from the physical architecture back to goals, objectives and User Services/User Service Requirements.

4.1 Traceability Between the Logical and Physical Architectures

There are two parallel efforts that work together to provide the foundation for building the RIA and customizing the components and service packages within the physical architecture. One aspect, the "traveler perspective", identifies what ITS needs to do to provide the required services to users of the transportation system. This concept is rooted in User Services and User Service Requirements, and is captured within the logical architecture. The second aspect is the "agency perspective", and identifies what physical components need to be deployed, integrated and operated (and by which agency) in order to deliver the desired services and functionality outlined in the user services and user services requirements. Both are important to achieve the overall goals and purpose of implementing ITS and communications in the MAG Region, but they each have a different focus.

The "Traveler Perspective" describes the traveler's experience in using the systems that agencies have planned and implemented. The goals and objectives of the MAG Region as defined in Section 2.2 describe the services that the agencies would like the traveler to experience and be able to use during their travel. There services are described in the National ITS Architecture as "User Services" that define broad functionality that the systems in the MAG Region perform for the traveler. User Service Requirements describe in more detail what will

need to be provided to the traveler and to the agencies to address a particular User Service. Both of these elements provide the foundation for the logical ITS architecture.

The "Agency Perspective" describes the interaction between agencies and devices that occurs to be able to manage the systems in the MAG Region. The ability to perform traffic management, incident management, and emergency response is rooted in the types of devices and communications that agencies utilize manage the roadways. The "Agency Perspective" begins with the implementation of devices and communications called Inventory. Equipment Packages are ultimately those services that the agency is performing that are using the inventory in each jurisdiction for the benefit of the traveling public. For example, real-time traffic condition information is shared between the center subsystem (traffic management center [TMC]) and the field subsystems (traffic signals) to be able to perform TMC Traffic Control which is an equipment package defined by the National ITS Architecture.

One important link between the logical architecture and the physical architecture is the relationship between the User Service Requirements (logical architecture) and the Equipment Packages (functional elements within the physical architecture). The User Service Requirements identified in this technical memorandum will provide traceability from the logical to the physical components.

The two perspectives are shown in **Figure 3** below.

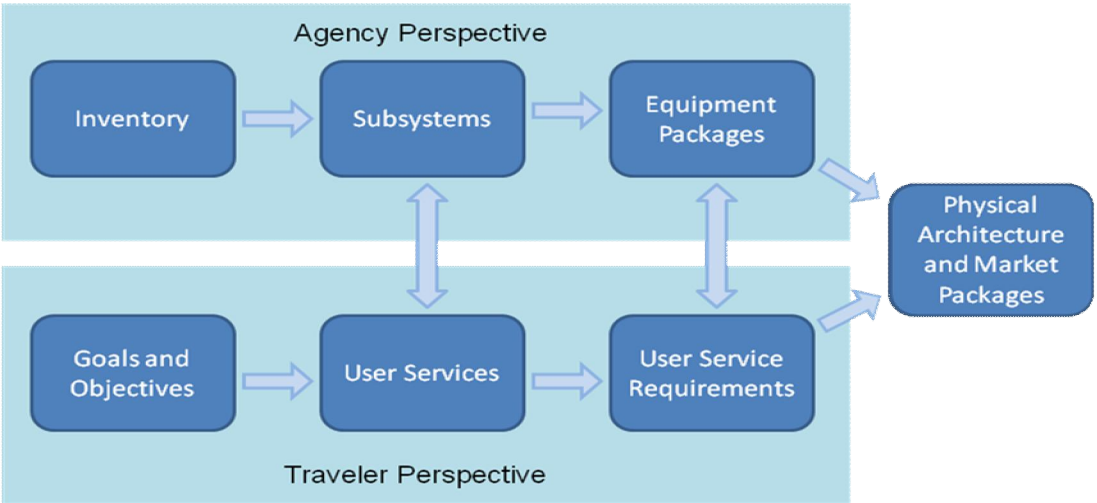


Figure 3 – Logical Architecture Development Process

As the process is developed, the perspectives in each step relate to one another by the type of input that it is providing to the logical architecture as well as the level of detail. Subsystems describe the physical entities that need to be currently operating or planned for the future in order for the User Service to be selected as appropriate for the MAG Region. For example, there is currently no commercial vehicle function that agencies in the MAG Region perform, which means that the commercial vehicle subsystem as well as any User Service that requires a commercial vehicle subsystem to interact with a center or other subsystem has been removed. The Equipment Packages are used as a check against the User Service Requirements to ensure that each are describing <u>how</u> the Subsystems and User Services, respectively, will be used in the MAG Region.

4.2 User Services and User Service Requirements

User Services in the National ITS Architecture describe broad functionality that the systems in the MAG Region perform for the traveler – what ITS should do from the user's perspective. The "Traveler Perspective" describes the traveler's experience in using the systems that agencies have planned and implemented. User Service Requirements describe in more detail what will need to be provided to the traveler and to the agencies to address a particular User Service.

4.2.1 User Services

User Services describe the transportation services that ITS can provide in the MAG Region to satisfy the user's needs. There are 33 User Services in the National ITS Architecture. User Services describe what types of actions are current and planned and how those actions relate by the types of information they share. User Services that apply to the MAG Region:

- Travel and Traffic Management
- Public Transportation Management
- Electronic Payment
- Emergency Management
- Information Management
- Maintenance and Construction Management

Two User Services were not identified as being applicable to the MAG Region:

- **Commercial Vehicle Operations** – these User Services apply primarily to private sector fleet/freight management, on-board freight applications, as well as border crossing technologies. This is not to say that Commercial Vehicle Operations would not be included as part of a different ITS architecture in Arizona (such as a statewide ITS architecture), but they do not represent services that are needed or envisioned in the MAG Region.
- **Advanced Vehicle Safety Systems** – this User Service bundle includes systems on-board vehicles (typically personal traveler vehicles) for crash avoidance, intersection warning systems, and other safety enhancements. The reason they were not included in the User Services for the MAG Region is because these types of safety systems would not be implemented by MAG member agencies; they would be led by private industry. One item to note is that with the emerging Vehicle Infrastructure Integration efforts being led by partners in this Region, there may be some applicability of some elements of this User Service bundle.

Each of the User Service bundles has many processes under them called User Service Requirements. These requirements describe in more detail the actions that take place to monitor, control, manage, and report on the ITS systems in the MAG Region. These are discussed in more detail in Section 4.2.2.

Table 9 maps the regional transportation goals and objectives as outlined in Section 2.2 to the User Services in the National ITS Architecture in order to identify candidate User Services for this region. The goals and objectives describe the services that the agencies would like the traveler to experience and be able to use during their travel, as well as capabilities that agencies need to provide the operational services identified. User Services that do not have identified functionality in the MAG Region based on the goals and objectives were not carried forward in this architecture. The Public Transportation Management User Service (2.1) has been separated into two categories because of the broad

topics that provide that service as a whole. These have been separated out in the table for clarification, and are an extension of the User Services in the National ITS Architecture. It is important to note that the Electronic Payment User Service (3.1) applies to transit operations in the MAG Region and does not include any tolling or parking payment services.

Table 10 defines the User Services that were selected for the MAG Region based on existing and planned inventory as well as the programs and services that are offered in the Region to support multiple agency operations. Many of the identified User Services are already established in the MAG Region through existing agency programs and systems.

Table 9 – Goals and Objectives Mapped to National ITS Architecture User Services

		Applicable User Services																				
		Travel and Traffic Management										Public Transportation Management						Electronic Payment	Emergency Management			Info. Mgmt	Maint. and Const. Mgmt
		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	2.1	2.1a	2.1b	2.2	2.3	2.4	3.1	5.1	5.2	5.3	7.1	8.1
Operational Category	**Goals and Objectives**	Pre-Trip Travel Information	En-Route Driver Information	Route Guidance	Ride Matching and Reservation	Traveler Services Information	Traffic Control	Incident Management	Travel Demand Management	Emissions Testing and Mitigation	Highway Rail Intersection	Public Transportation Management	Transit Operations	Communications Management	En-Route Transit Information	Personalized Public Transit	Public Travel Security	Electronic Payment Services	Emergency Notification and Personal Security	Emergency Vehicle Management	Disaster Response and Evacuation	Archived Data	Maintenance and Construction Operations
Traffic Management	Increase automated traffic data collection and archiving ability	X	X				X															X	
	Establish integrated freeway-arterial corridor operations for major arterial corridors						X	X														X	
	Enhance traffic management capabilities for normal conditions and special events	X	X				X															X	
	Provide advanced warning at railroad/street crossings										X												
	Coordinate signal systems within single jurisdictions and across jurisdictional boundaries						X																
	Increase ITS device shared operation partnerships along key arterial corridors						X																
	Establish center-to-center communications between traffic management agencies in the region		X				X	X														X	
Incident/Emergency Management	Improve incident detection capabilities and reduce incident clearance times						X	X											X			X	
	Increase incident information sharing between traffic management and public safety agencies for cooperative freeway and arterial incident management						X	X											X	X	X	X	
Transit Operations	Improve bus progression using traffic signal priority						X					X	X										
	Enhanced transit service (routes, frequency, hours, security, payment, and real-time transit information)	X			X				X			X	X	X	X		X	X					

		Applicable User Services																				
		Travel and Traffic Management										Public Transportation Management						Electronic Payment	Emergency Management			Info. Mgmt	Maint. and Const. Mgmt
		1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	1.10	2.1	2.1a	2.1b	2.2	2.3	2.4	3.1	5.1	5.2	5.3	7.1	8.1
Operational Category	**Goals and Objectives**	Pre-Trip Travel Information	En-Route Driver Information	Route Guidance	Ride Matching and Reservation	Traveler Services Information	Traffic Control	Incident Management	Travel Demand Management	Emissions Testing and Mitigation	Highway Rail Intersection	Public Transportation Management	Transit Operations	Communications Management	En-Route Transit Information	Personalized Public Transit	Public Travel Security	Electronic Payment Services	Emergency Notification and Personal Security	Emergency Vehicle Management	Disaster Response and Evacuation	Archived Data	Maintenance and Construction Operations
	Coordinate roadway closure/construction information with transit agencies							X				X	X	X	X								X
Traveler Information	Improve accuracy, timeliness, and availability of real-time, multi-modal traveler information to the public	X	X				X	X							X				X				X
	Increase the use of DMS for more types of traffic, work zone and incident information, including travel times	X	X				X	X															X
	Integrate transit information with traveler information services	X	X												X								

Table 10 – User Services Selected for the MAG Region

#	User Service	Description	MAG Region Application
		Travel and Traffic Management	
1.1	Pre-Trip Travel Information	• Allows travelers to access a complete range of real-time multimodal transportation information at home, work, and other major sites where trips originate • Information on road network conditions, incidents, weather, and transit services, are conveyed through these systems to provide travelers with the latest conditions and opportunities in order to plan their travel	511, HCRS information on roadway conditions az511.gov website Valley Metro transit and METRO Rail web sites Local media providers (TV, radio and web)
1.2	En-Route Driver Information	• Provides driver advisories to convey information about traffic conditions, incidents, construction, transit schedules, and other mode choice options to drivers of personal, commercial, and public transit vehicles	Permanent and portable DMS (freeways and arterials) 511 Media broadcasts (radio)
1.4	Ride Matching and Reservations	• Provides real-time ride matching information and reservations to travelers in their homes, offices or other locations, and assists transportation providers with vehicle assignments and scheduling	Rideshares Dial-a-Rides
1.6	Traffic Control	• Provides for the integration of the freeway and surface street systems and gives preference to transit and public safety vehicles • Real-time traffic information collected by this service is also disseminated for use by many other user services	Operational control and management of devices (signals, ramp meters, cameras, etc.) Agency TMC/TOC TMC information sharing
1.7	Incident Management	• Utilizes sensors, data processing, and communications to improve the incident management and response capabilities of transportation and public safety officials, the towing and recovery industry, and others involved in incident response • This service will help these groups to quickly and accurately identify incidents and implement a response	Coordination among public safety and transportation management for incident response operations Specialized incident response programs (ALERT, FSP, REACT) Integration of public safety systems with traffic management
1.8	Travel Demand Management	• Generates and communicates management and control strategies that support the implementation of programs to reduce the number of individuals who choose to drive alone; increase the use of high occupancy vehicles and transit; and provide a variety of mobility options for those who wish to travel in a more efficient manner, for example in non-peak periods	Collection of data to support multi-modal strategy implementation Ridematching and ridesharing services
1.10	Highway Rail Intersection	• Uses ITS technologies to provide improved control of highway and train traffic to avoid or decrease the severity of collisions that occur between trains and vehicles at highway/rail intersections	Highway/rail with ADOT facilities, highway/rail with municipal facilities
		Public Transportation Management	
2.1 2.1a 2.1b	Public Transportation Management Transit Operations Communications Management	• Automates the operations, planning and management functions of public transit systems • Monitors the location of transit vehicles, identifies deviations from the schedule, and offers potential solutions to dispatchers and operators • This service will help maintain transportation schedules and assure transfer connections between modes and can be coupled with traffic control services to facilitate quick response to service delays	Transit systems and technologies for real-time location, schedule and operations information Integration of transit with traffic/transportation management to share information

Table 10 – User Services Selected for the MAG Region (continued)

#	User Service	Description	MAG Region Application
		Public Transportation Management	
2.2	En-Route Transit Information	• Provides information to travelers using public transportation after they begin their trips • Real-time, accurate transit service information will be available on-board the vehicle, at transit stations and bus stops to assist travelers in making informed decisions	Transit traveler information through station displays, NextRide system and on-board systems
2.4	Public Travel Security	• Creates a secure environment for public transportation patrons, operators, and support staff • Provides systems that monitor the environment in transit facilities, transit stations, parking lots, bus stops and on-board transit vehicles and generates alarms when necessary	Security surveillance on-board vehicles and at transit stops
		Electronic Payment	
3.1	Electronic Payment Services	• Allows travelers to pay for transit services with a common electronic payment medium for all transportation modes and functions	Passenger fare counting for transit ridership, universal form of payment for Light Rail and bus system
		Emergency Management	
5.1	Emergency Notification and Personal Security	• Provides the ability for travelers to notify appropriate emergency response personnel regarding the need for assistance due to emergency or non-emergency situations • Provides for monitoring, threat alerts, and automated security system support in secure areas including transportation infrastructure • Provides wide area alert to notify the traveling public in emergency situations such as child abductions, severe weather watches and warnings, natural and human-caused disasters, military operations, and civil emergencies where lives and/or property are at stake	AMBER Alerts MAG CENS (Reverse 911 System)
5.2	Emergency Vehicle Management	• Oriented towards reducing the time from receipt of notification of an incident by a operator to arrival of the emergency vehicles on the scene • Includes improved communications between response vehicles and the Public Safety Answering Point dispatch center to provide improved display of emergency vehicle location and automation support to dispatchers to help them dispatch the vehicle that can most quickly reach the incident site • Provides route guidance and preemption of traffic signals on an emergency vehicle's route	Public safety AVL systems Traffic signal preemption for emergency responders Access to real-time road and traffic conditions information by public safety dispatch centers
5.3	Disaster Response and Evacuation	• Uses ITS to enhance the ability of the surface transportation system to respond to disasters • Provides enhanced access to the scene for response personnel and resources, provides better information about the transportation system in the vicinity of the disaster, and provides more efficient, safer evacuation for the general public if needed	AMBER Alert, disaster/evacuation traveler information dissemination, MAG CENS
		Information Management	
7.1	Archived Data	• Provides an ITS historical data archive for all relevant ITS data and will incorporate the planning, safety, operations, and research communities into ITS • Provides the data collection, manipulation, and dissemination functions of these groups, as they relate to data generated by ITS	Local agency archive system, HCRS, RADS

Table 10 – User Services Selected for the MAG Region (continued)

#	User Service	Description	MAG Region Application
		Maintenance and Construction Management	
8.1	Maintenance and Construction (MC) Operations	• Integrates key activities to ensure that roadways, associated infrastructure, and available resources are coordinated in the best possible manner • Areas covered by this user service are maintenance vehicle fleet management, roadway management, work zone management and safety, and roadway maintenance conditions and work plan dissemination	Maintenance vehicle, maintenance dispatch, coordination with traffic management

4.2.2 User Service Requirements

The User Services applicable to the MAG Region were determined based on identified goals and objectives from the previous task of this project. From the chosen User Services, more specific Requirements have been identified. These User Service Requirements define the processes (the activities or functions) that are required to satisfy the user services identified as part of this task. They are typically phrased in "shall" statements.

In the Archived Data User Services, for example, the requirements describe how the Archived Data function controls the archiving and distribution of ITS data through five key areas: managing the operations data integrity, acquire historical data, permanently archiving the data, integrating and processing the data products for the public agencies that can use them, and links to the data server that allows users to retrieve the data. In this example, the Archived Data User Service is describing what the data servers in the MAG Region as a whole are expected to do – not each individual archive.

To continue the example of the Archived Data User Service, one type of archived data service that is provided in this Region is ADOT's Highway Condition Reporting System (HCRS). The HCRS is an event-driven database that archives the construction and incident information directly entered into the database. HCRS receives traffic data and images information from the freeway management system as well as receives information from local agencies regarding the road closure and restriction status of main corridors in the arterial network. Each agency in the MAG Region is linked to HCRS to provide information to it or pull information from it. HCRS is generally an event-driven and actively updated database that is used for disseminating traveler information, sharing information with other agencies, archiving historical data for planning purposes, and a multitude of other uses. The archived data system that feeds the HCRS with freeway management system data is the RADS which also collect arterial traffic signal information.

An additional example is shown below:

<u>User Service Bundle: Travel and Traffic Management</u>

User Service: En-Route Driver Information

The En-Route Driver Information user service provides driver advisories to convey information about traffic conditions, incidents, construction, transit schedules, and other mode choice options to drivers of personal, commercial, and public transit vehicles.

Sample User Service Requirement:

ITS shall include an En-Route Driver Information (DI) function. Driver Information provides vehicle drivers with information, while en-route, which will allow alternative routes to be chosen for their destination. Driver Information consists of two major functions, which are, (1) Driver Advisory and (2) In-vehicle Signing. The potential decrease in traffic may also provide benefits in highway safety, reduced air pollution, and decreased congestion.

Applicable User Service Requirements from the National ITS Architecture for the MAG Region are listed in **Appendix B**. Not all User Service Requirements have been carried forward for consideration. The User Services and User Service Requirements described in this section and in the appendix have been filtered from their original state in the National ITS Architecture to align with functionality and objectives in the MAG Region. **The details of the actual and physical interactions and relationships between agencies to make this functionality occur are part of the physical ITS architecture development.**

4.3 Subsystems and Equipment Packages

The "Agency Perspective" begins with the implementation of devices and communications systems that are part of the regional inventory. Equipment Packages are ultimately those services that the agency is performing that are using the inventory elements for the benefit of the traveling public. For example, real-time traffic condition information is shared between the center subsystem (TMC) and the field subsystems (traffic signals) to be able to perform TMC Traffic Control which is an equipment package defined by the National ITS Architecture.

4.3.1 System Interconnect

The National ITS Architecture provides a comprehensive list of subsystems that are used in general architectures. **Figure 4** shows a system interconnect diagram, or "sausage diagram" which identifies the subsystems and primary interconnects among subsystems in the MAG Region. The National ITS Architecture interconnect diagram has been customized for the MAG Region based on the inventory gathered from stakeholders. This figure summarizes the existing, planned, and future ITS elements for the MAG Region in the context of a high-level physical interconnect. Those boxes that are shaded in gray are not being used currently in the MAG Region and are not planned for the future.

The primary purpose of the architecture is to identify specific connectivity between transportation systems and elements in the MAG Region. **Figure 4** also shows the high-level relationships of the subsystems in the MAG Region. How the systems actually interface with each other on a physical communication level is an integral part of the physical ITS architecture developed in a later task.

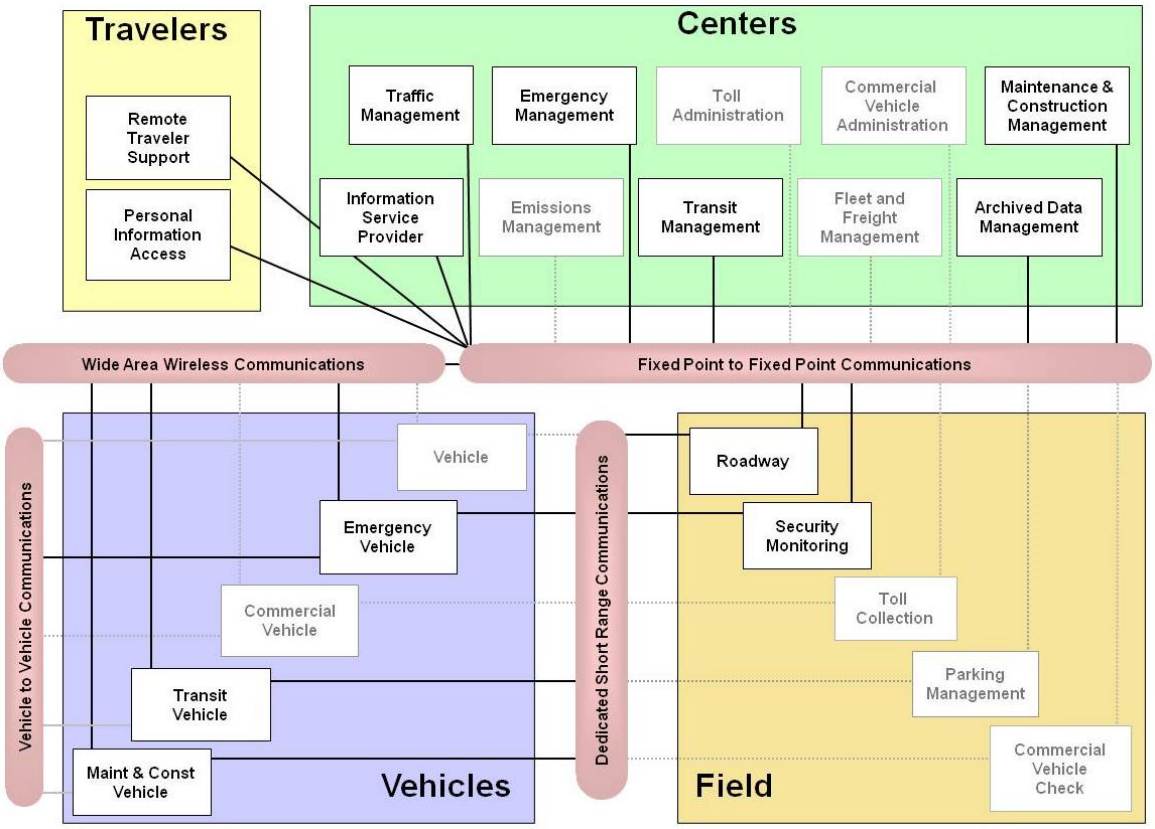


Figure 4 – MAG Region System Interconnect Diagram

4.3.2 Subsystems and Equipment Packages

Subsystems have been mapped to the Inventory which are then mapped to corresponding Equipment Packages. Equipment Packages are those services that the agency is performing that are using the subsystems in each jurisdiction for the benefit of the traveling public. Equipment Packages are essentially a small concept of operations describing a function being performed from the agency perspective. They are a key link between the logical architecture and the physical architecture because the concepts that are discussed at a high level in this logical architecture can be broken down into their physical ability to be performed by the agencies involved. User Service Requirements are another key link to the physical architecture and those were described previously in Section 4.2.2.

There are specific subsystems, such as the Toll Collection Field Subsystem, that would not be included in this architecture because toll collection is not being used on roadways currently in the MAG Region. If tolling or congestion pricing is identified as part of a future strategy, this would need to be updated within the RIA to show that future functionality. Subsystems that are identified in this table will be brought forward into the physical ITS architecture to be able to categorize the inventory in the MAG Region.

Equipment packages describe specific pieces of functionality that need to occur in the region in order for the user services to be provided to the traveling public. Equipment packages take the subsystems and designate deployment-sized pieces that can be applied to that subsystem to demonstrate the desired functionality of services in the region. Equipment

packages provide a detailed view of the architecture and are tied to specific service packages and specific inventory items as shown on the MAG ITS Architecture website.

Equipment packages group similar processes of a particular subsystem together into an "implementable" package. In the architecture website, equipment packages have been provided for each of the specific inventory items as shown in the "Inventory by Stakeholder" sublink. Multiple equipment packages are linked to that subsystem based on the different kinds of functionality that the one inventory item provides. For example, the ADOT DMS inventory item is involved in the functionality of "Roadway Freeway Control", "Roadway Traffic Information Dissemination", "Roadway Equipment Coordination", and others. Each one of those equipment packages is technology-neutral but describes the functionality of the ADOT DMS. Similarly, the DMS in other agencies, such as City of Chandler DMS and City of Scottsdale DMS provide the same or similar functionality as the ADOT DMS; therefore, the equipment packages will be the same or similar to those represented for the ADOT DMS.

While service packages describes function or service that is provided when multiple subsystems work together to share information and operate devices/systems, equipment packages describe the specific functionality that one element in the service package must have in order to be part of that service package to provide that service. In the example described above, ADOT DMS provides traveler information to travelers. That functionality is described in the equipment package "Roadway Traffic Information Dissemination" and is represented in the service package "ATMS06 – Traffic Information Dissemination." Multiple subsystems are shown in each service package and thus multiple equipment packages are represented by each service package.

As service packages were updated throughout the course of this project, equipment packages were added/removed/updated to be consistent with the service packages. It is important to note that only three of the many equipment packages that apply to this individual service package are shown in **Figure 5** on the next page. This figure is provided to show the relationship of the equipment package to service packages. Equipment packages are linked to the inventory rather than the service packages on the architecture website due to the complex overlaps that occur within the service packages. Therefore, when agencies are reviewing the website for their project applicability in the architecture, the agency should select the appropriate inventory item to identify the service packages and equipment packages that would apply to that project.

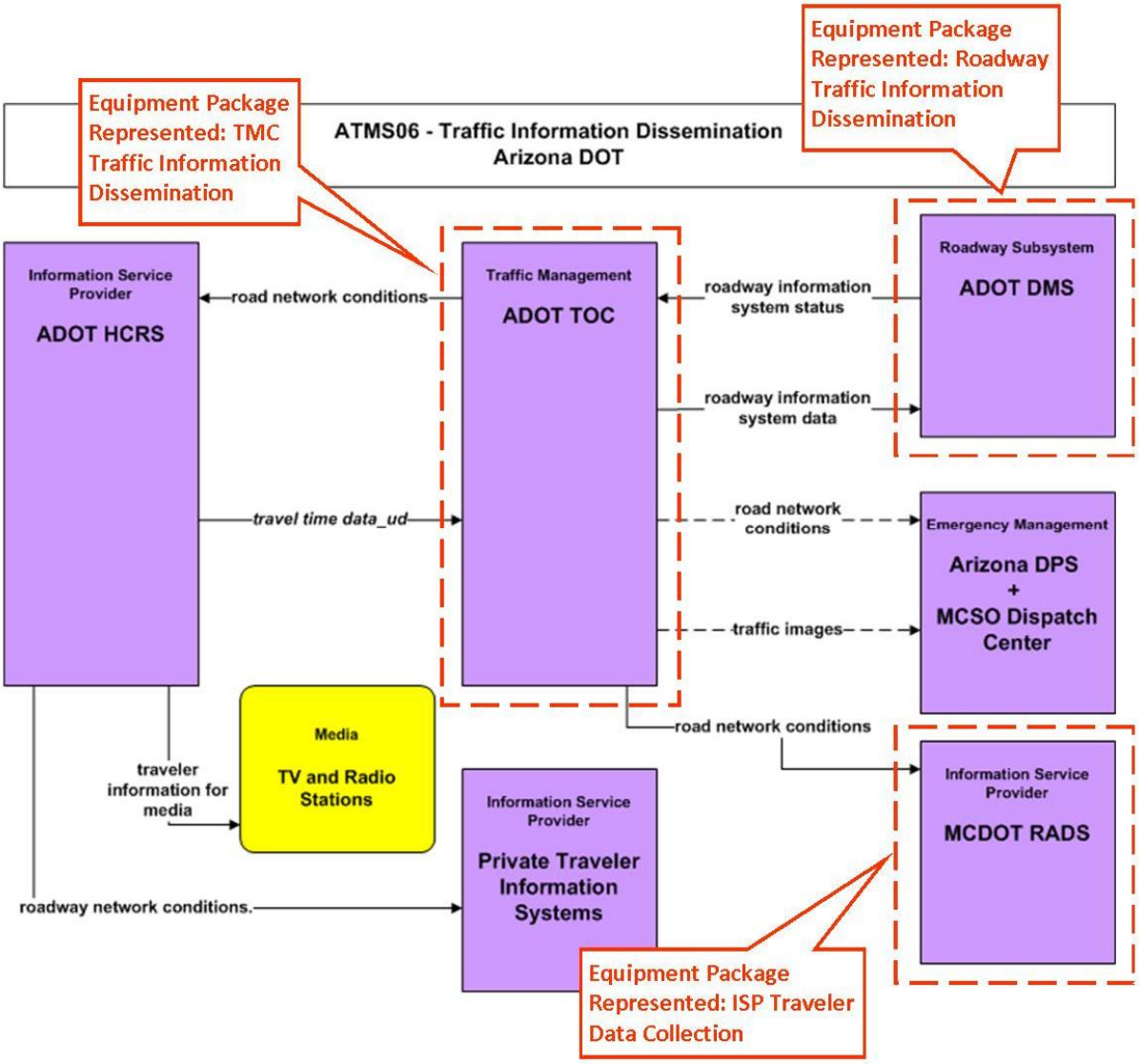


Figure 5 – Link Between Equipment Packages and Service Packages

Equipment packages describe the functionality of each subsystem ultimately through detailed functional requirements. ITS standards documented in this architecture provide interoperability capabilities for the architecture elements to be able to communicate. These standards are produced by the Turbo Architecture database which uses the inventory and service packages in this architecture to develop the list of standards to apply in this region. Subsystems and equipment packages that are applicable to the MAG Region are provided in **Table 11**; these are currently being used in the MAG Region in some capacity.

Table 11 – Subsystems and Equipment Packages for the MAG Region

Type	Subsystem	Inventory	Equipment Packages
Centers	Archived Data Management Subsystem	HCRS Local agency archives RADS server	ITS Data Repository Traffic and Roadside Data Archival Virtual Data Warehouse Services
	Emergency Management	Local Emergency Management Dispatch (City Police/Fire) County Emergency Management Dispatch (MCSO) State Emergency Management Dispatch (DPS) City Emergency Operations Centers (EOCs) County EOC Arizona Department of Emergency Management	Emergency Call-Taking Emergency Data Collection Emergency Dispatch Emergency Early Warning System Emergency Environmental Monitoring Emergency Evacuation Support Emergency Response Management Emergency Routing Incident Command Service Patrol Management
	Information Service Provider	HCRS RADS AZ511 City Websites Transit Websites Private Sector Providers (Media, Traffic.com, Others) MAG CENS (Reverse 911 System)	Basic Information Broadcast ISP Data Collection ISP Emergency Traveler Information ISP Operational Data Repository ISP Traveler Data Collection ISP VII Traveler Information Distribution Traveler Telephone Information
	Maintenance and Construction Management (MCM)	City Public Works County Maintenance ADOT Phoenix District Maintenance	MCM Data Collection MCM Environmental Information Collection MCM Incident Management MCM Roadway Maintenance and Construction MCM Vehicle Tracking MCM Work Activity Coordination MCM Work Zone Management
	Traffic Management	ADOT TOC County DOT City TMCs	Collect Traffic Surveillance HRI Traffic Management Rail Operations Coordination TMC Dynamic Lane Management and Shoulder Use TMC Freeway Management TMC Incident Detection TMC Incident Dispatch Coordination/Communication TMC Multimodal Coordination TMC Regional Traffic Management TMC Roadway Warning TMC Signal Control TMC Speed Monitoring TMC Traffic Information Dissemination TMC Variable Speed Limits TMC Work Zone Traffic Management Traffic Data Collection Traffic Maintenance
	Transit Management	Transit Dispatch/Operations Center	Transit Center Fare Management Transit Center Fixed-Route Operations Transit Center Information Services Transit Center Multi-Modal Coordination Transit Center Paratransit Operations Transit Center Passenger Counting Transit Center Security Transit Center Vehicle Tracking Transit Data Collection

Table 11 – Subsystems and Equipment Packages for the MAG Region (continued)

Type	Subsystem	Inventory	Equipment Packages
Field	Roadway Subsystem	Freeway permanent CCTV Arterial permanent CCTV Freeway permanent DMS Freeway portable DMS Arterial permanent DMS Arterial portable DMS Freeway ramp meters Freeway ramp meter w/preemption Freeway ramp meter w/priority (transit) Signalized intersections (not tied to TMC) Signalized intersections (tied to TMC) Signalized intersection w/preemption Signalized intersection w/priority (transit) Video Image Detection Loop detection Other detection (private sector, ITIP, other) Red light running enforcement Photo radar enforcement Weigh in Motion Railroad crossings Flood sensors	Advanced Rail Crossing Roadway Basic Surveillance Roadway Data Collection Roadway Dynamic Lane Management and Shoulder User Roadway Environmental Monitoring Roadway Equipment Coordination Roadway Freeway Control Roadway Incident Detection Roadway Signal Controls Roadway Signal Priority Roadway Speed Monitoring Roadway Traffic Information Dissemination Roadway Variable Speed Limits Roadway Warning Roadway Work Zone Safety Roadway Work Zone Traffic Control Standard Rail Crossing
Travelers	Personal Information Access	Personal Information Access Devices (Cell Phones, Email, PDAs)	Personal Autonomous Route Guidance Personal Basic Information Reception Personal Interactive Information Reception
	Remote Traveler Support	Traveler Information Displays (Transit and LRT Stations, Rental Car Center Traveler Information Displays)	Remote Basic Information Reception Remote Interactive Information Reception
Vehicles	Emergency Vehicle Subsystem	Law Enforcement Emergency Services Freeway Service Patrol ALERT REACT	On-board Emergency Vehicle En-Route Support On-board Emergency Vehicle Incident Management Communication
	Maintenance and Construction Vehicle	City Maintenance/Construction with Automated Vehicle Location County Maintenance/Construction with Automated Vehicle Location	MCV Roadway Maintenance and Construction MCV Vehicle Location Tracking MCV Work Zone Support
	Transit Vehicle Subsystem	Transit Vehicles with Automated Vehicle Location	On-board Maintenance On-board Passenger Counting On-board Transit Fare Management On-board Transit Information Services On-board Transit Security On-board Transit Signal Priority

4.4 Using the Logical Architecture to Develop the Physical Architecture

The inventory, goals and objectives in the MAG Region have been used to identify the applicable User Service Requirements and Equipment Packages. These tools will be used moving into the physical architecture as a representation of what is currently happening in the MAG Region. The physical architecture will describe how the services happen through sending information to and from specific subsystems. Each one of these services, and the actual information transfer that occurs to perform that service, is described as a Service Package in the National ITS Architecture. **Figure 6** below depicts the interrelationships that the "Traveler Perspective" and the "Agency Perspective" have to build the foundation for the physical architecture. It is important to consider that the "Agency Perspective" which includes the physical elements in the logical architecture is what the physical architecture uses as a basis for information. The subsystems and equipment packages are highlighted in this figure as the direct lead to the physical architecture with the user services and user service requirements describing from the users' perspective what the service should do.

Figure 6 depicts a specific example of the relationship between the subsystem, equipment package and the physical architecture. The "Center Subsystem" (identified as a TMC in the MAG Region) provides a service to the traveler called "Traffic Control" (User Service 1.6) which has many user service requirements that need to be performed in order to provide that service to the traveling public. In order to provide the "Traffic Control" service, the TMC physically operates the equipment package called "TMC Signal Controls" which describes at a high level how the roadway signals are physically controlled by the TMC. In order to actually physically control the roadway signals, specific information flows need to be identified between the TMC and the roadways signals which bridges the gap between the logical architecture and the physical architecture. The physical architecture will be used to identify the specific information flows as well as the functions of the MAG Region. Signal control is only one component of the "Surface Street Control" service package.

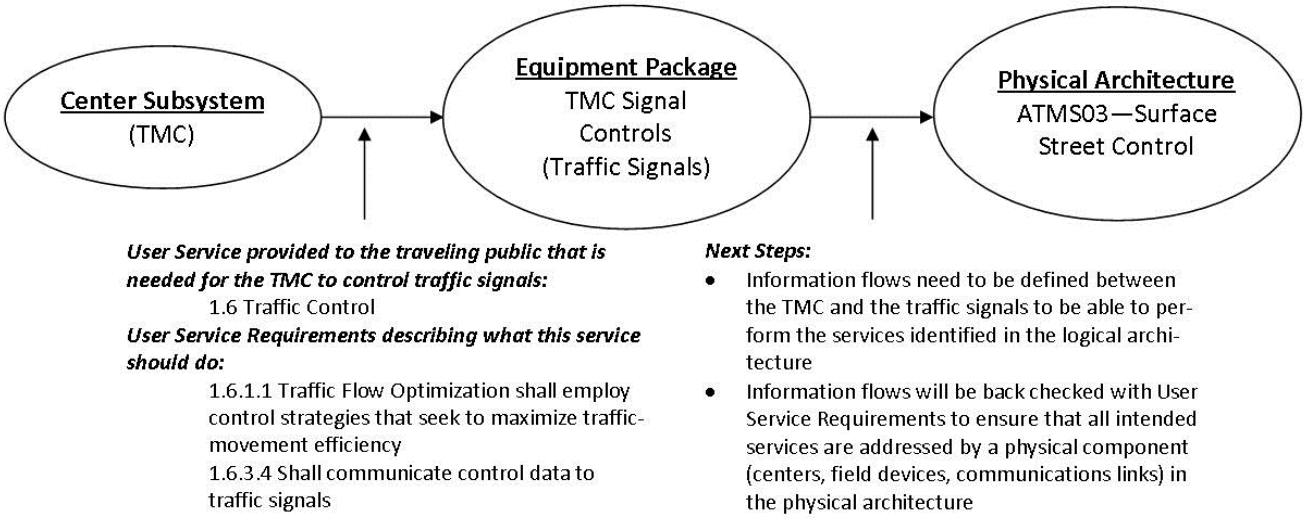


Figure 6 – Link to the Physical ITS Architecture

5. PHYSICAL ARCHITECTURE

5.1 Overview

The MAG RIA update includes both a logical architecture component and a physical architecture component. A logical architecture describes what various systems and agencies need to do to meet the needs of users (for travelers as well as system operators and managers). The physical architecture links to specific centers, infrastructure and system components, and focuses on how systems and agencies are linked and connected to share specific information or control various elements of the ITS systems and networks.

The physical ITS architecture is the third major step in developing the MAG RIA. An architecture maps the existing and planned functionality in the MAG Region and is required as part of the FHWA Final Rule/FTA Policy on Architecture Conformity and Standards. This architecture can be used as a tool by stakeholder agencies to document their ITS functionality, identify integration opportunities (within agencies and among multiple agencies), as well as show consistency with the regional architecture when developing ITS projects and applying for funding for new ITS projects.

The two primary components of the physical ITS architecture are service packages and equipment packages. The term "market packages" was changed to "service packages" as part of Version 7.0 of the National ITS Architecture. This architecture includes customized service packages to reflect MAG member agency systems, projects and status. Service packages provide an overview of the actual information sharing and actual physical coordination of services that occurs in a region. The physical architecture and service packages define the actual representation of controlling devices, sharing information with other agencies, and day-to-day operations of the equipment and systems in each jurisdiction and the regional systems. Stakeholder consensus on the physical architecture and the service packages that are customized for the local relationships is very important to accurately reflect the existing and planned functionality. This supports the future growth of existing systems and the implementation of new systems or technology.

Equipment packages describe specific pieces of functionality that need to occur in order for the User Services to be provided to the traveling public.

MAG's goal for focusing on the physical architecture component is to provide a level of traceability between User Services and the physical elements and infrastructure that comprise the functionality identified in the physical architecture. The goals of this physical architecture are to:

- Identify appropriate subsystems from the National ITS Architecture that can guide the development of the physical architecture;
- Focus on the components of this region that involve transportation-related functions and systems – internal processes for emergency management coordination have been represented at a high-level or are not discussed in this architecture;
- Identify and customize service packages selected from the National ITS Architecture specific to the devices, systems, and communications operated by agencies in this region;
- Identify equipment packages that apply to the functionality in this region; and
- Establish traceability from the physical architecture back to goals, objectives and User Services/User Service Requirements.

5.1.1 Stakeholder Involvement

A stakeholder workshop was used to review developed material and provide feedback to more accurately depict each agency and the communications they have within the ITS architecture. A project workshop held in November 2008 included members of the MAG ITS Committee. This workshop allowed stakeholders to review and discuss the proposed service packages. As part of the 2013 Update, the MAG ITS Committee was involved in an independent review of the draft updates as based on Committee feedback based on what has changed since the last update in 2010. Customized service packages were made available for stakeholders to review via the architecture website after to the 2013 meeting.

Involving stakeholders in the development of this architecture and its customized service packages allows for a consensus-based process prior to proceeding with full development of the ITS Architecture. The service packages were modified based on input received from stakeholders at this meeting.

5.1.2 Link from Logical to Physical Architecture

The physical architecture will describe how the services happen through sending information to and from specific subsystems. Each one of these services, and the actual information transfer that occurs to perform that service, is described as a Service Package in the National ITS Architecture. The interrelationship between the "Traveler Perspective" and the "Agency Perspective" in the logical architecture has built the foundation for the physical architecture. The subsystems and equipment packages are the direct lead to the physical architecture while the user services and user service requirements are describing from the users' perspective what the service should do.

5.2 Customized Service Packages

Service packages provide the most high-impact visualization of ITS functionality and element interfaces. These represent the core functions, relationships of agencies, information sharing and connections to entities outside the architecture (terminators). Service packages also provide the most direct correlation to infrastructure and projects, which is a high priority for MAG as part of this ITS Architecture. Service packages include stakeholders and elements that work together to provide a service to satisfy identified stakeholder needs. They illustrate the information exchanges between subsystems, such as center-to-center communications between agencies or center-to-field connections between an operations center and the field infrastructure that it operates. Examples of service packages from the National ITS Architecture include Traffic Information Dissemination, Traffic Incident Management System, and Work Zone Management.

With customized service packages, stakeholders are able to get a 'big picture' view of the functionality and see how their systems and projects fit within the context of an ITS architecture. The different components (equipment packages) work together to deliver the desired functionality in the region. There may be additional capabilities desired within these functions but are not represented in existing service packages as identified in the National ITS Architecture which were added and/or modified with stakeholder input.

Service packages have been diagrammed to show data flows and connections. The status of elements within service packages have also been identified (existing and planned). This section includes a description of service packages, selected service packages appropriate to the MAG Region, a description of the Turbo Architecture database and website tool for viewing the architecture, and the customized service packages that have been developed for this region.

5.2.1 Service Package Definition

The National ITS Architecture is a general framework for planning, defining, and integrating ITS and is a resource for any region in the U.S. independent of specific system design. The standard service package diagrams provided in the National ITS Architecture are relevant to functional services that ITS could provide, not what specific ITS technologies could provide for the region.

Service packages are tailored to fit, separately or in combination, real world transportation problems and needs. Service packages show the centers and devices that must work together to deliver a desired transportation service. Service packages depict current and future information transfer between ITS devices, management centers, and people. Those elements that represent the source of multiple levels of information transfer are called "subsystems". Subsystems are grouped into four classes: Centers, Field, Vehicles, and Travelers as described in greater detail as applicable in the MAG Region in **Table 12**.

Table 12 – Subsystem Definitions

Subsystem	Definition	Examples in MAG Region
Center	Provide management, administrative, and support functions for the transportation system. The center subsystems each communicate with other centers to enable coordination between modes and across jurisdictions.	Traffic Operations Centers Emergency Operations Centers Police/Fire Dispatch Centers
Field	Intelligent infrastructure distributed along the transportation network which perform surveillance, information gathering, and information dissemination whose operation is governed by the center subsystem.	Traffic Signals CCTV Cameras Dynamic Message Signs Vehicle Detection Flood Sensors
Vehicle	Covers ITS related elements on vehicle platforms such as automatic vehicle location equipment and operations capabilities for portable field equipment.	Maintenance and Construction Vehicles Public Safety Vehicles Incident Response Vehicles
Traveler	Equipment used by travelers to access ITS services pre-trip including information service providers.	Internet Web Sites AZ511

Each subsystem in a service package satisfies a particular role in that functionality. For example, as part of the ATMS01 – Network Surveillance service package, the Traffic Management Subsystem gives and receives information the Roadway Subsystem (such as cameras and vehicle detection deployed on the roads) and the Information Service Provider Subsystem (such as HCRS and RADS). The Traffic Management Subsystem provides the foundation of information transfer for the functionality of Network Surveillance. This service package has been further defined in this architecture to represent how each agency utilizes the network surveillance function in their jurisdiction which may change from agency-to-agency depending on the infrastructure used as well as the status (existing or planned) of that infrastructure.

The types of communications connections between each subsystem are shown in the interconnect diagram from the National ITS Architecture with the subsystems that apply to the functionality, systems, and primary interconnects in the MAG Region are in **Figure 7**.

The National ITS Architecture interconnect diagram has been customized using the applicable service packages and information flows in those service packages. This figure summarizes the existing, planned, and future ITS elements for stakeholders in the context of a physical interconnect. The primary purpose of the architecture is to identify the connections between transportation systems and elements in the MAG Region. In **Figure 7**, the network surveillance functionality includes information flows between cameras on the road and the centers that operate the cameras which have been highlighted in red. This has been shown as just one of the many interconnections between subsystems that can be represented by a service package (ATMS01 – Network Surveillance) that make up the complete picture of the ITS Architecture. **Figure 8** in Section 5.2.3 shows the Network Surveillance service package in more detail customized for the City of Scottsdale which represents the functionality highlighted in red in the figure below.

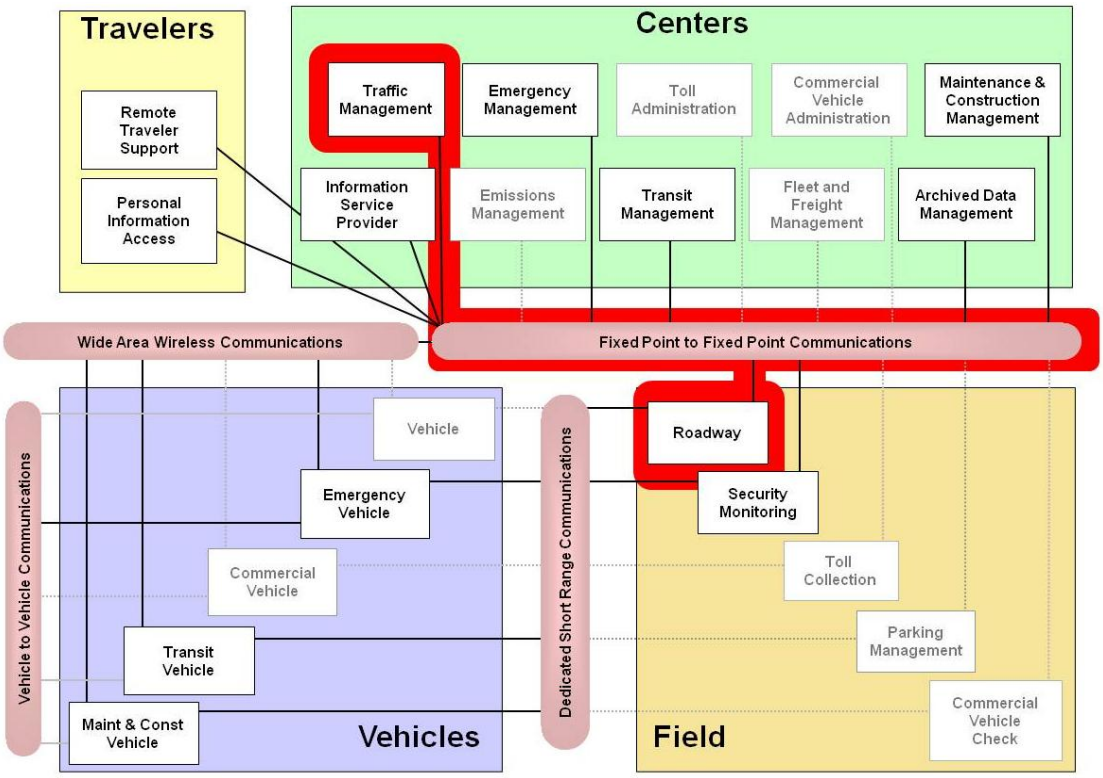


Figure 7 – Network Surveillance Functionality within Regional Interconnect Diagram

Information flows between the many different components in the service packages define the specific information (data) that is exchanged between each component. Each information flow specifies what information is exchanged and the direction of the flow. These information flows could be requests for information, alerts and messages, status requests, broadcast advisories, construction status, and other key information that is needed to be transferred between devices and agencies, or between agencies. Service packages that apply to the functions that occur in this Region have been customized for the agencies in the MAG Region.

Service packages have been used to serve as a mechanism for linking common transportation problems, challenges, goals, and policies with potential ITS solutions. A broad range of alternative solutions may be applied to solve identified transportation

problems – only some of these solutions may be labeled "ITS" and directly supported by the National ITS Architecture.

5.2.2 Selected Service Packages Applicable to the MAG Region

Specific service packages that are chosen for the MAG Region out of the 97 total service packages available in the National ITS Architecture help to illustrate the existing and planned functionality in the MAG region. A table listing and defining all of the available service packages from the National ITS Architecture that were reviewed for consideration in MAG's RIA is provided in **Appendix C**. Service packages that are not applicable to the region, such as commercial vehicle operations or winter maintenance, are not included in this architecture. The service packages selected from the National ITS Architecture were chosen based on the existing and planned inventory and documented communications and cooperation between agencies. Applying the goals and objectives as well as priorities to the National ITS Architecture, 42 service packages were selected for the MAG RIA and these are shown in **Table 13** below. Examples of what type of operations and coordination are discussed in each service package are provided in the table as well. The reference number (e.g. ATMS01) before each service package name refers to the relevant reference in the National ITS Architecture.

Table 13 – Service Packages Included in MAG ITS Architecture

Service Package	Service Package Name	Example MAG Region Devices/Systems/Services
Traffic Management Service Area		
ATMS01	Network Surveillance	Managing/operating cameras and vehicle detection on roadways
ATMS02	Traffic Probe Surveillance	Using automated vehicle location for transit and private sector systems
ATMS03	Traffic Signal Control	Managing/operating traffic signals
ATMS04	Traffic Metering	Managing/operating cameras, vehicle detection, ramp meters, DMS on freeways
ATMS06	Traffic Information Dissemination	Sending road network conditions and traffic images to other agencies and traveler information systems
ATMS07	Regional Traffic Management	TMC-to-TMC coordination through direct links or through regional systems such as the center-to-center information sharing
ATMS08	Traffic Incident Management System	Agency coordination during incidents between TMCs, public safety, emergency response, and incident response support
ATMS09	Transportation Decision Support and Demand Management	Active traffic management on freeway as part of future integrated corridor management strategies
ATMS13	Standard Railroad Grade Crossing	Traffic signal interaction with railroad at-grade crossings
ATMS17	Regional Parking Management	Coordination between parking management systems
ATMS18	Reversible Lane Management	Special event reversible lane signals
ATMS19	Speed Warning and Enforcement	Local speed displays that are archived locally and can be downloaded by the agency for analysis of speeds
ATMS22	Variable Speed Limits	Active traffic management on freeway as part of future integrated corridor management strategies
ATMS23	Dynamic Lane Management and Shoulder Use	Active traffic management on freeway as part of future integrated corridor management strategies
ATMS24	Dynamic Roadway Warning	Active traffic management on freeway as part of future integrated corridor management strategies
ATMS26	Mixed Use Warning Systems	Pedestrian-activated crosswalks in Phoenix, Glendale and Tempe
Emergency Management Service Area		
EM01	Emergency Call-Taking and Dispatch	Phoenix Fire dispatch responsibilities in the region, local police dispatching functions, TMC support for traffic images shared on public safety video distribution system
EM02	Emergency Routing	Dispatching of public safety vehicles and interaction with local traffic signals for preemption for fire vehicles
EM04	Roadway Service Patrols	DPS Freeway Service Patrol
EM06	Wide-Area Alert	Wide-area alerts to agencies to be displayed on DMS and input into traveler information systems, EOC relationship to transportation, AMBER Alerts
EM07	Early Warning System	Warnings to transportation agencies, EOC relationship to transportation
EM10	Disaster Traveler Information	Disaster traveler information to agencies to be displayed on DMS and input into traveler information systems, EOC relationship to transportation
Maintenance and Construction Management Service Area		
MC03	Road Weather Data Collection	Collection of flood sensor information
MC04	Weather Information Processing and Distribution	Sharing of flood sensor information with transportation, transit, and public safety agencies
MC09	Work Zone Safety Monitoring	Monitoring capability at ADOT work zones to be able to quickly respond to incidents, work zone warnings as needed
MC10	Maintenance and Construction Activity Coordination	Sharing of planned construction information with other agencies through HCRS or local reporting system

Table 13 – Service Packages Included in MAG ITS Architecture (continued)

Service Package	Service Package Name	Example MAG Region Devices/Systems/Services
Public Transportation Service Area		
APTS01	Transit Vehicle Tracking	Tracking transit vehicles
APTS02	Transit Fixed-Route Operations	Operation of fixed-route service for Valley Metro and METRO Light Rail
APTS03	Demand Response Transit Operations	Local dial-a-ride service operation that is requested service by a traveler
APTS04	Transit Fare Collection Management	Automatic fare collection system on-board transit and light rail vehicles
APTS05	Transit Security	On-board security measures to secure travelers and drivers, transit center security measures
APTS06	Transit Fleet Management	Transit maintenance scheduling through on-board status equipment
APTS07	Multi-Modal Coordination	Coordination among light rail and transit services
APTS08	Transit Traveler Information	Transit website schedules, routes, and fares, transit center real-time displays of transit traveler information
APTS09	Transit Signal Priority	Transit buses and light rail vehicles requesting priority from traffic signals for a green light in their direction for faster service
APTS10	Transit Passenger Counting	Automated passenger counting on-board transit vehicles
APTS11	Multimodal Connection Protection	Coordination of multimodal services to from SkyTrain or bus service to Light Rail travel
Traveler Information Service Area		
ATIS01	Broadcast Traveler Information	ADOT HCRS operations and information inputs/outputs, 511 traveler information service resource for information
ATIS02	Interactive Traveler Information	Interactive 511 telephone and web service for requesting information about specific roads or services
ATIS10	Short Range Communications Traveler Information	Supporting mobility applications for connected vehicles integration with ramp meters, traffic signals, and incident traveler information
Archived Data Management Service Area		
AD1	ITS Data Mart	Local data archives for each agency
AD2	ITS Data Warehouse	RADS archiving and sharing of information, HCRS archiving and sharing of information

These service packages were customized with MAG Region partner agencies and field equipment, and the interfaces between agencies and infrastructure were established. Interfaces have been identified for each element in the MAG RIA and each element has been mapped to those other elements with which it must interface.

5.2.3 Customized Service Packages

Customized service packages give stakeholders a real-world perspective on the roles and responsibilities their agency will have in providing a particular service to the region. In order to provide a conceptual perspective of how the service packages work together to support the MAG Region's goals for ITS deployment, high-level conceptual diagrams have been developed for each selected service package from the National ITS Architecture. Over 175 customized service packages have been developed which show the detailed information flows that occur within each one of these service packages in a format that is user-friendly and understandable. The customized service

packages will be included in the final ITS architecture and are available on the architecture website. They are categorized by "Service Packages by Stakeholder" or "Service Packages by Functional Area" to assist the stakeholder in finding the applicable service package for their project. The MAG RIA website located at http://azmag.gov/its/ includes all customized service packages for this architecture categorized by functional area. **Figure 8** below shows an example of a customized service package created for the City of Scottsdale network surveillance functionality.

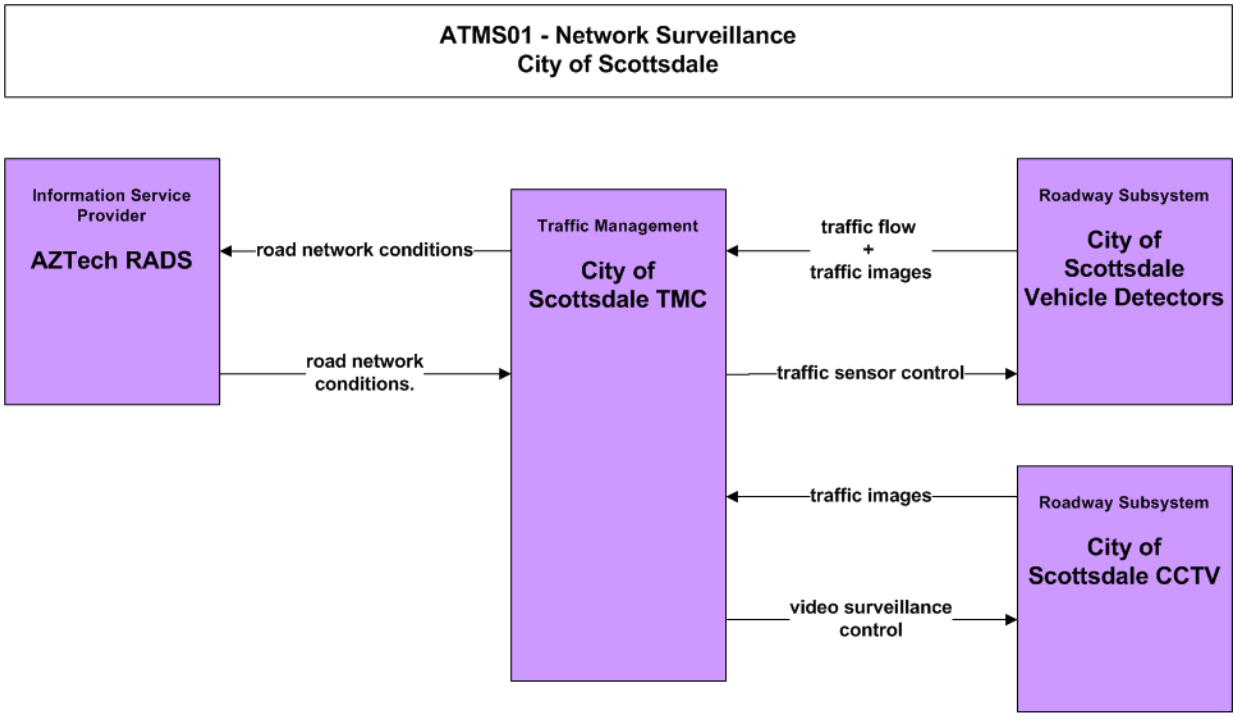


Figure 8 – Customized Service Package for City of Scottsdale

It is important to understand the use of customized service packages and the reasoning for multiple inventory items to be depicted differently based on the multiple functions they perform or for which they are used. The ADOT HCRS, for example, serves many purposes in this region: stores information about planned impacts to the freeway system, sends information to the 511 traveler information telephone service, shares information with the regional data archives for dissemination to other agencies, and its function as a data archive. These and other functions that the ADOT HCRS performs are shown in separate service packages in the architecture because the functionality differs depending on what information is being shared, and with what other systems or agencies that information is being shared.

A set of systems unique to this region is the center-to-center relationship between devices, local and regional archives, and traveler information services. The interaction of these various systems including RADS, HCRS, freeway management system components, and center-to-center systems throughout the region are shown in **Figure 9**. This showing the AZTech™ system diagram has been used extensively to depict existing and planned relationships utilizing these systems.

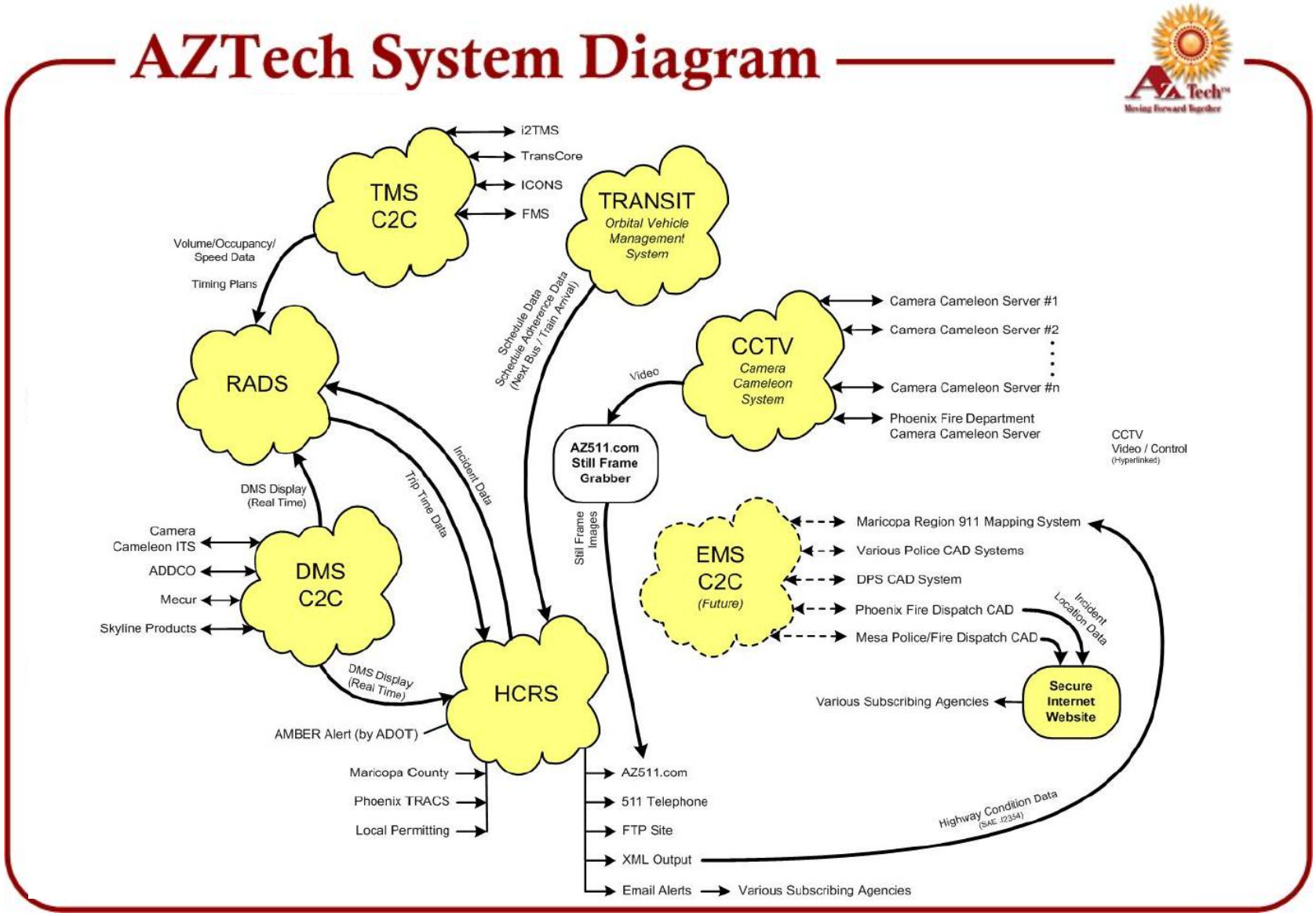


Figure 9 – AZTech™ System Diagram

Not every detailed information flow provided in the Turbo Architecture database is shown in these customized service packages – only the most influential on each agency to depict a concept of operations for the MAG Region. Some of the information flows are shown as "planned" because they do not currently exist for that particular agency or that particular function. As systems are put in place and connections are established, the architecture can be updated to reflect these information flows as "existing".

In many of the customized service packages, specific agencies have been called out to represent specific operations or local systems, such as the City of Chandler TMC managing and operating the City of Chandler Traffic Signals. Specific elements have been called out for cities such as Phoenix, Glendale, Goodyear, Scottsdale and others due to the amount of infrastructure already in place as well as the capabilities these agencies have through their TMCs. In order for the architecture to be expandable and adaptable to the changing operational responsibilities of each agency, a "City and Local Municipalities" grouping has been created to represent those agencies that are not called out specifically in a particular service package. Identifying centers, devices, and some agency systems as owned by "City and Local Municipalities" is a streamlined way of grouping agencies that behave the same way in the different functions in the architecture. This benefits the scalability of the architecture when and update is needed to include a new stakeholder or a new function. The requirements for the maintenance of the architecture are reduced through this grouping. Agencies included in the "City and Local Municipalities" category are:

- City of Apache Junction
- City of El Mirage
- City of Litchfield Park
- City of Tolleson
- Fort McDowell Yavapai Nation
- Gila River Indian Community
- Salt River-Pima Maricopa Indian Community
- Town of Buckeye
- Town of Carefree
- Town of Cave Creek
- Town of Fountain Hills
- Town of Gila Bend
- Town of Guadalupe
- Town of Paradise Valley
- Town of Wickenburg
- Town of Youngtown

As more ITS infrastructure begins to be implemented within these agencies, future updates of the RIA will warrant developing customized service packages for these specific agencies.

5.3 Functional Requirements, ITS Standards and Agreements

This section will describe how functional requirements were developed and are displayed on the project architecture website. Standards that are used in the MAG Region currently, those that are envisioned in the future, and their applicability will also be described in this section. Agreements that are in place in the MAG Region as well as those that would need to be developed are discussed in this section as well.

5.3.1 Functional Requirements

Functional requirements are the detailed purpose of an inventory item to provide the services as described by their equipment packages. The functional requirements identified for this architecture were based on the input of inventory elements and the customization of the service packages which resulted in a defined list of functional requirements for the entire architecture. In order to be able to use these functional requirements in project development, they have been provided on the project architecture website linked to the inventory elements for each agency.

The functional requirements are found by selecting the inventory that would be included in the agency project and then selecting the applicable equipment package service that the inventory would provide to the agency or the traveling public.

For example, in order to find the appropriate functional requirements for ADOT cameras to provide video images to the ADOT TOC, ADOT would follow the process of:

- Selecting "ADOT CCTV" in their Inventory list;
- Select "Roadway Basic Surveillance" in the Equipment Package list for providing video images to a center; and
- At the bottom of the screen is the list of functional requirements for that inventory element to be able to provide that function or service to ADOT.

Functional requirements are provided in this report in **Appendix D** organized by inventory item, then functional area, then applicable functional requirements for that functional area.

5.3.2 ITS Standards

ITS standards define how system components interconnect and work within the overall framework of the National ITS Architecture. Standards allow for the deployment of different components, vendor-specific technologies, and infrastructure to be interoperable at the local, regional, and national levels to interact together to support a seamless transportation system. Standards also allow innovation in technology development to occur without a forklift replacement in the hardware or software systems needed to operate that new technology. Other purposes for ITS standards use include:

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

New standards that are developed go through an approval process before they can be included in the formalized standards documents. Existing standards are amended and modified as needed based on new standards development or new technology development. Several national and international standards organizations are working toward developing ITS standards for communications, field infrastructure, messages and data dictionaries, and other areas. The organizations participating in ITS standards activities include:

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

The AZTech™ Center-to-Center Specification was developed specifically for this region which facilitates the sharing of information between centers relating to the functionality of CCTV cameras, DMS, HCRS, incident management, RADS, arterial traffic signal systems, and transit. The C2C protocol is currently being used between agencies that operate the Siemens I2 traffic signal system and will bring other agency traffic signal systems into the C2C sharing environment in the near future.

Two examples of ITS standards that are widely used by agencies in the MAG Region include:

- **NTCIP 1203: Object Definitions for Dynamic Message Signs (DMS) –** this ITS standard defines the protocol for sending and receiving data from a freeway, arterial, or portable DMS to be able to communicate with a center or another device.
- **NTCIP 1205: Object Definitions for Closed Circuit Television (CCTV) Camera Control –** this ITS standard defines the protocol for sending and receiving data from a freeway, arterial, or portable CCTV to be able to communicate with a center or another device.

National standards developed by the list of participating organizations are formalized and are currently in use in the MAG region. **Appendix E** identifies all of the ITS standards identified by Turbo Architecture that are used in the MAG Region.

5.3.3 Agreements

The MAG RIA has identified agency communications, device/center interfaces and information exchanges which provide the ITS services and systems in the MAG Region. Agreements allow agencies to document the roles and responsibilities of the particular service or function that is being agreed to as well as any obligations each agency has for maintenance, operations, or financial support. **Table 14** below summarizes the established institutional agreements in the Phoenix metropolitan area that support interagency operations, maintenance, shared ownership, shared data, and other systems/services which show interfaces in the architecture.

Table 14 – Summary of Institutional Agreements

Agreement Name	Agencies Involved	Summary
Regional Concept of Transportation Operations Memorandum of Understanding (October 22, 2003)	MAG, ADOT, Maricopa County DOT, Phoenix Transit, and Cities	Participants agree to cooperate to develop and implement regional priority functions for arterial and freeway multi-modal transportation issues. Signed by MAG; ADOT; MCDOT; cities
MOU AZTech™ ITS Model Deployment (1996)	ADOT, MCDOT, MAG Member Agencies	Provided a framework and guidelines to promote coordinated decision making and information sharing in planning, design, development, and evaluation of AZTech™ Model Deployment.
AZTech™ MDI IGA's (1998)	ADOT, MCDOT, RPTA, City of Phoenix, Phoenix Public Transit, City of Glendale	Facilitated integration of existing multi-modal ITS infrastructure into a regional system. The agreements identified funding arrangements, acceptance of equipment, and maintenance and operations obligations of each of the partners
AZTech™ Phase 1, 2 and 3 Private Partnerships (1998 – 2001)	AZTech™, and private partners (integration, traveler information providers [web, PDA, kiosk and in vehicle] and transit AVL partners)	Formalized the agreement between MCDOT and private agencies for data sharing and dissemination to the public.
AZTech™ SMART Corridor Phase 2 (2002) and Phase 3 (2006) IGA's	MCDOT and 8 Local Jurisdictions (Cities of Phoenix and Glendale, among others)	Cooperative arrangement between MCDOT and 8 local jurisdictions to plan and implement an integrated SMART Corridor program.
Emergency Traffic Management Mutual Aid (REACT) MOU and IGAs	MCDOT, MCSO, City of Glendale, City of Avondale, City of Goodyear (in progress)	Agreements to provide emergency traffic management support for arterial closures/incidents
Radio Interoperability for Public Safety and Transportation (December 6, 2004)	ADOT, MCDOT, DPS	Agreement between ADOT, MCDOT, and Arizona DPS to install automatic vehicle location on response vehicles.
AZTech™ Connectivity IGA (June 24, 2004)	ADOT, MCDOT	Agreement between ADOT and MCDOT to connect transportation and public safety agencies to the AZTech™ transportation operations telecommunications network in the Phoenix metro area.
AZTech™ Center-to-Center Stakeholder Agreement (January 2006)	AZTech™ Partner Agencies	Agreement of the AZTech™ stakeholders to develop and implement the C2C System.
Fiber Optic Backbone (April 3, 2006)	ADOT, City of Phoenix	Agreement between the City of Phoenix and ADOT to design and construct a fiber backbone, to designate fibers for each party, and for joint use of conduit.
Automatic Aid Agreement for Fire Protection and Emergency Services	Phoenix Fire Department, 18 Local Fire Departments	Automatic aid agreement including centralized dispatch at Phoenix Fire, and dispatch of closest vehicle to incident for fire agencies.
Intergovernmental Cooperative Purchasing Agreements	ADOT, MCDOT	MCDOT and ADOT established standard procurement specs for signal system, wireless communications and ITS equipment.
Agreements with Local Media (Established 2002-2004)	ADOT, Channel 3, Channel 5, Channel 10, Channel 12, Channel 15, Telemundo, Total Traffic	Agreements provide media access to ADOT CCTV freeway images for broadcasts.

Table 14 – Summary of Institutional Agreements (continued)

Agreement Name	Agencies Involved	Summary
Phoenix Downtown Traffic Management System Intergovernmental Agreement Amendment One	ADOT, City of Phoenix	City of Phoenix pay all costs associated with the DTMS project and ADOT granted the City use of State highway right of way.
Transit Services in Avondale (2004) and Glendale (2000)	City of Phoenix Transit, Local Cities	Agreement between the City of Phoenix Transit and other cities to provide fixed-route and dial-a-ride transit services.
Sky Harbor Rental Car Center ATIS Displays Agreement	MCDOT, City of Phoenix	MCDOT and City of Phoenix established an agreement for physical ATIS displays in the Rental Car Center and connection to the central communications room
Bell Road Operations Plan for Shared Use of Devices	MCDOT, City of Surprise, City of Peoria, City of Glendale, City of Phoenix, City of Scottsdale	Documented roles, responsibilities, permission levels, and shared operations between jurisdictions for devices along Bell Road between agencies
REACT MOU with Agencies	MCDOT, other Cities (future)	This agreement is being developed to provide consistency in REACT services and define the roles and responsibilities of the MCDOT versus the local REACT teams.

Table 15 provides a list of potential agreements based on the types of interfaces identified in the MAG RIA. It is important to note that as ITS services and systems are implemented or expanded in the Region, part of the planning and review process for those projects should include a review of potential agreements that would be needed for implementation or operations. These agreements are not specified for specific projects because the coordination/sharing/joint operations that are possible should be evaluated on every project. Example agencies for which each agreement would be beneficial to be developed between are shown in the table.

Table 15 – Potential Agreements that Support Existing/Future Coordination Shown in Architecture

Agreement and Agencies	Agreement Description
Data Sharing and Usage (Internal Public Divisions)	
TMC/EOC **TMC/Police** **TMC/Fire** **TMC/Public Works**	This agreement would define the parameters, guidelines, and policies for intra-agency ITS data, road restriction, maintenance activity and work zone activity information sharing. This data sharing would support regional activities related to traffic management, incident management, work zone notifications, traveler information, and other functions. The terms of this agreement should generally address such items as: ▪ Types of data and information to be shared – camera feeds, roadway restrictions, detector information, incident and special event information, maintenance activity ▪ How the information will be used (traffic incident management, displayed on web site for travel information, distributed to private media, etc.) ▪ Parameters for data format, quality, security ▪ Frequency of sharing data
Data Sharing and Usage (Public Agency-Public Agency)	
TMC/TMC **TMC/Transit** **TMC/Police** **TMC/Fire** **TMC/EOC** **TMC/Airport**	This agreement would define the parameters, guidelines, and policies for data sharing and usage of ITS-related information from public agency to public agency. Because this agreement is with external entities, it will likely be in the form of a Memorandum of Understanding or Inter-Governmental Agreement. This type of agreement is recommended to define terms of use for distributing public-agency information regarding: ▪ Traffic conditions ▪ Traffic signal timing plans ▪ Road closures and restrictions ▪ CCTV camera images ▪ Data sent to RADS or HCRS ▪ Work zone information ▪ Public safety coordination with traffic management ▪ Transit coordination with traffic management In specific, coordination among jurisdictions for traffic signal timing to improve overall flow and progression along multi-jurisdictional corridors is a priority for this region. MAG provides funding for signal coordination activities. As part of regional initiatives such as Center-to-Center and the Regional Community Network being developed to facilitate interagency sharing of information, agencies may need to sign a formal agreement already established as part of these programs or implement a new agreement to define the use of these programs.

Table 15 – Potential Agreements that Support Existing/Future Coordination Shown in Architecture (continued)

Agreement and Agencies	Agreement Description
Shared Video Monitoring (Public)	
TMC/Police **TMC/Fire** **TMC/EOC**	This agreement would enable shared video monitoring of CCTV by public safety and neighboring jurisdictions for incident and traffic management purposes. This agreement would define the parameters and policies for public safety and other transportation agencies to access video images. It is recommended that the agreement include any established or newly developed policies relating to video images (including archiving, privacy, disclaimers, use of video and redistribution) as well as processes for agency requests for specific views. Shared video monitoring does not address shared use or shared control of video equipment functions. There might be some cost incurred for infrastructure, systems or fiber to enable communications between agencies, particularly with the high bandwidth required for transmitting live video images. Lower bandwidth video images such as screen-shots could also be considered for sharing.
Mutual Aid Agreements – REACT (Public)	
TMC/Police/REACT	Formal mutual aid agreements will become more important as agencies integrate systems/capabilities, particularly automated dispatch and notification. There may be funding required to support regional incident management activities. The agreement also would outline resource commitments that would be part of any mutual aid arrangement (personnel, equipment, facilities, etc.).
Joint Operations/Shared Control Agreements (Public)	
TMC/TMC **TMC/Police**	This agreement is a formal arrangement to allow joint operations or control of certain systems and equipment. This agreement will allow the other TMCs or public safety to control certain devices such as permanent DMS and CCTV cameras in incident or emergency situations and in after-hours operations. The agreement would need to define the terms of this arrangement, such as hours of operation and time of day/day of week where shared control would take effect, circumstances or incidents where shared control would take effect, system requirements for each agency to be able to share device control, definition of permissions with device control, etc. Traffic signals are typically not included as part of a joint operations strategy. Agencies have typically determined that sharing access to traffic signal timing plans will enable enhanced corridor management and operations among multiple partners, but that actual control of signals or changing timing plans on traffic signals by another jurisdiction is not permitted.
Emergency Coordination Agreements (Public)	
TMC/Local EOC, Fire, Police, County or State EOC	This agreement would establish the roles and responsibilities of a TMC in supporting emergency coordination for disasters or threats requiring evacuation or other mass coordination efforts. May include sharing requirements of CCTV video images by emergency management agencies.
Fiber Sharing Agreements (Public)	
TMC/TMC	This agreement would establish the requirements and security needs of each agency in sharing fiber cable to connect to their respective devices. Cost sharing should be delineated in the agreement as well as network maintenance / management on the fiber infrastructure. These agreements are developed to define the roles and responsibilities of the agencies for the actual sharing of fiber and should outline cost sharing that established the fiber sharing path.

5.4 Operational Concepts

An operational concept identifies the stakeholders' roles and responsibilities in the implementation and operation of the regional systems that are defined in the MAG RIA. It provides an "executive summary" view of the way the region's systems will work together to provide ITS services. The objective is not to formally define each system or specify detailed integration requirements – it is to paint a picture of the operations of the regional transportation system. General principles that are inherent to the regional transportation system in the MAG Region include:

- ADOT is responsible for operating and maintaining their own center, the freeway management system ITS field devices, and the statewide traveler information telephone and web services
- ADOT and DPS are primarily responsible for freeway management/incident response
- Maricopa County is responsible for operating and maintaining their own center, traffic signal system and ITS field devices
- Cities are responsible for operating and maintaining their own centers, traffic signal systems and ITS field devices
- There are examples of shared operations for specific corridors, and additional collaborative efforts are envisioned for the future
- There are examples of regional approaches to public safety and mutual aid for fire and arterial incident response
- Regional archived information is captured through HCRS and RADS which is shared with all agencies and feeds statewide and regional traveler information services

Each one of the customized service packages in this architecture represents essentially a 'mini' concept of operations for a particular function of how systems will be linked together to share information, which stakeholders are sharing information with whom, etc. These service packages represent how telephone traveler information works, how a local traffic management center operates their ITS devices, how public safety is involved in traffic operations during an incident and others. Each of the service packages ('mini' concept of operations) represents a portion of an agency or departments operations. The complete picture of how an agency operates is most effectively communicated through operational scenarios which provide an overview of what an agency does to support operations during each specific scenario.

In order to achieve the overall vision of operations in this Region (both existing and planned), separate operational concepts have been developed to represent the interagency coordination that is intended to occur during different types of scenarios. **Current agency operations are discussed previously in Section 2 Table 2.** Operational concepts presented here are depicting scenarios in which all planned connections/communications for each agency are functioning. There is no evacuation scenario included because the coordination efforts from a transportation perspective are engaged during the incident and work zone scenarios included below. Scenarios for which roles and responsibilities for agencies include:

- **Day-to-Day:** Involves operating/managing the agency-owned devices, shared operational control of devices, traveler information services, and archive data servers. This scenario is used as a baseline for operations which will be modified or enhanced depending on the scenarios described below.
- **Freeway Incident:** Involves state agencies as the primary stakeholders in charge of monitoring and managing freeway incidents, information sharing with other agencies that could be affected by freeway incidents, and operating available traveler information

services on a statewide level. County and statewide emergency operations centers are engaged by this scenario as the incident magnitude may determine the coordination efforts required by agencies.

- **Arterial Incident:** Involves local agencies as the primary stakeholders in charge of monitoring/management of arterial incidents, information sharing with other local agencies, and utilizing available arterial traveler information services and statewide services as applicable to the incident location and effects. Transit agencies and local emergency operations centers are engaged by this scenario as the incident location or magnitude may determine the coordination efforts required by agencies.
- **Work Zone/Construction:** Involves the coordination of state and local agencies, public safety agencies, maintenance divisions, and media as well as traveler information services available depending on where the work zone is located. This scenario engages the transit agencies as the location of work zone/construction could impact transit operations.

Tables 16-19 below describe the roles and responsibilities of the stakeholders in each scenario described above. These descriptions are not intended to be all inclusive of the operations during each scenario but rather an example of coordination efforts that occur in the MAG Region and the multi-agency approach to operations and response.

5.4.1 Day-to-Day Operations

The agencies in the MAG Region all have specific duties that they perform on a day-to-day basis which typically include monitoring traffic (via camera or by vehicle), sharing of information, and traveler information tasks. For TMCs, day-to-day operations include operating/managing the agency-owned devices, shared operational control of devices, traveler information services, and archive data servers. For public safety agencies, day-to-day operations include standard patrol of transportation system (arterial or freeway depending on agency) and dispatch of vehicles. This operational scenario describes the typical functionality of the agencies. The purpose of the 'typical' functionality and additional functionality is introduced when incidents or work zones call for the involvement of the agencies. Incident and work zone scenarios are described in subsequent sections. **Table 16** describes the day-to-day operations of agencies in the MAG Region.

Table 16 – Roles and Responsibilities During Day-to-Day Operations

DAY-TO-DAY OPERATIONS		
Service Category	**Agency**	**Roles and Responsibilities**
Traffic Management	ADOT TOC	• Operates and manages the ITS devices on the freeways (CCTV cameras, freeway DMS, different types of vehicle detection sensors, and ramp meters) • Supports the ALERT incident management service on the freeway network • Operates, manages and updates HCRS for traveler information dissemination via 511 and az511.gov services • Post traveler information for motorists on freeway DMS of incident, closure, event, construction, travel times • Shares CCTV video feeds with other TMCs • Receives DPS and Phoenix Fire CAD feeds • Coordinates with ADOT maintenance as needed
	Maricopa County TMC	• Operates and manages arterials in unincorporated areas of Maricopa County including CCTV, DMS, and traffic signals • Share control of CCTV and DMS along Bell Road with Surprise and Peoria • Operates and manages REACT for Maricopa County and coordinates with a few local agencies to provide service • Operates, manages and updates the regional data archive RADS which coordinates with ADOT's HCRS for traveler information dissemination • Manages the Rental Car Center ATIS travel time displays based on real-time vehicle data from freeway network captured by the FMS and RADS • Manages the MCDOT ATIS which provides arterial data collection and real-time reporting of information in Maricopa County • Receives DPS and Phoenix Fire CAD feeds
	Local TMCs	• Operates and manages the arterial network within their jurisdiction including the traffic signal system and network of arterial DMS, CCTV, and vehicle detection • Posts traveler information for motorists on arterial DMS of incident, closure, special events, and construction • Operates/maintains signals at freeway interchanges in their jurisdiction (for agencies where this is applicable) • Coordinates with local police department and local arterial incident response team where applicable • Receives ADOT CCTV video feeds in the area of their jurisdiction • Share arterial road network conditions information with RADS (via center-to-center interfaces) through which applicable information is sent then to HCRS • Coordinate with neighboring local TMC for corridor operations
Public Safety and Emergency Response	Arizona DPS	• Public safety vehicles patrol regional/statewide freeway network • Public safety/emergency response dispatch of vehicles to incident location with vehicle location tracking to increase the efficiency of the response • Dispatches FSP vehicles to incidents as needed • View ADOT CCTV via an established interface • Provide updates to ADOT TOC via DPS CAD
	MCSO	• Public safety vehicles patrol unincorporated Maricopa County roads
	Local Police	• Public safety vehicles patrol city/town jurisdiction
	Phoenix Fire	• Dispatches for 18 local city fire department jurisdictions

5.4.2 Freeway Incidents

Incidents that occur on the freeway introduce a specific subset of responsibilities for each agency in order to efficiently respond to and resolve the incident. Depending on the severity of the incident, local arterials and local public safety may be called upon to support incident response and clearance efforts. The freeway incident operational scenario involves state agencies as the primary stakeholders in charge of monitoring and managing freeway incidents, information sharing with other agencies that could be affected by freeway incidents, and operating available traveler information services on a statewide level. **Table 17** describes the roles of agencies in the MAG Region during freeway incidents. It is important to note that typical day-to-day operational roles are described in this section has having an added purpose and direction when that functionality is used during freeway incidents. New roles are also described that are not present in the day-to-day operational scenario table because of the enhanced functionality required during incidents.

Table 17 – Roles and Responsibilities During Freeway Incidents

FREEWAY INCIDENTS		
Service Category	**Agency**	**Roles and Responsibilities**
Traffic Management	ADOT TOC	• Detects/verifies incidents via CCTV video images/traffic detection • Receives automated alerts and incident updates through Phoenix Fire CAD interface • Monitors DPS CAD feed at TOC • Notify motorists via freeway DMS of incident, closure, event • Shares CCTV video feeds with other TMCs • Coordinates with Local TMCs to adjust traffic signal timing to respond to potential increased traffic congestion entering onto the arterial network • Coordinate with ALERT teams to support incident • Post incident traveler information to HCRS for dissemination via 511 and az511.gov services • Share incident traveler information with ADOT PIOs for dissemination via media • Coordinate with ADOT maintenance as needed for incident clearance • If the incident is large enough to warrant an evacuation or warning to the public, the ADOT EOC is included in the coordination efforts
	Maricopa County TMC	• Receives automated alerts and incident updates through Phoenix Fire CAD interface • Notify motorists via arterial DMS of incident, closure, event as needed • Depending on the scale of the incident, the TMC may be engaged by the Local EOC, Maricopa County EOC, ADOT EOC, or Arizona Department of Emergency Management (ADEM) EOC to facilitate traffic management strategies for evacuation or other large scale emergencies
	Local TMCs	• View ADOT CCTV video feeds in the area of their jurisdiction to determine impacts to arterials based on detours/traffic congestion • Notify motorists via arterial DMS of incident, closure, event as needed • Coordinates with Local Police to manage traffic congestion entering onto the arterial network as a result of closures of detours on adjacent freeways
Public Safety and Emergency Response	Arizona DPS	• Public safety/emergency response dispatch of vehicles to incident location with vehicle location tracking to increase the efficiency of the response • Dispatches FSP vehicles to incident • ADOT CCTV via an established interface • Provide incident notification and updates to ADOT TOC via DPS CAD
	MCSO	• Support DPS through direct request as needed
	Local Police	• Coordinates with Local TMCs to manage traffic congestion entering onto the arterial network
	Phoenix Fire	• Responds to freeway incidents • Coordinates with Local TMCs to manage traffic congestion entering onto the arterial network • Updates to Phoenix Fire CAD system which are then shared with ADOT and MCDOT TMCs

5.4.3 Arterial Incidents

Similar to the freeway incidents scenario, incidents that occur on the arterial network introduce a specific subset of responsibilities for each agency in order to efficiently respond to and resolve the incident causing traffic congestion. Depending on the severity of the incident, ADOT and DPS may be called upon to support incident response and clearance efforts and particularly monitor detour traffic, although their roles for arterial incident management are minimal. The arterial incident operational scenario involves local responding to TMCs and local public safety agencies as the primary stakeholders in charge of monitoring, and managing arterial incidents, information sharing with other agencies that could be affected by arterial incidents, and operating available traveler information services and statewide services as applicable to the incident location and effects. **Table 18** describes the roles of agencies in the MAG Region during arterial incidents. Similar to freeway incidents, typical day-to-day operational roles are described in this section has having an added purpose and direction when that functionality is used during arterial incidents. New roles are also described that are not present in the day-to-day operational scenario table because of the enhanced functionality required during incidents.

Table 18 – Roles and Responsibilities During Arterial Incidents

ARTERIAL INCIDENTS		
Service Category	**Agency**	**Roles and Responsibilities**
Traffic Management	Local TMCs	• Adjust agency traffic signals and timing plans and intersection/corridor detection based on incident impact • View real-time CCTV video feeds on major corridors in city to monitor incident location and impacts to arterial traffic • Notify motorists via arterial DMS of incident, closure, event • Share CCTV video feeds with internal divisions (Local Police, Local Fire, Local Public Works) as needed to support incident response and management • Shares CCTV video feeds with other TMCs to support traffic management coordination during incidents • Coordinates with Local Police, Local Fire, and MCSO (if applicable) regarding incident information and response requests • If needed, coordinate with Local Police and MCSO to dispatch REACT/coordinate with REACT • Notify adjacent jurisdictions of incidents/closures/detour routes as well as notifying transit and media as needed • Post incident information on local jurisdiction website and send information via email alerts to local jurisdiction personnel if applicable • Coordinate with local maintenance as needed for incident response and management • If the incident is large enough to public works warrant an evacuation or warning to the public, the Local EOC is included in the coordination efforts • Distribute e-mail alerts about the incident and closures to pre-defined distribution list

Table 18 – Roles and Responsibilities During Arterial Incidents (continued)

ARTERIAL INCIDENTS		
Service Category	**Agency**	**Roles and Responsibilities**
Traffic Management (continued)	Maricopa County TMC	• View MCDOT CCTV video feeds as well as CCTV from Local TMCs to monitor incident location and impacts to traffic • Update incident and arterial road network conditions to RADS and ATIS (future) • Notify motorists via arterial DMS of incident, closure, event as needed • Adjust signal timing plans for MCDOT signals on MCDOT corridors to respond to incident traffic conditions • Coordinate with local agency TMCs if incident traffic may affect adjacent municipal corridors • Coordinate with MCDOT REACT teams and update incident status as information becomes available • Distribute e-mail alerts about the incident and closures to pre-defined distribution list, which includes media • Coordinate with Maricopa County maintenance as needed for incident clearance support • If the incident is large enough to warrant an evacuation or warning to the public, the Maricopa County EOC is included in the coordination efforts • Depending on the scale of the incident, the TMC may be engaged by the Local EOC, Maricopa County EOC, ADOT EOC, or ADEM EOC to facilitate traffic management strategies for evacuation or other large scale emergencies
	ADOT TOC	• Share ADOT CCTV video images with Local TMCs
Public Safety and Emergency Response	Local Police	• Public safety/emergency response dispatch of vehicles to incident location with vehicle location tracking to increase the efficiency of the response • On-scene management and clearance of incidents • Coordination with police dispatch to provide updates • Dispatch/coordinate with County or Local REACT team • View Local TMC CCTV and/or coordinate with Local TMC on incident monitoring
	MCSO	• Coordinates with Local TMC as needed to provide public safety resource support • Support local public safety through direct request as needed • Notifies local public safety and Local TMC of incident if MCSO is first to respond to incident
	Arizona DPS	• Support Local Police or MCSO through direct request as needed if arterial incident could impact freeway operations
	Phoenix Fire	• Respond to arterial incidents from 911 dispatch • Update Phoenix Fire CAD system with incident details and updated incident information (CAD feed is shared with traffic management agencies) • Support Local Police, Local Fire or MCSO through direct request as needed
Transit	Valley Metro, Phoenix Public Transit, METRO Light Rail	• Receives incident notification and closures direct from Local TMC and/or RADS that might affect transit routes or schedule adherence • If transit vehicle is in incident, transit agency will notify Local Police for assistance, Local TMC for assessment of traffic signal adjustments or maintenance that may be necessary

5.4.4 Work Zone/Construction

The responsibilities for each agency when a work zone or construction site is on the freeways or on the arterial network are described in this section. There are different responsibilities depending on where the location of the work zone is and what detour and monitoring requirements are required for that work zone. This scenario generally discusses the agency coordination necessary to minimize work zone related traffic congestion and maximize the monitoring capability of the traffic for safety purposes. This scenario engages the traffic and public safety agencies in the MAG Region but also engages the transit agencies as the location of work zone/construction could impact transit operations. **Table 19** describes these responsibilities during work zone/construction events.

Table 19 – Roles and Responsibilities During Work Zone/Construction

WORK ZONE/CONSTRUCTION		
Service Category	**Agency**	**Roles and Responsibilities**
Traffic Management	ADOT TOC	If work zone is in ADOT's jurisdiction: • Share real-time CCTV monitoring view with DPS and neighboring jurisdictions of work zone area • Notify motorists via freeway DMS of freeway closure and work zone information • Share traffic condition and work zone status with HCRS and RADS so local agencies will have work zone impact information • Receive work zone status information from other agencies • ADOT maintenance group will monitor portable and permanent equipment through work zone and on detours and adjacent routes If work zone does not affect jurisdiction: • Monitor/retrieve work zone status information from HCRS as needed
	Maricopa County TMC	If work zone is in MCDOT's jurisdiction: • Monitor portable and permanent equipment through work zone and on detours and adjacent routes • Share real-time CCTV monitoring view with police and neighboring jurisdictions • Notify motorists via arterial DMS of arterial closure and work zone information as needed • Adjust timing plans on work zone corridor and detours to accommodate increased traffic patterns due to work zone • Share traffic condition and work zone status with adjacent and other TMCs, update HCRS and RADS/ATIS as needed • Receive work zone status information from other agencies If work zone does not affect jurisdiction: • View CCTV camera feed as desired • Monitor/retrieve work zone status information from HCRS as desired

Table 19 – Roles and Responsibilities During Work Zone/Construction (continued)

WORK ZONE/CONSTRUCTION		
Service Category	**Agency**	**Roles and Responsibilities**
Traffic Management	Local TMCs	• Monitor portable and permanent equipment through work zone • Monitor portable and permanent equipment on detours and adjacent routes • Share real-time CCTV monitoring views with police and neighboring jurisdictions of work zone area • Notify motorists via arterial DMS of closure and work zone information as needed • Adjust timing plans on work zone corridor and detours to accommodate increased traffic patterns due to work zone • Share traffic condition and work zone status with adjacent and other TMCs, update HCRS and RADS as needed • Receive work zone status information from other agencies
Public Safety/Emergency Management	Local Police	• View real-time CCTV camera feeds from Local TMC of work zone corridor and detours/adjacent corridors • Dispatch response vehicles as requested by TMCs or based on view of CCTV camera feeds • Police personnel to monitor work zone and coordinate with Local TMC as needed
	MCSO	• Coordinates with Local TMC as needed to provide public safety resource support • Support local public safety through direct request as needed
	Arizona DPS	• Dispatch FSP vehicles for incident support in work zones as requested by TMC responsible for jurisdiction where the work zone is located
	Phoenix Fire	• Support Local Police, Local Fire or MCSO through direct request as needed • Coordinates with Local TMC or Maricopa County TMC as needed to provide support through direct request as needed
Transit	Valley Metro, Phoenix Public Transit, METRO Light Rail	• Receives work zone notification direct from Local TMC and/or RADS that might affect transit routes or schedule adherence • Coordinate with Local TMC as needed regarding traffic signal adjustments that could impact transit routes or schedule adherence

6. HOW TO USE THE MAG ITS ARCHITECTURE AND WEBSITE

An important goal of the MAG RIA was to make the regional ITS architecture a valuable resource to member agencies to support agency ITS project planning and development, ITS integration, and required systems engineering processes. An agency that intends to develop an ITS project in their jurisdiction or in partnership with other agencies and will be applying for MAG TIP funding will be required to use the MAG RIA. First, to identify where in the MAG RIA the project is represented – this shows the pre-planning done in support of that project development. Second, agencies may be required to complete a systems engineering analysis – for documentation of the project development process that is using federal funds. This section will describe how to use the MAG RIA in support of ITS project implementation from project development through the systems engineering analysis.

6.1 Project Identification/TIP Application

In order to use the RIA to support project development, the portion of the RIA that will be included in the project must be identified. This is a key step in architecture use because this is when the ITS project will be viewed in the broader context of the RIA. This is when the services, functionality, and integration opportunities envisioned in the region are reviewed and considered as the basic scope of the project is defined. This step is also required to meet the FHWA Rule/FTA Policy.

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

In order to define the full benefits that the MAG RIA provides to project development and application for funding, **Table 20** has been developed to highlight the location of information in this document and on the website for agencies to use to develop various types of ITS projects. When agencies are reviewing the architecture document and website for their project applicability, selecting the appropriate inventory item will identify the service packages and equipment packages that would apply to that project.

Agency requirements for projects to be mapped to the architecture for compliance with the MAG TIP application process includes:

- Associated Service Packages – listing of the service packages from the MAG ITS Architecture that are supported by this project.
- User Services – listing of the user services from the MAG ITS Architecture that are supported by this project.
- Subsystems – listing of the subsystems from the MAG ITS Architecture that are supported by this project.

These three components define the system/s that will be created or impacted by the project, the functionality that will be implemented, and the interfaces that will be added or updated. The current ITS projects in the MAG TIP have been included on the website, as shown in the links list from the website to the right, which also link to applicable agency-specific service packages.

Table 20 – Example Project Type Mapping to MAG Regional ITS Architecture Components

Project Type	ITS Inventory ("ITS Inventory" Link from Website or Table 11)	Example Subsystems ("Mapping" Category)	Example Associated Service Packages*	Example Equipment Packages*	Example Functional Requirements* (Select the appropriate equipment package/s)	Example User Services* (Table 10 – choose based on descriptions provided)
Installation of new CCTV cameras / expansion of existing camera system and integrating the cameras to be operational from a control center.	CCTV, TMC	Roadway Subsystem, Traffic Management	ATMS01 - Network Surveillance	Roadway Basic Surveillance	1 - The field element shall collect, process, and send traffic images to the center for further analysis and distribution.	1.6 Traffic Control 1.7 Incident Management
Installation of new DMS and integrating DMS to be operational from a control center.	DMS, TMC	Roadway Subsystem, Traffic Management	ATMS06 - Traffic Information Dissemination	Roadway Traffic Information Dissemination	1 - The field element shall include dynamic messages signs for dissemination of traffic and other information to drivers, under center control; the DMS may be either those that display variable text messages, or those that have fixed format display(s) (e.g. vehicle restrictions, or lane open/close).	1.2 En-Route Driver Information
Synchronization of traffic signals along key corridor and integrating system to be operational from a control center.	Traffic Signals, TMC	Roadway Subsystem, Traffic Management	ATMS03 - Surface Street Control	Roadway Signal Controls	1 - The field element shall control traffic signals at intersections and on main highways for urban and rural areas, under center control.	1.6 Traffic Control
Deployment of traffic detection for use at mid-block locations and intersections.	Vehicle Detectors, TMC	Roadway Subsystem, Traffic Management	ATMS01 - Network Surveillance	Roadway Basic Surveillance	1 - The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control.	1.6 Traffic Control
TMC to TMC communications installation to facilitate interagency coordination	TMC	Traffic Management	ATMS07 - Regional Traffic Management	TMC Regional Traffic Management	1 - The center shall exchange traffic information with other traffic management centers including incident information, congestion data, traffic data, signal timing plans, and real-time signal control information.	1.6 Traffic Control 1.7 Incident Management
Implement a project to archive data and send applicable information to a regional server for dissemination via 511 or another traveler information service.	Local City and Municipal Archived Data	Archived Data Management Subsystem	AD1 - ITS Data Mart AD2 - ITS Data Warehouse	ITS Data Repository	2 - The center shall collect data catalogs from one or more data sources. A catalog describes the data contained in the collection of archived data and may include descriptions of the schema or structure of the data, a description of the contents of the data.	7.1 Archived Data

** Projects will likely map back to more than one service package, equipment package, and requirement.*

The MAG Transportation Improvement Program (TIP) is a five year schedule of specific projects to be constructed across the MAG Region. The *"Guide to Transportation Programming"* for MAG (developed in October 2007 for fiscal year 2008) provides MAG member agencies background information, instructions, and deadlines on the different transportation programs and requirements for the MAG TIP for each fiscal year. The MAG TIP process is outlined in **Table 21**. The important dates for agencies to be aware of are bolded in the table: initial project recommendations from agencies are due in August and the final MAG TIP is not typically approved until the next year. The TIP application process could vary and agencies should periodically check with MAG to determine the application deadlines for the next TIP update cycle.

Table 21 – MAG TIP Process

Transportation Improvement Program - Fiscal Year	
Year 1	
August	• **Member agencies develop project requests for MAG Federal funds** • **Stakeholders meeting/workshop on applying for MAG Federal funds**
September	• **1st Week - Member agencies submit project requests for MAG Federal funds** • 3rd Week - Transportation Review Committee (TRC) review/recommend/approve draft list of MAG Federal Fund project requests
October	• Modal Transportation Advisory Committees (TACs) first review of requests for MAG Federal funds
November	• Modal TACs second review and rank modal projects
November/December	• TIP Data Entry System available to member agencies for project updates
December	• First Week - TRC review/recommend/approve second draft of MAG federally funded program
Year 2	
January	• 1st Week - Member agencies submit privately and locally funded projects for inclusion in TIP for an Air Quality Conformity Analysis (AQCA) • Managers, TPC, and RC review/recommend/approve second draft of MAG federally funded program • Draft MAG TIP (Listing of Projects) produced
February	• TRC recommends Draft TIP Project Listings for AQCA
February/March	• Draft TIP Project Listings for TAC and public review
April	• Managers, TPC and RC review/recommend/approve Draft TIP for an AQCA
April/May	• TIP undergoes AQCA
June	• AQTAC recommends approval of the AQCA • TRC review/recommend/approve TIP
July	• **Managers, TPC and RC review/recommend/approve TIP**
August	• Governor's designee approves TIP
August/September	• First Four Years of the TIP included in the Arizona STIP

For ITS projects, MAG allocates a specific amount per year, and agencies in the region apply for funding for specific ITS projects. Applications are reviewed and consolidated by MAG, and then presented to the MAG ITS Committee for review and discussion. In many cases, funding requests exceed available funding, and it is up to the MAG ITS Committee to agree on an appropriate

strategy, which could include reducing federal funding for some or all projects to be able to fund the majority of projects, or even eliminating some projects from consideration.

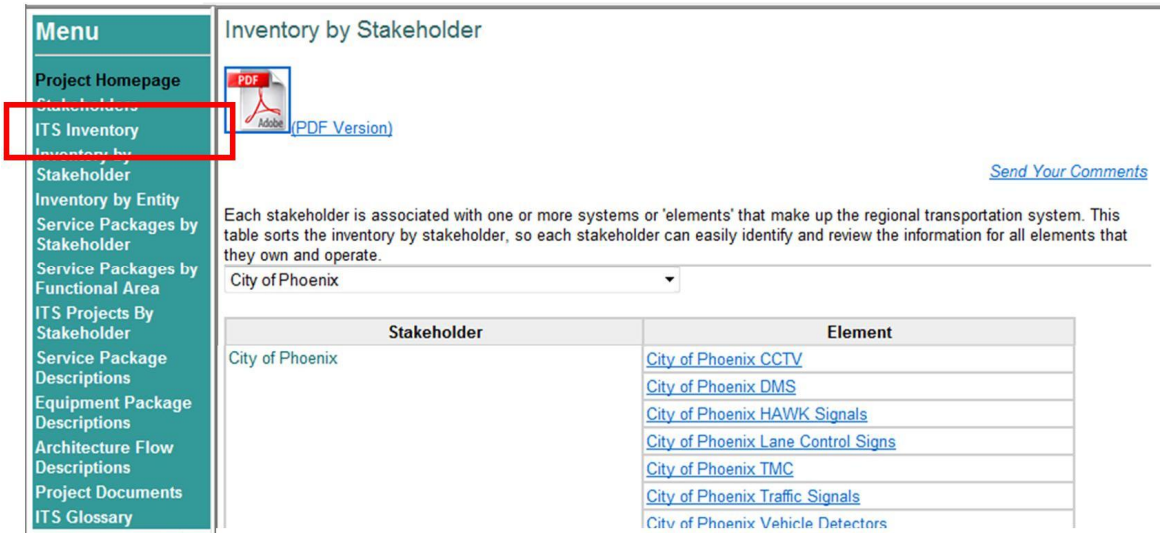
There have been opportunities for close-out funding through MAG, whereby there is a small surplus of funds available after all projects have been funded. This is not the case for every year, and should not be viewed as a consistent funding source. Often, with such short turn-around for the close-out process, projects that are funded are typically smaller in nature, do not require any design, or have designs complete and just need funding for implementation.

6.2 Project Development

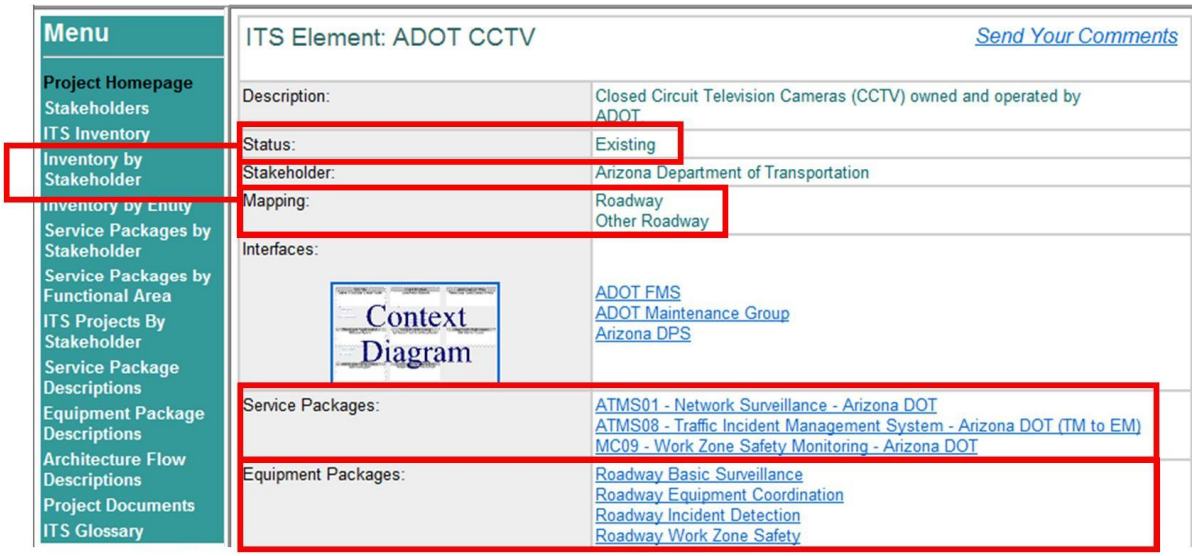
Once funding has been identified for the ITS project and the development is underway, the MAG RIA is beneficial for providing a context in which the project will fit within the regional ITS implementations (either existing or planned). Agencies can use the RIA website to determine the functionality for the project, and also detailed communications and operating requirements of the project based on the functionality desired. Potential inventory items will also be identified (centers, roadside, other stakeholders, etc.). This section will describe how to navigate the project architecture website from the agency perspective as well as how to integrate architecture components into the agency project.

The ITS architecture and website were developed to be able to provide stakeholders with a tool that makes navigating the architecture a more streamlined process and points the stakeholder in the right direction quickly. This section is developed to guide the agencies in how to use the website through various screen captures of the actual website. Under each link there are PDF boxes that can be clicked to bring up a PDF of the full list of inventory, customized service packages by stakeholder or by functional area, and other options. This PDF tool is helpful in the review of service packages that need to be updated as part of a future architecture.

ITS inventory provides the foundation of information for which the entire architecture was built and information flows were created. Agencies can find their specific inventory items by using the "Inventory by Stakeholder" link if inventory has been defined specifically for their agency, or by using the "ITS Inventory" link and finding the agency-specific inventory item. If there is not an inventory item created specifically for your agency (for example, City of Phoenix DMS), the agency should find the "Local Cities and Municipalities" list which provides generic service packages and information flows for inventory that has not been specified. Below is a screen capture of the "Inventory by Stakeholder" link showing the list City of Phoenix inventory items.



When an inventory item is selected, as shown in the example below of ADOT CCTV, four very important types of information are displayed. The status of the inventory item, the subsystem that the inventory item maps to in the architecture (the way it is represented in service packages), what service packages that inventory item is depicted in, and finally the equipment packages that are applicable to that inventory item. All of this information is applicable to the MAG TIP application process and to find functional requirements for a project to help with the design of the project.



Functional requirements can be found by selecting the equipment package that best represents the purpose of the project that the agency is developing. By selecting the equipment package, a list of functional requirements is displayed at the bottom of the screen which can be helpful for functional design considerations on the project.

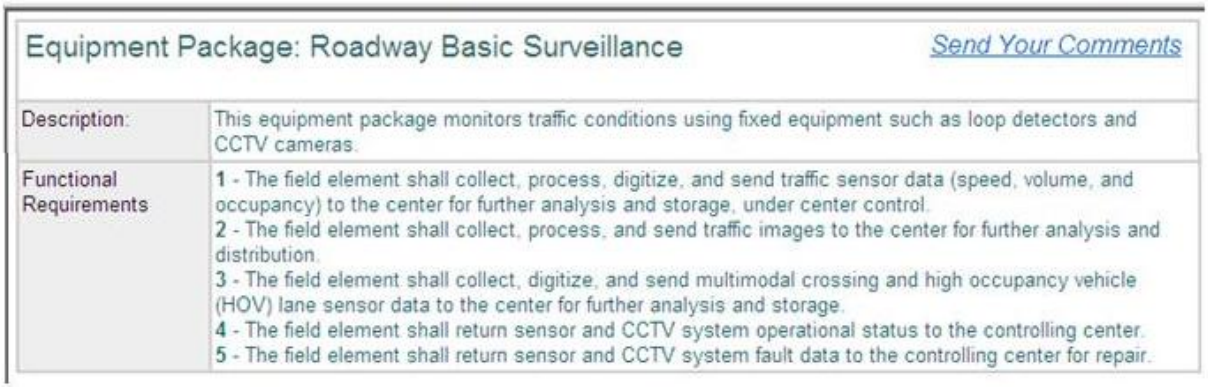
For example, in order to find the appropriate functional requirements for ADOT cameras to provide video images to the ADOT TOC, ADOT would follow the process of:

- Selecting “ADOT CCTV” in their Inventory list;
- Select “Roadway Basic Surveillance” in the Equipment Package list for providing video images to a center; and
- At the bottom of the screen is the list of functional requirements for that inventory element to be able to provide that function or service to ADOT. ADOT can then tailor these requirements to suit the needs of the project, but the RIA provides a starting point.

As another example, for the installation of arterial DMS in Avondale, Avondale would follow the process of:

- Selecting “City of Avondale DMS” in their Inventory list;
- Selecting “Roadway Traffic Information Dissemination” in the Equipment Package list for providing messages to travelers; and
- At the bottom of the screen is the list of functional requirements.

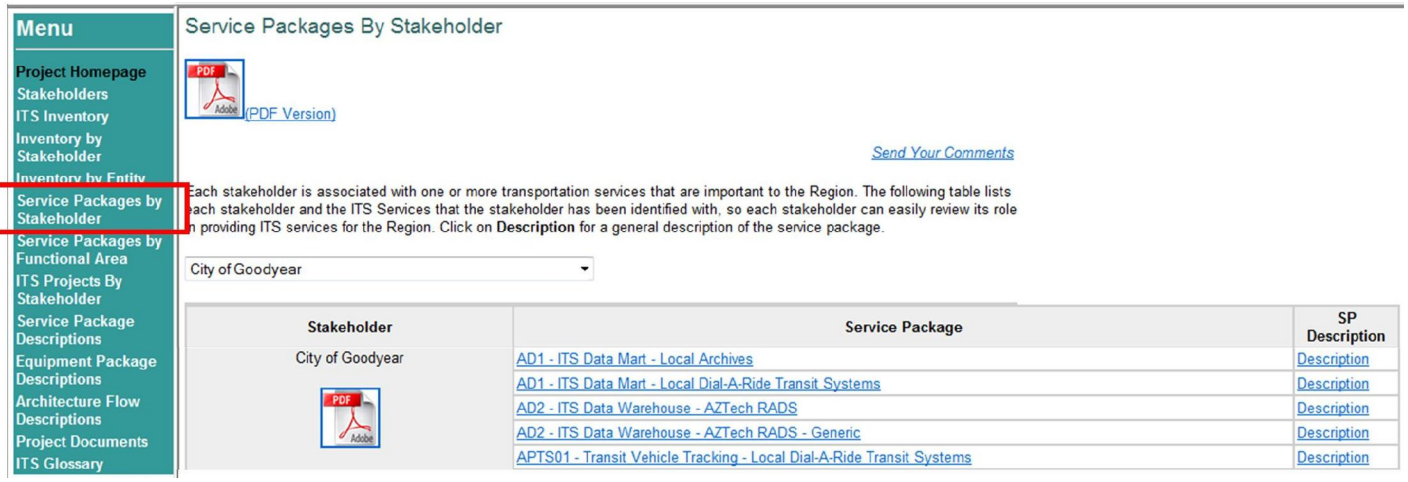
On the next page is a screen capture of the functional requirements that support the example equipment package “Roadway Basic Surveillance”.



Equipment Package: Roadway Basic Surveillance — Send Your Comments

Description:	This equipment package monitors traffic conditions using fixed equipment such as loop detectors and CCTV cameras.
Functional Requirements	1 - The field element shall collect, process, digitize, and send traffic sensor data (speed, volume, and occupancy) to the center for further analysis and storage, under center control. 2 - The field element shall collect, process, and send traffic images to the center for further analysis and distribution. 3 - The field element shall collect, digitize, and send multimodal crossing and high occupancy vehicle (HOV) lane sensor data to the center for further analysis and storage. 4 - The field element shall return sensor and CCTV system operational status to the controlling center. 5 - The field element shall return sensor and CCTV system fault data to the controlling center for repair.

The customized service packages are included in the final ITS architecture and are available on the architecture website. They are categorized by "Service Packages by Stakeholder" or "Service Packages by Functional Area" to assist the stakeholder in finding the applicable service package for their project. Below is a screen capture of the "Service Packages by Stakeholder" link showing the City of Goodyear in the list of stakeholders. The "Service Package by Functional Area" selection could be helpful for agencies that do not have a specific service package for the project/program they plan to implement.



Menu
- Project Homepage
- Stakeholders
- ITS Inventory
- Inventory by Stakeholder
- Inventory by Entity
- Service Packages by Stakeholder
- Service Packages by Functional Area
- ITS Projects By Stakeholder
- Service Package Descriptions
- Equipment Package Descriptions
- Architecture Flow Descriptions
- Project Documents
- ITS Glossary

Service Packages By Stakeholder

(PDF Version)

Send Your Comments

Each stakeholder is associated with one or more transportation services that are important to the Region. The following table lists each stakeholder and the ITS Services that the stakeholder has been identified with, so each stakeholder can easily review its role in providing ITS services for the Region. Click on **Description** for a general description of the service package.

City of Goodyear

Stakeholder	Service Package	SP Description
City of Goodyear	AD1 - ITS Data Mart - Local Archives	Description
	AD1 - ITS Data Mart - Local Dial-A-Ride Transit Systems	Description
	AD2 - ITS Data Warehouse - AZTech RADS	Description
	AD2 - ITS Data Warehouse - AZTech RADS - Generic	Description
	APTS01 - Transit Vehicle Tracking - Local Dial-A-Ride Transit Systems	Description

The architecture has been developed for agencies to use as a tool to support project development and provide a consensus-based vision of ITS services in the Region. There are many agencies that have unique functionality or communications This architecture can be used for agencies to not only see what other agencies are doing to expand their own services, but also can be used to bridge the gap between similar projects that adjacent or similar agencies are doing in order to support more regionally-focused ITS programs moving forward.

6.3 Systems Engineering

During the development of an ITS project, an agency may be required to perform a systems engineering analysis to document the planning and purpose of the project for MAG federal funding requirements. This section has been developed provide an overview of the systems engineering process and purpose as well as guide agencies with the development of their project-specific analysis.

6.3.1 Systems Engineering Process

Systems Engineering is a process for project development that considers the entire lifecycle of a project and emphasizes up-front planning and system definition. Systems Engineering is a requirement for the FHWA's Final Rule 23 CFR 940. As part of federal funding compliance, MAG requires that local and regional ITS projects using federal ITS funding apply the systems engineering process and principles.

Systems Engineering is a multi-step and iterative process for developing an ITS project that supports standards use and implementation. **Figure 10** shows the "Vee" diagram, which shows how each step of the process builds on the previous one. It stresses conceptual development and how the concept guides each of the key steps toward implementing and maintaining the system. This process typically applies to complex system design/integration/development efforts. This RIA maps to the beginning of the Systems Engineering process shown in the "Vee" diagram. Projects such as fiber design or a signal synchronization (which are represented as specific project types as part of the RIA) map to the high-level design and detailed design parts of the "Vee" diagram.

The structure provides for a process that asks critical questions along the way to make sure that important steps or issues that could impact a project and the Region are not overlooked. Systems Engineering is an effective risk management tool because by taking critical measures to identify project issues, benefits, risks and impacts, as well as going through a series of validation and approval points, there is less uncertainty about project objectives or expectations.

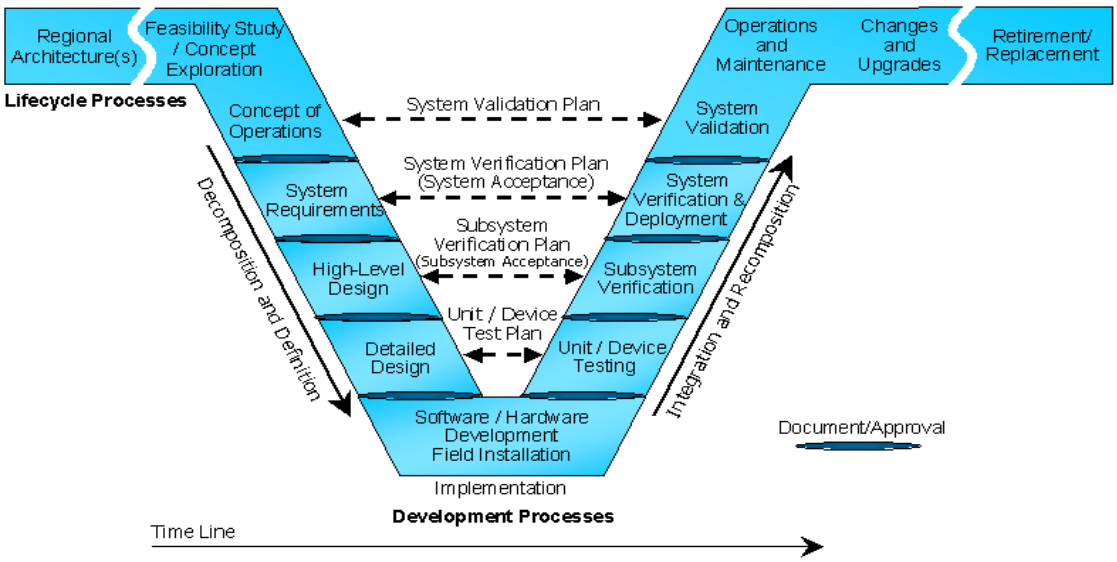


Figure 10 – "Vee" Systems Engineering Process Diagram

The purpose of using a systems engineering approach in developing a RIA and developing ITS projects are:

Regional ITS Architecture –

- Numerous project types are defined that together as a whole represent the MAG Region functionality;
- Allows stakeholders an opportunity to bring to the table the existing and planned functionality for their jurisdiction; and
- Allows stakeholders to understand the functionality of neighboring jurisdictions to ensure interoperability between the two or more jurisdictions.

ITS Projects –

- Improves stakeholder coordination;
- Develops more adaptable systems to the changing technologies of today's world;
- Verifies functionality of the project prior to making purchasing decisions;
- Supports the implementation of a system that meets the goals of the stakeholder and functions as planned; and
- Using a systems engineering approach reduces the risk of schedule and cost overruns.

6.3.2 MAG System Engineering Analysis Guidance

MAG has developed Interim Guidance on Systems Engineering Analysis Required for ITS Projects (August 2006). This guidance document was developed to outline the steps that need to be included in a Systems Engineering Analysis for all federally funded ITS projects in the MAG Region. The steps include:

- ***Interfacing with the Regional ITS Architecture –*** identify the relevant subsystems, user needs, user services, service package and architecture flows in the RIA that are covered by the project.
- ***Feasibility Study –*** technical, financial and institutional feasibility is explored in this step.
- ***Project Planning and Concept of Operations –*** defines the operation of the system developed/enhanced by the project and roles and responsibilities of each stakeholder as part of the project.
- ***System Requirements Definition –*** user service and functional requirements need to be defined in order to verify that the system performs as expected.
- ***System Design –*** a high-level and low-level design are developed to meet the system requirements.
- ***System Implementation –*** this step reviews the processes that are required to implement a project including procurement, hardware fabrication, software coding, configuration, etc.
- ***System Test and Verification –*** development of plans for testing, verifying and validating the functions of the new ITS project.
- ***System Operation and Maintenance –*** defines requirements for operations and maintenance and for ensuring that the system performs as planned.
- ***System Update, Retirement and Replacement*** – alternative studies for system upgrade and strategy plan for updating, retiring and replacing the system.

Some ITS projects that do not use the Highway Trust Fund need to apply for MAG funding and are therefore not subject to the Rule/Policy requirements. Projects developed exclusively with local funds and projects developed by non-transportation agencies (e.g., public safety agencies) fall into this category. For these projects, use of the architecture is voluntary and can be motivated by the potential interjurisdictional and regionally significant benefits of use and the need to reduce risks.

6.3.3 Using The MAG RIA to Support Systems Engineering Analysis For Projects

The MAG RIA supports the initial project planning, concept development, and requirements building for ITS projects. These steps are shown in the first leg of the "Vee" diagram as the foundation components of developing a project. The initial planning steps are used to be able to develop more detailed requirements and provide a back check for functionality throughout the project cycle to make sure that the project continues to address goals and needs defined in the initial planning stages of the project. This process has been required for ITS projects in the MAG Region because it is not efficient to redevelop or reinvest in an ITS project that been implemented in a fashion that changed in scope and purpose dramatically over the course of the project which could have been mitigated through proper project planning.

If an agency is required to develop a systems engineering analysis for an ITS project, this section defines the pieces of the architecture that will be useful in the analysis process. TThe MAG RIA supports the systems engineering analysis steps as defined in the MAG guidance document as follows:

- ***Interfacing with the Regional ITS Architecture***
  - Identify the subsystems, user services, customized service package and information flows that apply to the project following the example projects shown in Table 20 in Section 6.1.
  - The components applicable to the project are identified on the architecture website as described in Section 6.1 and 6.2.
- ***Feasibility Study***
  - This step will not require the use of the MAG RIA.
- ***Project Planning and Concept of Operations***
  - This step is supported by the customized service packages and information flows defined in the MAG RIA. Each service packages provides a 'mini' concept of operations for how various systems and stakeholders are envisioned to interact and share information.
  - ITS project types can be found in the customized service packages based on the functionality the project will provide, the types of communications that the project will use, and which inventory items will be needed for the project to support interfaces for data sharing and control.
  - The Concept of Operations will require agencies to describe the operations of the system provided by the project and this can be supported by identifying which service package/s and what functionality will be provided by the project in the architecture.
  - The roles and responsibilities of each stakeholder as part of the project can be supported by reviewing the inventory interfaces defined in the architecture.

    - Regional systems/servers that the project will link to can also be defined in the architecture to document the potential regional use of the project.
    - The RIA identifies types of agreements that may be required to support the functionality of different levels of information sharing and integration. Agencies can use these descriptions to identify where specific agreements might be needed. These are included in Section 5.3.3.
- ***System Requirements Definition***
    - Equipment packages, user services and functional requirements can be identified in the architecture to support project development as described in Section 6.1. Functional requirements are derived from equipment packages; these equipment packages outline specific functionality delivered by elements of the regional ITS. User services are contained in Section 4.2 and subsystems and equipment packages are shown in Section 4.3. Functional requirements are also detailed in Section 5.3.
    - These system requirements describe the intended project functionality and are used later in the project development process to verify that the project is performing according to the requirements set forth at the beginning.
- ***System Design***
    - Functional requirements are detailed requirements for the interfaces between field/center/server and can support the development of the high-level design for the project by qualifying a particular strategy for design.
    - Specific user services can be documented in this step to back check that the design will meet the intended project functionality.
- ***System Implementation***
    - This step will not require the use of the MAG RIA.
- ***System Test and Verification***
    - The agency is required to document how the functions provided by the ITS project will be verified and tested. This step can refer to back checking functionality with the system requirements defined in a previous step.
- ***System Operation and Maintenance***
    - Specific agency agreements as well as general agreement types that could support operations and maintenance of ITS projects are defined in Section 5.3.3.
    - It is important for the agency to evaluate the applicability of agreements that are defined in this architecture to provide more detail in this step of the systems engineering analysis as to the roles and responsibilities for operations and maintenance.
- ***System Update, Retirement and Replacement***
    - This step will not require the use of the MAG RIA.

The systems engineering analysis developed for an ITS process documents the project planning from initial concept development through design, implementation, system acceptance, and ultimately system retirement/replacement. The MAG RIA is a useful tool in the development of the systems engineering analysis for an ITS project through a majority of the steps required.

7. ITS ARCHITECTURE MAINTENANCE PLAN

The MAG ITS Architecture and associated Turbo Architecture database are dynamic plans that focus on documenting current and future ITS infrastructure and plans throughout the MAG Region as well as relationships with other agencies. To be consistent with changing needs and evolving technologies, the architecture and database require periodic updating and review as the ITS program evolves in the Region. As projects are implemented or expanded, as agency priorities change, or as other changes occur that impact ITS in the various jurisdictions in the Region, changes will be documented through updates and regular maintenance procedures for the upkeep of the architecture. This architecture maintenance plan acts as a control mechanism for maintaining order in the updating of the architecture and outlines a process for keeping the architecture up-to-date over time.

This maintenance plan is laid out in two parts, both of which act as instructions for changes to the architecture. The first portion is presented for the user or regional stakeholder. It provides some background information along with recommended procedures for how a change should be initiated by the user. The second portion of this document is presented for the maintainer of the architecture and database. It identifies how the change is handled after it is submitted by the user. This format allows each party to focus on the information that primarily pertains to them. MAG will have primary maintenance responsibility for the ITS architecture documents, website and database.

7.1 Purpose for Maintenance

The MAG RIA and database are dynamic planning tools that are subject to change as ITS needs and infrastructure evolves in the Region. New projects constructed or planned every year may change the status or existence of inventory elements and information flows. As changes occur, portions of the architecture document, website and database will need to be updated accordingly. These changes should be initiated by the stakeholders as the need arises and should be submitted to MAG via the MAG ITS Committee monthly meetings for inclusion in the next update. The following list includes events identified by the *Regional ITS Architecture Maintenance White Paper*[1] as events that may require change to an ITS architecture and deployment plan:

- **Changes in Regional Needs** – The ITS Architecture and website were created to support transportation planning in addressing individual agency, local interagency, and regional needs. Over time these needs can change and the corresponding aspects of the architecture may need to be updated.
- **New Stakeholders –** New stakeholders become active in ITS and the architecture and website should be updated to reflect their place in the local network of ITS elements, interfaces, information flows, and participation in regional activities. New transportation modes and new transportation services for example could be considered that touch the systems of additional stakeholders.
- **Changes in Scope of Services Considered –** The range of services considered by the architecture expands.
- **Changes in Other Architectures –** The MAG RIA covers not only elements and interfaces within the Region, but also identifies interfaces for specific agencies and local ITS architectures in the Region. Changes in the local city ITS architectures that are developed in the region may necessitate changes in the architecture for MAG to maintain consistency between them.

1 This white paper was developed by the FHWA in 2004 and is a guide for transportation professionals who are involved in the development, use and maintenance of regional ITS architectures. It provides guidance on what should be contained in an architecture maintenance plan and on the process of maintaining the architecture.

- **Changes due to Project Definition or Implementation –** When actually defined or implemented, a project may add, subtract, or modify elements, interfaces, or information flows within the architecture. The architecture is meant to describe the current (as well as future) implementation of ITS, it must be updated to correctly reflect how the newly deployed projects integrate into their system.
- **Changes due to Project Addition/Deletion –** Projects will be added or deleted through the MAG TIP planning process or through project delivery. This could change the status or existence of inventory items, information flows, and service packages in the architecture and database.

In order to MAG member agencies to be able to use the architecture for project development and application purposes, the architecture needs to reflect the most current state of ITS in the Region.

7.2 Frequency and Process of Review/Updates

There is no fixed time period or exact event on when the ITS Architecture **should** be updated. When such a change occurs as described in the previous section, it does not necessarily require that the ITS Architecture be updated immediately. For example, it is not necessary to update the RIA just because a new version of the U.S. National ITS Architecture is released, particularly if it has no direct effect on the existing MAG RIA. On the other hand, If there are no significant changes in policies or status on the deployment of ITS Systems in the region, it may not be necessary to update the ITS Architecture for several years. However, the update is necessary to ensure that the ITS Architecture continues to accurately represent the regional view of ITS Systems and that the architecture continues to stay compliant with federal requirements.

It will be important to periodically review the MAG RIA, even though a major update might not be warranted. A recommended review and update cycle is presented below:

- **Annual Review** – It is recommended that the ITS Architecture be reviewed on an annual basis for minor corrections and modifications to reflect other changes that may affect the RIA. These modifications may be a result of changes in project status, new stakeholders, or updates to agency agreements. Modifications may also result from projects being implemented (changing status of data flows from “planned” to “existing”). This review will be led by the MAG ITS Committee. It is recommended that this review be coordinated with the MAG TIP Call for Projects process.
- **Comprehensive Update** – A more thorough update of the MAG RIA is recommended every three years. With minor updates and modifications occurring in the interim, this Comprehensive Update would address new or adjusted projects outlined in the MAG TIP being included in the RIA, as well as identify significant changes or additions that could affect multiple stakeholders. It is recommended that this Comprehensive Update include input from the full MAG ITS Committee, either through a workshop format, individual phone calls or smaller workshops. Proposed updates and revisions to the RIA should be reviewed by the MAG ITS Committee for consensus.

When a possible change to the architecture has been identified, a **Change Request Form** should be completed by the initiator of the change and the form should be submitted to MAG. MAG will initiate a formal request for architecture changes as part of a regularly scheduled MAG ITS Committee meeting.

The Change Request Form should include the following information:

- Contact information of individual proposing change: name, title, agency, email, fax number and phone number;
- Date;
- Short description of proposed change;
- Detailed description of proposed change (what is to be added, deleted, or modified);
- Type of change proposed (e.g. new project, new stakeholder, etc.);
- Name of system(s) or project(s) being implemented or modified (if applicable);
- Status:
  - Proposed (want to implement but has not yet secured funding for the project);
  - Planned (secured funding for the project);
  - Under Construction (currently deploying the system); or
  - Existing (deployed the system and it is currently operational).

A sample Change Request Form is included in **Table 22** below.

Table 22 – Example Change Request Form

Stakeholder Proposing Change	**Name**		**Title**	
	Agency			
	Email			
	Phone No.		**Fax No.**	
Date				
Description of Change	**Title**	*Short Description*		
	Detailed Description	*(What is to be added, deleted, or modified? Attach additional documentation if necessary)*		
	Type of Change	☐ New Service Package ☐ Deleted Service Package ☐ Modified Service Package or Data Flow (attach mark up or sketch)	☐ New/Changed Stakeholder ☐ Change in Project Status (planned now existing) ☐ Other	
	Systems or Projects	*Name of System(s) or Project(s) being implemented or modified (if applicable)*		
Project Status	☐ PROPOSED (funding not yet secured) ☐ PLANNED (funding secured) ☐ UNDER CONSTRUCTION (stakeholder is currently deploying system/project) ☐ EXISTING			

MAG will be responsible for gathering information updates and the using the procedure listed below to complete the update process. As Change Request Forms for the MAG RIA are submitted for consideration, a master document or Change Log with all the proposed changes, dispositions, and maintenance history should be maintained by MAG.

This Change Log will contain the following information:

- Change Number (MAG will assign a unique identifying change number for each requested change that needs to be tracked);
- Change Disposition (accepted, accepted with modifications, rejected, deferred);
- Disposition Comment;
- ITS Architecture Plan Components Affected (estimated)
- The location and version number of the revised document, spreadsheet, database or graphic
- The date of the change so that stakeholders can easily identify recent changes; and
- Notes of any additional actions or decisions related to the change.

7.3 Roles and Responsibilities

As the gatekeeper of the RIA, MAG will carry out the change (addition, addition with modifications, deletion, or modification) as specified in the approved Change Request Form, including performing the following tasks:

- Evaluate how the changes affect the architecture documents, Turbo database, and website.
- Evaluate whether or not the change impacts multiple stakeholders, or could potentially impact other elements within the RIA. This will also include coordination with those stakeholders to obtain consensus on the proposed change.
- Ensure that changes are carried out on the most recent versions of the affected documents, databases, and graphics.
- Verify that all dependencies, updated and related documents are synchronized with each other.
- Ensure that after changes are made, revised documents are posted, stored online, or otherwise disseminated in “read-only” format to prevent any unauthorized changes from being made and databases are updated and saved in “read-only format” to reflect the most recent date when changes were made.
- Update the Change Log with the status of the change.
- Notify the MAG ITS Committee of changes and updates made to the RIA.

Roles and responsibilities of the various stakeholders in the maintenance of the MAG RIA are described below:

Responsible Agency - MAG

- Currently, MAG is the Responsible Agency, and is responsible for the baseline and revised MAG RIA. In this role, MAG is responsible for maintaining the ITS architecture as well as keeping the official architecture documentation, in hardcopy, softcopy, and website formats. MAG may elect to do minor updates in-house, or may decide to contract with a consultant for major RIA updates. MAG is responsible for overseeing and guiding the maintenance efforts as well as being responsible for the baseline document for this MAG RIA. The MAG RIA Manager will receive the Change Request forms and requests for documentation from

stakeholders, coordinates changes among affected stakeholders, notifies stakeholders of updates, maintains the "official" records, including Change Request Database, updates the status of Change Request Forms, and manages the consultant (if applicable). In addition, MAG is responsible for maintaining any subsequent changes to the baseline architecture as approved by the MAG ITS Committee.

MAG ITS Committee (RIA Maintenance Subgroup)

- MAG may elect to establish a subgroup of the MAG ITS Committee to support review and/or update of the RIA. It is important to note that all substantial changes would need to be reviewed and agreed upon by the full MAG ITS Committee. As ITS in the region continues to expand and as there becomes a stronger focus on integrated systems, there will be significant emphasis on input and consensus from the MAG ITS Committee to approve changes to the architecture that may impact multiple stakeholders.

Stakeholders

- Any government agency or private organization that has a role in providing transportation services in the region. In the context of the MAG RIA, a Stakeholder, owns, operates, and/or maintains at least one ITS element in the ITS Architecture. Thus, that Stakeholder is called out in the corresponding Turbo Architecture database to the ITS Architecture. Each stakeholder responsible for updating its projects and ITS elements in the architecture as their ITS projects come online or get approved funding. It is envisioned that members of the MAG ITS Committee will provide input, review, recommended changes and consensus on behalf of their agency.