



MAG Regional ITS Architecture

Technical Memorandum #3 Physical Architecture

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1. INTRODUCTION

1.1 Overview of Technical Memorandum

The MAG Regional ITS Architecture 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 Regional ITS Architecture. 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 ITS architecture are market packages and equipment packages. This architecture includes customized market packages to reflect MAG member agency systems, projects and status. Market packages provide an overview of the actual information sharing and actual physical coordination of services that occurs in a region. The physical architecture and market 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 market 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 market 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.

1.2 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 market packages. Customized market packages were made available for stakeholders to review via the architecture website prior to the meeting. Due to the volume of customized market packages created for this architecture, only a limited amount of customized market packages were able to be reviewed during the workshop. These included regionally significant functions such as the ADOT HCRS, MCDOT RADS, and some example market packages from the advanced traffic management system and emergency management groupings to show stakeholders how to review their customized market packages.

A review of the architecture website was also provided at the meeting to educate stakeholders on the most effective and efficient method of reviewing the architecture that applies to their jurisdictions and operations.

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

1.3 ITS Architecture Database and Website

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 agency's 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 market 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.

The Turbo Architecture software tool that provides a database for the region-specific ITS architecture, which can be customized to match the specific requirements of the ITS system as well as update the architecture based on new implementation and growth. 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 market packages by stakeholder agency. The website is accessible at the address: www.consystem.com/mag/web/, and also through a link from the MAG ITS Committee web page. Stakeholders are able to view the customized market packages specific to their agency and comment directly to the architecture developers. Agencies can also see what other market packages have been identified for other agencies as well as to illustrate regional ITS integration. This provides a beneficial tool in reviewing the complete ITS architecture that has been developed for this region.



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1.4 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 Market 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.

2. CUSTOMIZED MARKET PACKAGES

The National ITS Architecture was established in 1994 as a guideline for future transportation systems to define a national interoperable ITS structure that can be used by any “region-defined” area to establish their vision for the future of their ITS network. In the National ITS Architecture, services and functions are referred to as market packages.

Market 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). Market packages also provide the most direct correlation to infrastructure and projects, which is a high priority for MAG as part of this ITS Architecture. Market 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 market packages from the National ITS Architecture include Traffic Information Dissemination, Traffic Incident Management System, and Work Zone Management.

In developing the customized market packages, stakeholders will be 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 market packages as identified in the National ITS Architecture which will be added and/or modified with stakeholder input.

Market packages have been diagrammed to show data flows and connections. The status of elements within market packages have also been identified (existing and planned). There are currently a total of 91 market packages identified in the recently updated National ITS Architecture Version 6.0. This section includes a description of market packages, selected market packages appropriate to the MAG Region, a description of the Turbo Architecture database and website tool for viewing the architecture, and the customized market packages that have been developed for this region.

2.1 Market 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 market 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.

Market packages are tailored to fit, separately or in combination, real world transportation problems and needs. Market packages collect the centers and devices that must work together to deliver a desired transportation service. Market 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 1**.



Table 1 – 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 market package satisfies a particular role in that functionality. For example, as part of the ATMS01 – Network Surveillance market package, the Traffic Management Subsystem gives and receives information from various other subsystems such as the Roadway Subsystem (such as cameras and vehicle detection deployed on the roads). The Traffic Management Subsystem provides the foundation of information transfer for the functionality of Network Surveillance. This market 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 1**. The National ITS Architecture interconnect diagram has been customized using the applicable market packages and information flows in those market 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 1**, 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 market package (ATMS01 – Network Surveillance) that make up the complete picture of the ITS Architecture. **Figure 2** in Section 2.3 shows the Network Surveillance market package in more detail customized for the City of Scottsdale which represents the functionality highlighted in red in **Figure 1**.

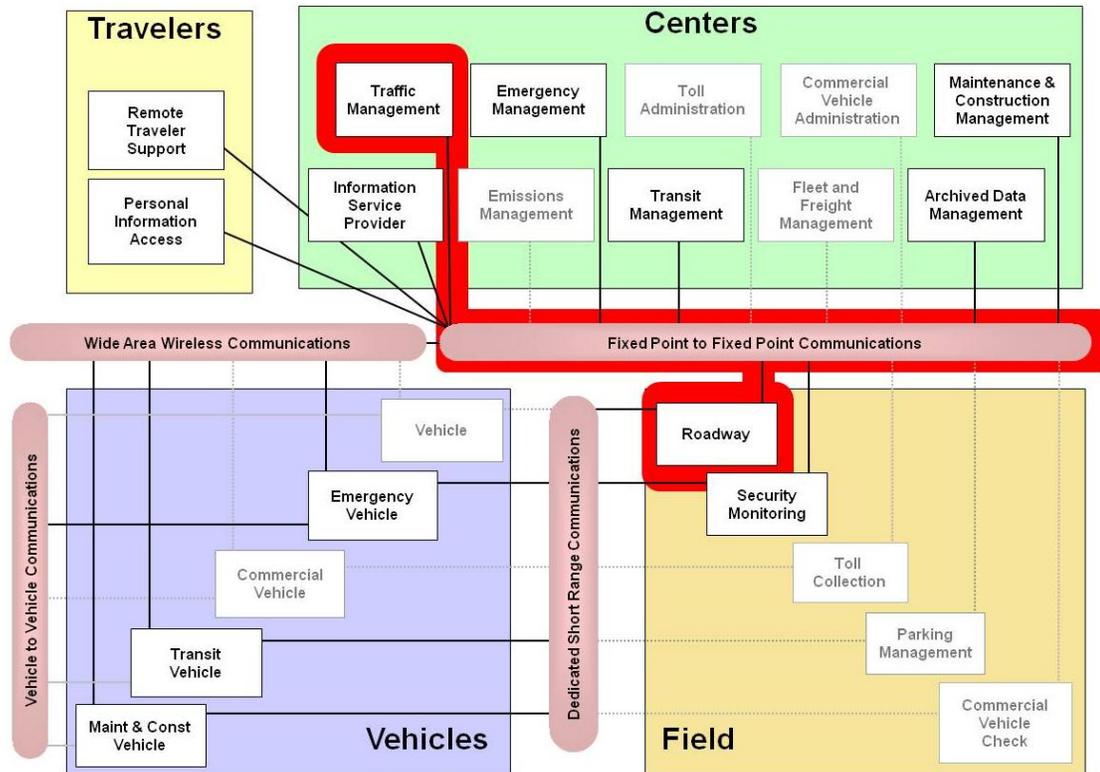


Figure 1 – Network Surveillance Functionality within Regional Interconnect Diagram

Information flows between the many different components in the market 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. Market packages that apply to the functions that occur in this region, have been customized for the agencies in the MAG Region.

Market 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.

2.2 Selected Market Packages Applicable to the MAG Region

Specific market packages that are chosen for the MAG Region out of the 91 total market 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 market packages from the National ITS Architecture that were reviewed for consideration in MAG’s regional ITS architecture is provided in **Appendix A**. Market packages that are not applicable to the region, such as commercial vehicle operations or winter maintenance, are not included in this architecture. The market 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, 36 market packages were selected for the MAG Regional ITS Architecture and

these are shown in **Table 2** below. Examples of what type of operations and coordination are discussed in each market package are provided in the table as well. The reference number (e.g. ATMS01) before each market package name refers to the relevant reference in the National ITS Architecture.

Table 2 – Market Packages Included in MAG ITS Architecture

Market Package	Market 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	Surface Street Control	Managing/operating traffic signals
ATMS04	Freeway Control	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
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 Monitoring	Local speed displays that are archived locally and can be downloaded by the agency for analysis of speeds
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 2 – Market Packages Included in MAG ITS Architecture (continued)

Market Package	Market 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
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	VII Traveler Information	Emergency VII 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 market 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 Regional ITS Architecture and each element has been mapped to those other elements with which it must interface.

2.3 Customized Market Packages

Customized market 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 market packages work together to support the MAG Region’s goals for ITS deployment, high-level conceptual diagrams have been developed for each selected market package from the National ITS Architecture. Over 150 customized market packages have been developed which show the detailed information flows that occur within each one of these market packages in a format that is user-friendly and understandable. The customized market packages will be included in the final ITS architecture and are available on the architecture website. **Figure 2** below shows an example of a customized market package created for the City of Scottsdale network surveillance functionality. Additional descriptions of each market package are provided in **Appendix A**.

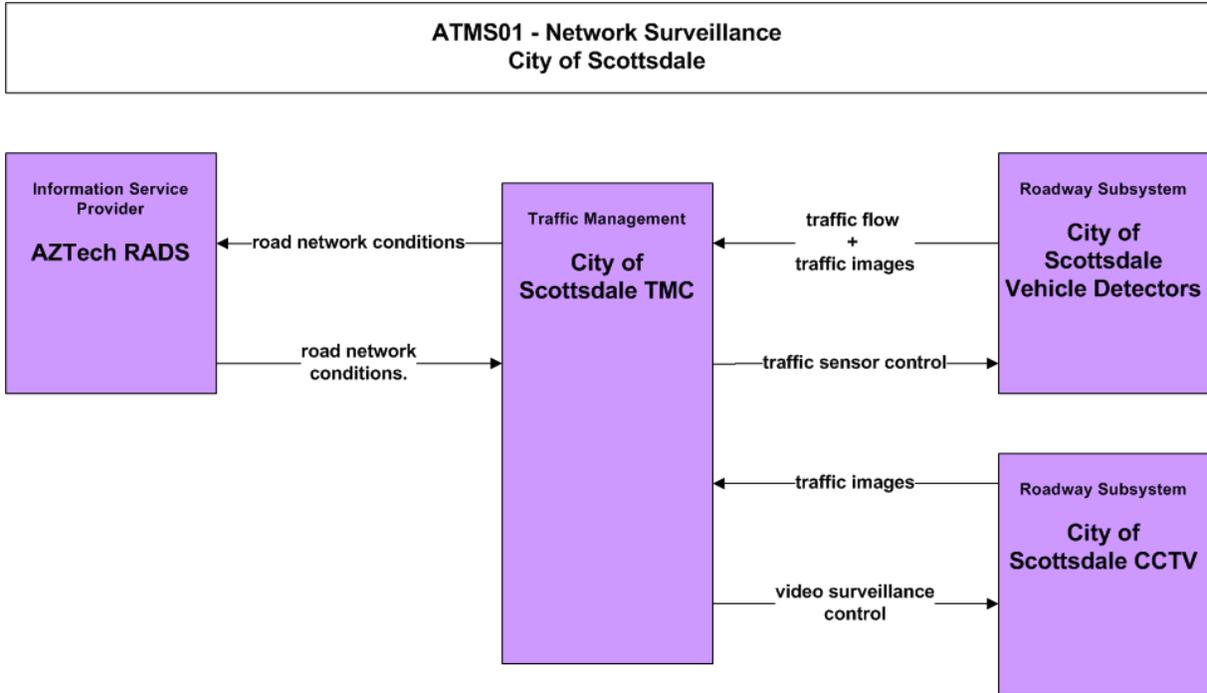


Figure 2 – Customized Market Package for City of Scottsdale

It is important to understand the use of customized market 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 market 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 3**. This showing the AZTech™ system diagram has been used extensively to depict existing and planned relationships utilizing these systems.

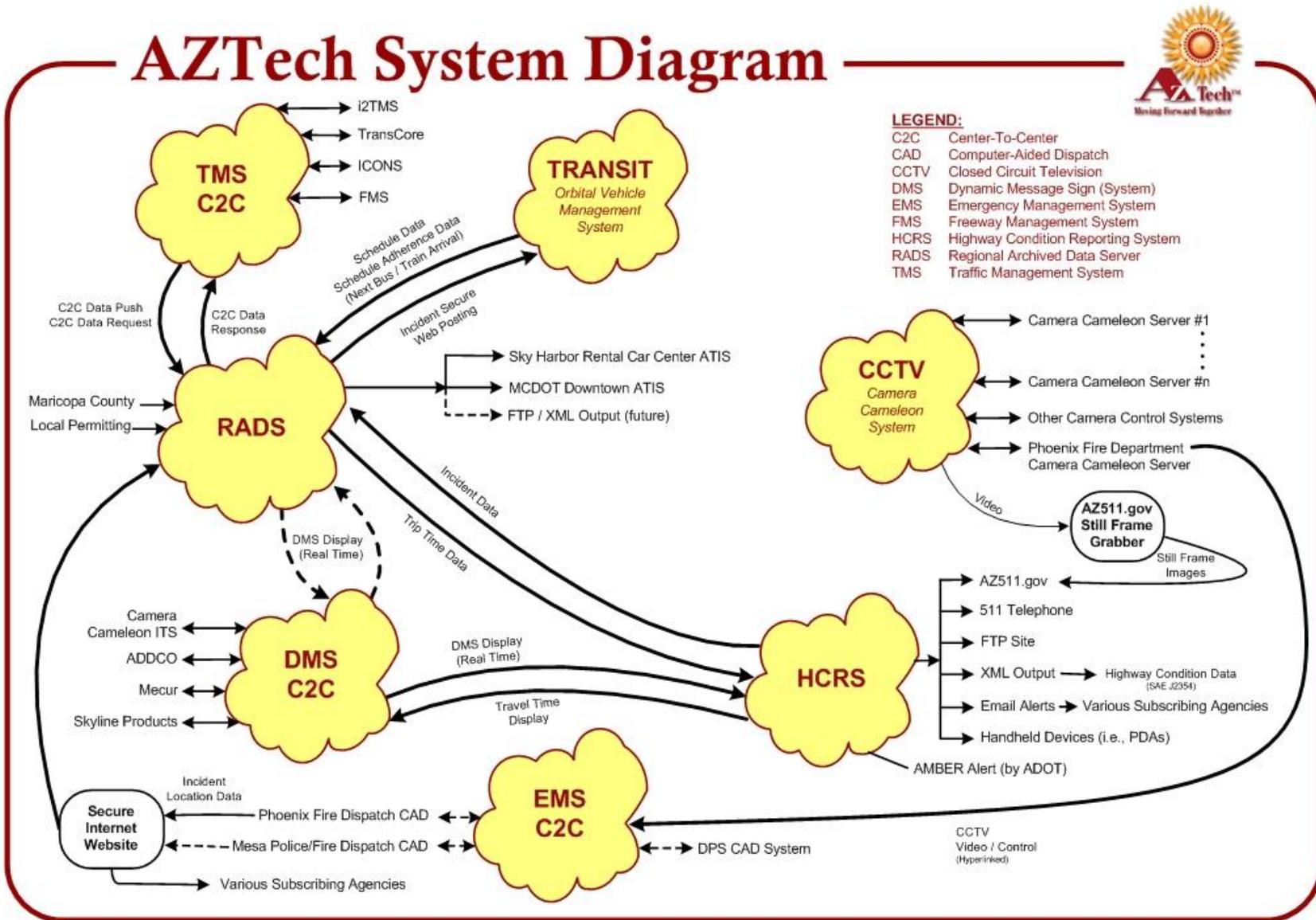


Figure 3 – AZTech™ System Diagram

Not every detailed information flow provided in the Turbo Architecture database is shown in these customized market 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 market 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 market 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 this 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 Queen Creek
- Town of Wickenburg
- Town of Youngtown

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

3. EQUIPMENT PACKAGES

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 market 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 market 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 market package must have in order to be part of that market package to provide that service. In the example described above, ADOT DMS provide traveler information to travelers. That functionality is described in the equipment package “Roadway Traffic Information Dissemination”. That specific subsystem functionality at work with other subsystems working to achieve traveler information dissemination is shown in the market package “ATMS06 – Traffic Information Dissemination.” Multiple subsystems are shown in each market package and thus multiple equipment packages are represented by each market package. The mapping of these equipment packages to their specific market packages and specific inventory elements are provided on the architecture website through a due to the complexity of interconnections.

As market packages are updated throughout the course of this project, equipment packages will be added/removed/updated to be consistent with the market packages. It is important to note that only three of the many equipment packages that apply to this individual market package are shown in **Figure 4** below. This figure is provided to show the relationship of the equipment package to market packages. Equipment packages are linked to the inventory rather than the market packages on the architecture website due to the complex overlaps that occur within the market packages.

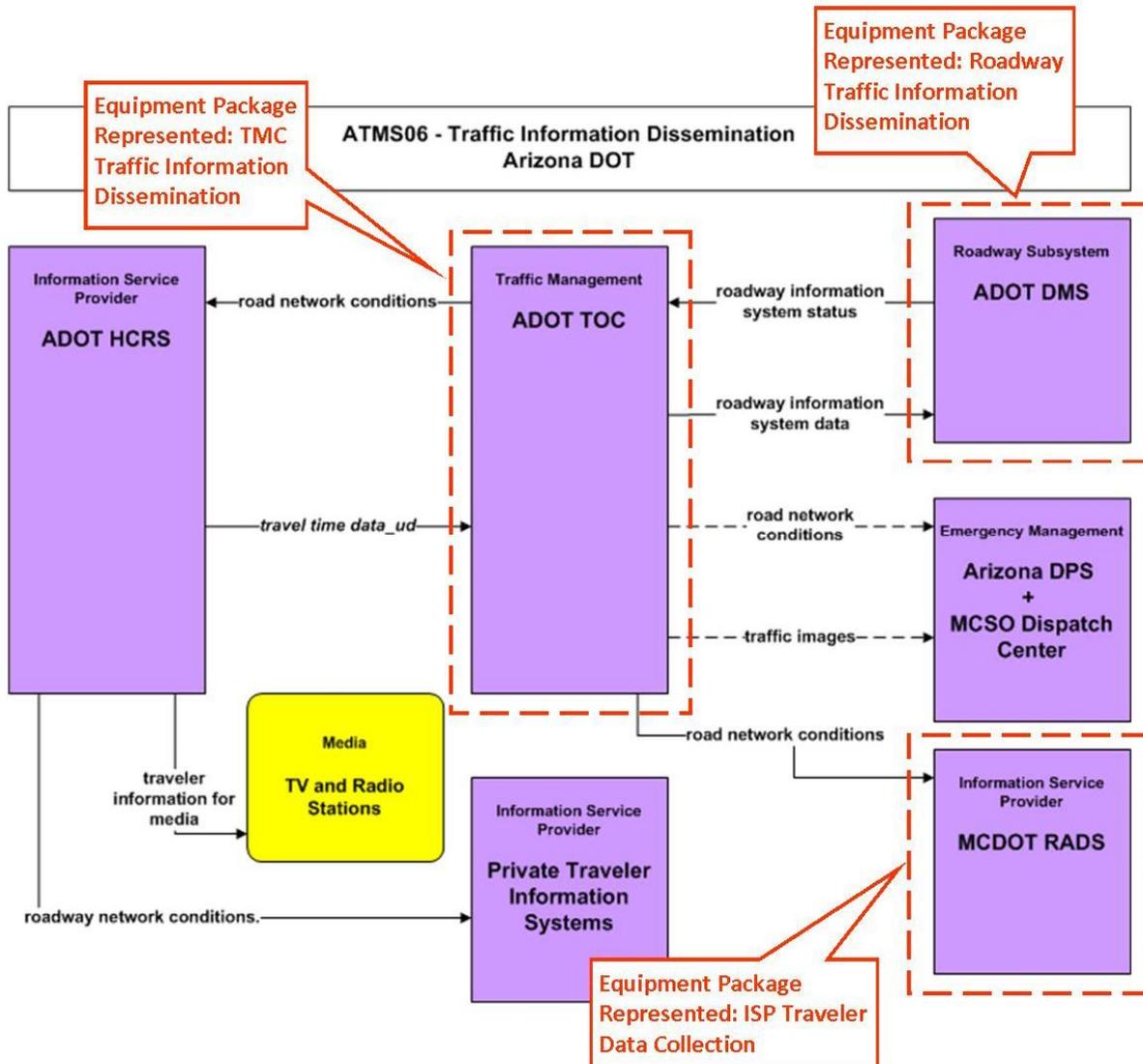


Figure 4 – Link Between Equipment Packages and Market Packages

Equipment packages describe the functionality of each subsystem ultimately through detailed functional requirements which will be discussed in the next task of the process. ITS standards will also be documented in the next task of the architecture process which provide interoperability for the architecture elements to communicate. These standards are produced by the Turbo Architecture database which uses the inventory and market packages in this architecture to develop the list of standards to apply in this region.

APPENDIX A – SELECTED MARKET PACKAGES FROM NATIONAL ITS ARCHITECTURE

Market Package	Market Package Name	Description
Traffic Management Service Area		
ATMS01	Network Surveillance	Includes traffic detectors, CCTV cameras, other surveillance equipment, supporting field equipment and fixed point-to-point communications to transmit the collected data back to a traffic management center.
ATMS02	Traffic Probe Surveillance	Provides an alternative approach for surveillance of the roadway network. Probe vehicles are tracked, and the vehicle's position and speed information are utilized to determine road network conditions such as average speed and congestion conditions.
ATMS03	Surface Street Control	Provides the central control and monitoring equipment, communication links and signal control equipment that support local street and/or arterial traffic management. This market package is consistent with typical urban traffic signal control systems.
ATMS04	Freeway Control	Provides the communications and roadside equipment to support ramp control, lane controls and interchange control for freeways. This market package is consistent with typical urban traffic freeway control systems. Also includes the capability to utilize surveillance information for detection of incidents.
ATMS05	HOV Lane Management	Manages HOV lanes by coordinating freeway ramp meters and connector signals with HOV lane usage signals. Vehicle occupancy detectors may be installed to verify HOV compliance and notify enforcement agencies of violations.
ATMS06	Traffic Information Dissemination	Provides driver information using roadway equipment such as dynamic message signs or highway advisory radio. Information can include traffic and road conditions, closure and detour information, incident information, emergency alerts, disaster traveler information and driver advisories. This package also covers the sharing of traffic information with media, transit, emergency management and other service providers.
ATMS07	Regional Traffic Management	Sharing of traffic information and control among traffic management centers to support a regional management strategy. This package relies principally on roadside instrumentation of each traffic management jurisdiction and provides the communications links and cooperative control strategies that enable integrated interjurisdictional traffic management.
ATMS08	Traffic Incident Management System	Manages both unexpected incidents and planned events so that the impact to the transportation network and traveler safety is minimized. This market package includes incident detection capabilities through roadside surveillance devices as well as notification from other agencies. It supports traffic operations personnel in developing an appropriate response in coordination with emergency management, maintenance and construction management, and other incident response personnel.
ATMS09	Traffic Forecast and Demand Management	Includes advanced algorithms, processing, and mass storage capabilities that support historical evaluation, real-time assessment, and forecasts of the roadway network performance and better link travel time forecasts.
ATMS10	Electronic Toll Collection	Provides toll operators with the ability to collect tolls electronically and detect and process violations. The toll tags and roadside readers that these systems use could also be used to collect road use statistics for highway authorities.
ATMS11	Emissions Monitoring and Management	Monitors individual vehicle emissions and provides general air quality monitoring using distributed sensors to collect the data. The gathered information can be used to implement environmentally sensitive TDM programs, policies, regulations.
ATMS12	Roadside Lighting System Control	Manages electrical lighting systems by monitoring operational conditions and using the lighting controls to vary the amount of light provided along the roadside.



Market Package	Market Package Name	Description
Traffic Management Service Area		
ATMS13	Standard Railroad Grade Crossing	Manages highway traffic at highway-rail intersections (HRIs) where rail operational speeds are less than 80 mph. Passive and active warning signs are supported.
ATMS14	Advanced Railroad Grade Crossing	Manages highway traffic at highway-rail intersections (HRIs) where operational speeds are greater than 80 mph. Augments Standard Railroad Grade Crossing market package with additional safety features to mitigate the risks associated with higher rail speeds.
ATMS15	Railroad Operations Coordination	Provides an additional level of strategic coordination between freight rail operations and traffic management centers. Could include train schedules, maintenance schedules or any other anticipated HRI closures.
ATMS16	Parking Facility Management	Provides enhanced monitoring and management of parking facilities. Market package assists in the management of parking operations, coordinates with transportation authorities, and supports electronic collection of parking fees.
ATMS17	Regional Parking Management	Supports coordination between parking facilities to enable regional parking management strategies.
ATMS18	Reversible Lane Management	Provides for the management of reversible lane facilities and includes the field equipment, physical lane access controls, and associated control electronics.
ATMS19	Speed Monitoring	Monitors the speeds of vehicles traveling through a roadway system. This service can support notification to an enforcement agency to enforce speed limits on a roadway system.
ATMS20	Drawbridge Management	Supports systems that manage drawbridges at rivers and canals and other multimodal crossings. Includes control devices as well as traveler information systems.
ATMS21	Roadway Closure Management	Closes roadways to vehicular traffic when driving conditions are unsafe, maintenance must be performed, or other situations. Market package covers general road closures applications; specific closure systems that are used at railroad grade crossings, drawbridges, reversible lanes, etc. are covered by other market packages.
Emergency Management Service Area		
EM01	Emergency Call-Taking and Dispatch	Provides basic public safety call-taking and dispatch services. Includes emergency vehicle equipment, equipment used to receive and route emergency calls, wireless communications and coordination between emergency management agencies.
EM02	Emergency Routing	Supports automated vehicle location and dynamic routing of emergency vehicles. Traffic information, road conditions and suggested routing information are provided to enhance emergency vehicle routing. Includes signal preemption and priority applications.
EM03	Mayday and Alarms Support	Allows the user to initiate a request for emergency assistance and enables the emergency management subsystem to locate the user, gather information about the incident and determine the appropriate response.
EM04	Roadway Service Patrols	Supports the roadway service patrol vehicles that aid motorists, offering rapid response to minor incidents (flat tire, accidents, out of gas) to minimize disruption to traffic. This market package monitors service patrol vehicle locations and supports vehicle dispatch.
EM05	Transportation Infrastructure Protection	Includes the monitoring of transportation infrastructure (bridges, tunnels and management centers) for potential threats (acts of nature, terrorist attacks, other incidents causing damage to the infrastructure) using sensors, surveillance equipment, barriers and safeguard systems to preclude an incident, control access during and after an incident or mitigate the impact of an incident.
EM06	Wide-Area Alert	Uses ITS driver and traveler information systems to alert the public in emergency situations such as child abductions, severe weather, civil emergencies or other situations that pose a threat to life and property.



Market Package	Market Package Name	Description
Emergency Management Service Area		
EM07	Early Warning System	Monitors and detects potential, looming and actual disasters including natural, technological and man-made disasters. This market package notifies all responding agencies of detected emergencies.
EM08	Disaster Response and Recovery	Enhances the ability of the surface transportation system to respond to and recover from disasters. Supports coordination of emergency response plans including evacuation plans, provides enhanced access to the scene and better information about the transportation system in the vicinity of the disaster, and maintains situation awareness.
EM09	Evacuation and Reentry Management	Supports evacuation of the general public from a disaster area and manages subsequent reentry to the disaster area. This market package supports both anticipated, well-planned and orderly evacuations such as for a hurricane, as well as sudden evacuations with little or no time for preparation or public warning such as a terrorist act. Employs a number of strategies to maximize capacity along an evacuation route including coordination with transit.
EM10	Disaster Traveler Information	Use of ITS to provide disaster-related traveler information to the general public, including evacuation and reentry information and other information concerning the operation of the transportation system during a disaster.
Maintenance and Construction Management Service Area		
MC01	Maintenance and Construction Vehicle and Equipment Tracking	Tracks the location of maintenance and construction vehicles and other equipment to ascertain the progress of their activities. This market package requires on-board tracking devices for maintenance and construction vehicles and a location tracking map to be maintained.
MC02	Maintenance and Construction Vehicle Maintenance	Performs vehicle maintenance scheduling and manages both routine and corrective maintenance activities. Includes on-board sensors capable of automatically performing diagnostics.
MC03	Road Weather Data Collection	Collects current road weather conditions using data collected from environmental sensors deployed on and about the roadway.
MC04	Weather Information Processing and Distribution	Processes and distributes the environmental information collected from the Road Weather Data Collection market package. This market package uses the environmental data to detect environmental hazards such as icy road conditions, high winds, dense fog, etc. to allow system operators can make decisions on corrective actions to take.
MC05	Roadway Automated Treatment	Automatically treats a roadway section based on environmental or atmospheric conditions. Includes the sensors that detect adverse conditions, automated treatment (such as anti-icing chemicals), and driver information systems.
MC06	Winter Maintenance	Supports winter road maintenance. Monitors environmental conditions and weather forecasts and uses the information to schedule winter maintenance activities.
MC07	Roadway Maintenance and Construction	Supports numerous services for scheduled and unscheduled maintenance and construction on a roadway system or right-of-way. Environmental conditions information is also received from various weather sources to aid in scheduling maintenance and construction activities.
MC08	Work Zone Management	Directs activity in work zones, controlling traffic through portable dynamic message signs and informing other groups of activity for better coordination management. Also provides speed and delay information to motorists prior to the work zone.
MC09	Work Zone Safety Monitoring	Includes systems that improve work crew safety and reduce collisions between the motoring public and maintenance and construction vehicles. Detects vehicle intrusions in work zones and warns workers and drivers of safety hazards when encroachment occurs. Contractors should be required to provide work zone safety measures such as police enforcement or monitoring.



Market Package	Market Package Name	Description
Maintenance and Construction Management Service Area		
MC10	Maintenance and Construction Activity Coordination	Supports the dissemination of maintenance and construction activity to centers that can utilize it as part of their operations. (i.e., traffic management, transit, emergency management)
MC11	Environmental Probe Surveillance	Collects data from vehicles in the road network that can be used to directly measure or conclude current environmental conditions.
MC12	Infrastructure Monitoring	Monitors the condition of pavement, bridges, tunnels, associated hardware, and other transportation-related infrastructure using both fixed and vehicle-based infrastructure monitoring sensors. Monitors vehicle probes used to determine current pavement conditions.
Public Transportation Service Area		
APTS01	Transit Vehicle Tracking	Monitors current transit vehicle location using an automated vehicle location system. Location data may be used to determine real time schedule adherence and update the transit system's schedule in real time.
APTS02	Transit Fixed-Route Operations	Performs vehicle routing and scheduling, as well as operator assignment and system monitoring for fixed-route and flexible-route transit services.
APTS03	Demand Response Transit Operations	Performs vehicle routing and scheduling, as well as operator assignment and system monitoring for demand responsive transit services.
APTS04	Transit Fare Collection Management	Manages transit fare collection on-board transit vehicles and at transit stops using electronic means. Allows the use of a traveler card or other electronic payment device.
APTS05	Transit Security	Provides for the physical security of transit passengers and transit vehicle operators. Includes on-board security cameras and panic buttons.
APTS06	Transit Fleet Management	Supports automatic transit maintenance scheduling and monitoring for both routine and corrective maintenance.
APTS07	Multi-Modal Coordination	Establishes two way communications between multiple transit and traffic agencies to improve service coordination.
APTS08	Transit Traveler Information	Provides transit users at transit stops and on board transit vehicles with ready access to transit information. Services include stop annunciation, imminent arrival signs and real-time transit schedule displays. Systems that provide custom transit trip itineraries and other tailored transit information services are also represented by this market package.
APTS09	Transit Signal Priority	Determines the need for transit priority on routes and at certain intersections and requests transit vehicle priority at these locations to improve on-time performance of the transit system.
APTS10	Transit Passenger Counting	Counts the number of passengers entering and exiting a transit vehicle using sensors mounted on the vehicle and communicates the collected passenger data back to the management center.
Commercial Vehicle Operations Service Area		
CVO01	Fleet Administration	Provides the capabilities to manage a fleet of commercial vehicles. Vehicle routing and tracking as well as notification of emergency management of any troublesome route deviations (such as a HAZMAT vehicle) are part of this market package.
CVO02	Freight Administration	Tracks the movement of cargo and monitors the cargo condition. Connection between freight shippers and depots allows tracking from source to destination.
CVO03	Electronic Clearance	Provides for automatic clearance at roadside check facilities. Allows a good driver/vehicle/carrier to pass roadside facilities at highway speeds using transponders and dedicated short range communications to the roadside.
CVO04	CV Administrative Processes	Provides for electronic application, processing, fee collection, issuance and distribution of CVO credentials and tax filing.
CVO05	International Border Electronic Clearance	Provides for automated clearance at international border crossings. Processes entry documentation for vehicle, cargo, and driver, checks compliance with regulations, and reports the results for passing across an international border.

Market Package	Market Package Name	Description
Commercial Vehicle Operations Service Area		
CVO06	Weigh-In-Motion	Provides for high speed weigh-in-motion with or without automated vehicle identification capabilities.
CVO07	Roadside CVO Safety	Provides for automated roadside safety monitoring and reporting. Automates commercial vehicle safety inspections at the roadside check facilities.
CVO08	On-board CVO and Freight Safety and Security	Provides for on-board commercial vehicle safety monitoring and reporting as well as roadside support for reading on-board safety data via tags.
CVO09	CVO Fleet Maintenance	Supports maintenance of CVO fleet vehicles with on-board monitoring equipment and automated vehicle location capabilities.
CVO10	HAZMAT Management	Integrates incident management capabilities with commercial vehicle tracking to support effective treatment of HAZMAT material and incidents.
CVO11	Roadside HAZMAT Security Detection and Mitigation	Provides the capability to detect and classify security sensitive HAZMAT on commercial vehicles using roadside sensing and imaging technology. Credentials information can be accessed to verify if the commercial driver, vehicle and carrier are permitted to transport the identified HAZMAT.
CVO12	CV Driver Security Authentication	Provides the ability for fleet and freight management to detect when an unauthorized commercial vehicle driver attempts to drive a vehicle based on stored identity information. If an unauthorized driver has been detected the commercial vehicle can be disabled.
CVO13	Freight Assignment Tracking	Provides for the planning and tracking of the commercial vehicle, freight equipment and the commercial vehicle driver.
Traveler Information Service Area		
ATIS01	Broadcast Traveler Information	Collects traffic conditions, advisories, general public transportation, toll and parking information, incident information, roadway maintenance and construction information, air quality and weather information, and broadly disseminates this information through existing infrastructures (radio, cell phones, etc.).
ATIS02	Interactive Traveler Information	Provides tailored information in response to a traveler request. The traveler can obtain current information regarding traffic conditions, roadway maintenance and construction, transit services, ride share/ride match, parking management, detours and pricing information. This market package is consistent with phone and web-based traveler information systems.
ATIS03	Autonomous Route Guidance	Using vehicle location and other information, this market package enables route planning and detailed route guidance based on static, stored information.
ATIS04	Dynamic Route Guidance	Offers advanced route planning and guidance that is responsive to current conditions.
ATIS05	ISP Based Trip Planning and Route Guidance	Offers the user pre-trip route planning and en-route guidance services. Routes may be based on static or real time network conditions.
ATIS06	Transportation Operations Data Sharing	Collects, processes, and stores current information on traffic and travel conditions and other information about the current state of the transportation network and makes the information available to transportation system operators.
ATIS07	Yellow Pages and Reservation	Provides yellow pages and reservations services to the user.
ATIS08	Dynamic Ridesharing	Provides dynamic ridesharing/ride matching services to travelers.
ATIS09	In Vehicle Signing	Supports the distribution of traffic and travel advisory information to drivers through in-vehicle devices.
ATIS10	VII Traveler Information	Provides location specific information to travelers in vehicles using Vehicle Infrastructure Integration (VII). These devices use dedicated short range communications to deliver real-time traveler information to vehicles as they pass the VII roadside equipment along their route.



Market Package	Market Package Name	Description
Archived Data Management Service Area		
AD1	ITS Data Mart	Provides a focused archive that houses data collected and owned by a single agency or other organization. Focused archive typically covers a single transportation mode and one jurisdiction.
AD2	ITS Data Warehouse	Includes all the data collection and management capabilities of the ITS Data Mart. Adds the functionality to allow collection of data from multiple agencies and data sources across modal and jurisdictional boundaries.
AD3	ITS Virtual Data Warehouse	Provides the same broad access to multimodal, multidimensional data from varied sources as in the ITS Data Warehouse Market Package, but provides this access using enhanced interoperability between physically distributed ITS archives that are each locally managed.