



MAG Regional ITS Architecture

DRAFT Logical Architecture

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October 29, 2008
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1. INTRODUCTION

1.1 Overview of Technical Memorandum

The purpose of this project is to develop a Regional ITS Architecture for the Maricopa Association of Governments (MAG) Region. An ITS architecture 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 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.

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 is 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 will map 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. 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, and link these to the goals and objectives from Technical Memorandum #1;
- 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.

1.2 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 market 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 *Technical Memorandum #1 – Region Definition and Inventory* describe the services that the agencies would like the traveler to experience and be able to use during their travel. These 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 a traceability from the logical to the physical components.

The two perspectives are shown in **Figure 1** below.

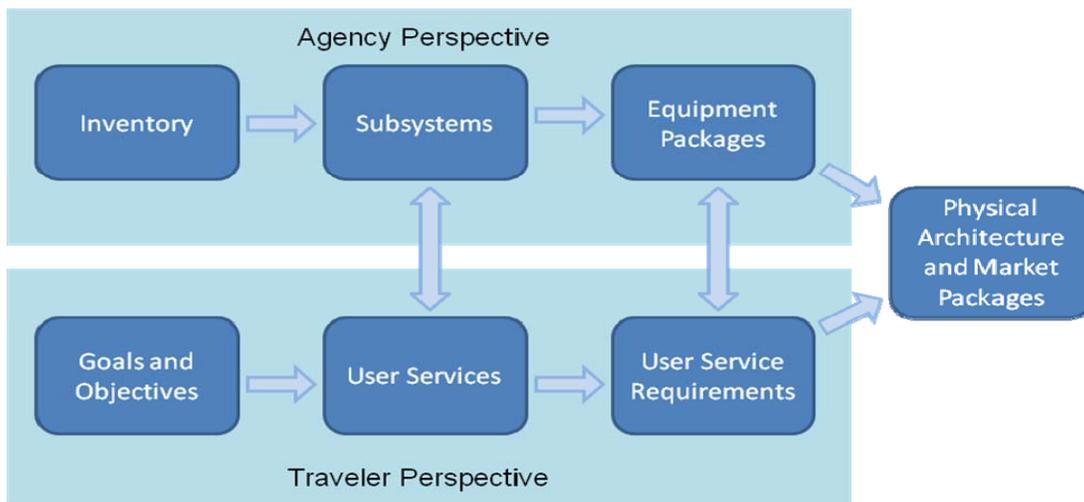


Figure 1 – Logical Architecture Development Process



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 how the Subsystems and User Services, respectively, will be used in the MAG Region.

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.

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. This will be reviewed closely as the physical architecture develops, and if appropriate, updated within this logical architecture if needed.

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 2.2 later in this document.

Table 1 maps the regional transportation goals and objectives as outlined in *Technical Memorandum #1 – Region Definition and Inventory* 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 established in the last task have not been 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 2 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.



		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	
Freeway and Arterial Incident Management	Improve incident detection capabilities and reduce incident clearance times						X	X												X			X	
	Provide PSAP managers with access to real-time traffic information							X													X	X		
	Increase incident information sharing between traffic management and public safety agencies for cooperative freeway and arterial incident management							X														X	X	
	Increase arterial incident response services throughout the Region							X													X	X		
	Improved coordination with transit agencies for incident notification							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)				X				X			X	X		X		X	X						
	Enhanced information at transit centers	X										X		X			X							
	Coordinate roadway closure/construction information with transit agencies							X				X	X	X	X									X
	Establish a mass transit service that will coordinate with agencies and other modal services (regional light rail system)								X			X	X	X				X						
Multi-Agency Coordination	Increase inter-agency and intra-agency coordination						X	X																X
	Coordinate signal systems across jurisdictional boundaries and improve progression						X																	
	Establish center-to-center communications between traffic management agencies in the region		X				X																X	



Operational Category		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
		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
Multi-Agency Coordination	Establish communications between traffic management agencies and public safety agencies in the region					X	X											X		X			
	Collect and store data from implemented transportation systems					X															X		
Traveler Information	Improve accuracy, timeliness, and availability of real-time traveler information to the public	X	X			X	X							X				X				X	
	Increase the use of DMS for more types of traffic and incident information	X	X			X	X															X	
	Make available work zone and incident information to HCRS	X																				X	
	Integrate transit information with traveler information services	X	X											X									



Table 2 – User Services Selected for the MAG Region

#	User Service	Description	MAG Region Application
Travel and Traffic Management			
1.1	Pre-Trip Travel Information	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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, etc.) Agency TMC/TOC TMC information sharing
1.7	Incident Management	<ul style="list-style-type: none"> 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
1.10	Highway Rail Intersection	<ul style="list-style-type: none"> 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	Public Transportation Management	<ul style="list-style-type: none"> 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
2.1a	Transit Operations		
2.1b	Communications Management		
2.2	En-Route Transit Information	<ul style="list-style-type: none"> 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, and on-board systems. Future systems may include next-bus arrival information at stops



Table 2 – User Services Selected for the MAG Region (continued)

#	User Service	Description	MAG Region Application
Public Transportation Management			
2.4	Public Travel Security	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<p>AMBER Alerts</p> <p>Arizona CENS (Reverse 911 System)</p>
5.2	Emergency Vehicle Management	<ul style="list-style-type: none"> 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 	<p>Public safety AVL systems</p> <p>Traffic signal preemption for emergency responders</p> <p>Access to real-time road and traffic conditions information by public safety dispatch centers</p>
5.3	Disaster Response and Evacuation	<ul style="list-style-type: none"> 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, Arizona CENS
Information Management			
7.1	Archived Data	<ul style="list-style-type: none"> 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
Maintenance and Construction Management			
8.1	Maintenance and Construction (MC) Operations	<ul style="list-style-type: none"> 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

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 capable of doing – not each individual archive.

One type of archived data service that is provided in this Region is ADOT’s Highway Condition Reporting System (HCRS). The HCRS receives information from the freeway management system as well as receives information from local agencies regarding the arterial network. There is either a direct link or an indirect link from each agency in the MAG Region to this HCRS data archive system to provide information to it or pull information from it. The information from the HCRS 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 Regional Archived Data Server (RADS) which also collects arterial traffic signal information.

An additional example is shown below:

User Service Bundle: Travel and Traffic Management

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 A**. 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 in the next task.**

3. SUBSYSTEMS

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 (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.

3.1 System Interconnect

The National ITS Architecture provides a comprehensive list of subsystems that are used in general architectures. **Figure 2** 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 2** 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.

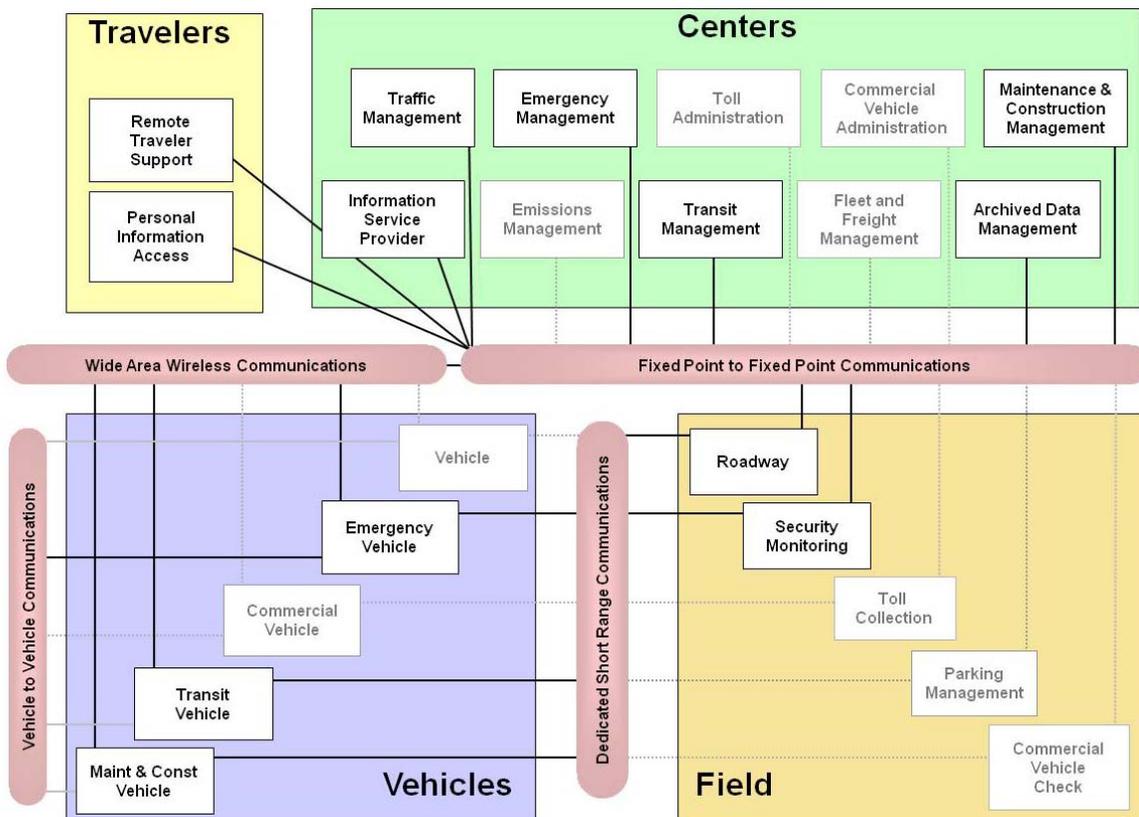


Figure 2 – MAG Region System Interconnect Diagram

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 2.

Subsystems that are applicable to the MAG Region are provided in **Table 3**; these are currently being used in the MAG Region in some capacity. 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.

Table 3 – 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 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) Arizona 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

Table 3 – Subsystems and Equipment Packages for the MAG Region (continued)

Type	Subsystem	Inventory	Equipment Packages
Centers (continued)	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 Freeway Management TMC Incident Detection TMC Incident Dispatch Coordination/Communication TMC Multimodal Coordination TMC Regional Traffic Management TMC Signal Control TMC Speed Monitoring TMC Traffic Information Dissemination 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 3 – 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 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 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. USING THE LOGICAL ARCHITECTURE TO DEVELOP THE PHYSICAL ARCHITECTURE

4.1 Link to the Physical ITS 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 Market Package in the National ITS Architecture. **Figure 3** 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 3 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 “Roadway Signal Controls” which describes in 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 roadway 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 complete “Surface Street Control” functional market package that will be customized for this Region.

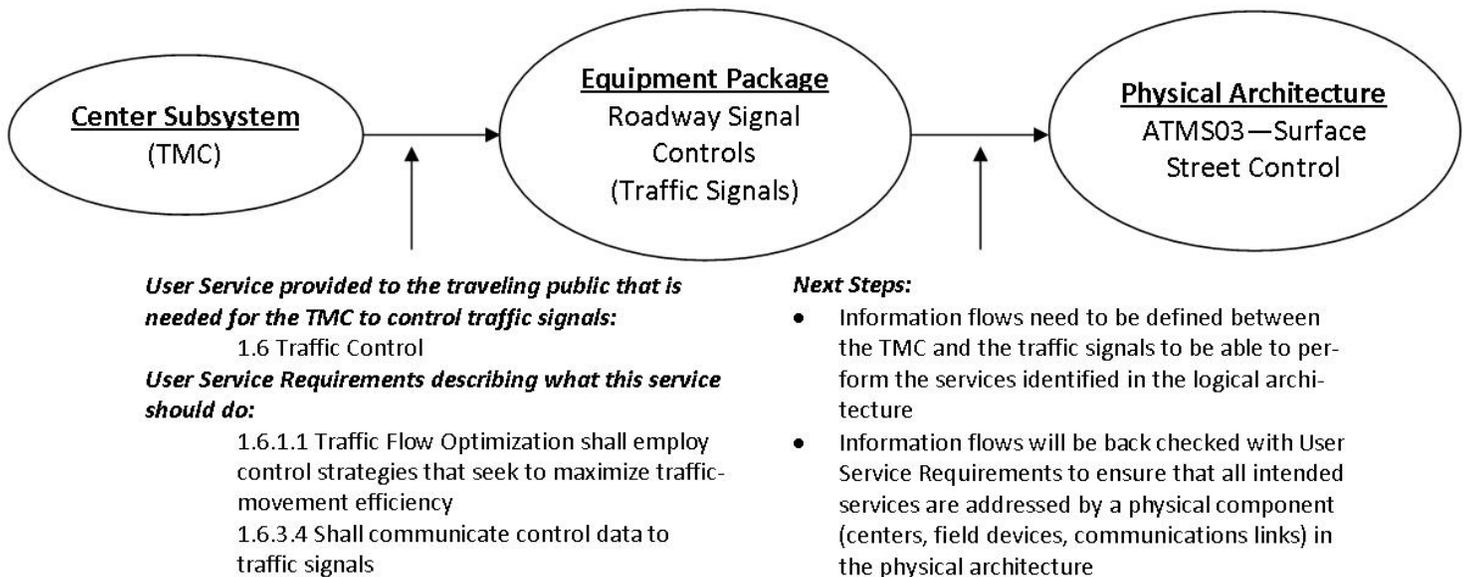


Figure 3 – Link to the Physical ITS Architecture

4.2 Next Steps

Following the logical architecture, the functionality and services provided in this task will be used to provide the detail that is necessary to develop the physical architecture. Equipment Packages and User Service Requirements will be used as a back check the physical ability for services to be performed in the MAG Region. The ITS Architecture and database will be the functional tool that agencies will be able to use in planning for the future of ITS projects/programs in their jurisdictions and in coordination with other jurisdictions.



APPENDIX A – USER SERVICE REQUIREMENTS APPLICABLE TO THE MAG REGION

1.1 *Pre-Trip Travel Information*

- 1.1.0 ITS shall include a Pre-Trip Travel Information (PTTI) capability to assist travelers in making mode choices, travel time estimates, and route decisions prior to trip departure. It consists of three major functions applicable to the MAG Region, which are, (1) Available Services Information, (2) Current Situation Information, (3) Trip Planning Service, and (4) User Access. Information is integrated from various transportation modes and presented to the user for decision making.
- 1.1.1 PTTI shall provide travelers with Available Services Information on travel, for their use.
 - 1.1.1.1 PTTI shall provide users with available services information that is timely.
 - 1.1.1.1.1 PTTI shall provide users the latest available information on transit routes.
 - 1.1.1.1.2 PTTI shall provide users the latest available information on transit schedules.
 - 1.1.1.1.3 PTTI shall provide users with the latest available schedule adherence information.
 - 1.1.1.1.5 PTTI shall provide users the latest available information on transit fares.
 - 1.1.1.1.6 PTTI shall provide users information on accessing ridematching services.
- 1.1.2 PTTI shall provide the capability for users to access the Current Situation Information on transportation systems.
 - 1.1.2.1 PTTI shall provide the latest available information on the current status of transportation services.
 - 1.1.2.1.1 Real-time information provided by PTTI shall include the current condition of any weather related incidents.
 - 1.1.2.1.2 Real-time information provided by PTTI shall include the current status of any accidents or incidents.
 - 1.1.2.1.3 Real-time information provided by PTTI shall include the current condition of any road construction.
 - 1.1.2.1.5 Real-time information provided by PTTI shall include the current speeds on specific routes.
 - 1.1.2.1.7 Real-time information provided by PTTI shall include the schedules for any current or soon to start events.
 - 1.1.2.1.8 Real-time information provided by PTTI shall include the current weather situation.
- 1.1.3 PTTI shall include a Trip Planning Service.
 - 1.1.3.1 PTTI trip planning service shall provide the users with information needed for planning an upcoming trip.
 - 1.1.3.1.1 Based on user specified parameters PTTI shall provide users with a calculated itinerary.
 - 1.1.3.1.2 Based on user specified parameters PTTI shall provide users with transportation mode choices.
 - 1.1.3.1.3 Based on user specified parameters PTTI shall provide users with real-time travel conditions for time of inquiry and estimated conditions for estimated time of travel.
 - 1.1.3.1.4 Based on user specified parameters PTTI shall provide users with one or more alternate itineraries in addition to the primary calculated itinerary.
 - 1.1.3.2 PTTI shall provide the capability for users to specify transportation parameters that are unique to their individual needs.
 - 1.1.3.2.1 PTTI shall provide the capability for users to specify a desired destination.
 - 1.1.3.2.2 PTTI shall provide the capability for users to specify a planned departure location.
 - 1.1.3.2.3 PTTI shall provide the capability for users to specify their desired departure time.



- 1.1.3.2.4 PTTI shall provide the capability for users to specify their desired arrival time.
- 1.1.3.2.5 PTTI shall provide the capability for users to specify their maximum acceptable travel time.
- 1.1.3.2.6 PTTI shall provide the capability for users to specify their maximum acceptable number of mode changes.
- 1.1.3.2.7 PTTI shall provide the capability for users to specify a maximum number of transfers.
- 1.1.3.2.8 PTTI shall provide the capability for users to specify their preferred route(s) or segment of route(s).
- 1.1.3.2.9 PTTI shall provide the capability for users to specify their preferred transportation mode(s).
- 1.1.3.2.10 PTTI shall provide the capability for users to specify their preferred weather conditions.
- 1.1.3.3 In addition to the user specified parameters PTTI shall use additional factors when planning trips.
 - 1.1.3.3.1 PTTI shall consider current travel conditions when calculating a trip itinerary.
- 1.1.4 PTTI shall provide the capability for User Access.
 - 1.1.4.1 PTTI shall provide the capability for users to access the system from multiple distributed locations.
 - 1.1.4.1.1 PTTI shall provide the capability for users to access the system from their homes.
 - 1.1.4.1.2 PTTI shall provide the capability for users to access the system from their place of work.
 - 1.1.4.1.3 PTTI shall provide the capability for users to access the system from major trip generation sites.
 - 1.1.4.1.4 PTTI shall provide the capability for users to access the system from personal portable devices.
 - 1.1.4.2 PTTI shall provide the capability for users to access the system over multiple types of electronic media.
 - 1.1.4.2.1 Access media shall comply with the Americans with Disabilities Act (ADA) legislation.

1.2 En-Route Driver Information

- 1.2.0 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 one major function applicable to the MAG Region which is (1) Driver Advisory. The potential decrease in traffic may also provide benefits in highway safety, reduced air pollution, and decreased congestion.
- 1.2.1 DI shall be implemented in a manner that is beneficial to the transportation system and the public.
 - 1.2.1.1 DI shall be implemented in a manner that helps improve highway safety.
 - 1.2.1.2 DI shall be implemented in a manner that helps reduce air pollution.
 - 1.2.1.3 DI shall be implemented in a manner that helps decrease congestion.
 - 1.2.1.4 DI shall be designed in a manner that permits a two-phase implementation.
 - 1.2.1.4.1 The DI two-phase implementation shall include a short term capability to address those features that can be implemented in the present time frame.
 - 1.2.1.4.2 The DI two-phase implementation shall include a long term capability to address those features that can be implemented when the remainder of the ITS system is deployed.
- 1.2.2 DI shall include a Driver Advisory function, which shall be implemented in two phases with first a short term capability and later a long term capability.
 - 1.2.2.1 The short term DI driver information capability shall include the ability to provide information to travelers within the limited area of deployment.
 - 1.2.2.1.1 DI shall include the capability to provide travelers with accurate information concerning available



- travel options and their state of operational availability.
- 1.2.2.1.2 DI shall provide information to travelers required for them to avoid areas of congestion.
- 1.2.2.1.2.1 DI shall provide information needed for travelers to select transportation modes that allow them to avoid congestion.
- 1.2.2.1.4 In the short-term DI shall be deployed in those limited areas where the need and associated benefits are more immediate.
- 1.2.2.2 The long term DI driver information capability shall include the ability to provide information to travelers within all geographic areas of the ITS deployment.

1.4 Ride Matching and Reservation

- 1.4.0 ITS shall include a Ride Matching and Reservation (RMR) function. Ride Matching and Reservation will provide travel users with information on rideshare providers. Three major functions are provided in the MAG Region, which are, (1) Rider Request, (2) Transportation Provider Services, and (3) Information Processing. This will also include a billing service to the providers.
- 1.4.1 RMR shall include a Rider Request capability.
 - 1.4.1.1 Rider Request shall provide the capability for a traveler to request a ride by placing a single request from a facility to include, but not be limited to, the following:
 - 1.4.1.1(a) Telephones (including hearing-impaired capability).
 - 1.4.1.1(b) Kiosks.
 - 1.4.1.2 Rider Request shall provide a traveler the capability to request a specific itinerary by specifying, but not be limited to, the following:
 - 1.4.1.2(a) Date.
 - 1.4.1.2(b) Time of pick-up and drop-off.
 - 1.4.1.2(c) Origin.
 - 1.4.1.2(d) Destination.
 - 1.4.1.2(e) Specific restrictions or preferences.
 - 1.4.1.3 Rider Request shall provide the traveler with the available ridesharing options, based on the traveler's request and specified itinerary.
 - 1.4.1.4 Rider Request shall also include the capability to perform real-time ridematching by instantly matching rider and driver.
 - 1.4.2 RMR shall include a Transportation Provider Service function.
 - 1.4.2.1 Transportation Provider Services shall include the capability for providers to have their billing arranged through a central clearinghouse.
 - 1.4.2.3 Transportation Provider Services shall automatically generate needed reports and financial documentation.
 - 1.4.3 RMR shall include an Information Processing function.
 - 1.4.3.1 Information Processing shall quickly match preferences and demands of requesting travelers with the services available from providers.
 - 1.4.3.2 Information Processing shall provide a clearinghouse capability for rideshare financial transactions.
 - 1.4.3.3 Information Processing shall link together the services available from all travel modes including, but not limited to, the following:
 - 1.4.3.3(a) Bus.
 - 1.4.3.3(c) Vanpools.
 - 1.4.3.3(d) Express bus.



- 1.4.3.3(f) Specialized service.
- 1.4.3.4 Information Processing shall provide the informational infrastructure to connect providers and consumers.
- 1.4.3.5 Information Processing shall provide the capability to gather market information to assist in the planning of service improvements.
- 1.4.3.6 Information Processing shall provide the capability to gather market information to assist in operations.

1.6 Traffic Control

- 1.6.0 ITS shall include a Traffic Control (TC) function. Traffic Control provides the capability to efficiently manage the movement of traffic on streets and highways. Four functions applicable to the MAG Region are provided, which are, (1) Traffic Flow Optimization, (2) Traffic Surveillance, (3) Control, and (4) Provide Information. This will also include control of network signal systems with eventual integration of freeway control.
- 1.6.1 TC shall include a Traffic Flow Optimization function to provide the capability to optimize traffic flow.
 - 1.6.1.1 Traffic Flow Optimization shall employ control strategies that seek to maximize traffic-movement efficiency.
 - 1.6.1.1.1 Traffic-movement control shall manage movement of traffic on streets.
 - 1.6.1.1.2 Traffic-movement control shall manage movement of traffic on highways.
 - 1.6.1.1.3 Traffic-movement control shall include the goal of minimizing delay times.
 - 1.6.1.1.4 Traffic-movement control shall include the goal of minimizing energy use.
 - 1.6.1.1.5 Traffic-movement control shall include the goal of minimizing air quality impacts due to traffic.
 - 1.6.1.2 Traffic Flow Optimization shall include a wide area optimization capability, to include several jurisdictions.
 - 1.6.1.2.1 Wide area optimization shall integrate the control of network signal systems with the control of freeways.
 - 1.6.1.2.2 Wide area optimization shall include features that provide preferential treatment for transit vehicles.
 - 1.6.1.3 Traffic Flow Optimization shall be implemented in a manner that seeks to optimize traffic movement over a large geographic area.
 - 1.6.1.4 Traffic Flow Optimization shall include a Control function that is responsive to both the current demand as well as the expected demand.
 - 1.6.1.4.1 The Control function shall include the capability to facilitate the dissipation of traffic congestion.
 - 1.6.1.5 Traffic Flow Optimization shall provide the capability to predict travel patterns.
 - 1.6.1.6 The Control function shall include the use of data acquired from traffic surveillance as feedback to the control strategies.
- 1.6.2 TC shall include a Traffic Surveillance function.
 - 1.6.2.1 Traffic Surveillance shall include a vehicle detection function with the capability of accurately detecting vehicles in a real-time fashion.
 - 1.6.2.2 Traffic Surveillance shall include a data collect function to provide the capability to collect data for determining traffic flow and prediction.
 - 1.6.2.2.1 The data collect function shall provide the capability to quickly feedback traffic data to the control processes.
 - 1.6.2.3 Traffic Surveillance shall include a wide-area surveillance capability to include several jurisdictions.
 - 1.6.2.3.1 The wide-area surveillance shall gather speed and flow information.



- 1.6.2.3.2 The wide-area surveillance shall cover a large number of roadway segments.
- 1.6.2.4 TC shall provide the capability to acquire detailed traffic measurements at specific locations.
- 1.6.2.4.1 Traffic Surveillance shall include a data process function to process the traffic data which are acquired.
- 1.6.2.5 The wide area surveillance shall acquire sufficient data to provide the system with the knowledge of the existing conditions.
- 1.6.2.5.1 The data process function shall combine and process traffic data from multiple sources and times in order to improve the accuracy of the view of the current traffic condition.
- 1.6.3 TC shall include a Device Control function.
 - 1.6.3.3 The Device Control function shall provide the capability to exercise control over those devices utilized for traffic control.
 - 1.6.3.3.1 Device Control shall include the capability to control traffic signalization, including rapid modification of signalization parameters to respond to traffic requirements.
 - 1.6.3.3.2 Device Control shall include the capability to dynamically control traffic signing.
 - 1.6.3.4 Device Control shall communicate control data to the following devices.
 - 1.6.3.4(a) Traffic signals.
 - 1.6.3.4(c) Information signs.
 - 1.6.3.4(e) Human operator support.
 - 1.6.3.4.1 Traffic Surveillance shall include a data process function to process the traffic data which are acquired.
 - 1.6.3.5 Device Control shall provide the operator with the capability to manually override the system's automatic controls.
 - 1.6.3.6 Device Control shall provide the operator the capability to adaptively change system response in order to provide a response that is coordinated with other TMCs responding to incidents.
- New Req Device Control shall provide TMCs with the ability to share control of ITS devices including CCTV and DMS according to specified permissions

1.7 Incident Management

- 1.7.0 ITS shall include an Incident Management (IM) function. Incident Management will identify incidents, formulate response actions, and support initiation and ongoing coordination of those response actions. Four major functions applicable to the MAG Region are provided, which are, (1) Incidents Identification, (2) Response Formulation, (3) Response Implementation, and (4) Predict Hazardous Conditions.
- 1.7.1 Incident Management shall provide an Incident Identification function to identify incidents.
 - 1.7.1.2 The Incident Identification function shall include the capability to identify existing (both planned and unplanned) incidents.
 - 1.7.1.2.1 The Incident Identification function shall use information from the following types of sources, where available, to identify existing incidents:
 - 1.7.1.2.1(a) Traffic flow sensors.
 - 1.7.1.2.1(b) Environmental sensors.
 - 1.7.1.2.1(c) Public safety sources.
 - 1.7.1.2.1(d) Media sources.
 - 1.7.1.2.1(e) Weather information sources.
 - 1.7.1.2.1(f) Transportation providers.



- 1.7.1.2.1(g) Travelers.
- 1.7.1.2.2 The Incident Identification function shall determine and continuously monitor at least the following characteristics of each existing incident:
 - 1.7.1.2.2(a) Type (including Terrain Hazards).
 - 1.7.1.2.2(b) Extent.
 - 1.7.1.2.2(c) Severity.
 - 1.7.1.2.2(d) Location.
 - 1.7.1.2.2(e) Expected duration.
- 1.7.1.2.3 The Incident Identification function shall determine and continuously monitor the current and expected traffic flow impact of each existing incident.
- 1.7.2 IM shall provide a Response Formulation function to formulate appropriate response actions to each identified incident and revise those actions when necessary.
 - 1.7.2.2 The Response Formulation function shall propose and facilitate the appropriate dispatch of emergency response vehicles to an incident.
 - 1.7.2.3 The Response Formulation function shall propose and facilitate the appropriate dispatch of service vehicles to an incident.
 - 1.7.2.4 The Response Formulation function shall propose and facilitate the appropriate dissemination of incident related information to travelers and potential travelers.
 - 1.7.2.5 The Response Formulation function shall propose and facilitate the appropriate control of traffic signals and other traffic control to reduce the traffic flow impact of an incident.
- 1.7.3 IM shall include a Response Implementation function to provide the services to implement a response coordinated with all appropriate agencies.
 - 1.7.3.1 The Response Implementation function shall provide at least the following decision support capabilities needed to implement coordinated incident response actions by all participating institutions:
 - 1.7.3.1(a) Response Implementation shall allow coordinated selection/determination of the procedures, including alternate routes, needed for resolution of each incident and provide the procedures to those agencies responding to the incident.
 - 1.7.3.1(b) Response Implementation shall provide the status of all resources needed for incident resolution to those agencies responding to the incident.
 - 1.7.3.2 The Response Implementation function shall provide a link between Incident Management and all other user services necessary to implement incident response actions.
 - 1.7.3.3 The Response Implementation function shall provide the capability to disseminate information relating to response status to other agencies and user services.

1.8 Travel Demand Management

- 1.8.0 ITS shall include a Travel Demand Management (TDM) function. Travel Demand Management will generate and communicate management and control strategies that will support and facilitate the implementation of TDM programs, policies and regulations. It consists of two major functions applicable to the MAG Region, which are, (1) Increase Efficiency of Transportation System and (2) Provide Wide Variety of Mobility Options.
- 1.8.1 TDM shall include a communications function.
 - 1.8.1.1 The communications function shall include the capability to send the information needed to implement management and control strategies that are in response to policies and regulations.
 - 1.8.1.2 The communications function shall include the capability to send information and rates needed to implement management and control strategies that respond to changing environments, conditions, and policy needs to include, but not limited to, the following locations of action:
 - 1.8.1.2(c) Transit centers.



- 1.8.1.2(f) Travel (and traveler) information facilities.
- 1.8.1.2(g) Ridesharing facilities.
- 1.8.1.3 TDM shall provide the capability to receive information and rates needed to implement management and control strategies that respond to changing environments, conditions, and policy needs to include, but not limited to, the following locations of action:
 - 1.8.1.3(c) Transit centers.
 - 1.8.1.3(f) Travel (and traveler) information facilities.
 - 1.8.1.3(g) Ridesharing facilities.
- 1.8.1.4 The communications function shall provide the capability to send information and data as needed to implement management and control strategies that respond to changing environments, conditions, and policy needs to include, but not limited to, the following:
 - 1.8.1.4(a) Sensor data.
 - 1.8.1.4(b) Individual vehicle monitoring.
 - 1.8.1.4(d) Usage data.
- 1.8.1.5 The communications function shall provide the capability to receive information and data from transportation operators and/or users that delineate their:
 - 1.8.1.5(a) Current status.
 - 1.8.1.5(c) Level of activity.
- 1.8.1.6 The communications function shall include the capability for two-way communications with other ITS user services including, but not limited to, the following:
 - 1.8.1.6(a) Pre-Trip Planning.
 - 1.8.1.6(b) En-Route Transit Advisory.
 - 1.8.1.6(c) Driver Information.
 - 1.8.1.6(d) Ride Matching and Reservation.
 - 1.8.1.6(e) Electronic Payment.
- 1.8.2 TDM shall include a processing function.
 - 1.8.2.1 The processing function shall provide the capability to generate management and control strategies that facilitate the implementation of policies and regulations designed to address the following:
 - 1.8.2.1(a) Vehicle trip reduction.
 - 1.8.2.1(d) Ridesharing and transit.
 - 1.8.2.1(f) Public awareness of travel alternatives.
 - 1.8.2.2 The processing function shall provide capabilities to enhance the ability to implement and enforce the following:
 - 1.8.2.2(a) Federal policies.
 - 1.8.2.2(b) State policies.
 - 1.8.2.2(c) Local policies.
 - 1.8.2.3 Strategies developed by the processing function shall include the guidance for the operation of physical systems that:
 - 1.8.2.3(a) Monitor traffic.
 - 1.8.2.3(b) Inform travelers.
 - 1.8.2.3(c) Collect fees.
 - 1.8.2.4 The processing function shall provide the capability generate guidance for the pricing and control for locations of action that include, but are not limited to, the following:
 - 1.8.2.4(c) Transit centers.



- 1.8.2.4(f) Travel information facilities.
- 1.8.2.4(g) Ridesharing facilities.
- 1.8.2.5 The processing function shall provide the capability to develop strategies for implementation of policies and regulations that will accommodate the following:
 - 1.8.2.5(a) Public sector users and service providers.
 - 1.8.2.5(b) Private sector users and service providers.
- 1.8.2.6 The processing function shall provide the capability to generate management and control strategies that dynamically respond to changing environments, conditions, and policies.
- 1.8.2.10 The processing function's dynamically generated management and control strategies shall include the parking management and controls to include, but not be limited to, the following:
 - 1.8.2.10(b) Allocation to selected vehicles.
 - 1.8.2.10(c) Variable message signs.
- 1.8.2.11 The processing function's dynamically generated management and control strategies for parking management and controls shall be based on factors that include, but are not limited to, the following:
 - 1.8.2.11(a) Parking availability.
 - 1.8.2.11(b) Usage data.
- 1.8.2.14 The processing function's dynamically generated management and control strategies shall include the capability to respond to the need for the travelers to change modes by generating messages for variable signs that include, but are not limited to, the following:
 - 1.8.2.14(a) Where the mode change requests are being made.
 - 1.8.2.14(b) How the mode changes are requested to be made.
 - 1.8.2.14(c) Why the mode changes are requested to be made.

1.10 Highway Rail Intersection

- 1.10.0 ITS shall include a Highway-Rail Intersection (HRI) function to control highway and rail traffic in at-grade HRIs. The sub-services supported by this user service applicable to the MAG Region is Standard Speed Rail Subservice which is applicable to light rail transit, commuter rail and heavy rail trains with operational speeds up to 79 miles per hour (MPH).
- 1.10.1 The Highway-Rail Intersection (HRI) function shall be applicable to operational, at-grade highway-rail intersections with train operational speeds up to 125 MPH.
 - 1.10.1.1 HRI users shall include light rail transit and rapid rail transit approaching and crossing HRIs.
 - 1.10.1.3 HRI users shall include freight and intercity passenger trains approaching and crossing HRIs.
 - 1.10.1.4 HRI users shall include highway vehicles approaching and crossing HRIs.
 - 1.10.1.5 HRI users shall include motor vehicle operators, bicyclists and pedestrians approaching and crossing HRIs.
 - 1.10.1.6 HRI users shall include train crews operating rail traffic while approaching and crossing HRIs.
 - 1.10.1.7 HRI users shall include rail maintenance and inspection vehicles approaching and crossing HRIs.
- 1.10.2 HRI shall provide interfaces between highway and rail management functions.
 - 1.10.2.1 HRI shall provide information management interfaces between highway and rail to coordinate traffic, demand and schedules.
 - 1.10.2.1.1 HRI shall be capable of acquiring current train schedules from rail operations functions, and shall determine projected HRI closure times and duration.
 - 1.10.2.1.2 HRI shall be capable of interacting with traffic management functions.
 - 1.10.2.2 HRI shall provide the capability for interactive real-time interfaces.



- 1.10.2.2.1 HRI shall provide the capability to interface with rail operations functions for rail traffic control information.
- 1.10.2.2.2 HRI shall provide the capability to interface with traffic management functions for highway traffic coordination.
- 1.10.2.2.3 HRI shall provide the capability to interface with trains approaching and crossing the HRI for traffic coordination.
- 1.10.2.2.4 HRI shall provide the capability to interface with highway vehicles approaching and crossing HRIs for traffic control information.
- 1.10.3 At all HRIs with active railroad warning systems, HRI shall manage the traffic in the intersection.
 - 1.10.3.1 HRI shall be capable of augmenting the intersection with standard highway traffic signal devices.
 - 1.10.3.3 HRI shall provide an Intelligent Intersection Controller (IIC) function to manage highway and rail traffic in the intersection.
 - 1.10.3.3.1 IIC shall control active highway traffic signal devices at HRIs to manage highway traffic.
 - 1.10.3.3.2 IIC function shall control active railway warning devices, including flashing lights and physical barriers for highway and walkway lanes at HRIs.
 - 1.10.3.3.3 IIC function shall provide an intersection surveillance system to derive the real-time status of traffic in the intersection.
 - 1.10.3.3.4 IIC function shall report real-time HRI equipment status.
 - 1.10.3.3.5 IIC function shall report real-time HRI traffic status as advisories or alerts.
- 1.10.4 HRI shall include a Standard Speed Rail (SSR) Subservice to manage highway and rail traffic at HRIs for rail lines with operational speeds less than 80 MPH.
 - 1.10.4.1 SSR shall include active railroad warning systems at designated HRIs.
 - 1.10.4.2 SSR shall include passive HRIs with non-active warning systems.
 - 1.10.4.2.1 SSR shall augment passive warning signs with additional highway traffic control devices at passive HRIs.

2.1 Public Transportation Management

- 2.1.0 ITS shall include a Public Transportation Management (PTM) function.
- 2.1.1 PTM shall include an Operation of Vehicles and Facilities (OVF) function that provides computer assisted control of the operation of vehicles and their associated facilities.
 - 2.1.1.1 To enable the automation of the vehicle and facilities operations OVF shall provide the capability to gather the needed data to include, but not be limited to, the following:
 - 2.1.1.1(a) Vehicle passenger loading by bus stop and trip segment.
 - 2.1.1.1(b) Bus running times between time points.
 - 2.1.1.1(c) Fare collection by fare category.
 - 2.1.1.1(d) Drive-line operating condition.
 - 2.1.1.1(e) Mileage accumulated by individual buses.
 - 2.1.1.1(f) Real-time vehicle location reports.
 - 2.1.1.2 OVF shall include a Command and Control (CC) capability.
 - 2.1.1.2.1 CC shall provide the capability for real-time Vehicle Command and Control (VCC).
 - 2.1.1.2.1.1 VCC shall provide the capability to compare received information with predetermined operating condition specifications and note any deviations.
 - 2.1.1.2.1.2 VCC shall provide the capability to transmit noted deviations to central control.
 - 2.1.1.2.1.3 VCC shall provide the capability to display any noted deviations.



- 2.1.1.2.1.4 VCC shall provide the capability to automatically issue corrective instructions to the operator including, but not limited to, the following:
 - 2.1.1.2.1.4(a) Route corrections.
 - 2.1.1.2.1.4(b) Changes in stops.
- 2.1.1.2.2 When CC detects a vehicle(s) has deviated from schedule it shall provide the capability to automatically determine the optimum scenario for returning the vehicle or fleet to schedule.
- 2.1.1.2.3 CC shall include an integrated traffic control capability that provides traffic signal preemption when required for schedule adjustment to Transit Vehicles at traffic signals (i.e., centralized or distributed).
- 2.1.1.2.4 CC shall include the capability for its computational capabilities to be located either on-vehicle and/or at remote locations.
- 2.1.2 PTM shall include a Planning and Scheduling Services (PSS) function to automate the planning and scheduling of public transit operations.
 - 2.1.2.1 The PSS shall include a Planning capability.
 - 2.1.2.1.1 PSS Planning shall be performed off-line from stored data that were collected in real-time.
 - 2.1.2.1.2 PSS Planning shall include processing of the data in a manner that will permit improvements in routes and services.
 - 2.1.2.2 The PSS shall include a Schedule Generation capability.
 - 2.1.2.2.1 The PSS Schedule Generation function shall collect data for schedule generation including, but not limited to, the following:
 - 2.1.2.2.1(a) Route segment running-time.
 - 2.1.2.2.1(b) Passenger loading at each stop.
 - 2.1.2.2.1(c) Revenue information.
 - 2.1.2.2.2 The PSS Schedule Generation function shall use the collected data in the automatic or semiautomatic development of transportation system schedules.
 - 2.1.2.2.3 The PSS Schedule Generation function shall provide the capability to print schedules.
 - 2.1.2.2.4 The PSS Schedule Generation function shall provide the capability to disseminate schedules to, but not be limited to, the following:
 - 2.1.2.2.4(a) Kiosks.
 - 2.1.2.2.4(b) Transportation Management Centers.
 - 2.1.2.2.5 The PSS Schedule Generation function shall provide the capability to automatically update the customer service operator system with the most current schedule and schedule adherence information.
 - 2.1.2.2.6 The PSS Schedule Generation function shall provide the capability to generate vehicle schedules (block schedules) and vehicle operator schedules (run schedules).
- 2.1.3 PTM shall include a Personnel Management (PM) function to facilitate the management of operator, and maintenance personnel.
 - 2.1.3.2 PM shall include an Operator Personnel Management (OPM) function.
 - 2.1.3.2.1 OPM shall automatically generate assignments of individual vehicle operators to runs produced by the Schedule Generation function.
 - 2.1.3.2.2 OPM shall assign vehicle operators to runs in a fair manner while minimizing labor and overtime costs.
 - 2.1.3.2.5 OPM shall provide the capability for authentication of vehicle operators prior to operating a transit bus or rail vehicle.
 - 2.1.3.2.6 OPM shall provide an exception handling capability to provide for replacement vehicle operators in the event of operator unavailability due to operator absence, vehicle incident, or vehicle mechanical problem.
- 2.1.4 PTM shall include a Communications function.



- 2.1.4.1 PTM Communications shall provide the capability to establish two-way voice communication between vehicle operators and the central facility.
- 2.1.4.2 PTM Communications shall provide the capability for two-way data communications between individual vehicles and the control facility (e.g., sensor data and bus position).
- 2.1.4.3 OVF Communications shall provide the capability to send information from individual facilities to a central facility for processing and analysis.
- 2.1.4.4 As support for responding to the detection of an on-board emergency, the OVF Communications shall provide dispatchers with the capability to inform the following:
 - 2.1.4.4(a) Police.
 - 2.1.4.4(b) Fire department.
 - 2.1.4.4(c) Paramedic.
 - 2.1.4.4(d) Vehicle operator (initiation of silent or audible alarm notification).
- 2.1.4.5 PTM shall use an open vehicle communication network standard for all on-board electronic equipment.
- 2.1.5 PTM shall include a Vehicle Management (VM) function to facilitate the management of Public Transit Vehicles (PTVs).
 - 2.1.5.1 VM shall include a Maintenance Vehicle Management (MVM) function.
 - 2.1.5.1.1 MVM shall automatically track vehicle miles on each vehicle in real-time.
 - 2.1.5.1.2 MVM shall use vehicle mileage data to automatically generate preventative maintenance schedules for each specific vehicle.
 - 2.1.5.1.3 MVM shall automatically generate maintenance and repair schedules based on other significant maintenance indicator data, including vehicle operator notations of fault conditions.
 - 2.1.5.1.4 MVM shall provide the capability to record and verify that maintenance work was performed.
 - 2.1.5.2 VM shall include an Operational Vehicle Management (OVM) function.
 - 2.1.5.2.1 OVM shall automatically generate assignments of individual vehicles to blocks produced by the Schedule Generation function.
 - 2.1.5.2.2 Vehicles shall be assigned to blocks based on available inventory, suitability to provide the service required by the block, and operational in-service status.
 - 2.1.5.2.3 OVM shall provide a dispatch control function to initialize vehicles and vehicle operators for the start of the operating day, control exit and return to transit facility, and maintain real-time awareness of returning vehicles approach to transit facility.
 - 2.1.5.2.4 OVM shall provide an exception handling capability to provide recovery from vehicle incidents or mechanical problems.
 - 2.1.5.2.5 OVM shall provide a vehicle inventory management function.



2.2 *En-Route Transit Information*

- 2.2.0 ITS shall include an En-Route Transit Information (TI) function. En-Route Transit Information provides travelers with real-time transit and high-occupancy vehicle information allowing travel alternatives to be chosen once the traveler is en-route. It consists of three major functions applicable to the MAG Region, which are, (1) Information Distribution, (2) Information Receipt, and (3) Information Processing. This capability integrates information from different transit modes and presents it to travelers for decision making.
- 2.2.1 TI shall include an Information Distribution function that disseminates information to travelers.
 - 2.2.1.1 Information Distribution shall include an Information Network capability.
 - 2.2.1.1.1 The Information Network shall provide the capability to furnish users with real-time travel related information while they are traveling.
 - 2.2.1.1.2 The Information Network shall provide the capability to disseminate information to travelers that will assist them in making decisions about transfers.
 - 2.2.1.1.3 The Information Network shall provide the capability to disseminate information to travelers that will assist them in making decisions in the modification (includes both intermode and intramode) of their trips.
 - 2.2.1.1.4 The Information Network shall provide all users with information that is from a single source in order to ensure consistency across all users.
 - 2.2.1.2 Information Distribution shall include a User Interface feature.
 - 2.2.1.2.1 User Interface shall provide the capability for users to access travel related information at fixed locations.
 - 2.2.1.2.1.1 Fixed location user interfaces shall be provided at transit stops.
 - 2.2.1.2.1.1.1 Transit stop user interfaces shall have interactive visual displays.
 - 2.2.1.2.1.1.2 Transit stop user interfaces shall provide audio messages containing the following:
 - 2.2.1.2.1.1.2(a) Notification of imminent transit arrival.
 - 2.2.1.2.1.1.2(b) Identification of route of arriving transit vehicles.
 - 2.2.1.2.1.1.3 Transit stop user interfaces shall provide the capability to provide information to individuals who are physically impaired.
 - 2.2.1.2.2 User Interface shall provide the capability for users to access travel related information at mobile locations.
 - 2.2.1.2.2.1 Mobile Location user interfaces shall provide the capability for users, either one passenger at a time or to a group environment, to access travel related information while on board transit vehicles.
 - 2.2.1.2.2.2 Mobile user interfaces shall provide the capability for users to access travel related information while in transit vehicles through the use of variable message signs.
 - 2.2.1.2.2.3 Mobile user interfaces shall provide the capability for users to access travel related information via personal portable devices.
 - 2.2.1.2.2.4 Mobile user interfaces shall include the capability to provide audible messages to the on-board users.
- 2.2.2 TI shall include an Information Receipt function for acquiring that data that are used for generation of the En-Route Transit Information.
 - 2.2.2.1 Information Receipt shall provide the capability to be continuously updated with real-time information from each transit system within the local area of jurisdiction.
 - 2.2.2.2 Information Receipt shall provide the capability to be updated with information that is inclusive of all possible transportation modes within the local area of jurisdiction.
 - 2.2.2.3 Information Receipt shall provide the capability to be updated with information from all providers of transportation services in the local area of jurisdiction to include:
 - 2.2.2.3(a) Regional paratransit services.



- 2.2.2.3(b) Public providers.
- 2.2.2.3(c) Private providers.
- 2.2.3 TI shall include an Information Processing function for processing that data used for generation of the En-Route Transit Information.
 - 2.2.3.1 Information Processing shall include an information collection feature.
 - 2.2.3.1.1 Information collection shall acquire transit operations information to include, but not be limited to, the following type:
 - 2.2.3.1.1(a) Schedule.
 - 2.2.3.1.1(b) Actual service provided.
 - 2.2.3.1.1(c) Next available vehicle, based on actual operating conditions.
 - 2.2.3.1.1(d) Transfer options describing available services and their associated schedules.
 - 2.2.3.1.2 Information collection shall acquire transit situation conditions to include, but not be limited to, the following type:
 - 2.2.3.1.2(a) Actual road data.
 - 2.2.3.1.2(b) Traffic data.
 - 2.2.3.2 Information Processing shall include an information integration feature.
 - 2.2.3.2.1 Information integration shall collect data, store it and maintain it on-line.
 - 2.2.3.2.2 Information integration shall collect data from traffic and transit systems including, but not limited to, the following:
 - 2.2.3.2.2(a) Transit systems.
 - 2.2.3.2.2(b) Traffic management services.
 - 2.2.3.2.2(c) Rideshare programs.

2.4 Public Travel Security

- 2.4.0 ITS shall include a Public Travel Security (PTS) function to create an environment of safety in public transportation, including bus transit systems and passenger rail systems.
- 2.4.1 PTS shall include specific Secure Areas.
 - 2.4.1.1 The Secure Areas shall encompass all physical areas related to public transit travel including the following:
 - 2.4.1.1(a) Transit (bus and rail) stop areas, including Bus Rapid Transit stops.
 - 2.4.1.1(b) Transit (bus and rail) stations.
 - 2.4.1.1(c) Park and Ride areas.
 - 2.4.1.1(d) Riding on transit vehicles (bus and rail cars).
 - 2.4.1.1(f) Transit transfer locations.
 - 2.4.1.1(g) Transit facilities (e.g. transit yards and shops).
 - 2.4.1.2 All public Secure Areas shall have traveler activated alarms monitored by central dispatch or local police.
 - 2.4.1.3 There shall be silently activated alarms and/or audible alarms on board public transit vehicles which are capable of activation by the operator, monitored by central dispatch or local police.
- 2.4.2 PTS shall include a Security Sensors (SS) function.
 - 2.4.2.1 SS shall provide sensor technology required to alert operators and police of potential incidents.
 - 2.4.2.2 SS shall include video and audio systems at key locations, including rest areas, transit stops and stations, and transit facilities (i.e., transit yards and shops), to monitor activities, incidents, and potential threats. These systems and sensors shall be monitored by central dispatch.



- 2.4.2.4 SS shall include systems on board the public transit vehicle (bus, rail car) for video, audio (including covert microphones that can be triggered by the transit vehicle operator), and event recorder (i.e., "black box") outputs to monitor activities, incidents, and potential threats. These systems and sensors shall be monitored by central dispatch.
- 2.4.2.10 SS shall include sharing of sensor information with appropriate security agencies or systems to assist in analysis of possible threats.
- 2.4.2.11 SS shall include notification of appropriate security agencies or systems regarding potential threats.
- 2.4.3 PTS shall include a Personal Sensors Items (PSI) function.
 - 2.4.3.2 PSI shall provide the capability for riders to use electronic payment to eliminate the need for passengers to carry cash and to reduce cash handling.
- 2.4.4 PTS shall include a Security Management and Control (SMC) function.
 - 2.4.4.1 SMC shall provide the capability to receive alarm information through electronic communication systems.
 - 2.4.4.3 SMC shall include the capability for transit operators to direct and control fleet operations in a manner that supports law enforcement and emergency response agencies with flexible and responsive transportation for large numbers of people.
 - 2.4.4.4 SMC shall include the capability to generate coordinated preplanned responses for incidents.
 - 2.4.4.5 SMC shall include the capability to support coordinated multiple agency responses to incidents.
 - 2.4.4.6 SMC shall include the capability to remotely disable a transit vehicle (bus or transit rail).
 - 2.4.4.7 SMC shall include the capability to identify when a transit vehicle has deviated from its assigned route.

3.1 Electronic Payment Services

- 3.1.0 ITS shall include an Electronic Payment capability. Electronic Payment Services allows travelers to pay for transportation services by electronic means. Two functions are applicable to the MAG Region and are provided by this user service, which are, (2) Electronic Fare Collection and (4) Electronic Payment Services Integration.
- 3.1.2 Electronic Payment shall include an Electronic Fare Collection (EFC) capability.
 - 3.1.2.1 EFC shall be implemented in a manner that the traveler is able to use a compatible fare medium for all applicable surface transportation services.
 - 3.1.2.2 EFC shall provide the capability to implement variable and flexible fare structures.
 - 3.1.2.3 EFC shall be capable of identifying voided and/or invalid payment media.
 - 3.1.2.4 EFC shall provide the capability for third party payment of transportation services.
 - 3.1.2.5 For those systems requiring special eligibility, EFC shall provide the capability to verify the eligibility of riders.
 - 3.1.2.6 EFC shall be implemented in a manner that permits expansion into other uses for the payment medium such as payment of retail, telephone, etc.
 - 3.1.2.7 EFC shall include the capability to collect the data required to determine accurate ridership levels.
 - 3.1.2.8 EFC shall provide the capability for passengers to pay fares without stopping.
- 3.1.4 ITS shall include an Electronic Payment Services Integration (EPSI) feature.
 - 3.1.4.1 EPSI shall provide the capability to combine electronic payments made for use of various transportation modes into a single integrated system.
 - 3.1.4.3 EPSI shall collect and provide usage data to develop pricing strategies that favor certain transportation modes or routes.
 - 3.1.4.4 EPSI shall be implemented in a manner that ensures that it may be deployed across multiple



agency political boundaries without degrading the services it provides.

5.1 *Emergency Notification and Personal Security*

- 5.1.0 ITS shall include an Emergency Notification and Personal Security (ENPS) function in the MAG Region that provides for automated notification when travelers are involved in an incident and security in remote areas frequented by travelers and of critical transportation infrastructure. This section is in relation to transit capabilities as well as area wide alerts such as AMBER Alerts and public information dissemination regarding mass evacuations or threats.
- 5.1.1 ENPS shall include a Driver and Personal Security (DPS) function.
 - 5.1.1.1 DPS shall include an in-vehicle manually initiated distress signal capability to provide a first-alert that an incident has occurred to include the following:
 - 5.1.1.1(a) Medical services required.
 - 5.1.1.1(b) Minor property damage only crashes.
 - 5.1.1.1(c) Breakdowns.
 - 5.1.1.1(d) Vehicle location.
 - 5.1.1.1(e) Vehicle identification.
 - 5.1.1.2 DPS shall include the capability to cancel a previously issued manual request for help.
 - 5.1.1.3 DPS shall include the capability to send an acknowledge signal to the motorist to indicate that the signal was received and help is on the way.
- 5.1.3 ENPS shall include a Remote Security and Emergency Monitoring (RSEM) function to create an environment of safety in secure areas.
 - 5.1.3.1 RSEM shall include specific Secure Areas.
 - 5.1.3.1.1 The Secure Areas shall encompass physical areas related to travel including but not limited to the following: critical infrastructure (such as bridges, tunnels, interchanges, management centers, etc.), rest stops and picnic areas, park-and-ride areas, tourism and travel information areas and emergency pull off areas.
 - 5.1.3.2 RSEM shall include a Surveillance and Sensors (SS) function.
 - 5.1.3.2.1 SS shall provide surveillance and sensor technology and the data processing required to alert operators and appropriate agencies of potential incidents and threats at the Secure Areas.
 - 5.1.3.2.1.1 SS shall include both video and audio surveillance systems at key locations in the Secure Area to monitor activities.
 - 5.1.3.2.1.2 SS shall provide sensors that may include, but are not limited to acoustic, environmental threat (such as nuclear, biological, chemical, and explosives), infrastructure condition and integrity, motion and object sensors.
 - 5.1.3.2.2 SS shall allow operators to monitor and control operation of surveillance and sensor devices including operator override.
 - 5.1.3.4 RSEM shall include a Monitor Alert Levels (MAL) function.
 - 5.1.3.4.1 MAL shall monitor alert levels and threat information provided by federal, state, and local emergency management and public safety agencies.
 - 5.1.3.4.2 MAL shall assess risk based on current activities and conditions.
 - 5.1.3.4.3 MAL shall increase system preparedness as the likelihood of an incident increases, including:
 - 5.1.3.4.3(a) Activating physical security systems and implementing security procedures
 - 5.1.3.4.3(b) Adjusting parameters of surveillance and sensor devices.
 - 5.1.4 ENPS shall include a Wide Area Alert (WAA) function to notify the public in emergency situations using ITS driver information and traveler information capabilities.
 - 5.1.4.1 WAA shall notify transportation operators and information providers when an emergency situation



- occurs that requires public notification.
- 5.1.4.1.1 The WAA notification shall identify the originator, the nature of the emergency, the geographic area affected by the emergency, the effective time period, and information and instructions necessary for the public to respond to the alert.
 - 5.1.4.1.2 The WAA shall provide necessary information for emergencies including, but not limited to, child abductions, severe weather watches and warnings, military activities, civil emergencies, other natural and human-caused disaster advisories, and law enforcement warnings.
 - 5.1.4.2 WAA shall use available dynamic message signs, highway advisory radio, 511 and other telephone information systems, traveler information web sites, transit vehicle information systems, message display boards, and other information systems to provide the WAA information to the public.
 - 5.1.4.2.1 WAA shall tailor the information provided for individual driver and traveler information systems, limiting messages to short notifications for human-factors limited devices like dynamic message signs.
 - 5.1.4.3 WAA shall keep the WAA initiator apprised of the current status of public notification, including an accounting of the driver and traveler information resources that are being utilized.
 - 5.1.4.4 WAA shall notify transportation operators and information providers when public notification is no longer required.
 - 5.1.5 ENPS shall include a Protect Sensitive Traveler Information (PSTI) function to inhibit distribution of traveler information that is deemed to be sensitive.
 - 5.1.5.1 PSTI shall notify transportation operators and information providers when access to information from ITS surveillance and sensor systems must be restricted.
 - 5.1.5.2 The PSTI notification shall identify the geographic area, time, specific devices, and/or other information necessary to determine the traveler information that must be protected.
 - 5.1.5.3 PSTI shall restrict access to traveler information for the affected area until access restrictions are removed.
 - 5.1.5.4 PSTI shall notify transportation operators and information providers when traveler information access restrictions are removed.

5.2 Emergency Vehicle Management

- 5.2.0 ITS shall include an Emergency Vehicle Management (EVM) Service.
 - 5.2.1 EVM Service shall include an Emergency Vehicle Fleet Management System.
 - 5.2.1.1 Emergency Vehicle Fleet Management System shall maintain the availability status of relevant emergency vehicles.
 - 5.2.1.2 Emergency Vehicle Fleet Management System shall determine the emergency response vehicles best suited to respond to an incident.
 - 5.2.1.3 Emergency Vehicle Fleet Management System shall dispatch the appropriate emergency response vehicle (s) to the incident.
 - 5.2.2 EVM Service shall include a Route Guidance System.
 - 5.2.2.1 Route Guidance System shall maintain real-time information on traffic conditions in urban and rural areas, emergency response vehicle locations, and emergency response vehicle destinations.
 - 5.2.2.2 Route Guidance System shall advise emergency response vehicles of appropriate routes.
- 5.2.3 EVM Service shall include a Signal Priority System.
 - 5.2.3.1 Signal Priority System shall maintain real-time information on signal timing, emergency vehicle locations and emergency vehicle routing.
 - 5.2.3.2 Signal Priority System shall determine signal prioritize timing sequences for relevant signals.



5.3 *Disaster Response and Evacuation*

- 5.3.0 ITS shall provide a Disaster Response and Evacuation (DRE) function that provides for effective, coordinated management of the surface transportation system during all types of disasters including natural disasters (hurricanes, earthquakes, floods, severe winter storms, tsunamis, etc.), terrorist acts, and other catastrophic events (e.g., nuclear power plant disasters). Two primary subservices that are provided by this user service and are applicable to the MAG Region include: (1) Disaster Response and (2) Evacuation Coordination. The Disaster Response Subservice provides support for planning, transportation management, resource sharing, and information coordination between transportation agencies and principal responding agencies (emergency management, public safety, and other allied agencies) to improve the effectiveness and safety of a disaster response. The Evacuation Coordination (EC) Subservice efficiently manages an evacuation and provides evacuees with the information they need during evacuation and subsequent reentry to the evacuated area.
- 5.3.1 Disaster Response shall provide a Coordinate Response Plans (CRP) function to support dissemination and coordination of emergency response plans, continuity of operations plans, and other emergency plans between agencies in preparation for a potential future disaster.
- 5.3.2 Disaster Response shall provide a Monitor Alert Levels (MAL) function.
- 5.3.2.1 MAL shall monitor alert levels and threat information provided by federal, state, and local agencies to include the Homeland Security Advisory System (HSAS) and related systems for terrorist alerts, the weather forecasts, watches, and warnings issued by the National Hurricane Center, other National Weather Service components and other weather service providers, and the various early warning systems operated by federal, state, and local emergency management agencies.
- 5.3.2.2 MAL shall increase system preparedness as the alert level or the likelihood of a disaster increases, taking actions including:
- 5.3.2.2(a) Activating physical security systems and implementing security procedures,
- 5.3.2.2(b) Pre-staging activities
- 5.3.2.2(c) Review and update resource inventories
- 5.3.2.2(d) Stage resources
- 5.3.2.2(e) Assign personnel
- 5.3.2.2(f) Clear obstructions
- 5.3.2.2(g) Implement traffic management strategies and traffic control plans
- 5.3.3 Disaster Response shall provide a Detect and Verify Emergency (DVE) function that provides initial emergency situation information to all allied agencies.
- 5.3.3.1 DVE shall use available sensors, weather information, and field reports to detect potential emergencies.
- 5.3.3.2 DVE shall verify the emergency and collect available information to include location, nature of the emergency, nature and extent of the damage, nature and extent of the impact area, and potential hazards.
- 5.3.3.3 DVE shall notify emergency management, public safety, and other allied response agencies and provide available information about the emergency situation.
- 5.3.3.4 DVE shall alert transportation agencies to disasters that have been identified by other agencies
- 5.3.3.5 DVE shall alert transportation agencies of safe reentry conditions following a disaster.
- 5.3.5 Disaster Response shall include a Manage Area Transportation (MAT) function that manages the transportation system in the vicinity of the disaster. Depending on the nature of the disaster and the status of the infrastructure, the following actions may be taken.



- 5.3.5.1 Detours or alternative transportation resources, including transit systems, shall be identified to mitigate the transportation impacts of the disaster.
- 5.3.5.2 Closures and detours shall be implemented. Closures may exclude all vehicles except for emergency vehicles or other special vehicles.
- 5.3.5.3 Transit and transit fare schedules shall be modified.
- 5.3.5.4 Special traffic control strategies to manage traffic in the vicinity of the disaster shall be implemented to limit and/or manage traffic in the area to include signal timing modifications and special traffic signal modes used in conjunction with personnel manually directing traffic.
- 5.3.5.5 Special traffic management strategies shall be implemented in surrounding areas to support efficient movement of personnel and resources into the disaster area.
- 5.3.6 Disaster Response shall include a Critical Service Restoration function that will coordinate with allied agencies to restore critical transportation and utility services.
 - 5.3.6.1 Emergency construction and maintenance shall be planned, coordinated, and initiated to restore critical transportation infrastructure.
 - 5.3.6.2 Emergency access to right-of-way, permits, and needed equipment and resources shall be coordinated as necessary to support restoration of other critical public works.
- 5.3.7 Disaster Response shall include a Coordinate Response (CR) function to coordinate the disaster response between transportation, public safety, emergency management, and other allied agencies. Information may be shared with individual agency centers, emergency operations centers, and unified command systems at the scene.
 - 5.3.7.1 CR shall provide information about the transportation system including:
 - 5.3.7.1(a) Egress and ingress routes for the scene and staging areas.
 - 5.3.7.1(b) Transportation system condition information including video surveillance information as appropriate
 - 5.3.7.1(c) Traffic management strategies in effect, including closures, detours, tolls, and HOV restrictions.
 - 5.3.7.1(d) Routes for specific origins and destinations on request
 - 5.3.7.2 CR shall provide information on transportation resources and personnel that are available, en-route, or deployed at the scene. Transportation resources include construction and maintenance equipment used at the scene and transit vehicles that may be used to move emergency response personnel to and from the scene.
 - 5.3.7.3 CR shall receive information from emergency operations centers and other emergency management systems including:
 - 5.3.7.3(a) Current situation information
 - 5.3.7.3(b) Requests for resources
 - 5.3.7.3(c) Requests for transportation information, including video surveillance
 - 5.3.7.3(d) Requests for ingress and egress routes
 - 5.3.7.3(e) Requests for special traffic management strategies, including detours and closures, and HOV restrictions lifted.
- 5.3.8 Disaster Response shall include a Disaster Traveler Information (DTI) function that will coordinate with public information offices of the principal responding agencies in providing traveler information for the disaster scene and surrounding area to include:
 - 5.3.8(a) Special traffic restrictions,
 - 5.3.8(b) Detours and closures,



- 5.3.8(c) Special transit schedules,
- 5.3.8(d) Traffic conditions at and around the scene.
- 5.3.8(e) Special traffic allowances (HOV restrictions lifted, shoulder use, reverse lane operation).
- 5.3.9 Evacuation Coordination shall provide an Evacuation Planning Support (EPS) function.
 - 5.3.9.1 EPS shall provide archived evacuation data such as traffic flows, travel speed, vehicle occupancy, road closures, network geometry, traveler behavior, travel origins, travel destinations and evacuation traffic management strategies.
 - 5.3.9.4 EPS shall assist in defining the required resources for evacuation strategies.
 - 5.3.9.5 EPS shall avoid simultaneous work zones on parallel routes in case evacuation without warning is required
- 5.3.10 Evacuation Coordination shall include an Evacuation Traveler Information (ETI) function.
 - 5.3.10.1 ETI shall be accessible to users from multiple distributed locations, including, but not limited to:
 - 5.3.10.1(a) homes,
 - 5.3.10.1(b) public buildings,
 - 5.3.10.1(d) rest areas,
 - 5.3.10.1(g) airports and other mode terminals, and
 - 5.3.10.1(h) wireless devices (in-vehicle and handheld).
 - 5.3.10.2 ETI shall identify mandatory and voluntary evacuation zones and any special evacuation requirements for each zone.
 - 5.3.10.3 ETI shall provide a list of alternative evacuation destinations.
 - 5.3.10.5 ETI shall provide recommended evacuation and reentry route(s) based on:
 - 5.3.10.5(a) Real-time and forecast traffic and road conditions.
 - 5.3.10.5(b) Traveler-specified route parameters.
 - 5.3.10.6 ETI shall provide the recommended evacuation start time for a selected evacuation origin and destination based on:
 - 5.3.10.6(a) The travel time required for the trip.
 - 5.3.10.6(b) The capability of the evacuation network to handle evacuation demand based on current and future network conditions.
 - 5.3.10.6(c) The existing and forecast conditions at the evacuation origin and destination.
 - 5.3.10.7 ETI shall identify reentry times for those jurisdictions that have cleared an area for reentry.
 - 5.3.10.8 ETI shall provide road and traffic conditions on evacuation routes including:
 - 5.3.10.8(a) Current and forecast speed and travel times
 - 5.3.10.8(b) Incident information
 - 5.3.10.8(c) Current and forecast road, bridge and lane closure information.
 - 5.3.10.8(d) Advisories of hazardous conditions such as flooding, malfunctioning traffic signals, debris and falling objects.
 - 5.3.10.8(e) Current and forecast weather information
 - 5.3.10.9 ETI shall provide information for transportation modes including buses, airlines, trains, ferries, and ships Including:



- 5.3.10.9(a) The availability of transportation mode services.
- 5.3.10.9(b) Arrival and departure information for available transportation services.
- 5.3.10.10 ETI shall provide general evacuation guidance information to travelers, including guidance/tips for trip preparation, trip duration and trip return.
- 5.3.10.11 ETI shall provide information regarding traveler services available along evacuation routes and at evacuation destinations including:
 - 5.3.11 Evacuation Coordination shall provide an Evacuation Transportation Management (ETM) function to assist evacuation coordination personnel as they manage evacuation operations.
 - 5.3.11.1 ETM shall have a real-time data collection process to assist in the selection of evacuation strategies and to monitor the operations of the selected evacuation strategies.
 - 5.3.11.2 ETM shall have a demand forecasting function that takes into consideration current traffic flows, current and historical evacuation trends, the size of the area to be evacuated and expected human responses.
 - 5.3.11.3 ETM shall include a strategy selection function that maximizes efficiency during evacuation and reentry operations and supports the overall response plan of the principal responding agencies.
 - 5.3.11.3.1 The strategy shall integrate the control of freeways and surface streets.
 - 5.3.11.3.2 The strategy shall consider traffic movement over the entire evacuation network.
 - 5.3.11.3.3 The strategy shall be responsive to current demand as well as the forecast demand.
 - 5.3.11.3.4 The strategy shall optimize the movement of emergency, public safety, and other vehicles associated with the disaster response and evacuation.
 - 5.3.11.3.5 The strategy shall consider the operation of the access to and from the evacuation routes.
 - 5.3.11.3.6 The strategy shall consider the impacts to local traffic along evacuation routes.
 - 5.3.11.3.7 The strategy shall consider the time available for evacuation, time required for evacuation and time required for implementing the evacuation strategy.
 - 5.3.11.3.8 The strategy shall consider the availability of the resources required for the evacuation strategy.
 - 5.3.11.3.9 The strategy shall consider the severity of the expected disaster and the size of the area affected by the disaster.
 - 5.3.11.3.10 The strategy shall consider the use of transit and school bus fleets during mandatory evacuations.
 - 5.3.11.3.11 The strategy shall consider current maintenance and construction activities and their impact on evacuation route capacity.
 - 5.3.11.4 ETM shall provide the control of devices as required by the evacuation management plan, including:
 - 5.3.11.4(a) traffic signals,
 - 5.3.11.4(b) dynamic message signs,
 - 5.3.11.4(c) ramp meters,
 - 5.3.11.4(f) road closure devices,
 - 5.3.11.4(g) lane closure devices,
 - 5.3.11.4(h) HAR,
 - 5.3.11.5 ETM shall provide the operator with the capability to manually override the system automatic control.



- 5.3.11.6 ETM shall manage incidents on evacuation routes.
- 5.3.11.7 ETM shall discontinue current work zone activities on evacuation routes where possible.
- 5.3.11.8 ETM shall manage the evacuation of special needs populations including matching transit resources with locations/individuals, planning evacuation routes, and managing the special needs evacuation.
- 5.3.11.9 ETM shall have the capability to eliminate transit fares.
- 5.3.11.10 ETM shall have a lane reversal management function.
- 5.3.11.10.1 It shall be possible to collect real-time data for traffic moving in all traveling lanes, with and without lane reversal.
- 5.3.11.11 ETM shall have the capability to monitor the location and status of transit vehicles participating in evacuation operations.
- 5.3.11.12 ETM shall implement special traffic control strategies including traffic diversions and closures if emergency termination of an in-process evacuation is required.
- 5.3.12 Evacuation Coordination shall provide a Resource Sharing (RS) Function that allows information and resource sharing between agencies involved in the evacuation including transportation, emergency management, law enforcement and other emergency service agencies.
 - 5.3.12.1 RS shall allow information sharing between agencies at local, state, multi-state, and federal levels, covering all jurisdictions affected by the evacuation
 - 5.3.12.1.1 RS shall provide information sharing capabilities among transportation agencies and between these agencies and the emergency management, public safety, and other allied response agencies.
 - 5.3.12.1.2 RS shall provide information to assist evacuation management personnel in making decisions including traffic management and shelter operations.
 - 5.3.12.2 RS shall assist evacuation management personnel in making decisions regarding deployment of resources and sharing of resources based on existing and forecast demand for these resources.
 - 5.3.12.2.1 RS shall identify the resources required for the current and forecast evacuation scenarios.
 - 5.3.12.2.2 RS shall identify the resources required to implement alternative evacuation management strategies.
 - 5.3.12.2.3 RS shall identify the resource deployment stages, in time and space, for each evacuation scenario.
 - 5.3.12.2.4 RS shall assist local, state, multi-state, and federal agencies in sharing resources between agencies.

7.1 Archived Data

- 7.1.0 ITS shall provide an Archived Data function to control the archiving and distribution of ITS data. The Archived Data User Service provides the Historical Data Archive Repositories and controls the archiving functionality for all ITS data with five major functions applicable to the MAG Region: 1) the Operational Data Control function to manage operations data integrity; 2) the Data Import and Verification function to acquire historical data from the Operational Data Control function; 3) the Automatic Data Historical Archive function for permanently archiving the data; 4) the Data Warehouse Distribution function, which integrates the planning, safety, operations, and research communities into ITS and processes data products for these communities; and 5) the ITS Community Interface which provides the ITS common interface to all ITS users for data products specification and retrieval. ADUS helps achieve the ITS information goal of unambiguous interchange and reuse of data and information throughout all functional areas.
- 7.1.1 The Archived Data function shall provide a Historical Data Archive (HDA) system for ITS data.



- 7.1.1.1 HDA shall include repositories of operational data received from field equipment or data collection devices.
- 7.1.1.2 HDA shall provide permanent historical data repositories.
- 7.1.1.3 HDA repositories shall include meta data and meta-attributes repositories.
- 7.1.1.4 HDA shall provide ITS data system security.
 - 7.1.1.4.1 HDA shall be capable of employing security solutions.
 - 7.1.1.4.2 HDA shall be capable of preventing data loss.
 - 7.1.1.4.3 HDA shall be capable of preventing unauthorized access to ITS data repositories
 - 7.1.1.4.4 HDA shall be capable of providing a secure interface for online support of the ITS user interface.
- 7.1.1.5 HDA shall be capable of supporting online analytical functions to enable users to analyze data across multiple sources or acquire data for their off-line applications.
- 7.1.2 The Archived Data function shall include an Operational Data Control (ODC) function to ensure integrity of operational data as received from field equipment or data collection devices.
 - 7.1.2.1 ODC shall be capable of receiving and storing all ITS operational data, as received from the source.
 - 7.1.2.1.1 ODC shall ensure ITS operational data are in proper format.
 - 7.1.2.1.3 ODC shall be capable of assigning the following meta attributes, when available, to ITS operational data during the archive process.
 - 7.1.2.1.3(a) The equipment used to collect the data.
 - 7.1.2.1.3(b) The conditions under which the data were collected.
 - 7.1.2.1.3(c) The status of the equipment at the time of collection.
 - 7.1.2.1.4 ODC shall be capable of applying user-defined quality control verification on ITS data and annotating results in the appropriate meta files.
 - 7.1.2.1.5 ODC shall be capable of assigning meta-attributes to the data indicating the methods used to perform:
 - 7.1.2.1.5(a) summarization and aggregation
 - 7.1.2.1.5(b) transformations (i.e., reconstructing original data or constructing new data elements)
 - 7.1.2.2 ODC shall be capable of collecting user-selected data.
 - 7.1.2.3 ODC shall be capable of archiving, in data repositories, ITS operational data as received from field equipment or data collection devices.
 - 7.1.2.4 ODC shall be capable of maintaining the integrity of all received operational data.
 - 7.1.2.5 ODC shall be capable of disseminating data replicates to ITS operational users in real-time.
 - 7.1.2.6 ODC shall be capable of performing data fusion on replicated data for operational users in near real-time.
- 7.1.3 The Archived Data function shall include a Data Import and Verification (DIV) function to acquire historical data from the Operational Data Control function.
 - 7.1.3.1 DIV shall be capable of importing selected ITS Operational data from the ITS Operational Repositories.
 - 7.1.3.1.1 DIV shall be capable of importing ITS Freeway Operations data to include:
 - 7.1.3.1.1(a) Freeway traffic flow surveillance data.
 - 7.1.3.1.1(c) Ramp meter operational data.
 - 7.1.3.1.1(d) Freeway visual and video surveillance data.
 - 7.1.3.1.1(e) Traffic Management Center generated freeway flow metrics.
 - 7.1.3.1.3 DIV shall be capable of importing ITS Arterial data to include:
 - 7.1.3.1.3(a) Traffic signal preemptions.



- 7.1.3.1.3(b) Traffic signal operational data.
- 7.1.3.1.3(c) Arterial visual and video surveillance data.
- 7.1.3.1.3(d) Traffic Management Center generated arterial flow metrics.
- 7.1.3.1.3(e) Arterial traffic flow surveillance data.
- 7.1.3.1.4 DIV shall be capable of importing ITS Transit and Ridesharing data to include:
 - 7.1.3.1.4(a) Transit usage data.
 - 7.1.3.1.4(b) Transit route data including schedule deviations.
 - 7.1.3.1.4(c) Rideshare requests.
 - 7.1.3.1.4(d) Multimodal Origin/Destination.
 - 7.1.3.1.4(e) Fares
 - 7.1.3.1.4(f) Vehicle maintenance
 - 7.1.3.1.4(g) Personnel management data
- 7.1.3.1.5 DIV shall be capable of importing ITS Incident Management data to include:
 - 7.1.3.1.5(a) Incident characteristics.
 - 7.1.3.1.5(c) Emergency vehicle dispatch data.
 - 7.1.3.1.5(d) Emergency vehicle location data.
 - 7.1.3.1.5(e) Construction and work zone identification.
 - 7.1.3.1.5(f) Emergency request data
 - 7.1.3.1.5(g) Video surveillance data
 - 7.1.3.1.5(h) Emergency response
- 7.1.3.1.7 DIV shall be capable of importing ITS Environmental data to include:
 - 7.1.3.1.7(a) Emission data.
 - 7.1.3.1.7(b) Weather data.
- 7.1.3.1.8 DIV shall be capable of importing ITS Vehicle and Traveler data to include:
 - 7.1.3.1.8(a) Commercial and non-commercial vehicle probe data.
 - 7.1.3.1.8(b) DMS message set data.
 - 7.1.3.1.8(f) Origin/destination trip data.
 - 7.1.3.1.8(g) Service requests
 - 7.1.3.1.8(h) Information utilization
- 7.1.3.1.9 DIV shall be capable of importing data on ITS Physical Characteristics of Transportation Infrastructure to include:
 - 7.1.3.1.9(a) Roadway network attributes.
 - 7.1.3.1.9(b) Transit network attributes.
 - 7.1.3.1.9(c) Equipment maintenance status
 - 7.1.3.1.9(d) Transportation facilities.
 - 7.1.3.1.9(e) GIS map of network.
 - 7.1.3.1.9(f) Infrastructure maintenance data
- 7.1.3.2 DIV shall be capable of accepting pre-defined data inputs from transportation or other sources.
- 7.1.3.3 DIV shall be capable of applying pre-defined quality control verification on the imported ITS data and annotating results in the appropriate meta files.
- 7.1.3.4 DIV shall be capable of formatting the data to conform to the archive schema.
- 7.1.3.5 DIV shall be capable of cleansing imported data



- 7.1.3.5.1 Cleansing shall include the removal of source privacy attributes.
- 7.1.3.5.2 Cleansing shall be capable of assigning unique system-developed anonymous identifiers to data during archiving.
- 7.1.3.6 DIV shall be capable of performing pre-defined data mining functions to import data.
- 7.1.3.7 DIV shall be capable of performing pre-defined data fusion on imported data near real-time.
- 7.1.3.8 DIV shall be capable of assigning meta attributes to ITS operational data if data modification is required during the historical archive process.
- 7.1.3.9 DIV shall be capable of notifying source system owners of potential data or equipment errors.
- 7.1.4 The Archived Data function shall provide the Automatic Data Historical Archive (ADHA) function for permanently archiving the data.
 - 7.1.4.1 ADHA shall provide an archive schema for all ITS data entering the archives.
 - 7.1.4.1.2 ADHA shall strip all identifiers of individual citizens or private firms from all data before archiving.
 - 7.1.4.1.3 ADHA shall be capable of assigning unique system-developed anonymous identifiers to data during archiving.
 - 7.1.4.2 ADHA shall manage the ITS historical data archiving processes for all functional areas as follows:
 - 7.1.4.2(a) Format data to archive schema conformance.
 - 7.1.4.2(b) Maintain a centralized meta schema to specify how data is archived.
 - 7.1.4.2(c) Maintain data quality meta attributes.
 - 7.1.4.2(d) Schedule archiving of data.
 - 7.1.4.3 ADHA shall permanently store historical archives and only provide data replicates to users.
 - 7.1.4.4 ADHA shall be capable of supporting user-specified data archiving procedures as follows:
 - 7.1.4.4(a) When specified by a user, archive operational data as received in the user's storage files.
 - 7.1.4.4(b) When specified by a user, archive edited data in the User's storage files.
 - 7.1.4.4(c) When specified by a user, perform pre-defined data fusion before archiving in User's storage files.
 - 7.1.4.5 ADHA shall be capable of assigning meta attributes to ITS operational data if data modification is required during the historical archive process.
 - 7.1.5 The Archived Data function shall provide a Data Warehouse Distribution (DWD) function as the ITS data source to support the ITS community user functions.
 - 7.1.5.1 DWD shall be capable of supporting the generation of data products for transportation agencies.
 - 7.1.5.2 DWD shall include a User Data Products (UDP) function.
 - 7.1.5.2.1 UDP shall provide an online analytical functionality to generate pre-defined data products for ITS users, to include:
 - 7.1.5.2.1(a) Reports
 - 7.1.5.2.1(b) Analyses
 - 7.1.5.2.1(c) Aggregations or summaries.
 - 7.1.5.2.1(d) User defined archiving of data concepts.
 - 7.1.5.2.2 UDP shall be capable of recreating ITS operational data formats from the historical archives.
 - 7.1.5.2.3 UDP shall be capable of providing user defined data mining functions on ITS data sources.
 - 7.1.5.2.4 UDP shall be capable of performing user defined data fusion functions on data extracted from ITS Archives.
 - 7.1.5.3 DWD shall have the single point of administration for the archived data system.
 - 7.1.6 The Archived Data function shall provide users with an ITS Community Interface (ICI) including all ITS users for the specification and retrieval of data products.



- 7.1.6.1 ICI shall be the common data interface for all ITS users to access the ITS Data Archives.
- 7.1.6.1.1 ICI shall provide users' systems with the data interface functionality.
- 7.1.6.2 ICI shall manage user access and security across the interface.
- 7.1.6.2.1 ICI shall be capable of cleansing data to remove source privacy attributes before archiving data.
- 7.1.6.2.2 ICI shall be capable of cleansing data to remove source privacy attributes before exporting data to users.
- 7.1.6.3 ICI shall provide a user-interface functionality to existing data warehouse data schema for users to define their data products.
- 7.1.6.3.1 The user-interface shall permit users to define access to multiple databases as data sources for their data products.
- 7.1.6.3.2 The user-interface shall permit users to select online analytical functions to produce their data products.
- 7.1.6.3.3 The user-interface shall permit the user to view sample data products.
- 7.1.6.4 ICI shall provide the user interface for ITS Transportation Agencies.

8.1 Maintenance and Construction Operations

- 8.1.0 ITS shall provide Maintenance and Construction Operations (MCO) functions to support monitoring, operating, maintaining, improving and managing the physical condition of roadways, the associated infrastructure equipment, and the required resources. MCO shall focus on four major functions applicable to the MAG Region: 1) the Maintenance Vehicle Fleet Management function, to monitor and track locations and conditions of fleets of maintenance, construction, and specialized service vehicles; 2) the Roadway Management function, to monitor and forecast conditions and manage treatment of roadways during various travel conditions; 3) the Work Zone Management and Safety function, to support effective and efficient roadway operations during work zone activities; and 4) the Roadway Maintenance Conditions and Work Plan Dissemination function, to coordinate work plans and to communicate conditions. This User Service will utilize ITS systems and processes to support interchange of information among diverse groups of users, to improve efficiency and effectiveness of operational, maintenance, and managerial activities.
- 8.1.1 Maintenance and Construction Operations shall provide a Maintenance Vehicle Fleet Management (MVFM) function to schedule and dispatch, monitor and track location, and monitor operational condition and maintenance requirements of public and contracted fleets of maintenance, construction, and specialized service vehicles. This function includes interactions among Traffic Managers, Supervisors, Dispatchers, Field Crews, Construction Crews, Vehicle Maintenance Crews, Equipment Maintenance Crews, Weather Services Organizations, and Information Service Providers.
 - 8.1.1.1 MVFM shall be capable of monitoring and tracking the locations of public and contracted fleets of maintenance, construction, and specialized service vehicles to provide current location and status information.
 - 8.1.1.1.1 MVFM shall be capable of monitoring and tracking the locations of fleets of maintenance, construction, and specialized service vehicles, including but not limited to:
 - 8.1.1.1.1(a) Roadway maintenance trucks
 - 8.1.1.1.1(b) Other motorized roadway maintenance equipment
 - 8.1.1.1.1(c) Roadway construction trucks
 - 8.1.1.1.1(d) Other motorized roadway construction equipment
 - 8.1.1.1.1(e) Roadway service patrols
 - 8.1.1.1.1(h) Bucket trucks
 - 8.1.1.1.1(i) Vegetation Control and Grass cutting equipment
 - 8.1.1.1.1(j) Traffic control vehicles



- 8.1.1.1.1(k) Street and drainage cleaning vehicles
- 8.1.1.1.2 MVFM shall be capable of monitoring information regarding fleets of maintenance, construction, and specialized service vehicles, including but not limited to:
 - 8.1.1.1.2(a) Location
 - 8.1.1.1.2(b) Speed
- 8.1.1.2 MVFM shall be capable of supporting route scheduling and dispatching of public and contracted fleets of maintenance, construction, and specialized service vehicles.
- 8.1.1.3 MVFM shall be capable of supporting interactive data communications between dispatchers and operators of public and contracted maintenance, construction, and specialized service vehicles.
 - 8.1.1.3.1 MVFM shall be capable of communicating information to vehicle operators, including but not limited to:
 - 8.1.1.3.1(a) Routing information
 - 8.1.1.3.1(b) Scheduling data
 - 8.1.1.3.1(c) Dispatch instructions
 - 8.1.1.3.1(d) Corrective actions
 - 8.1.1.3.1(e) Environmental information (road and weather conditions)
 - 8.1.1.3.2 MVFM shall be capable of communicating information from vehicle operators, including but not limited to:
 - 8.1.1.3.2(a) Work data
 - 8.1.1.3.2(b) Operator status
 - 8.1.1.3.2(c) Crew status
 - 8.1.1.3.2(d) Equipment status
- 8.1.1.4 MVFM shall be capable of using on-board vehicle sensors to monitor the vehicle diagnostics and operating conditions of public and contracted fleets of maintenance, construction, and specialized service vehicles.
 - 8.1.1.4.1 MVFM shall be capable of collecting information on the operating conditions of vehicles.
- 8.1.1.6 MVFM shall be capable of providing dispatchers and operators of maintenance, construction, and specialized service vehicles with information regarding potential and actual roadway problems.
 - 8.1.1.6.1 MVFM shall provide information to dispatchers and vehicle operators, including but not limited to:
 - 8.1.1.6.1(a) Congestion
 - 8.1.1.6.1(b) Incidents
 - 8.1.1.6.1(c) Roadway restrictions
 - 8.1.1.6.1(d) Environmental conditions
 - 8.1.1.6.5 MVFM shall provide information to the vehicle operators concerning roadway problem spots and alternate routes because of potential or actual roadway problems.
 - 8.1.1.6.6 MVFM shall support transmission of fleet operations data to other Operations centers.
 - 8.1.1.6.7 MVFM shall support transmission of fleet operations data to archives.
 - 8.1.1.6.8 MVFM shall support the comparison of incident data with scheduled fleet activities.
- 8.1.1.7 MVFM shall be capable of communicating status information to other maintenance, construction or specialized service vehicles.
- 8.1.2 Maintenance and Construction Operations shall provide a Roadway Management (RWM) function to monitor traffic, road surface, and environmental conditions and forecast traffic and road surface conditions to support management of routine and hazardous road condition remediation and to communicate changes in conditions. This function includes interactions among Traffic Managers, Supervisors, Dispatchers, Field Crews, Construction Crews, Asset Managers, Planning Agencies, and Weather Services Organizations.
 - 8.1.2.1 RWM shall support a number of different services, including but not limited to:



- 8.1.2.1(b) Hazard removal (removing trash, animals, etc.)
- 8.1.2.1(c) Emergency activities (incident response, planning, alternate routing, etc.)
- 8.1.2.1(d) Routine maintenance activities (cleaning, cutting, etc.)
- 8.1.2.1(e) Repair activities
- 8.1.2.2 RWM shall support provision of efficient and effective roadway operations during normal and severe weather or adverse travel conditions.
- 8.1.2.4.3 RWM shall make use of information on current and forecast weather.
- 8.1.2.5 RWM shall support management of resources to perform hazardous road condition remediation.
- 8.1.2.5.2 RWM shall support appropriate responses to other environmental conditions that effect travel.
- 8.1.2.7 RWM shall monitor the amount and availability of materials at storage facilities.
- 8.1.2.8 RWM shall support maintenance crew dispatching.
- 8.1.3 Maintenance and Construction Operations shall provide a Work Zone Management and Safety (WZMS) function, which provides support for the effectiveness, safety, and efficiency of roadway operations during all work zone activities. This function includes interactions among Traffic Managers, Supervisors, Dispatchers, Field Crews, Construction Crews, Public Safety Organizations, Information Service Providers, and Travelers.
 - 8.1.3.1 WZMS shall monitor, control, and direct activity in the vicinity of work zones.
 - 8.1.3.1.1 WZMS shall provide information about work zones, including but not limited to:
 - 8.1.3.1.1(a) Anticipated delays
 - 8.1.3.1.1(b) Alternate routes
 - 8.1.3.1.1(c) Suggested speed limit
 - 8.1.3.1.2 WZMS shall provide support for automated speed enforcement around work zones.
 - 8.1.3.1.3.2 WZMS shall support archiving of field data.
 - 8.1.3.2 WZMS shall support the management of data about work zones.
 - 8.1.3.2.1 WZMS shall collect information concerning work zone activities, including but not limited to:
 - 8.1.3.2.1(a) Location
 - 8.1.3.2.1(b) Nature / type
 - 8.1.3.2.1(c) Scheduled start time
 - 8.1.3.2.1(d) Duration
 - 8.1.3.2.1(e) Lane shifts
 - 8.1.3.2.1(f) Staging areas
 - 8.1.3.2.1(g) Length of work zone
 - 8.1.3.2.1(h) Scheduled phases of work zone configuration
 - 8.1.3.2.1(i) Alternate routes
 - 8.1.3.2.1(j) Anticipated delays for travel route
 - 8.1.3.2.1(k) Anticipated delays for diversion route
 - 8.1.3.2.2 WZMS shall correlate planned activities with actual work.
 - 8.1.3.2.3 WZMS shall support preparation of reports on work zone activities.
 - 8.1.3.2.4 WZMS shall provide information on work zone activities to other agencies, including but not limited to:
 - 8.1.3.2.4(a) Other maintenance and construction operations systems
 - 8.1.3.2.4(c) Emergency vehicle fleets
 - 8.1.3.2.4(d) Traveler information systems
 - 8.1.3.2.4(e) Traffic management systems



- 8.1.3.3 WZMS shall provide systems that communicate reliable, accurate, and timely traveler information, including but not limited to:
 - 8.1.3.3(a) Location, including lane closure information
 - 8.1.3.3(b) Alternate route / detour
 - 8.1.3.3(c) Work zone speed limit
 - 8.1.3.3(d) Delay
- 8.1.3.4 WZMS shall support the provision of vehicle intrusion warnings.
- 8.1.3.5 WZMS shall be capable of tracking individual crew movements.
- 8.1.4 Maintenance and Construction Operations shall provide a Roadway Maintenance Conditions and Work Plan Dissemination (RMCWPD) function to provide Intra- and Inter-agency coordination of work plans. This function includes interactions among Traffic Managers, Supervisors, Planning Agencies, Public Safety Organizations, and Information Service Providers.
 - 8.1.4.1 RMCWPD shall coordinate information on planned maintenance and construction activities, including work zone information, and unplanned remediation activities, such as inclement weather responses, so that routing, scheduling, and resource allocation can be accomplished.
 - 8.1.4.2 RMCWP shall support inter-agency coordination of response and scheduling of resources for significant events with broad impact, like natural disasters, major incidents, and large planned or seasonal events.
 - 8.1.4.3 RMCWPD shall coordinate information with other transportation agencies, including but not limited to:
 - 8.1.4.3(a) Public Safety
 - 8.1.4.3(b) Emergency Medical Management
 - 8.1.4.3(c) Transit
 - 8.1.4.3(d) Traffic Management
 - 8.1.4.3(e) Railroads
 - 8.1.4.3(f) Airports
 - 8.1.4.3(g) Information Service Providers